

Affective concerns shape pupils' attitudes toward creation and evolution

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In a qualitative study on students' attitudes toward creation and evolution, twelve students from three different school years (5/8/11) were interviewed on their attitudes toward creation, evolution, creationism and scientism. The data indicate that whether students adopt or reject evolution or creation and whether they opt for conflict or compatibility, is not determined by cognitive factors like biological, exegetical, and epistemological knowledge alone. Rather, affective concerns such as the need for reliability, autonomy, and self-identity have a considerable impact on the formation of the students' attitudes. The results suggest that a deeper understanding of the affective concerns and existential motivations that shape young people's attitudes is essential both for religious education as well as for biology teaching.

Keywords: creation, evolution, attitudes, cognition, affection, conflict

1. Introduction

When I was younger, about four, I thought that God created us. Because I always watched this movie. There was a girl in school and the teacher explained that God formed human beings from mud and put them on the earth. ... And then, when I was seven, because we had it at school, I thought we come from monkeys. And now I don't know what to believe. (Marie¹, 11, roman-catholic)

The introductory quote reveals the dilemma that students encounter when faced with the seemingly contradictory claims of creation belief and evolutionary theory. Scholars have repeatedly observed that questions about the origin of life and of the world pose major challenges to young people's faith (Nipkow 1990; Rothgangel 1999). Numerous surveys, many from the fields of science education, psychology, and sociology indicate that not only in the United States, but also in Europe a significant percentage of students perceive the relationship between scientific and religious claims as conflicting. They regard the scientific explanations about the origins and the biblical creation narrative as incompatible and often endorse either creationism or scientism (e.g. Fulljames and Francis 1988; Francis and Greer 2001; Curry 2009; Astley and Francis 2010; Klose 2011, 2014).

Surveys (and also qualitative studies) have explored the creation-versus-evolution conflict predominately as a cognitive conflict sparked by divergent theories about the origins and epistemological issues (e.g. Rothgangel 1999; Fetz, Reich, and Valentin 2001; Höger 2008; Smith 2010). In contrast, affective and existential aspects have received only little attention. If at all, surveys focused on affective aspects primarily as a reason why people reject evolutionary theory despite persuasive evidence (Griffin 2007; Ranney 2012; Nadelson und Hardy 2015). Accordingly, a need to explore the existential dimension of the conflict has been pointed out (Kliemann and Schweitzer 2009).

Results from our qualitative interview study indicate that with regard to both evolution and creation, affective and existential aspects play a major role. Students adopt their positions not solely on the basis of knowledge, evidence, and reasoning. Rather, cognitive factors are closely intertwined with (and sometimes dominated by) affective and existential concerns.

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The data suggest that these have considerable impact on the students' positions and are a significant dimension of the conflict.

2. Theoretical approach, data and methods

How do students cope with the seemingly contradictory claims of the creation narrative and evolutionary theory? Which factors shape their attitudes toward creation and evolution? These were the questions which motivated our study. It encompassed qualitative interviews across three different school years: fifth grade (age 11 years), eighth grade (age 13–14 years), and eleventh grade (age 17–18 years).

The study built on the multicomponent model of attitudes developed in social psychology. Eagly and Chaiken (1993, 1) define attitudes as 'a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor'. They distinguish three components: cognitive, affective, and behavioral. The cognitive component refers to beliefs, thoughts, and attributes associated with an object. The affective component refers to feelings and emotions linked to it. The behavioral component refers to past behavior or experiences regarding it. The interview guide included all three of these aspects in equal measure. While the behavioral dimension turned out as rather fruitless, the cognitive, but in particular the affective dimension yielded substantial results.

The interviews followed Witzel's problem-centred approach (Witzel and Reiter 2012). The interview guide contained six parts: (a) attitudes toward creation, (b) attitudes toward evolution, (c) creationism, (d) scientism, (e) relationship between natural sciences and theology and creation and evolution, (f) Nature of Science and Nature of Theology (Rothgangel 1999). An extensive development process with six pretest interviews (two students from each grade) ensured that all of the three dimensions cognition, affection, and behavior were well covered. Two versions of the interview guide were developed: one for grade five and eight, and a slightly expanded version for grade eleven (Konnemann et al. 2013).

Twelve interviews were conducted at a public school in Germany. The students had been suggested by a biology teacher and all attended the school's religious education classes. Two male and two female students were interviewed each in grade five, eight, and eleven. Four of the students were Protestants, eight Roman-Catholics. For the analysis of the interviews the Grounded Theory in the version of Strauss and Corbin (1990) was employed.

3. Results

3.1 Prevalence of the conflict model

Although none of the students hold creationist or scientific views, the perception of creation and evolution as conflicting plays a dominant role in the interviews. A recurrent theme is:

Science and religion deal with the same questions concerning the origin of the world and of life. However, they answer these questions in ways that entail conflicts on the factual as well as on the epistemological level: the Big Bang and evolution versus God, millions of years versus seven days, the firm foundation of evidence and proof versus belief and speculation, a modern account of the origins versus an outdated one.

Nevertheless, the conflict model that is manifest in the young people's statements would only in part be captured by a standardized questionnaire. When explicitly requested to choose whether they see science and theology as conflicting, independent, or in dialogue (Barbour 1990) 'only' one third of the students opt for 'conflicting' while others state that science and theology 'have to do with each other' or are in dialog – despite perceived contradicting claims on the factual level. As it turns out, there are remarkable differences between the age groups regarding the perception of conflict.

Fifth grade: Beyond the notion of 'humans coming from monkeys', the fifth-grade students have no reliable knowledge about evolutionary theory. When faced with evolution in the interviews, they associate it positively with animals and progress and readily accept it. With regard to creation, the fifth-graders have some knowledge about the content of the creation narrative but are unaware of its exegetical background. At large, they regard the biblical story as a factual report that is literally true. Even though they find some aspects of the creation narrative a little hard to believe ('like magic') and ponder the possibility that not every single word might be true, all fifth-graders respond positively to the notion of creation and accept the biblical story in its literal interpretation. Differences or contradictions to evolution are never mentioned as a reason to reject creation.

Faced with two contradictory stories which they both see as trustworthy, the youngest interviewees struggle with the 'obvious' conflict on the factual level. When asked what she thinks of the biblical creation narrative, Annika (11, protestant) first replies:

[Q1] I don't know. There is the theory that humans came from monkeys and the theory that God created them.

Marie (11, roman-catholic) states that she finds the creation narrative 'real' but also indicates that she does not know how to reconcile it with what she has heard about monkeys:

[Q2] I find it [the creation story] quite real. But then I once heard that we come from monkeys. And now I don't know what to believe.

Nevertheless, all of the fifth-graders support a dialogical relationship between science and theology. (The term 'theology' sometimes needed explanation.) They all state that both fields are different, but connected:

[Q3] Religion says something about animals. And biology is also about nature. That's what connects them. (Elias, 11, protestant)

[Q4] I think they have to do with each other. Because God created the world, and science is helpful for this. (Annika, 11, protestant)

Confronted with differences and possible contradictions, the fifth-graders unanimously plead for harmony and compromises on the factual level. They call upon the advocates of creation and evolution to settle their disagreements and learn from each other.

[Q5] When theology says that God created us and science says that we come from monkeys, at some point they have to meet. (Marie, 11, roman-catholic)

[Q6] One side knows this, and the other side knows that. Then they can exchange what they know. And then one side says: Yes, that can be true. ... And the other side says: Yes, what they say, that can also be true. (Mauritz, 11, roman-catholic)

[Q7] Otherwise, one side thinks they are always right. And the other side does the same. And so I find it important that they both know that both are sometimes right and both are sometimes wrong. (Elias, 11, protestant)

Beyond the mere call for compromise, all of the fifth-grade students make suggestions as to how the conflicting claims could be reconciled. Their harmonizing ideas are all creative and often peculiar. Marie (11, roman-catholic), for example, suggests that God created primitive animals which then evolved:

[Q8] Some animals must've come on the earth directly from God. I once heard about such small water animals. And then somehow the other animals evolved.

Annika (11, protestant) consistently advocates the theory that some humans are created by God and some 'come from monkeys' and insists that both groups differ in their personalities:

[Q9] Student: I think some people are from God and some people come from monkeys. Sometimes you recognize it because of their personality. ... Those who are from God, they are sometimes so absent-minded. ... You never know.

Interviewer: And how do you feel when you meet such a person?

Student: Sometimes it gets on my nerves when they daydream ... but they have such an aura, it's very beautiful.

Similarly, Mauritz (11, roman-catholic) suggests that plants originated naturally while God created human beings and animals, while Elias (11, protestant) simply trusts that there are scientists and theologians who know how to reconcile both claims.

Eighth grade: The eighth-grade students have a basic knowledge about evolution (e.g. Charles Darwin, origin of life, origin of species, adaptation) as well as some notion of science as a discipline. Like the younger students, they know some elements of the creation narrative but are not aware of an exegetical interpretation of the text. They still mostly understand the biblical story as a factual account.

What contrasts their positions to the ones of the younger interviewees are their stances on the relationship between science and theology. All maintain that science and theology hold divergent views about the origin of life and mostly perceive this relationship as conflicting.

[Q10] I find they [science and religion] are conflicting, they are opposites. (Lara, 13, roman-catholic)

[Q11] I ... think that science and theology conflict. Because both concepts, for example, about creation are completely different. (Niklas, 13, roman-catholic)

The eighth-graders strongly support evolutionary theory. They have considerable trust in science. In particular, they often refer to the presumed power of science to support its claims by proof. For example, Yannik (14, protestant) argues that he supports evolutionary theory:

[Q12] Because all these archeological findings prove it.

For the same reasons, and in contrast to the fifth-grade students, they are fairly critical of the notion of creation: The creation narrative is not supported by proof or witnesses but, on the contrary, contradicts what has been 'proven by science'.

[Q13] I don't really believe it [the creation narrative]. I find scientific methods more likely. (Yannik, 14, protestant)

[Q14] I can't really believe it [the creation narrative]. ... There is a lot more scientific proof that the Big Bang happened and that these little animals then eventually evolved into monkeys and the monkeys into humans and so on. And, that God existed and that this creation really happened, there is no proof of it and no witnesses. (Lara, 13, roman-catholic)

The eighth-graders thus unanimously advocate that evolutionary theory trumps creation.

Eleventh grade: The opinions of the eleventh-grade students are considerably more differentiated and diverse. They know the basic mechanisms of evolution (mutation, selection, adaptation) and are aware of the non-teleological nature of the evolution process. In contrast to the younger students they also have some exegetical knowledge about the creation narrative, e.g. the etiological character of the narrative, its origin in the exile, the seven-day structure as a means to ground the Sabbath in creation. All maintain a non-literal interpretation of Genesis 1.

Nevertheless, two eleventh-graders voice doubts about creation and tend to lean toward rejection. Despite their exegetical knowledge and non-literal understanding of the creation narrative, the reason most frequently mentioned is the apparent contraction with evolutionary theory.

[Q15] I think it [the creation narrative] is wrong. ... I think it all happened through the Big Bang. (Raphael 17, roman-catholic)

[Q16] I find they [the creation narratives] are nice for children when you want to explain how the world originated. But I personally rather believe in scientific theories. (Isabelle, 17, roman-catholic)

One student feels drawn to faith as well as to science but struggles with reconciling creation and evolution.

[Q17] Student: I give leeway to both sides [faith and science]. I try to understand both. ...

Interviewer: Do you see the creation narratives as a reason to reject evolution?

Student: As I already said, I am really ambivalent. I accept one side and also the other, of course, it's my faith. And I don't entirely question evolution. (Felix, 18, roman-catholic)

Only one student fully endorses creation belief and holds a consistent view of a complementary relationship.

[Q18] I find that both [creation and evolution] should be taken into account. I don't think it's good to be completely naive and to understand the creation narrative entirely literally. Because it does contradict reason a little. ... Therefore, you can accept this very factual history of origins. Which doesn't mean, however, that there is no divine history of origins. I simply find that one doesn't exclude the other. (Natascha, 18, roman-catholic)

In principle, all of the oldest students have the knowledge on board that is necessary for a complementary view of the relationship between creation and evolution. However, this knowledge neither entails that they actually do hold complementary positions nor that their stances are unanimous. Rather, their perception about the relationship between evolution and creation ranges from conflicting or potentially conflicting to independent and complementary, with often more than just one interpretation in a single interview. These findings demonstrate that cognitive knowledge about the exegetical background of the creation narrative and a non-literal interpretation of Genesis 1 do not suffice for students to develop a non-conflicting view.

3.2 *Cognitive aspects and affective concerns*

The positions expressed by the students raise a number of questions. Why do the fifth-graders perceive creation and evolution as conflicting but deny the conflict? Why is there such a strong switch between the fifth-graders' strife for harmony and the eighth-graders' assertion of conflict? Why are the positions of the eleventh-graders so diverse despite of their advanced and fairly homogenous knowledge?

Without doubt, cognitive aspects like the advancement of the students' knowledge and their developing intellectual abilities account for some of the differences among the age groups. Divergent theories about the origins of the world and of life spark cognitive conflicts. Students employ their increased biological and theological knowledge to come to terms with these conflicts. Also, epistemological issues play an important role. Repeatedly, students address questions like: What is a particular claim built on? How do I know it is true? Understanding (or the lack of understanding) of the Nature of Science has an influence on their positions.

However, the interviewees' statements are often emotionally charged. Frequently, affective and existential concerns surface in the responses and appear to have a significant impact on their positions. Three issues are particularly prominent:

Reliability comes up not only as an epistemological topic but frequently as an affective concern encompassing the need for security and reassurance.

Autonomy is expressed in stances like 'I have my own opinion' and appears to have a strong effect on the positions which the students adopt.

Finally, *complex self-identity* emerges as a basic existential concern that (as for many other positions) provides the frame of reference for the students' stances toward creation and evolution.

The prevalent affective concerns differ considerably between the age groups.

3.3 *Affective concerns in different age groups*

Fifth grade – Reliability: The dominant affective concern among the fifth-grade students is the need for reliability. They frequently resort to parents, teachers and experts, but also to films or books, which they regard as authorities and prime guarantors for reliability. For example, when asked why he accepts evolutionary theory and the expertise of biologists, Elias (11, protestant) replies:

[Q19] Mrs. Paul [his biology teacher] explained it that way and that's why. ... I've been told so.

The youngest students regard the opinions and claims of authorities as trustworthy and do not question them. Older students occasionally refer to this stage in retrospect. For example, Raphael (17, roman-catholic) recalls:

[Q20] As a little child when you didn't know anything about the Big Bang and about science and when you were told something, for example by your parents, you believed it at first.

However, when the youngest interviewees regard authorities as a source for reliability, considerable affective conflicts entail when these make claims that seem contradictory. The statement of Marie (11, roman-catholic) quoted in the introduction is an expression of this conflict:

[Q22] When I was younger, about four, I thought that God created us. Because I always watched this movie. There was a girl in school and the teacher explained that God formed human beings from mud and put them on the earth. ... And then, when I was seven, because we had the topic at school, I thought that we come from monkeys. And now I don't know what to believe.

Similarly, Annika indicates that she is faced with two positions which she both finds 'trustworthy':

[Q21] I find it interesting to read the Bible and ... I've also read lot of books about evolution. ... I do believe that God created some people. But I also believe that some people come from monkeys. I find both quite trustworthy.

Both girls then go on to suggest their own reconciliatory solution (see Q8–9).

The main intention of the fifth-graders is arguably not to figure out the 'true facts' but to rescue their foundation for reliability. The primary conflict is not a cognitive one but rather plays on the affective level. The need for reliability and the fact that authorities are regarded as its prime source are in line with three remarkable findings in the interviews with the fifth-graders.

Firstly, negation of the conflict: Even though they struggle with the contradicting assertions, the youngest students trust that there is not an actual conflict between creation and evolution (Q3–4).

Secondly, reconciliatory strategies: In accordance with their conviction that no conflict exists, they go to great lengths to suggest harmonizing strategies (Q8–9).

Thirdly, insistence on compromise and mutual respect: The fifth-graders unanimously state that if there is nevertheless a dispute between the advocates of creation and of evolution, they should compromise and resolve it (Q5–7).

Eighth grade – Autonomy: Although the need for reliability is as important for the eighth-grade students as for the younger ones, a new affective concern surfaces in their responses and dominates their statements: their need for autonomy. The young adolescents no longer regard parents, teachers or other authorities as indisputable sources for reliability. Instead, they actively question their positions and do not want to be told what to think and believe.

[Q23] Interviewer: How do you feel when somebody tells you this [that you are created by God and that God wants you to live]?

Student: It warms my heart. ... Well, a little. I go to confirmation class and because of that a little. When I always hear that from my confirmation teacher, it gets on my nerves. (Yannik, 14, protestant)

Lara (13, roman-catholic) makes it clear that she puts her own opinion against what she was told as a child:

[Q24] Already in nursery school one was told that God created the world. ... I resigned myself to it. I have my own opinion about it.

The eighth-graders stances like ‘I have my own opinion’ mark a clear contrast to the fifth-grade students. The responses suggest that concerns for reliability and autonomy have an influence on three findings characteristic for the interviews with the young adolescents:

Firstly, turn toward conflict: Since the eighth-graders no longer rely on authority there is no need to reconcile divergent claims. On the contrary, they articulate the differences which they perceive, label them as conflict and take sides (Q10–11).

Secondly, strong support for science, proof and evolutionary theory: Throughout the interviews they refer to the reliability and assurance that proof provides.

[Q25] If something can be proved, you think, of course, that it is true. And then, somehow you feel reassured. (Niklas, 13, roman-catholic)

[Q26] I like it [the concept of evolution]. Because ... there is enough proof that all of this existed, for example that the dinosaurs existed. There are bones and plaster casts and so on. That’s something you can really believe in. I find this is completely different from creation. ... And I find it is a belief that is more beautiful than creation. Simply, that you can hold on to it. That there is proof. (Lara, 13, roman-catholic) [See also Q12.]

It appears that among the eighth-graders scientific methods and proof have replaced authorities as a source for reliability. They state in unison that evolutionary theory appeals to them because

[Q27] ... it is clearer than the story about God. (Yannik, 14, protestant)

[Q28] ... there is enough proof that all of this existed. (Lara, 13 roman-catholic)

[Q29] ... it makes sense. (Niklas, 13 roman-catholic)

[Q30] ... I can’t imagine that all was there immediately. (Julia, 13, protestant)

Science has the considerable benefit of corresponding with the young adolescents’ need for autonomy. The claims of evolutionary theory are not to be received as an absolute truth but can, in principle, be tested by the individual.

Thirdly, critical stance toward creation: When no longer authorities, but scientific methods and proof guarantee reliability, creation is at a disadvantage. The eighth-graders frequently object that creation belief (and faith in general) is unable to provide the reliance and assurance that evolutionary theory grants. The clear rejection of the ‘wrong’ theory seems to enhance their feeling of reliance as expressed in Q13–14 and the following statements:

[Q31] With creation I am simply never sure what of it is true and what isn’t. With natural science, all the theories that they put forward, you can actually prove them. (Lara, 13, roman-catholic)

[Q32] After all, you are never completely sure whether God exists and probably no one will ever prove it. (Niklas, 13, roman-catholic)

When autonomy is a prime affective concern this also seems to have a detrimental effect on the acceptance of creation. Since creation is what most students were taught as children and since it is proclaimed by an authority like the church, taking a stance for science instead can be an expression of developing an independent opinion. In two interviews the rejection of creation even seems to go beyond this and creation is perceived as a potential threat to autonomy:

[Q33] I find it [the notion of being created by God] strange. You think you have your own mind. Because I can decide for myself what I do and what I don't want to do. It's strange when you're told that someone else rules the thoughts that you think or the action that you do. That someone can control you. (Lara, 13, roman-catholic)

[Q34] I find it more reassuring that everything was created by nature. Because, then you know that we, that human beings did all of this and that we managed on our own. (Julia, 13, protestant)

It appears that for the young adolescents science has the power to satisfy two of their affective concerns: the need for reliability and autonomy. This seems to tilt the balance against creation and in evolution's favour.

Eleventh grade – Complex self-identity: Among the eleventh-grade students the perception of conflict is more diverse and in part less acute. Advanced biological and theological knowledge enable them to cope better with the divergent claims of evolution and creation. Yet, affective concerns still have an influence on their attitudes.

Self-identity manifests itself as the most dominant affective issue. While self-identity also comes up occasionally in the interviews with the younger students, it has gained both in importance as well as in complexity among the eleventh-graders. In discussing their views on evolution and creation, the young adults frequently refer to their individual development and their self-image and use them as a basis for their positions. For example, Isabelle (17, roman-catholic) resorts to her own development as an analogy and an explanation why she accepts evolutionary theory:

[Q34] I myself develop as well. When I was young, I was different from what I am now. ... And so it makes only sense to me that life developed over long periods of time. ... It only sounds logical to me that different species develop over millions of years.

On the basis of her self-identity as a human being, Natascha (18, roman-catholic) argues for the compatibility of science and religion. She reasons that humans are biological beings as well as related to the Divine. Since they are not in an internal conflict but in inner harmony, she concludes that also science and religion are not conflicting, but compatible.

[Q35] There can't be a conflict [between science and religion]. ... Because we as humans are biological beings. But theology also plays a role. But nevertheless, this is not in conflict within us. I rather see it as a dialogue. ... Both exist together and can be in harmony.

Yet, the self-identities of the young adults can also conflict with either evolution or creation and cause doubts or rejections. Felix (18, roman-catholic) perceives creation belief as conflicting with his self-identity as a 'science fan'. On the other hand, he also voices doubts about evolution on the basis of his self-image as a believer. Throughout the interview, he indicates his ambivalence:

[Q36] If you look at it from the point of view of science, and I am a fan of science, it [creation] can't have taken place that way. ... But if you see it in context that on the seventh day of the week people needed a day of break in the exile in Babylon, then it is of course written to this end. ... I'm quite ambivalent. ... I keep at a certain distance to science ... especially when it goes into a wrong direction from a faith point of view. ... It is not in accordance with the ideas of the Christian faith. [See also Q17.]

Isabelle (17, roman-catholic) sees herself as a non-believer for whom faith does not fit. As a consequence, she rejects creation even though she states that, in principal, science and

religion could complement each other and that she respects people who support both creation and evolution.

[Q37] It is a good thing, that they can both: accept evolutionary theory ... but also believe in God. I can't and from my standpoint I can only admire it. ... To believe in God is far from my mind.

Again, self-identity as the dominant affective concern of the eleventh-grade students could account for some of the findings of the interviews.

Firstly, diversity of opinions: When positions are not based on 'objective truths' but on complex self-identities which are necessarily diverse, it is plausible that the range of opinions voiced in the interviews is wide.

Second, tolerance: The role of self-identity and the awareness that different people have divergent identities might also explain the considerable degree of tolerance which the eleventh-graders indicate toward dissenting opinions:

[Q38] Interviewer: Many Christians accept evolutionary theory. What do you think of such Christians?

Student: I accept many opinions, also this opinion, of course. They can gladly accept it. And also the people who believe in science. ... I also accept this opinion. There are always two sides. (Felix, 18, roman-catholic) [See also Q37.]

Affective concerns across age groups: While reliability provided by authorities, autonomy, and complex self-identity differ between the school years, we also identified two issues that emerge in all age groups.

The first one is *existential reassurance*. To elicit both cognitive as well as affective responses to creation belief, the interviewees were asked to respond to the following scenario: 'A friend tells you: "You are created by God. God wants you to live." ... How do you feel about his/her comment?' Even though on the cognitive level not all students agree that their friend's comment is true and some clearly object, on the affective level all of them respond positively. Across all school years (including the eighth-graders) students report: They are pleased about the comment, that it causes them to feel safe, happy and loved, that they take it as a compliment and encouragement.

[Q39] I am happy. I take it as a compliment. (Annika, 11 protestant)

[Q40] It is something that you can tell yourself in times that are not so good. You can tell yourself that there is a creator who wanted you to live. ... So that you are not accidental and in fact useless. (Lara, 13, roman-catholic)

[Q41] It makes you feel good. Because it is an encouragement. And everybody likes being encouraged ... and know that someone is there for you. ... Or someone wants you to live. It gives confidence and hope and encourages to live. (Philip 17, roman-catholic)

A second affective issue concerns feelings about *human evolution*. Although none of the interviewees cognitively rejects human evolution, in all age groups individual students voice feelings of uneasiness. Human evolution appears to conflict with some students' self-identity as human beings. The interviewees' self-images include a strict boundary between humans and animals encompassing physical appearance (hairless vs. bodies covered with hair), communication (human speech vs. disturbing noises) as well as religious aspects (humans' relation to the Divine).

[Q42] Student: It is strange when you know that you could have been a monkey once, that you were covered with hair. And monkeys are so strange ... so different.

Interviewer: So the thought makes you feel uncomfortable?

Student: Yes. ... Monkeys are not as beautiful as humans. They are so covered with hair and make strange noises. (Marie, 11, roman-catholic)

[Q43] I just find it a little difficult to imagine. Normally, there are the animals and the humans. And you can't imagine that there is something in between. (Julia, 13, protestant)

[Q44] I find the differences between humans and apes dramatic. ... I find that in this point also the Divine plays a role. Humans, by their very nature, are searching and trying to find inner peace. ... You don't see this as pronounced among animals. ... Therefore, it is a little difficult for me to say: Yes, humans descended from apes. (Natascha, 18, roman-catholic)

3.4 The interaction of cognitive and affective concerns

In the statements of the interviewees, cognitive and affective aspects are often closely intertwined. Indeed, it is often a combination of cognition and affection that influences acceptance or rejection of evolutionary theory and creation belief. We illustrate this with three examples.

Affective motivation induces cognitive solution: Annika (grade 5, 11, protestant) states that she has learnt about two theories: that human beings 'come from monkeys' and that God created the world, animals and humans. She finds both theories 'trustworthy' (Q21). Rejecting either one of the theories appears to conflict with her trust in her parents, teachers and books and her sense of loyalty (affective). She solves this conflict by developing a harmonizing theory (cognitive): Some humans are created by God, some evolved (Q9).

Affective-cognitive conflict substituted by a solution harmonizing cognition and affection: Lara (grade 8, 13, roman-catholic) finds the notion of existential creation comforting (affective, Q40). However, she also indicates a strong need for autonomy (affective, Q24) and interprets existential creation as contradicting autonomy and free will (cognitive, Q33). She assesses her needs for autonomy to be met best by science and proofs (cognitive, epistemological, Q26). As a consequence, she endorses evolutionary theory and raises doubts about creation. She states that evolution is 'a belief that is more beautiful than creation', one that she can 'hold on to' (affective, Q26).

Affective concern generates cognitive and affective conflicts: Felix (grade 11, 18, roman-catholic) describes himself both as a Christian and a 'science fan' (self-identity, affective, Q17, Q36). Even though he supports a non-literal interpretation of the creation narrative and has some exegetical expertise, the relationship between evolutionary theory and creation remains an unsolved problem for him (cognitive/affective, Q17, Q36). In the course of the interview, he suggests a tentative solution and advances the theory that creation belief is of minor importance to Christian faith (cognitive).

[Q45] Ultimately, I don't find the creation story all that important. ... When I think about it, it appears to me, it is rather: What is written in the books? What can you draw from them for your principle of life, for your faith?

4. Discussion

In an influential empirical analysis of young people's statements about God, Nipkow emphasized the cognitive challenge posed by questions concerning the origin of the world and the enigma of existence. Rather than what students feel about or how they experience God, their statements indicate how they *think* about God and how they relate God cognitively to the world as a whole. This assessment was supported by further research (Rothgangel 1999). Accordingly, many researchers have recommended that school curricula include scholarly interpretations of the biblical creation narrative and some teaching of the Nature of Science to enable students intellectually to deal with the creation-versus-evolution debate (Fulljames und Francis 1988; Dieterich 1990a, 1990b; Poole 1990, 1992, 1995; Fulljames 1996; Rothgangel 1999, 2011, 2012, 2013; Astley und Francis 2010).

The findings of our interview study neither contradict Nipkow's assessment nor do they lend themselves as an argument against the teaching of exegesis and Nature of Science. On the contrary, creation and evolution are intellectually challenging notions. Our study confirms yet again that the cognitive dimension is indispensable to understand students' views on creation and evolution. Only when young people dispose of adequate cognitive tools will they be able to surpass a naïve conflict scenario.

However, our data also – and strongly – suggest that young people's stances are not shaped by intellectual reflection alone. While cognitive aspects are necessary, they are not sufficient to comprehend the students' position. Why do fifth-grade students conceive peculiar constructs for compatibility? The lack of adequate knowledge in itself does not explain this phenomenon. Rather, the youngest interviewees' dependence on parents and other authorities as stable sources for reliability need to be taken into consideration as well. Why is there such a clear switch from grade five to grade eight? While increased cognitive abilities are essential, also the adolescents' needs for autonomy seem to play an important role. Why are the positions of the eleventh-graders so diverse despite fairly homogenous knowledge? Arguably, this diversity cannot be explained by cognitive differences among the oldest students alone. Our data support that their complex self-identities could be the additional key. It thus appears that all these phenomena can only be explained when both cognitive and affective aspects are considered.

Affections have caught some prior attention in science education and psychology as a reason why people reject evolution. Griffin (2007, 1765) concludes: 'Low acceptance of evolution may be partially a product of people relying upon affective epistemic goals rather than accuracy goals that would be served by evidence-based reasoning.' Other researchers draw similar conclusions. Yet, the findings of our study suggest a much more diverse picture of the relationship between affections and theoretical positions than the opposition between reason-based acceptance of evolution and its affection-based rejection. Both cognitive and affective aspects can have an impact on any stance that students adopt, whether they adopt or reject evolution or creation and whether they opt for conflict or compatibility.

The conclusion that students' stances on creation and evolution transcend pure cognition is in accordance with the findings of Klose who reports that students' positions on creation and evolution correlate with value preferences. Of particular interest is her observation that scientific attitudes correspond with an orientation toward autonomy and self as opposed to tradition and relationships (2011, 150).

A further conclusion from the data concerns the differences between the age groups. In each age group one dominant affective concern was observed: reliability in grade five (11 years), autonomy in grade eight (13-14 years) and self-identity in grade eleven (age 17-18 years). This raises the question whether these differences are indicators of development. For the cognitive dimension, the study of Fetz, Reich, and Valentin (2001) showed that how children and adolescents understand the world and creation and how they relate science and creation depend on their cognitive development. Do the different affective issues observed in our interviews indicate a comparable relationship between affective development and students' positions? Do students' views develop generically from trying to reconcile the positions that are presented to them by authorities to a stronger orientation toward autonomy and self? To some extent, such an inference is supported by developmental psychology. As for autonomy, Oser and Gmünder (1991) found that it becomes a major concern among young adolescents and leads them to abandon positions which they previously embraced. Identity was described by Erikson (1959, 1968) as the dominant issue during middle adolescence that is characterized by the crisis between identity and role confusion. Yet, at present, the number of interviewees in our study is still too small for reliable generalizing conclusions.

What are implications of our results for further religious educational research? The analysis of the interviews shows: Gaining a deeper insight into the affective dimension of students' dealing with the creation-versus-evolution debate is an important direction for further religious educational research. If affective concerns indeed play an essential role, religious education needs to take this into account. Whether or not teaching on creation fosters understanding and induces conceptual changes will not only depend on intellectual stimulation but also on the question how affective needs are met. To explore these affective needs in research is, however, a sensitive issue that depends not only on stimulating incentives, but also on some amount of trust. Most likely, at least at the current stage, further qualitative research will yield deeper insights than quantitative studies.

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Acknowledgement

The development of the interview guide and the twelve interviews were carried out by Elisabeth Oberleitner. Since she subsequently left the project, she wished not to be named as an author of this article as she would deserve. Therefore, I would like to thank her for her considerable contribution to this study. I also thank Martin Rothgangel for his advice during the implementation of the project. The study was in parts funded by the German Friedrich-Ebert-Stiftung.

ⁱ All the names used in this article are pseudonyms.