

# High school biology students' use of values in their moral argumentation and decision-making

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## ABSTRACT

In this qualitative case study we examined the impact of a specially-designed classroom intervention for a group of 15–16-year-old Dutch biology students' use of values in contemplating five socioscientific issues in the human-nature context. The students worked in small groups to support various aspects of their morality. An ethical matrix was used as a heuristic to explore different arguments and moral values from different perspectives. The collected data consisted of written assignments, group conversations, and individual interviews. The results show that students' use of values differed from one issue to another. The values they used in their moral decision-making indicated that the influence of the intervention activities, aimed at enhancing a relationship between moral agent (student) and moral object (topic), was limited. The study provides evidence that the intervention positively conducted to students' cognition of the values that are personally relevant. Recommendations for further theorization, research and practice are discussed.

## KEYWORDS

Values; socioscientific issues; moral argumentation and decision-making; secondary biology education

## Introduction

Answers to important questions and challenges of our time, such as how to reduce CO<sub>2</sub> emissions, counteracting the loss of biodiversity, whether or not to return to 'the world before Covid-19', and how to ensure that future generations can live well on earth, are moral dilemmas underpinned by values and ethics. These socioscientific issues (SSI), at the interface of science and society, have caught increased interest among science educators. More than 25 years ago, scholars like Fensham (1988) and Solomon and Aikenhead (1994) emphasized the importance of teaching and learning science in its political, social and cultural context. More recently, the SSI movement explicitly stresses the importance of the ethical dimensions of science (e.g., Zeidler et al., 2005), in which the exploration and use of values in students' moral argumentation and decision-making is central (e.g., Bell & Lederman, 2003; Corrigan et al., 2020).

In this study we do not deny the scientific conceptual dimension of SSI, but we emphasize the moral-ethical dimension of SSI (cf. Zeidler, 2015). According to Bagnoli

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(2013), there are various possible definitions of moral dilemmas, whereby ‘moral dilemmas are cases where agents are bound by conflicting moral claims’, (p. 1348) often applies as the common denominator.

Jickling et al. (2021) conceptualize moral dilemmas as ‘quandaries’, describing the inherent complex and perplexing ethical questions related to them. More specifically, they argue that environmental issues seldom boil down to only two choices. They are more often complex, multifaceted, reflecting multiple perspectives. From a pedagogical point of view, the process of engaging with moral dilemmas and associated ethical questions is difficult as it involves deliberations, trade-offs, development of creative alternatives, and considering realities in different contexts (Jickling et al., 2021).

Given the importance of values in science students’ moral argumentation and decision-making, this study aims to investigate how students’ engagement in topical moral dilemmas in the human-nature context can be supported by a specially-designed intervention. We pay particular attention to how and what kind of values students use in their moral argumentation and decision-making, and to the way values-based engagement in moral dilemmas can be supported.

The following research question guided this study:

How does a specially-designed classroom intervention affect students’ use of values in their moral argumentation and decision-making regarding moral dilemmas in the human-nature context?

In the next sections we discuss the role of morality in SSI science education and the theoretical and analytical framework used in this study.

### ***Morality in SSI science education***

SSI can be characterized as wicked problems (Rittel & Webber, 1973; Van der Leij et al., 2021a), which means that they are controversial, open-ended and ill-structured in nature, implying they can be addressed from multiple perspectives (e.g., Driver et al., 2000). There are no simple, unambiguous solutions to such issues and in order to make informed decisions, consideration of values, morality and ethics is indispensable (e.g., Zeidler & Sadler, 2008). The moral nature of SSI illustrates the necessity to promote the development of students’ morality (e.g., Zeidler et al., 2005).

‘Morality’ as a concept has been extensively investigated in moral psychology, which led to the emergence of the Four Component Model of morality (FCM) (Narvaez & Rest, 1995; Rest et al., 1999). The FCM identifies four integrated abilities as necessary conditions for effective moral functioning, namely ethical sensitivity, moral reasoning, moral motivation, and ethical implementation or moral behaviour. Moral decision-making, as the final step in the process of moral reflection and morality, includes taking perspective, moral reasoning and reflection on moral motivation and (possible) moral behaviour (cf., Narvaez & Rest, 1995; Rest et al., 1999).

In science education research, various researchers have used the FCM as a conceptual framework to investigate students’ morality (e.g., Bencze et al., 2012; Jones et al., 2012; Juntunen & Aksela, 2014; Kolstø, 2006). These studies contributed to valuable insights into teaching morality in secondary science education. However, an important limitation is that they focused on a single or a few morality components.

Our present study builds upon our earlier research (Van der Leij et al., 2021b), which investigated the nature of high school biology students' morality when engaged with SSI in the human-nature context by employing the FCM as both a theoretical and analytical framework. The study revealed that students' moral decisions were mainly based upon emotions, like compassion and (self-evident) feelings of guilt or duty, illustrating, from a meta-ethical perspective, the non-naturalistic character of students' morality (cf., Ridge, 2019). Only a limited number of students used rational arguments in their moral decision-making (Van der Leij et al., 2021b; cf., Sadler & Zeidler, 2005).

In the present study, we describe students' use of values in their moral argumentation and decision-making, as they demonstrated during the implementation of a specially developed design, prior to the above-mentioned individual interviews (Van der Leij et al., 2021b).

### ***Theoretical underpinnings***

Philosophical reflections on the relationship between humans and nature are central in environmental ethics, a relatively young discipline in philosophy, mainly developed after 1970 (Armstrong & Botzler, 1993). Early work in environmental ethics was mainly based upon normative ethical theories (Jickling, 2013), like utilitarianism and deontology.

Central to utilitarianism—also named consequentialism—is teleological moral reasoning, in which 'the value of an action—and thence its ethical character—derives entirely from the value of its consequences' (Curry, 2011, p. 43). An important ethical principle is as much well-being for those concerned, which implies that decisions (often) use a measurement-based cost-benefit analysis to decide what is the 'right thing to do'. As a consequence, ultimately consequentialism is collective: 'social well-being trumps individual rights' (Curry, 2011, p. 44).

In deontological moral reasoning the focus is on duty ('deon' in Greek), i.e., something that ought to be done, regardless of the consequences. An important ethical principle in deontological moral reasoning is respect for autonomy, which appeals to our responsibility and duty to treat others as ends in themselves. Respect for autonomy is not only about duties, but also about rights. In order to properly weigh up rights on the one hand and duties on the other, justice is another important ethical principle in deontological reasoning (Curry, 2011).

The premise of the use of the above normative frameworks is that if the moral agent considers the central ethical principles, (s)he will come to a moral decision. The critique on such frameworks is that, given their monistic structure and their striving for normative determinacy, they ignore the experience of the moral agent, who often has difficulty making a choice. Thus, the process of moral argumentation within these frameworks can be characterised as a cognitive-rational activity, thereby misunderstanding the true nature of 'moral life' (cf., Williams, 1981).

Research shows that dilemmas contain conflicting ethical principles (Black, 2013). Departing from a meta-ethical perspective, Lance and Little (2007) argue for 'moral holism', which assumes that the most relevant moral factor depends on context, and that 'good moral reasoning and judgment' depends on 'knowing whether a given circumstance is privileged' (Black, 2013, p. 3418).

In summary, we consider reflection on moral values—like well-being, autonomy and justice—important to encourage students' moral argumentation and decision-making. However, in line with Lance and Little (2007), it is our meta-ethical stance that arriving at a moral decision is not merely following some sort of decision-making framework. In contrast, our view of moral education explicitly includes how students' experience in a specific context influences their moral argumentation and decision-making.

The importance of context is also reflected in the above-mentioned FCM (Narvaez & Rest, 1995; Rest et al., 1999). The model makes a conceptual distinction between 'moral reasoning', in which the question 'what should I do?' is central, and 'moral motivation', in which the question 'what would I do?' is central (Van der Leij et al., 2021b). Whereas moral reasoning often uses the aforementioned normative frameworks, the outcome of which usually has a normative character, moral motivation has a descriptive character, in which non-moral values also play a role, and which may lead to a different moral decision (e.g., Rest et al., 1999).

In taking a prescriptive ethical perspective, Jickling (2013) argues that instead of 'strictly following moral principles' (like deontological and teleological moral reasoning), moral education ought to be a 'process of reflection, imagination and experimentation where individuals and/or groups create new ways of being in their part of the world' (Jickling, 2013, p. 168). This conceptualisation guides the pedagogical framework of our intervention, which centralizes student-led peer interactions (cf., Piaget, 1932). Through group activities the students are encouraged to engage in (meaningful) moral reflections (cf., Nucci, 2009) on topical moral dilemmas that touch upon their world of experience.

Such an approach to moral education creates more space for emotional-affective factors in the process of moral argumentation and decision-making. The emphasis on 'creating new ways of being in their part of the world' (Jickling, 2013, p. 168) with the associated (group) activities presupposes the establishment of a relationship between a moral agent (the student) and the addressed dilemmas and/or its stakeholders.

### ***Conceptual and analytical framework***

Adopting a descriptive ethical perspective, we explore students' use of values in their moral argumentation and decision-making where, along with Jickling et al. (2021), we assume that values are expressions indicating students' preferences, revealing what is important to her or him.

The concept of 'values' is very broad, being expressed, at one end of the spectrum, as simple choices that are made (e.g., the choice of a particular colour of clothing), or, at the other end of the spectrum, as the extent to which the student shows concern for others (e.g., humans, nature). These values extend beyond the students themselves, and reflect more profound differences in the kinds of relationships they have in the world (cf., Jickling et al., 2021).

The latter conceptualisation of values corresponds to the environmental ethical conceptual framework of Kronlid and Ohman (2013). The framework distinguishes between values based on different ontological perspectives of how humans relate to the non-human world. As such, it distinguishes between 'values that reflect a relationship' (relation-oriented environmental ethical values) between the students as moral agents and those involved in the moral dilemma, and 'values that reflect a (certain) moral

distance' (value-oriented environmental ethical values) between the students and those involved in the dilemma.

According to Kronlid and Ohman (2013), the framework can be applied in three ways: (1) In a normative application, it is used to substantiate why a particular (sub-) position should be favoured before others. For instance, argue whether nature should or should not be respected as a moral object; (2) Using the framework descriptively means describing certain states of affairs concerning the moral dimension of material. As such, the framework is used as a typology to categorise the ethical content of the empirical material being worked with; (3) The framework can also be used to derive an analytical perspective. This means that the empirical material may be analysed from a specific environmental ethics vantage point. For instance, analysing data from a (little-used) non-anthropocentric perspective, may lead to new insights.

With this framework, we aim to gain insight into students' morality, the assumption being that a relationship between student and those involved provides insight into the students' morality. As such, our application of the framework was primarily descriptive in nature, using analytical schemes to interpret students' use of values, both from a value-oriented and a relation-oriented perspective.

In value-oriented perspectives there are three central moral considerations: (a) the moral object; (b) the human-nature relationship; and (c) definitions of nature's value. In this perspective only humans can be held accountable for their actions, therefore they are considered 'moral agents'. A 'moral object' means to be morally relevant, i.e., 'one's well-being, interests, health, preferences, flourishing, functions etc. ought to be taken into consideration beyond whatever instrumental value one might have for the other' (Kronlid & Ohman, 2013, p. 27). Moral objects are considered from both anthropocentric, in which the well-being of (other) humans is central, and non-anthropocentric perspectives, in which the well-being of people as well as animals, plants, species, ecosystems and landscapes is central.

As we indicated above, the distinction between value-oriented and relation-oriented environmental ethics is largely based upon different ontological perspectives of how humans relate to the non-human world (Kronlid & Ohman, 2013). A major critique on value-oriented environmental ethics of a prescriptive ethical nature, is that from this perspective the idea of the world consisting of two different spheres is perpetuated.

More specifically, according to its critics, the value-oriented perspective is based on the philosophy of 'ethical extensionism', which uses philosophical arguments for extending the 'circle of moral relevance'. Or, as Kronlid and Ohman (2013) put it: 'Value-oriented theories use moral extensionism to draw certain objects into a rationalist embrace of moral agents' (p. 29). As such, the moral distance between moral agent and moral object is bridged by assigning concepts of 'instrumental and intrinsic value' to moral objects (cf., Table A3(a,b))

According to relation-oriented ethics, moral dilemmas are always situated in a relational space, which is both rational and emotional by nature. Hence, the emphasis is not on the 'object' but rather on the relation between moral agent and those involved in the dilemma (human, nature). Therefore, from a relation-oriented perspective, the moral outlook of a moral agent cannot be divided into different moral spheres. Moreover, it is emphasised that morality 'acts in mysterious and sometimes inconsistent ways' (Kronlid & Ohman, 2013, p. 37).

The relation-oriented perspective on ethics is consistent with our prescriptive perspective on moral education and on the nature of students' moral argumentation and decision-making, namely that (actual) moral decision-making, as the final step in the process of moral consideration, ideally takes place within a particular context and relationship.

## Methodology

### Research aims

We adopted a qualitative case study approach to gain an in-depth understanding of students' use of values based on data from multiple sources (Creswell, 2014; Denscombe, 2014).

As indicated above, this study aims to answer the following research question: *How does a specially-designed classroom intervention affect students' use of values in their moral argumentation and decision-making regarding moral dilemmas in the human-nature context?*

In doing so, we formulated the following sub-questions:

- (1) What values do students espouse when addressing moral dilemmas during the intervention, and in individual interviews?
- (2) What values do students use in individual and group assignments aimed at addressing the 'meat' dilemma?
- (3) How can the possible change in students' use of values in the 'meat' dilemma be characterized?

In order to respond to questions 2 and 3, we zoomed in on one dilemma, namely the 'meat' dilemma (see [Table A1 and A2](#)), which was about half-way through the intervention—meaning that the students were already used to 'this way of working'. We considered this dilemma appropriate given its conceptual ties to both sustainability and animal welfare. In other words, a context that lends itself to approaching the dilemma from both anthropocentric and non-anthropocentric perspectives, and from both value-oriented and relation-oriented environmental ethics.

From the perspective of relation-oriented environmental ethics, the question 'Should we stop eating meat? Why?' is strongly related to personal (student) behaviour, appealing to both rational and emotional moral argumentation and decision-making, and thus contributing to an understanding of the students' morality, as conceptualised in the FCM of morality (Narvaez & Rest, 1995; Rest et al., 1999).

### Participants

The participants in the intervention were sixty 15–16-years old Dutch upper secondary biology students, divided over three classes with 20 students each in two comprehensive schools, located in semi-urban towns in the northeast of the Netherlands. The two biology teachers (one of whom is the first author of this paper) both had more than 20 years of experience of teaching high school biology in secondary schools, although this was the first time that they were involved in (more explicitly) stimulating students'

morality development. During the intervention the students worked in groups of four, so there were five groups in each class, the composition of which remained unchanged during the intervention. Audio recordings were made from three groups, and paper data (short introductory essays, worksheets) were collected.

The data for this study came from six students who participated in both the intervention and the interviews after the intervention. The students (three female, three male) were purposefully selected from one school, because paper data at one of the two schools were lost. Two students were selected from each group, aiming for a variation in characteristics: gender, average score in biology, and the talkativeness and task orientation they had shown during the group discussions.

### **Intervention**

The intervention was aimed at supporting various components of students' morality in moral dilemmas centred on the tense relationship between humans and nature. More specifically, regarding such moral dilemmas, the intervention aimed to support their moral sensitivity, moral reasoning, moral motivation and reflection upon possible moral behaviour.

The intervention was developed following interviews with six biology teachers, three teacher educators (biology, social studies, philosophy), two (environmental) philosophers, and an expert in green pedagogy to explore their views on aims, pedagogies and learning opportunities of moral education in upper secondary biology classes.

Additionally, outcomes from science education research, like the importance of peer group discussions (e.g., Grace, 2009; Juntunen & Aksela, 2014), reflection upon personal values (e.g., Jones et al., 2012; Kolstø, 2006), and the Four Component Model of Morality (e.g., Narvaez & Rest, 1995) informed the design of the intervention. A prototype of the intervention was evaluated by a group of twelve preservice biology teachers, and in a professional learning group of five experienced biology teachers. Their feedback was used for revision of the intervention design.

Resulting from this design phase a number of characteristics became leading in the design, namely: (a) At the start of each lesson, a short video clip introduces the dilemma, showing different perspectives; (b) An ethical matrix (Mephan, 2018) is used as a heuristic for students to explore the different perspectives. The matrix is based upon three moral values (well-being, autonomy, justice), which serve as 'reference points'. The idea is that the students contemplate about these values (and different arguments) from various stakeholders' perspectives. [Table A1](#) (appendices) shows an example; (c) The students work in groups of four, in which they alternately work on individual and group tasks. [Information box 1](#) (appendices) shows an illustrative example of a lesson structure; (d) The module is aimed at supporting different morality components, as conceptualized by the FCM of morality (cf., Narvaez & Rest, 1995; Rest et al., 1999).

The intervention took place in a three-month period in the school year in the classes of two biology teachers from two different schools. During the intervention, each week the students discussed a topical moral dilemma in small groups. Values clarification was

stimulated by encouraging the students to take perspective in several ways. First, by examining the type of arguments from different stakeholders as published in recent media (see [Table A1](#)). Secondly, by discussing questions like ‘Which moral values are central to the addressed dilemma?’ [Table A2](#) (in the appendices) presents an overview of the topics in the intervention.

During the assignments the students were encouraged to reflect on the arguments and moral values from the matrix, by asking them which arguments and values they consider most important, and why. The group tasks were especially aimed at encouraging dialogue between the group members, thus stimulating values communication. More specifically, the students were prompted to ask each other additional questions, to listen and attempt to understand each other’s point of view. The latter aspect concerns the ability to take perspective of the other group members, and to mirror this to one’s own view.

Given that the module consisted largely of student-directed activities, the teachers’ role was limited to introducing the module. During the group tasks the teachers had a coaching role. For instance, in groups in which there was very little discussion, they asked questions like ‘What do you mean by? . . . Why?’ Likewise, every now and then they re-emphasized the ‘rules of the game for conducting a group discussion’<sup>1</sup> to give all students the opportunity to share their views.

## **Data sources**

### **Data from classrooms**

The data sources consisted of introductory essays, i.e., at the start of each lesson the students were asked to write down their initial opinion after the introduction of the dilemma. Other written data sources were answer sheets for individual and group assignments. These assignments varied from analytical tasks (e.g., what kind of argument—factual or appreciative—is central to this perspective?) and reflective tasks (e.g., which moral value do you consider most important, and why?). The students completed answer sheets for each dilemma separately. During the lessons, audio recordings were made aimed at investigating students’ use of values during the group conversations.

### **Data from interviews**

Individual semi-structured interviews were conducted approximately 1–2 weeks after the final lesson of the intervention. During the interviews the students were introduced to a moral dilemma they had not encountered before: ‘Should we stop the rehabilitation of seals from the Wadden Sea? Why?’ At the time of the interviews, there was controversy in the Netherlands about the continued need of taking care of needy seals, since the seal population had increased considerably in the years before.

After the dilemma’s introduction, in which it was highlighted from different perspectives, the students were asked to give their opinion and to substantiate it with arguments. They were also asked to reflect upon moral values they considered important. The audio recordings from the interviews served as data sources for investigating the nature of students’ morality as described in Van der Leij et al. (2021b). For the purpose of the



present study, together with the data of the intervention, the data from the interviews was used for answering our first sub-question.

### **Data analysis**

After transcribing the data, three analytical schemes derived from Kronlid and Ohman (2013) were adapted for the development of a coding scheme (see [Table A3](#) in the appendices) in order to explore the students' use of values, and gain insight into their moral argumentation and decision-making. [Table A3\(a,b\)](#) show anthropocentric and non-anthropocentric values, both from a value-oriented perspective; [Table A3\(c\)](#) shows values from a relation-oriented perspective. For each code, a description and an illustrative quote are added.

In order to describe students' use of values, we took a student's statement with reference to a value as our unit of analysis. We interpreted these statements from both a value-oriented and relation-oriented environmental ethical perspective. Therefore, we analysed the same dataset twice. As a result, it occurred that a statement was coded both as value-oriented and relation-oriented. It also occurred that we assigned multiple codes to values within the same perspective. The quote below is an illustrative example:

Without insects, humanity is in danger. (Bruce, neonics)

From a value-oriented perspective (cf., [Table A3\(a\)](#)) we coded this statement as INTER (i.e., 'moral object' is people living today and future generations); BIO-AEE (i.e., from an anthropocentric perspective humans and nature are biologically integrated); NV (i.e., natural resources are valued because humankind is dependent on nature for its basic well-being and survival). From a relation-oriented perspective (cf., [Table A3\(c\)](#)) we coded this statement as DE (i.e., identifications with other species involve a deeper sense of belonging (. . .)).

For reliability purposes, 20% of the data was analysed and coded by another researcher from our research team, which led to an interrater agreement of over 90%. Different interpretations were discussed and verified (cf., Lincoln et al., 2011).

To ensure the validity of our study, we employed triangulation. To this end, we used multiple data sources (Creswell, 2014), namely the written tasks of the six students on their worksheets and the audio recordings of the group discussions and the post-intervention interviews. The students' responses on the worksheets often lacked the necessary connotation to come to a reliable interpretation. Hence, especially in those cases it proved useful to also analyse the audio recordings, which, combined with the analysis of the written tasks, provided a more reliable characterization of their use of values.

### **Results**

For each sub-question, we present students' use of values, interpreted on the basis of our analytical framework. With regard to sub-questions 2 and 3 we used students' quotes from group conversations, when they discussed the 'meat' dilemma.

### ***Sub-question 1: What values do students espouse when addressing the moral dilemmas?***

To answer this question, although there were obvious differences between the students, we combined the values of the whole group of students. The results show that students' use of values was dilemma-dependent. Below we discuss the variety of values used, and how this usage was influenced by the particular dilemma. In doing so, we focus on students' use of value-oriented anthropocentric and non-anthropocentric values, as well as their use of relation-oriented values.

#### ***Use of value-oriented anthropocentric values***

Students' use of value-oriented anthropocentric values (codes in [Table A3\(a\)](#)) demonstrate that they regarded 'people living today' (INTRA) as moral objects (MO). In the dilemmas 'meat' and 'neonics', 'future generations' (INTER) were regarded as moral objects as well, likely because of the sustainability context of both dilemmas. Students emphasized that 'natural resources are valued because humankind depends on nature for its basic well-being and survival' (NV). More specifically, in the 'meat' dilemma students argued that humans depend on meat for their health, while in the 'neonics' dilemma, they emphasized that bees guarantee food production.

Students' use of values indicating their views on the instrumental value of nature (IVN), especially in the 'feeding' and 'wolf' dilemmas, showed that 'natural resources are valued because they satisfy our felt preferences' (DV). This is likely due to the nature of the dilemmas, which evokes (strong) moral-ethical and aesthetic preferences (i.e., concerned with beauty): 'feeding' evokes a predilection of what nature 'is' or 'should be', and what role humans have, i.e., whether or not to feed large herbivores during severe winters. The same applies to the 'wolf' dilemma, evoking a preference of what nature 'should be', i.e., whether or not the wolf deserves the opportunity to resettle in the Netherlands. In the 'seals' dilemma 'people' were absent as moral objects, presumably due to the absence of human stakeholders during the discussion of the dilemma.

In summary, the involvement of human stakeholders in the dilemmas influenced the extent to which the students regard them as a moral object. If the dilemmas were situated in a sustainability context, future generations were taken into consideration as moral objects. With regard to students' use of values emphasizing nature's instrumental value, we found that in dilemmas evoking (strong) moral or aesthetic values, students considered 'demand values', while in sustainability dilemmas they emphasized the importance of 'need values'.

#### ***Use of value-oriented non-anthropocentric values***

Students' use of non-anthropocentric values (codes in [Table A3\(b\)](#)) showed that values related to Sentientism (SENT) and Animal Rights (ANIM) were used in all dilemmas, except in 'neonics'. Nevertheless, in the latter dilemma, as in the other dilemmas, students used values related to Biocentrism (BIOC), meaning that they acknowledged the intrinsic value of the moral object.

In 'feeding' and 'seals' students most often used values related to Ecocentrism (ECOC), indicating that they recognized the ecosystems' intrinsic value. In their moral

argumentation they often focused on the carrying capacity of the ecosystems: large herbivores in the ‘Oostvaardersplassen’, seals in the ‘Wadden Sea’. Furthermore, in all dilemmas the students used values indicating they recognized that non-human nature has an objective value of its own (INHW).

In summary, in their use of non-anthropocentric values, the students recognized the intrinsic value of the involved organisms in all dilemmas. It appeared that the context influenced which values were emphasized when considering the moral object (i.e., the self-conscious and suffering animal, or the ecosystem of which the animals are part).

### ***Use of relation-oriented values***

In all dilemmas, students’ relation-oriented values (codes in Table A3(c)) were related to Social Ecology (SE), Ecofeminism (EF), and Pragmatism (PR), using Social Ecology values most often. Likely, the nature of the dilemmas caused students to consider justice as an important moral value. Values related to Pragmatism were also used relatively often, meaning that, in their moral argumentation and decision-making, students emphasized practical solutions. Likewise, students used values indicating Ecofeminism in all dilemmas. From this perspective, the emphasis is on values of care, partnership, kinship, love, friendship in human–non-human relationships. The dilemmas ‘feeding’, ‘meat’, and ‘seals’ emphasized the concern for the suffering of large herbivores, farm animals and seals, respectively. Central to the ‘wolf’ dilemma was students’ admiration for the wolf, while in ‘neonics’ the students emphasized their care for nature.

Values related to Deep Ecology (DE) were merely used in ‘meat’ and ‘neonics’, which illustrates students’ awareness of ‘a deeper sense of belonging with other species and the land’. As we already discussed above, these dilemmas are predominantly situated in a sustainability context, which likely causes students to emphasize the importance of ‘dependency’ (of nature, biodiversity) in their moral argumentation and decision-making.

Summarized, all dilemmas evoked the use of relation-oriented values, in particular those related to Social Ecology, Pragmatism and Ecofeminism, illustrating that the students considered values like ‘justice’, ‘practical solutions’ and values like ‘care and love’ important in their moral argumentation and decision-making. Only the sustainability-situated dilemmas evoked the use of values related to Deep Ecology.

### ***Sub-question 2: What values do students use in individual and group assignments in the ‘meat’ dilemma?***

To answer this question, we analysed students’ use of values during individual and group activities in the ‘meat’ dilemma, based on written (i.e., their initial opinion based on the dilemma’s introduction, and worksheets) and audio (group discussions) sources. More specifically, we identified whether a certain value was used in the introductory essay, and how often the value was used during the lesson.

The results demonstrate that students’ use of value-oriented (VO) and relation-oriented (RO) values increased during the lesson. Based on an increase in students’ use

of values towards future generations, the results indicate an increase in their awareness of the sustainability context, illustrated by quote [1].

[1] It's important how we treat the earth. (Sarah)

Other statements also indicate an increase in students' awareness of the sustainability context of the issue. For instance, we found an increase in values indicating that humankind and nature are biologically integrated (HN-BIO), specifically from an anthropocentric perspective (VO-AEE): Quote [2] illustrates the importance of keeping meat consumption possible, thereby realizing that resources are finite, implying that responsible (sustainable) consumption is important.

[2] We want to keep eating meat. (Vernon)

Likewise, we found that the students increasingly used values indicating that 'natural resources are valued because humankind is dependent on nature for its basic well-being and survival' (IVN-NV). Quote [3] illustrates such a need value, which applies to both people today and in the future, showing that current and future generations are considered an important 'moral object'. (INTER):

[3] I don't think we should stop eating meat, but I do think we should eat less meat, so we can reduce global warming, and less people become dissatisfied. (Vaughan)

We also found that the students increasingly used non-anthropocentric values. For instance, during the lesson activities they used values related to Sentientism (SENT), which they did not use in their introductory essays:

[4] It's without sedation . . . so, then they do suffer . . . ( . . . ) they also smell blood everywhere. Then a knife comes to their throat . . . then these animals become a little . . . scared. (Bruce)

This quote [4] illustrates taking the perspective of animals that they can 'suffer' and 'become scared' before taken for slaughter.

Also, the students demonstrated an increase in their use of values related to Animal Rights (ANIM):

[5] It is ( . . . ) important that we take good care of our animals. (Sarah)

We interpreted this statement [5] as Animal Rights, since it illustrates that this student respects animals' intrinsic value.

Also, the students showed an increase in their use of values related to Biocentrism (BIOC), considering animals as 'living beings'. Quote [6] illustrates a student valuing the animals' intrinsic value, regardless of their potential usefulness to humans:

[6] Animals are ( . . . ) living beings. (Vaughan)

Students increasingly used values illustrating that 'non-human nature has an objective value of its own' (INHW):

[7] We take away so many animals' lives. Less is enough. (Sophie)

This quote [7] illustrates that the student is concerned about the self-evident nature by which human take animals' lives. She takes the animals' perspective, emphasizing that 'less is enough'.

In their use of non-anthropocentric values students showed their awareness of the human-nature relationship, which was evidenced by an increase in their use of values indicating that humankind and nature are biologically integrated (BIO). The quote below [8] illustrates this awareness:

[8] We eat meat by nature. (...) We want to continue eating meat, but the earth should not be destroyed. (Vernon)

Finally, with regard to relation-oriented values, students showed an increase in their use of values related to Deep Ecology (DE), thereby illustrating an awareness of humankind's 'sense of dependence, or belonging to nature', illustrated by quote [9]:

[9] I am a consumer myself, and it is important that consumers remain healthy, and (the) living environment (as well), because it is important that the CO<sub>2</sub> in the air no longer increases. (Sarah)

Students' use of values related to Social Ecology (SE) also increased; see quote [10] as an example of a student taking the perspective of fish caught for human consumption, acknowledging their suffering.

[10] Those fish don't really die in a pleasant way, with those (...) nets choking (them) to death. (Vaughan)

Finally, the students more often used values related to Ecofeminism (EF), emphasizing values like 'care and love' in human-non-human relationships, illustrated by quote [11]:

[11] It is (also) important that we take good care of our animals. (Sarah)

In summary, the results demonstrate that students' use of value-oriented anthropocentric and non-anthropocentric values as well as their use of relation-oriented values increased. They increasingly used values indicating the importance of future generations and 'humans' dependency on nature'. These values illustrate students' awareness of the sustainability context of the dilemmas. Students' use of non-anthropocentric values is illustrated by an increase in values related to Sentientism, Animal Rights, Biocentrism and emphasizing nature's intrinsic value. The students showed their awareness of the human-nature relationship, which is demonstrated by an increase in their use of values indicating that humankind and nature are biologically integrated.

Finally, the students increasingly used relation-oriented values, which is shown by an increase of their use of values related to Deep Ecology, Social Ecology, and Ecofeminism. It appeared that pragmatic values were used by all students, both at the beginning of the lesson, in their introductory essays, and during the lesson in the group conversations and in their worksheets.

### ***Sub-question 3: How can the possible change in students' use of values in the 'meat' dilemma be characterized?***

In this subsection, we show if students' use of values in reaching a moral decision changed during the 'meat' dilemma and, if so, how this change can be characterized. We compared students' use of values in their introductory essays with their use of values in the final task. In this written individual assignment they were asked about 'what values

were decisive' in arriving at a (final) moral decision. [Table A4](#) (appendices) provides insight in the extent to which their use of values changed during the lesson.

From [Table A4](#) we conclude that there is generally little change in students' use of values, since most of the values in their final decision were already used in the introductory essays (code B). In the cases where new values were decisive (code N), these were mainly value-oriented (VO), while there was virtually no change in the degree of decisiveness regarding relation-oriented values (RO). Hereafter, we highlight some notable results with regard to students' values concerning moral objects, the human-nature relationship, and their use of non-anthropocentric and relation-oriented values.

For one thing, 'people living today' (INTRA) remained important, illustrated by quote [12] in the student's final decision:

[12] Keep consumers satisfied, take farmers into account. (Sarah)

This student values the opportunity to keep eating meat, which is especially important for the current generation, namely consumers (food) and farmers (work).

Likewise, 'future generations' (INTER) remained important in students' final decisions, illustrated by quote [13]:

[13] This is how we destroy the earth and it has to stop. (Sarah)

This student presumes that continuing to eat meat leads to the destruction of the earth, which, arguably, is detrimental to present and future generations.

From an anthropocentric perspective, two students used values in their moral decision they had not used before, showing that 'human interests' were considered more important than those of 'nature' (HN-BIO). This is illustrated by the following quote [14]:

[14] It would be better to reduce [eating meat], but it is so delicious, and the alternatives are not. (Bruce)

Likewise, two students used 'need values' in their final moral decision for the first time, illustrating their view that they (or: humans, humanity) depend on meat for the provision of (healthy) food (NV), which is illustrated by quote [15]:

[15] You need the nutrients and vitamins. (Madelyn)

With regard to students' use of non-anthropocentric values, an increasing number considered values related to Sentientism (SENT) to be decisive:

[16] [Which values were decisive? (question asked on worksheets)] Animal welfare. (Sophie)

This student considers 'animal welfare' a decisive value in her moral decision-making. It is likely she takes the animals' perspective, for which pain and suffering must be prevented.

Finally, students' use of relation-oriented values hardly changed in their decisions (RO-EE, code B). Both at the beginning of the lesson (in the introductory essay) and at the end (in the final individual task), values related to 'pragmatic environmental ethics' (PR) were used in students' final decision-making. Central to Pragmatism is 'thinking about solving problems in a practical and sensible way rather than by having fixed ideas and theories', illustrated by quote [17] (from worksheet):

[17] Maybe we should switch to cultured meat. We should not stop, but we should reduce (for instance, three times a week) (Madelyn)

This student suggests the possibility of ‘switching to cultured meat’. At the same time, she values following the golden mean, namely the opportunity to continue to eat meat (anthropocentric perspective), but less (both an anthropocentric and non-anthropocentric perspective).

Comparing our analysis of sub-question 2 and 3, we get insight into the values used during the lesson and those in students’ final moral decisions. It shows that most of the values used during the lesson were also used in students’ final moral decision. Looking more closely, it turns out that for all students most of the value-oriented anthropocentric values used during the lesson were also used in their final decision. With regard to the use of value-oriented non-anthropocentric values, this also applies to Sarah and Vaughan. However, the other four students used values during the lesson that did not return in their final decision. For example, Bruce used values that are interpreted as SENT, ANIM, BIOC and INHW, which were not part of his final decision. Finally, although most of the students used relation-oriented values (DE, SE, EF, PR) during the lesson, for most of them Pragmatism (PR) was the only decisive relation-oriented value.

Concluding, we found little change in students’ use of values, given the fact that most of the values used in their introductory essays were used in their final moral decision as well. More specifically, in cases where new values were decisive, these were mainly value-oriented, in which ‘human interests’ became more important than ‘nature’ or ‘animals’, especially with regard to the guarantee of meat consumption. Value-oriented animal welfare increasingly weighed more heavily in students’ final moral decision. Also, students’ use of relation-oriented values hardly changed, which is illustrated by their equal use of pragmatic values at the beginning and at the end of the lesson.

## Discussion

To analyse the students’ use of values, we used an environmental ethical conceptual framework (Kronlid & Ohman, 2013), which distinguishes between predominantly rational values (i.e., value-oriented environmental values) and values that are both rational and emotional in nature (i.e., relation-oriented environmental values). The use of the framework was primarily descriptive in nature in order to gain conceptual insight into the kinds of values the students used in their moral argumentation and decision-making and, hence, into their morality.

In order to answer our first sub-question, we investigated how the students related to the topics by interpreting their use of values. We found that the kind of values the students used differed per dilemma. It is likely that this is due to the moral objects that were central to the dilemmas. These were humans (e.g., present and future generations, farmers, consumers) or non-humans (e.g., large grazers, wolves, farm animals, insects, seals) or ecosystems. Students’ use of values regarding non-humans as moral objects are related to Sentientism and Animal Rights in all dilemmas, except in ‘neonics’, which is likely due to the moral object (insects), which are probably thought not to experience pain or have a ‘sense of self’. These results are consistent with other morality research,

which shows that moral argumentation and decision-making is context-dependent (e.g., Rest et al., 2000).

To answer our second sub-question, we examined which values six students used in the 'meat' dilemma during the individual assignments (introductory essay, answer sheets) and during the group discussions. We found that they demonstrated a growing awareness of the sustainability context of the dilemma. Furthermore, it appeared that there was an increase in their use of value-oriented non-anthropocentric values, illustrating a growing awareness of the human-nature relationship.

In line with Kronlid and Ohman's (2013) argument, we emphasize the importance of creating a relationship between the student and the moral object central to the dilemma. We assume that such a relationship provides insight into the student's (actual) morality (cf., Jickling & Paquet, 2005). Our result, an increase in students' use of relation-oriented values in the 'meat' dilemma, seems to indicate that this relationship has been established. However, due to difficulties with interpreting the data (described below), we should be careful with drawing definite conclusions. In other words, our interpretation of a progressive use of relation-oriented values does not conclusively indicate a genuine relationship between the students and the dilemma's stakeholders (human, non-human; Jickling & Paquet, 2005; Kronlid & Ohman, 2013). Likewise, following our assumption that a relationship provides insight into the students' actual morality, we should also be cautious with drawing conclusions with regard to possible insights into their morality.

To answer the third sub-question, we investigated whether the extent to which the six students used values in arriving at a moral decision changed in the 'meat' dilemma, and, if so, how this change can be characterized by comparing their introductory essays and their final moral decisions. It appeared that the kind of values hardly changed: in general, the values the students used in their introductory essays were also decisive in their final decision. In the few cases where new values were decisive, it appeared that these were mainly value-oriented, while students' use of relation-oriented values hardly changed. Therefore, it seems that students' moral decision-making was mainly based on their use of value-oriented values, which supports our caution with regard to drawing conclusions about the establishment of a student-dilemmas' stakeholders relationship. In summary, the influence of the intervention activities in enhancing this relationship appears to be limited, which is likely due to a number of factors.

First, this limitation is presumably related to class time, which was 50 minutes per week during a period of six weeks. Obviously, time and place are essential factors for creating the conditions for establishing a relationship between student and moral object. During the intervention in this study, time was limited and students worked inside the classroom, which likely hindered the establishment of such a relationship. Related to this, children's morality development is a complex process, with many (social) influences outside the school, e.g., family (parents) and media (internet, social media). There are even indications of biological influences, like hormonal changes during puberty (Hart & Carlo, 2005). Obviously, these influences were beyond the scope of this study.

Second, due to the focus of this study, the activities during the intervention were mainly student-centred and the teacher's role was limited. Literature shows that science teachers often find it difficult to organize classroom discussions on SSI (Bennett et al.,



2010), and that they need support on how to strengthen student argumentation (Dawson & Venville, 2010). Similarly, the teacher-researcher and the teacher in this study felt a need for further developing their skills in guiding students' morality in their classrooms. A more prominent role for the teacher could challenge students to adopt a broader spectrum of values in their moral argumentation and decision-making (Van der Zande et al., 2012).

Third, Dutch secondary science students are often not used to discussing moral dilemmas, especially in the human-nature context. A similar result was found in a study in Finnish chemistry education (Juntunen & Aksela, 2014), which showed that the students more often used 'moral arguments' in their individual essays than in group activities, indicating that students may need more support to share their moral views with other students.

Regarding the data analysis, a number of limitations come to the fore. The study was conducted with a specially developed intervention aimed at stimulating students' values clarification and values communication. It is likely, given that the students were involved in group tasks and group discussions, that the values they used do not only reflect their own personal perspectives. Their use of values was probably influenced by the arguments of the other group members, who have not been analysed, nor did we analyse how and to what extent the interaction influenced the students' use of values.

As we indicated in the description of the data analysis, in a number of cases value statements were assigned with multiple codes, which was somewhat to be expected. In the substantiation of our conceptual framework we already explained that value-oriented environmental ethics are based, to a large extent, on the idea of 'moral extensionism'. As such, the moral agent (student) enters into a relation with the dilemmas' stakeholders. However, as Kronlid and Ohman (2013) argue, such a relationship is based on philosophical argumentation (a 'rationalist embrace' (p. 29) as they call it), and therefore it is predominantly rationality-based. In other words, in contrast to relation-oriented environmental ethics, there is a shortage of moral argumentation and decision-making in which both the rational and emotional relational contexts are taken into consideration. The students oftentimes used relatively short value statements, lacking the (necessary) connotation, leaving room for different interpretations.

Another plausible reason might be the overlap of codes in the coding book. For instance, the description corresponding to Animal Rights is 'Non-human animals with a sense of self have intrinsic value', while the description of Biocentrism is 'All organisms have intrinsic value by virtue of having a good of their own related to their flourishing' (Table A3(b)). All in all, such challenges with data analysis show the importance of a second coder with whom different interpretations were discussed and verified.

In summary, we cannot draw definite conclusions as to the establishment of a relationship between students and topic. However, we consider it plausible to conclude that the intervention positively contributed to students' ability to systematically investigate the values involved in the moral dilemmas. Hence, the intervention design potentially conducted to a positive cognition of the values that are important to the students, which likely enhanced their ability to make informed decisions with regard to moral dilemmas within the human-nature context. All things considered, this study contributes to further insight into how students' values-based engagement in moral dilemmas can be supported.

This brings us to a number of recommendations and implications with regard to further theorization, research and practice about encouraging science students' use of values within their moral argumentation and decision-making.

With regard to theory, we recommend to explicitly differentiate between value-oriented and relation-oriented environmental ethics. This will likely provide insight into the extent to which the relationship between moral agent and moral object is predominantly rational, or both rational and emotional.

Further, our work shows that further research is needed into effective pedagogies that contribute to a classroom climate in which students feel safe enough to engage in joint reflections on their values, and how (science) teachers can realise this climate.

Finally, with regard to implications for educational practice, the preconditions for establishing a relationship, both rationally and emotionally, between student and moral object (or: dilemmas' stakeholders) ought to be taken into consideration (Zeidler et al., 2019).

## Note

1. The 'rules for conducting a group discussion', which were included in the student manual, were the following: Everyone is allowed to say or ask the same amount; Try to be open, respectful and understanding towards each other; Support your opinion with arguments. Is your reasoning correct?; Listen to each other and try to understand what the other wants to say.

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## APPENDICES

**Table A1.** Ethical matrix: ‘Should we stop eating meat? Why?’.

(Factual and appreciative) arguments (quotes from recent media)	well-being (health/welfare)	autonomy (freedom/ choice)	justice (fairness)
<p><i>Animals</i> 50% of the pigs suffer from pneumonia; more than 70% of the fattening pigs have a growth disorder. More than 70% of the sows have a stomach condition, such as a stomach ulcer. 10% of the sows have a bladder infection. Animals are deprived of freedom. They have no possibility of performing their natural behaviour.</p>	<p><i>Animal welfare</i> 'pneumonia . . . growth disorder . . . stomach condition, such as a stomach ulcer. . . bladder infection'</p>	<p><i>Freedom (of natural behaviour)</i> 'They have no possibility of performing their natural behaviour.'</p>	<p><i>Intrinsic value</i> 'Animals are deprived of freedom'</p>
<p><i>The living environment</i> The meat you want to eat is at the expense of a whole bunch of other animal species. 35% of the biomass of mammals is taken by humans and 61% by livestock consumed by humans. Only 4% is still wild. This percentage of wild animals is further decreasing: it is estimated that around 2100 there will only be 2% wild animals left. One cow annually delivers just as many greenhouse gases as driving 70,000 kilometres by car, and the production of 1 kilo of beef requires a total of 15,000 litres of water.</p>	<p><i>Nature conservation</i> '(meat consumption) is at the expense of a whole bunch of other animal species.'</p>	<p><i>Biodiversity (self-regulating)</i> 'Only 4% (of the mammals) is still wild.' 'This percentage of wild animals is further decreasing. . .'</p>	<p><i>Sustainability</i> 'One cow annually delivers just as many greenhouse gases as . . .'</p>

<sup>1</sup>Due to space limitations we only present two groups of stakeholders. In the original matrix, ‘Farmers’ and ‘Consumers’ were also included as stakeholders.

<sup>2</sup>At the start of each lesson, the moral values were still omitted in the matrix. Halfway through the lesson, the students were provided with a completed matrix—to compare their results with, and to let them continue with the other tasks.

**Information box 1.** Illustrative example of a lesson.**Start of the lesson**

The lesson starts with several video fragments, presenting arguments from different perspectives. Then the dilemma is introduced with a question. For instance: 'Should we stop eating meat? Why?' Subsequently the students work on a number of individual and group tasks (see below).

**Individual tasks:** Indicate whether you consider this to be an important dilemma. For me this dilemma is: *not at all important—not important—neutral—important—very important*

What do you think? What is the first thing that comes to mind when you think about this dilemma? Are you for or against? Why? What are important arguments for you? Maybe you do not know, or not know yet, which is also possible. *Write down your answers to these questions.*

*The students receive an ethical matrix for this dilemma<sup>1</sup> (cf., Table A1).*

**Group tasks:** *Discuss:* Which arguments (quotations from stakeholders) belong to which moral values? Which arguments are factual and which are appreciative? How do you determine whether an argument is factual or appreciative?

**Individual tasks:** Think about the dilemma again (on your own). Use the completed matrix: what are important stakeholders to you? Which (factual and appreciative) arguments and moral values do you consider important? Why? Are there any other personal values that you consider important as well? For example, values you carry from home, or from your religion, or from a group of friends, or a political party that you're a member of. *Write down your answers to these questions.*

**Group tasks:** *Discuss:* What do the others think? What are (the most) important values for them, both those from the matrix and personal values? Which (factual and appreciative) arguments and moral values carry the most weight? Why? Do you think the same? Where do you differ?

**Individual tasks:** Are you still for or against? What are important (factual and appreciative) arguments and moral values that have been put forward? Which ones did you not know yet? Did it influence your opinion? Which arguments or values are decisive for you? Why?

Of course, it is also possible that you still don't know, or you don't know anymore. What do you think is the reason for that? *Write down your answers to these questions.*

**Group task:** You might think you have little influence on what happens, or is decided, in this dilemma. Discuss with your group in what way(s) you could influence it anyway.

**Individual task:** Is this dilemma still as important to you, or has it become more or less important? For me, this dilemma: *became less important—remained just as important—became more important*

<sup>1</sup>About halfway through the lesson, the students were provided with a completed matrix—to compare their results with, and to let them continue with the other tasks.

<sup>2</sup>Due to space limitations, we only present the student tasks. In the students' original worksheets, space was left open to write down their answers.

**Table A2.** Overview of the module's implementation: introductory lesson and the addressed moral dilemmas.

Week <sup>1</sup>	topic/moral dilemma	label
1	Introductory lesson on the use of ethics in socioscientific issues	intro
2	Should we feed the large herbivores in 'Oostvaardersplassen' during severe winters? Why?	feeding
3	Should wolves have every opportunity to resettle in the Netherlands? Why?	wolf
4	Should we stop eating meat? Why?	meat
5	Should we ban the use of neonicotinoids? Why?	neonics
(7–8) <sup>2</sup>	Should we stop the rehabilitation of seals from the Wadden Sea? Why?	seals

<sup>1</sup>The classroom time was 50 minutes per week.

<sup>2</sup>Individual interviews after the intervention.

**Table A3.** (a) Coding scheme (Value-oriented anthropocentric environmental ethics: VO-AEE). (b) Coding scheme (Value-oriented non-anthropocentric environmental ethics: VO-NAEE). (c) Coding scheme (Relation-oriented environmental ethics (RO-EE)).

Category	Description	Code	Illustrative quote
<b>(a)</b>			
<b>Moral object (MO)</b> <i>Intragenerational</i> <i>Intergenerational</i>	People living today People living today and future generations	<b>INTRA</b> <b>INTER</b>	(Our) crops depend on bees. (Bruce, neonics) Farmers should be able to continue to do their work. (Vernon, meat)
<b>Human-nature relationship (HN)</b> <i>Biologically</i>	Humans and nature are biologically separated or integrated	<b>BIO</b>	You need the nutrients and vitamins. (Madelyn, meat)
<b>Instrumental value of Nature (IVN)</b> <i>Demand value</i> <i>Need value</i>	Natural resources are valued because they satisfy our felt preferences <b>Natural resources are valued because humankind is dependent on nature for its basic well-being and survival</b>	<b>DV</b> <b>NV</b>	The animals have to be shot. Then there is less hunger. (Sophie, feeding) <b>Some crops cannot be grown without bees. (Vaughan, neonics)</b>
<b>(b)</b>			
<b>Moral object (MO)</b> <i>Sentientism</i>	Non-human animals with the ability to experience pain and suffering have intrinsic value	<b>SENT</b>	If a seal pup is injured, you take care of it. (Madelyn, seals)
<i>Animal Rights</i> <i>Biocentrism</i>	Non-human animals with a sense of self have intrinsic value All organisms have intrinsic value by virtue of having a good of their own related to their flourishing	<b>ANIM</b> <b>BIOC</b>	The wolf must have freedom where it wants to live. (Sarah, wolf) Bees and insects are living creatures. (Vaughan, neonics)
<i>Ecocentrism</i>	Ecosystems and species have intrinsic value because it is possible to relate to them as separate entities	<b>ECOC</b>	Let nature take its course. (Madelyn, feeding)
<b>Human-nature relationship (HN)</b> <i>Biologically</i>	Humans and nature are biologically separated or integrated	<b>BIO</b>	They are not pets. (Bruce, feeding)
<b>Intrinsic value of Nature (inVN)</b> <i>Inherent worth</i>	<b>Non-human nature has an objective value of its own</b>	<b>INHWN</b>	<b>They are living creatures and you don't want that they die that way. (Vaughan, seals)</b>
<b>(c)</b>			
<b>Deep ecology (DE)</b>	Identifications with other species and the land involve a deeper sense of belonging, which means developing aesth/ethical practice	<b>DE</b>	Without insects, humanity is in danger. (Bruce, neonics)
<b>Social ecology (SE)</b>	Environmental justice, i.e., a fair political system that acknowledges the suffering of both humans and non-humans	<b>SE</b>	We owe it to those poor animals, after all, we released them ourselves. (Sarah, feeding)
<b>Ecofeminism (EF)<sup>1</sup></b>	Underlines how values of care, partnership, kinship, love, friendship etc. take precedence in human-non-human relationships	<b>EF</b>	I think you (should) take care of them and ensure that they can go back to nature. (Bruce, seals)
<b>Pragmatism (PR)</b>	<b>Accentuates the need for ethical pluralism arguing that the goal is to describe people's actual reasons for valuing nature</b>	<b>PR</b>	<b>Wolves should not become extinct, but it is possible to make a reserve for the wolves. (Vernon, wolf)</b>

<sup>1</sup>An ecofeminist approach (e.g., Warren, 1997) emphasizes situated human-non-human relationships of dominion in context, and it relates environmental degradation to the social oppression of women. According to an ecofeminist approach, affectively-loaded concepts as care, sympathy, and compassion should be central to the process of moral argumentation and decision-making. The ecofeminist approach is not without controversy, which is evidenced by later research, in which (initial) assertions that traits like care, sympathy and compassion are predominantly female characteristics or abilities were largely refuted (cf. Nucci, 2013).

**Table A4.** Students' decisive values in their moral argumentation and decision-making regarding 'meat'.

Values (codes)	Bruce	Madelyn	Sophie	Sarah	Vaughan	Vernon
<b>VO-AEE</b>						
<i>MO-INTRA</i>	B <sup>a</sup>	B	I	B	B	B
<i>MO-INTER</i>		B	N	B	B	
<i>HN-BIO</i>	N <sup>b</sup>	N		I	B	B
<i>IVN-DV</i>		N			I	B
<i>IVN-NV</i>	N	N		B	B	B
<b>VO-NAEE</b>						
<i>MO-SENT</i>			N	N	N	
<i>MO-ANIM</i>				I		
<i>MO-BIOC</i>				B	N	
<i>MO-ECOC</i>	I <sup>c</sup>					
<i>InVN-INHW</i>				B	N	
<b>RO-EE</b>						
<i>DE</i>				B		
<i>SE</i>			I	B		
<i>EF</i>				N		
<i>PR</i>	<b>B</b>	<b>B</b>	<b>B</b>	<b>B</b>	<b>B</b>	<b>B</b>

<sup>a)</sup>'B' refers to decisive values used in *both* the introductory essay and in the students' final moral decision.

<sup>b)</sup>'N' refers to *newly used values* as being decisive (i.e., not used in the students' introductory essay).

<sup>c)</sup>'I' refers to values that were used in the *introductory essay*, but were absent in the students' final decision.