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Understanding Controversies and Ill-Structured Problems Through Argument Visualization. Curriculum and Learning Materials for Problem-based Learning in Small Groups of Students Who Work Autonomously on Projects with the Interactive AGORA Software, Including an Exemplary Reader on Genetically Modified Plants

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UNDERSTANDING CONTROVERSIAL ISSUES AND ILL-STRUCTURED PROBLEMS THROUGH ARGUMENT VISUALIZATION

CURRICULUM AND LEARNING MATERIALS FOR PROBLEM-BASED LEARNING IN SMALL GROUPS OF STUDENTS WHO WORK AUTONOMOUSLY ON PROJECTS WITH THE INTERACTIVE AGORA SOFTWARE, INCLUDING AN EXEMPLARY READER ON GENETICALLY MODIFIED PLANTS

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1. Introduction

A precondition for making sound ethical decisions, and for knowing what is right and what is wrong, is the ability to analyze complex decision situations and ill-structured problems in a way that all the involved stakeholders can be identified, their varying perspectives and values be understood, positions be justified in reasoned dialogue, and possible alternative courses of action or solutions must be imagined.[2]

The ability to analyze complex situations, however, cannot simply be taught by instruction; it must also be learned through practice. This ability can best be acquired—as has been shown in a large number of general educational studies[3]—by problem-based learning (PBL) in small-group settings. Confronted with a problem or case they perceive as a real challenge, students are motivated both to acquire the content knowledge they need and to try various strategies to cope with difficulties. If the problem or case is sufficiently complex so that it allows a variety of equally justified approaches and ways to frame it, collaborating students will be motivated to explore this variety of options, and they will experience the need to reflect critically on their own framing, implicit assumptions, and the effectiveness of the strategies employed.

The need to reflect critically on one's own assumptions is particularly pressing when people from culturally diverse backgrounds collaborate. There are always misunderstandings, conflicts, and problems of communication. While there is general agreement that the experience of team work, problem-based learning, and developing the skills necessary to cope with problems of communication is crucial for the education of future generations, there are serious problems to realize these goals in educational programs. Research on problem-based learning (PBL) in small groups has shown that collaboration in these settings works only when it is supported and guided by an experienced facilitator. "The facilitator helps monitor group discussions, guides students in the learning process, pushes them to think deeply, and models the kinds of questions that students need to be asking themselves" (Hmelo-Silver & Barrows, 2008). The PBL approach, for example, that has

2 This formulation is adapted from the summary of a workshop on "Ethics Education and Scientific and Engineering Research," organized by the National Academy of Engineering (Hollander & Arenberg, 2009). See also NAE, 2004.

3 See Barrows & Tamblyn, 1980; Duch, Groh, & Allen, 2001; Gijbels, Van de Watering, Dochy, & Van den Bossche, 2006; Hmelo-Silver, 2004; Hmelo-Silver & Barrows, 2008; Hmelo-Silver, Duncan, & Chinn, 2007; Newstetter, 2005, 2006; Woods, 1996.

been instituted in the graduate and undergraduate curricula in the Department of Biomedical Engineering at Georgia Tech requires for each group of six to eight students to have a facilitator for all collaboration sessions (Newstetter, 2006). This means that collaborative and problem-based learning environments are much more resource intensive than traditional instruction. In times of limited financial resources, this poses a serious threat to the quality of ethics education.

The AGORA approach addresses this problem by providing a web-based software application called "AGORA: Participate – Deliberate!". The AGORA software guides the activities of small groups of students (about four students per group) who collaborate on challenging problems and cases. The guidance and "scaffolding" provided by the software allows the integration of an AGORA component in classes without the need of facilitators; an instructor who is familiar with the AGORA approach will be sufficient to organize this innovative learning experience and to support the groups.

The key idea of the AGORA approach is to confront small student groups with the task of developing a position—or set of possible positions—on a challenging case and to defend this/these position(s) by chains of arguments that will be visualized by means of the interactive AGORA software. The software guides students step by step through a process of argument mapping. In contrast to other Computer Supported Argument Visualization tools (CSAV tools), AGORA is specifically designed to direct and guide students' activities and collaboration in small, independently learning groups. The software provides the sort of guidance and scaffolding that otherwise a facilitator would contribute. AGORA can overcome, thus, the problems of existing CSAV tools that we identified in previous research.[4] The AGORA learning approach aims at helping students to understand the justifications of a multitude of stakeholder positions through projects in which they reconstruct these justifications in the form of graphically represented logical argument maps. Argument mapping in problem-based learning environments provides an exciting opportunity for students to develop critical thinking, argumentation skills, and the ability to collaborate in teams, leading to overall higher academic performance and better chances on the job market.

4 Hoffmann, 2007, 2008. See also Carr, 2003, Bell, 2004, Munneke, Andriessen, Kanselaar, & Kirschner, 2007. With regard to the function of CSAV to enable students to cope with ill-structured problems, see Andriessen, Baker, & Suthers, 2003; Conklin, 2003; Kirschner, Buckingham Shum, & Carr, 2003; Okada, Buckingham Shum, & Sherborne, 2008; van Gelder, Bissett, & Cumming, 2004; Suthers, Vatrapu, Medina, Joseph, & Dwyer, 2008; Toth, Suthers, & Lesgold, 2002.

Using the AGORA software in ethics and other classes provides an opportunity to focus on a skill that—as far as we can tell—did not get enough attention in the past: the ability to clarify and structure complex situations. This ability is a precondition for problem solving, for decision making, for designing, and for planning. This has been acknowledged as "one of the most intractable problems" already in 1973 by Horst Rittel and Melvin Webber in their seminal paper "Dilemmas in a General Theory of Planning" (Rittel & Webber, 1973). Rittel and Webber came to the conclusion that the real challenge is not those "tame" or "benign" problems that are clearly specified and that allow a clear determination whether a solution has been achieved—as we find them, for example, in the textbook problems of mathematics; the real challenge is what they called "wicked problems."

A problem is "wicked"—to recount Rittel and Webber's ten characteristics of **wicked problems**—when

1. there is "no definitive formulation" of it and any sufficiently detailed description of what the problem "is" is already predetermined by a certain vision of its solution—a vision that is often biased by diverse values and interests;
2. it is "wicked" when there is "no stopping rule" because any "solution" can still be improved, and
3. when there is "no immediate and no ultimate test of a solution" to it because any "solution, after being implemented, will generate waves of consequences" which "may yield utterly undesirable repercussions which outweigh the intended advantages."
4. "Solutions to wicked problems are not true-or-false, but good-or-bad" because there are many parties with potentially varying interests, value-sets, and ideological predilections who are more likely to assess a solution as "better or worse" or "satisfying" or "good enough."
5. "Every solution to a wicked problem is a 'one-shot operation'," because its implementation "is consequential. It leaves 'traces' that cannot be undone. One cannot build a freeway to see how it works, and then easily correct it after unsatisfactory performance."
6. "Wicked problems do not have an enumerable (or an exhaustively describable) set of potential solutions, nor is there a well-described set of permissible operations that may be incorporated into the plan";
7. every "wicked problem is essentially unique" and

8. “can be considered to be a symptom of another problem.”
9. “The existence of a discrepancy representing a wicked problem can be explained in numerous ways. The choice of explanation determines the nature of the problem’s resolution.” And finally:
10. “The planner has no right to be wrong,” because: “Planners are liable for the consequences of the actions they generate; the effects can matter a great deal to those people that are touched by those actions” (Rittel & Webber, 1973, pp. 161-167).

A substantial part of the wickedness of this sort of problems results, as Rittel and Webber emphasized, from the fact that in pluralist societies, in which a multitude of world views and values compete, the determination and formulation of a problem as well as the assessment of its “solution” are in themselves controversial and open to discussion. Based on differing belief and value systems, problems and solutions can be “framed” in a variety of ways, and there is no one who could legitimately claim an authoritative position to decide who is right and who is wrong. For Rittel and Webber the openness of wicked problems implies that they should be approached “based on a model of planning as an argumentative process in the course of which an image of the problem and of the solution emerges gradually among the participants, as a product of incessant judgment, subjected to critical argument” (Rittel & Webber, 1973, p. 162).

2. Outline of an AGORA class

The present curriculum describes how small groups of autonomously collaborating students can acquire—as we said in the first sentence above—the skills that are necessary “to analyze complex decision situations and ill-structured problems in a way that all the involved stakeholders can be identified, their varying perspectives and values be understood, positions be justified in reasoned dialogue, and possible alternative courses of action or solutions must be imagined.” We envision that this project-based work runs parallel to traditional instruction in a sequence of three phases in one semester, taking about 40% of the entire time in class. In the test-runs that we performed at Georgia Tech over the past years in a series of about eight 3-credit hour courses,[5] we reserved one of two 80-minutes class meetings per

5 In these courses, the AGORA software was not yet available. The students used the freely available concept mapping software cmap (http://cmap.ihmc.us/) to perform “Logical Argument Mapping (LAM)” on which the AGORA software is based. See http://lam.spp.gatech.edu.

week for group work and the presentation and discussion of results. A basic outline of an AGORA project looks like this:

1. Students read individually text materials at home and submit a homework before they come to class, answering the question: “What is the main conclusion of this text? What are the reasons that the author provides for this conclusion?”. This is to ensure that everybody is equally prepared for the project. During the entire project phase students are encouraged to search for additional material and to prepare it for the group work.
2. In class, students collaborate in groups of four on the construction of an argument map over one to three weeks, depending on the complexity of the project. In each group at least one computer with an internet connection must be available. Since the software allows synchronous collaboration, everybody can work on his or her own laptop. All maps are stored on the AGORA server at agora.gatech.edu and are publicly available unless they are password-protected in a “Project” by the user or instructor.
3. The groups present their argument maps in class, followed by a class discussion. Depending on the class size, the presentations will take one or two weeks since every group will need on average of minutes for a more complex project. If several groups are working on the same material, it is not necessary that all groups present.
4. In the class meeting after the presentations the groups revise their argument maps based on the feedback they got in the discussion and submit it for grading. Since all groups are working on the same schedule, they have to collaborate outside of class on the maps in case they need more time than allocated.

In order to achieve the learning objective mentioned above, three different class phases should be distinguished. In a first phase, students need to become familiar with the AGORA software and learn how to map the structure of an argumentation or a simple debate. In the second phase, each group will apply and train their argument mapping skills in the analysis of one stakeholder position on a controversial technology. A list of preselected positions is presented to all students in advance, together with short abstracts that describe these positions. Groups will be formed according to the interests of the students. The analysis of just one position is supposed to promote an in-depth understanding of this position, its justification, and its limits and weaknesses. In the third phase, finally, the groups are confronted

with the task to develop a clear and convincing position to an open-ended decision problem. Whereas in Phase 2 stakeholder positions are given, the challenge is here to imagine possible stakeholder perspectives and their respective justifications.

In the following sections, we describe these three phases in some more detail, and we provide exemplary learning material and examples for each phase.

2.1. First phase: Learning how to map an argument or debate.

The objective in this phase to train the efficient use of the AGORA software. Smaller groups of two to three students are confronted with short texts, beginning with simple arguments that are presented in a few sentences, and then short articles from newspapers or magazines (1-2 pages). The task is to identify the main claim or recommendation of these texts ("What is the author arguing for?") and to map the structure of the reasons or evidence that the author provides for his or her main claim or recommendation. That is, students should eventually be able to solve the following task in form of a logical argument map: "Reconstruct the entire structure of this article, that is, how the author relates reasons to the central claim or recommendation so that it is justified."

It is important in this learning phase that all maps are presented, discussed, and criticized in class, and that the instructor goes from group to group to provide ongoing feedback to the work of the students. Even though the software guides the user through the process of argument construction, students should get immediate feedback with regard to their interpretation of the example arguments. It is important to show them how the various argument schemes that the software provides can be used for specific purposes (see below in the the comments on the examples).

For the preparation, keep the following points in mind:

- Students need to be asked to bring a laptop to class, with an internet browser and the Flash Player[6] installed; additionally, they have to make sure that they will have an internet connection in class. Alternatively, computers with the same equipment need to be provided. Not every student needs a

6 Download from http://get.adobe.com/flashplayer/

computer. But there should be at least one computer in each group of students

- To familiarize students with the AGORA software in weeks 1 and 2, it should be better to form smaller groups of two to three students
- As an introduction the “AGORA-net: Participate – Deliberate!” it is important that the students are informed about the content of the first page of the online AGORA Manual: What you should know before you start. (http://agora.gatech.edu/?page_id=255). This needs to be presented by the instructor or read by the students. Over the course of the entire semester the instructor has to make sure that especially the "main point" in the last two paragraphs is realized in the student work: finding the optimal structure of arguments and argumentations
- As part of the introduction, an argument should be constructed step by step starting with the option “What is the main claim of your argument?” It should be made clear that there are four different places in a basic argument where something can be added: (a) at the conclusion so that another independent argument for the same conclusion can be created; (b) under the “therefore” connection so that an argument with “linked reasons” gets constructed in which only the combination of all reasons can justify the claim; and (c) at any of the reasons and (d) the enabler to justifies the premises of an argument by further arguments.
- The concept of an “enabler” and the distinction between “particular” and “universal statement” should be explained according to the support texts to these concepts as they are provided by the software.
- The structure of the eight argument schemes used in the AGORA system should be explained by starting the process of argument construction at “Click here if you want to use a specific argument scheme.” [This feature is not yet available, but this can be done via “What is the main claim of your argument?”; also, only five argument schemes are implemented at the moment.]

After this instruction, students should work in small groups on the "AGORA exercises" listed below. It would be good to have them working always on a set of four tasks; then each task should be presented by one or more groups and discussed. Ask whether other student groups came up with different solutions and discuss those as well.

Exercises[7] can be introduced as follows: "Map the following arguments by means of the AGORA software. "Enter the AGORA-net" at http://agora.gatech.edu/, register, and "create" the arguments. Keep in mind that you have to add something in some cases to create a logically valid argument, and that it might be necessary to reformulate the given text so that it fits as closely as possible to the argument scheme you choose. Check the AGORA Manual at http://agora.gatech.edu/ if you have any questions. If you have an objection to one of the arguments, add those to your map It might be necessary to reformulate statements or to add reasons. Keep in mind that the structure of your argument or argumentation is crucial."

Since the AGORA software has been used in the classroom only once by now, it is unclear how much time is needed for Phase 1. It is expected, however, that it will be significantly less than the roughly four weeks (each 80 minutes in class) that turned out to be necessary to learn the predecessor "Logical Argument Mapping" (LAM). The reason is that in LAM students have to learn first how to construct logically valid arguments. In AGORA, arguments will automatically be constructed by the software in logical form based on user input. This way, the user is expected to learn implicitly how to structure logically valid arguments; there is no need for extra instruction. Using the software when working with the examples should be sufficient.

Learning objectives

The discussion of the following examples in class and instructor feedback should concentrate on the following points (other points are mentioned in the "comments" to each task). These learning objectives should be kept in mind also for phases 2 and 3. Students should learn to

1. assess whether the reasons provided are sufficient to justify a claim (this question can be addressed by assessing the system-generated "enabler"[8] of arguments); this question refers to the *structure* of an argument
2. realize that the structure of an argument can be improved by (a) adding further dependent reasons or independent arguments; (b) inserting an intermediate argument if a reason is not sufficient to justify a claim; (c)reformu-

7 The exercises (without the comments) are available in an html document "AGORA_exercises." Exemplary solution will be made available in a password-protected "Project" called "Instructor material." Send an e-mail to m.hoffmann@gatech.edu to get access.

8 See the AGORA user manual at http://agora.gatech.edu/?page_id=250.

lating the conclusion of the argument so that it is easier to defend; (d) qualifying the strength of the arguments by qualifiers like "probably," "in usual circumstances," or "in this situation" (see examples 7, 10, and 13); (e) or by reorganizing the structure of reasons

3. assess whether the reasons are acceptable, convincing, or need support by further arguments
4. become aware that the central conclusion of an argumentation can either be a factual statement ("it is the case that ...") or a normative statement ("we should ...")
5. select an appropriate argument scheme, and to change the argument scheme if this simplifies the structure of the argument (see also the comment to example 8)
6. realize that the argument schemes available in AGORA allow inferences from negated reasons to negated conclusions (modus tollens, example 9); affirmed reasons to affirmed conclusions (modus ponens); negated reasons to affirmed conclusions (disjunctive syllogism, examples 8, 11, and 16); and affirmed reasons to negated conclusions (not-all syllogism,[9] example 8)
7. use disjunctive syllogism for arguments that are based on a limited set of possibilities or alternatives (see examples 8, 11, and 16, but not 12)
8. realize that disjunctives syllogisms can be defeated by arguing that the list of alternatives is incomplete (see example 8)
9. use modus tollens (see example 9)
10. use not-all syllogism (see example 8)
11. distinguish between dependent reasons in an argument (examples 5, 7, and 10) and independent arguments for the same claim (example 6): A claim can either be justified by one reason, by a set of independent reasons (each connected to the conclusion by its own enabler), or by a set of mutually dependent reasons (all reasons are connected to the conclusion by one enabler, meaning that if one of the reasons can be defeated, then the entire argument is defeated)

9 Note that "not-all syllogism" has been created exactly for this purpose; in contrast to all the other argument schemes used in AGORA, this one in known in the literature only in the form of "not-both."

12. realize that the advantage of independent arguments is that each of them needs to be defeated independently by an opponent so that the argumentation is the stronger the more independent arguments are provided
13. realize that it is not always necessary to add a universal statement used in a text as a self-created reason; often such a universal statement will be automatically created by the software in form of the enabler. (See examples 1 and 4)

Examples (ranked from simple to more complex ones):

1. When Judy drives her car, she's always late. Since she is driving her car now, she will be late. [COMMENT: Students sometimes add as a reason "When Judy drives her car, she's always late." This can be done, but this reason is equivalent to the automatically generated enabler "if Judy is driving her car now, then she will be late." Using the universal statement as an additional reason will lead to an enabler that is unnecessarily complicated.]
2. Campaign reform is needed because many contributions to political campaigns are morally equivalent to bribes. [COMMENT: "because" needs to be introduced as an indicator word for arguments; structure: claim – because – reason].
3. The Wall Street Journal says that people should invest heavily in stocks. Therefore, investing in stocks is a smart move. [COMMENT: As with the examples above, this argument can easily be represented as a ***modus ponens*** argument. It should be made clear, however, that the enabler is problematic. This is an argument from authority (or expert opinion) transformed into logical form]
4. Listen, any movie with clowns in it cannot be a good movie. Last night's movie had at least a dozen clowns in it. Consequently it was awful. [COMMENT: The universal statement in the first sentence is represented in the enabler; see #1 above]
5. Tom's Tomatoes will grow because he waters them regularly and they get enough sun. [COMMENT: Arguments like this one are important to discuss the distinction between arguments with **dependent reasons** and those with independent reasons. Here, the two reasons are dependent because both need to be true to infer the conclusion. In the next one, there are two independent arguments for the same conclusion. Arguments with dependent

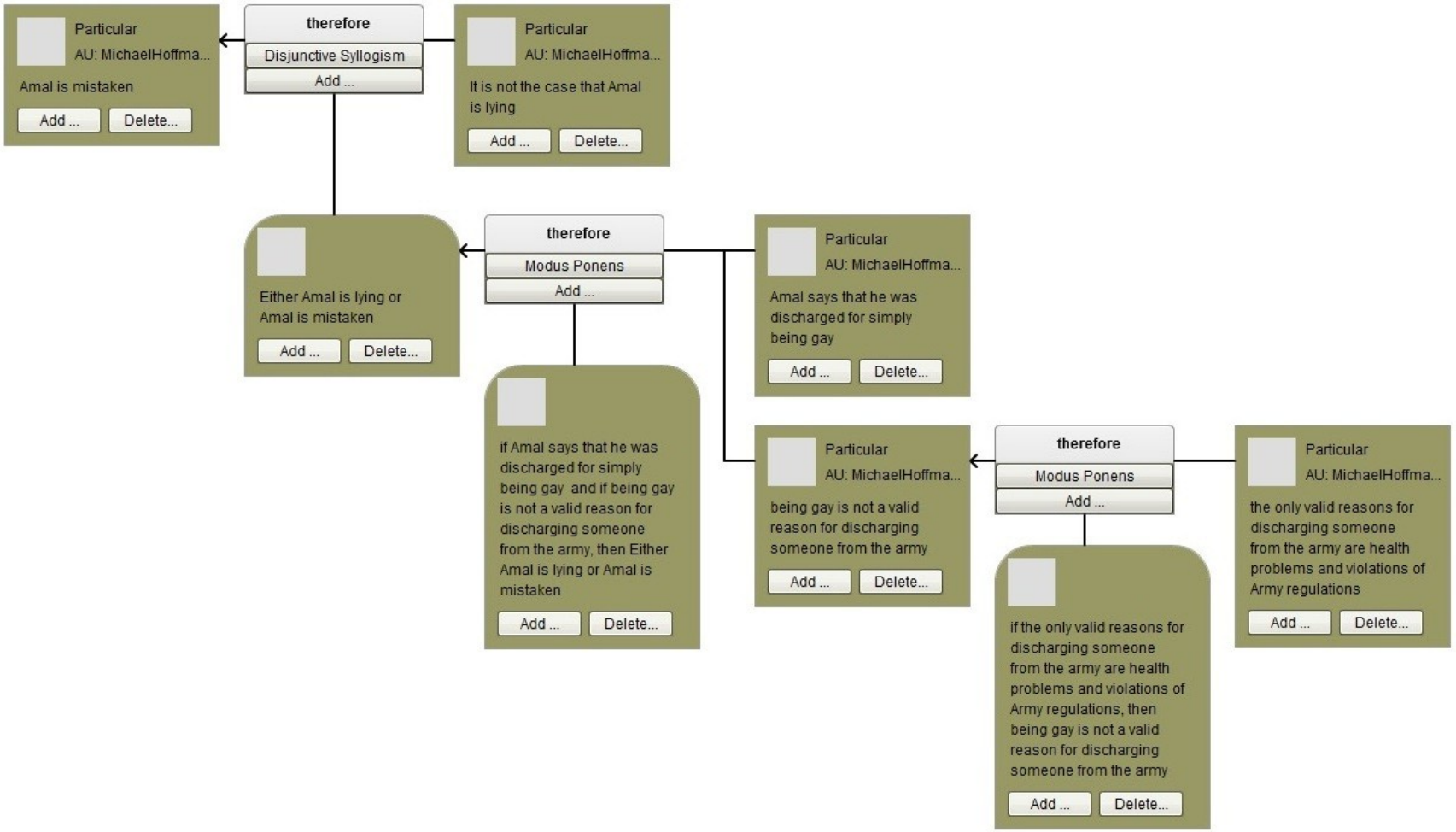
reasons are constructed so that all reasons appear in the same enabler, whereas every independent argument has its own enabler. It is important to note that an argument with dependent reasons can be defeated by defeating only one of the reasons. If you have two independent arguments, by contrast, the other one still stays if one is defeated. Therefore, it is strategically better to have independent arguments, but that is not always possible. Some conclusions can only be inferred if all the reasons are true, as in the tomato-example.]

6. Everybody should use public transportation. If there are fewer cars on the road, there is less congestion, less fuel consumption, and less pollution, and one thing is clear: We want to get to our destination as quickly as possible and we want to safe money. Also, using public transportation is safer than using a car [COMMENT: all these arguments are **independent**; see the AGORA map "test-125"]
7. Miriam was in the library when the books were stolen from the librarian's desk. She was also seen hanging around the desk. So she's probably the one who stole them. [COMMENT: Two dependent reasons in one argument. The "probably" should be in the conclusion. This is an example of how to use the modus ponens form to represent **inductions**.]
8. To secure the stability of our social security system in the long term, we should either foster immigration or support families so that more children are born. There is a lot of resistance against immigration in this country so that we need to support families. [COMMENT: This can best be represented as a chain of two arguments. The main argument should be a **disjunctive syllogism** with the enabler "Either we should foster immigration to secure the stability of our social security system in the long term or we should support families so that more children are born." The reason "it is not the case that we should foster immigration to secure the stability of our social security system in the long term" can then be defended by a second argument with the reason "there is a lot of resistance against immigration in this country." **Not-all-syllogism** can be used as the argument scheme for this second argument. Note that available argument schemes are selected so that a positive statement can be inferred from a negative one by disjunctive syllogism (first argument) and a negated statement from a positive one by not-all-syllogism (second argument). In this example the main argument should be criticized because the enabler offers a false alternative: there are

not only two options, because we could also raise taxes or borrow money. So, the set of alternatives should be enlarged.]

9. If the dictum to always tell the truth in all circumstances is a valid moral principle, then it should fit well with our considered moral judgments. But it does not fit well with our moral considered judgments because there are times when lying is actually the right thing to do, as when we lie to save a life. So the dictum to always tell the truth is not a valid moral principle. [COMMENT: use as an example for a **modus tollens** argument]
10. Taxing energy is more cost-efficient than a cap-and-trade system, at least in the short run. While the benefits of both approaches are probably the same regarding the goal to reduce emissions, the up-front costs of setting up a cap-and-trade system are much higher than the costs for taxing energy. [COMMENT: In ANY cost-benefit argument you need at least two ***dependent* reasons**, one for the costs, the other for the benefits. The argument works only if you combine both]
11. Everybody agrees that the president must have been informed by Johnson or by Lippert, and that one of them gave him the documents at this opportunity. But Johnson was out of town at the time, at least that is what we can assume based on the testimony by Lindler-Craig. So, who is to blame? Lippert, obviously [COMMENT: It is important to train awareness for the fact that all arguments that are based on a limited number of alternatives in which all but one alternative can be negated should be formulated as **disjunctive syllogism**]
12. Either Jack is lying or he is not. If his ears turn red, he is lying. If they don't turn red, he's telling the truth. His ears are red. Jack is lying. [COMMENT: lots of superfluous stuff in the text. The enabler is simply: "if Jack's ears turn red, then Jack is lying."]
13. All the evidence in this trial suggests that Lizzy Borden is guilty of murder. Let's face it: She's probably guilty. [COMMENT: can be simplified. The enabler is simply: "if all the evidence in this trial suggests that Lizzy Borden is guilty of murder, then she is probably guilty."]
14. The defendant is guilty. After all, he confessed to stealing the jewels and he was undoubtedly present at the scene of the crime since his fingerprints are on the safe.

15. Stem-cell research encourages abortions because abortions are a prime source for stem cells. Anything that encourages abortions should be banned. We ought to ban all stem-cell research. [COMMENT: This can best be represented as a chain of two arguments. The enabler of the main argument can be "if stem-cell research encourages abortion, then it should be banned." The enabler of the second argument which defends the reason "stem-cell research encourages abortions" can be: "if abortions are a prime source for stem cells, then stem-cell research encourages abortions."]
16. Either Maggie, Jose, or Ling broke the window. Jose couldn't have done it because he was studying in his room and was observed the whole time. Maggie couldn't have done it because she was out of town at the time and has witnesses to prove it. So Ling must have done it. [COMMENT: **disjunctive syllogism** with three alternatives]
17. We should encourage companies to determine the carbon footprint of their products because this can help to save money and to reduce carbon emissions at the same time. PepsiCo, for example, learned based on an analysis of the carbon footprint of a package potato chips that carbon emissions can be reduced by 7 % and money saved if potatoes are bought by dry weight instead of gross weight. They discovered that farmers humidified their potatoes before selling to increase their gross weight. Giving up humidification leads to a reduction of frying time by 10 % and to saving money and energy both for frying and for humidification. [COMMENT: see the AGORA map "test-127"]
18. The war on terrorism must include a massive military strike on nation X because without this intervention, terrorists cannot be defeated. They will always be able to find safe haven and support in the X regime. Even if terrorists are scattered around the world, support from nation X will increase their chances of surviving and launching new attacks. [COMMENT: Missing premise: "we want to defeat the terrorists." Also, not everything needs to be used. The enabler could be: "if we want to defeat the terrorists and nation X supports the terrorists and provides a safe haven for them, then we should perform a massive military strike against nation X."]
19. The only valid reasons for discharging someone from the army are health problems and violations of Army regulations. So if Amal says that he was discharged for simply being gay, he is lying or is mistaken. He is not lying. So


Particular
AU: MichaelHoffma...
Amal is mistaken
Add ...
Delete...
therefore
Disjunctive Syllogism
Add ...
Particular
AU: MichaelHoffma...
It is not the case that Amal is lying
Add ...
Delete...
Either Amal is lying or Amal is mistaken
Add ...
Delete...
therefore
Modus Ponens
Add ...
Particular
AU: MichaelHoffma...
Amal says that he was discharged for simply being gay
Add ...
Delete...
if Amal says that he was discharged for simply being gay and if being gay is not a valid reason for discharging someone from the army, then Either Amal is lying or Amal is mistaken
Add ...
Delete...
Particular
AU: MichaelHoffma...
being gay is not a valid reason for discharging someone from the army
Add ...
Delete...
therefore
Modus Ponens
Add ...
Particular
AU: MichaelHoffma...
the only valid reasons for discharging someone from the army are health problems and violations of Army regulations
Add ...
Delete...
if the only valid reasons for discharging someone from the army are health problems and violations of Army regulations, then being gay is not a valid reason for discharging someone from the army
Add ...
Delete...

he is mistaken. [COMMENT: This one is very hard to figure out; see the AGORA map "test-126" and the Figure in this document]

20. There is an undoubted psychological easing of standards of truthfulness toward those believed to be liars. It is simply a fact, for instance that one behaves differently toward a trusted associate and toward a devious, aggressive salesman. But this easing of standards merely explains the difference in behavior; it does not by itself justify lies to those one takes to be less than honest. Some of the harm the liar may have done by lying may be repaid by the harm a lie can do the him in return. But the risks to others, to general trust, and to those who lie to liars in retaliations merely accumulate and spread thereby. Only if there are separate, and more compelling, excuses, can lying to liars be justified (Sissela Bok, *Lying. Moral Choice in Public and Private Life* (New York: Pantheon Books, 1978), p.134)

Some examples relating to engineering ethics

1. Chemical A or B? (see Russian translation below)

Author: William J. Frey (here slightly modified). Online Ethics Center for Engineering 1/19/2010 National Academy of Engineering Accessed: Friday, October 29, 2010 www.onlineethics.org/Resources/Cases/ChemAorB.aspx

A chemical engineering student has been working with a local manufacturing firm as a part of her university's co-op program. For several years the firm has been using chemical A as a catalyst in their manufacturing process. Chemical A is carcinogenic, although studies supporting this claim have only recently been published. Without taking elaborate safety precautions, workers handling chemical A would be exposed to sufficient amounts to risk cancer. Moreover, the disease takes up to 20 years to manifest itself. The company has tried to implement safety procedures and controls, but workers routinely ignore them. The safety procedures slow down the manufacturing process, and the workers frequently cut corners to meet quotas.

The co-op student knows of another chemical, B, which also serves as a catalyst in this manufacturing process but is not carcinogenic. Nevertheless, chemical B is considerably more expensive.

A meeting has been called to refine and possibly reengineer the company's manufacturing process. Along with the student are four other group members: a senior engineer, a manager, an industrial engineer who supervises the manufacturing process, and a marketing specialist.

The student decides to bring the issue up at the meeting. She cites the recently discovered dangers of chemical A and the tendency of the workers to violate safety procedures in using it. She then discusses the research on chemical B: although B is more expensive than A, it is much safer and is as effective a catalyst as A in the manufacturing process.

Her argument meets with stiff resistance, especially from the manager present at the meeting. He tells her that her job is to make suggestions for streamlining the existing manufacturing process, not design a new one. Furthermore, he argues, if there were a problem with safety he would have heard about it by now from the Human Resources or Legal Affairs departments.

The two engineers present say very little; they are intimidated by the manager and apparently intend to follow his lead. The manager asks the two engineers if using chemical A violates OSHA regulations; they reply that to the best of their knowledge, it does not. The manager concludes by proposing that if there are no further objections, the company will continue using chemical A. Nobody objects.

Task for group work:

- You are the Co-op student. What should you do?
- Justify your position by arguments in the AGORA system

вещество «А» или вещество «В»?

Автор: William J. Frey (отредактировано)

Студентка, по специальности инженер-химик, проходит стажеровку в местной промышленной компании. В течении нескольких лет эта компания использовала химическое вещество «А» в качестве катализатора производственного процесса. Данное вещество является канцерогенным, но исследования, представляющие доказательства вредности этого вещества, были опубликованы совсем недавно. Без строгого соблюдения правил безопасноти, работники, имеющие дело с веществом «А», в высокой мере подвержены риску заболевания раком. Кроме того, болезнь может проявиться и в течении 20 лет после окончания работы. В компании предпринимались попытки ввести процедуры безопасности и контроля, однако, работники регулярно их нарушали. Так как процедуры безопасности замедляют производственный процесс, работники зачастую игнорируют их с целью выполнить квоту.

Студентка имеет информацию о другом химическом веществе «В», которое также может быть использовано как катализатор в данном производственном процессе, но при этом не является канцерогенным. Однако вещество «В» является значительно более дорогостоящим.

Для усовершенствования и возможной реорганизации производственного процесса было созвано собрание, в котором принимала участие студентка-стажер и четверо

других сотрудников: старший инженер, менеджер, инженер по организации производства и специалист по маркетингу.

На собрании студентка решает поднять вопрос о химических веществах. Она ссылается на недавние исследования, говорящие об опасности использования вещества «А», и на склонность работников к нарушению правил работы с этим веществом.

Все её аргументы встречают жесткое сопротивление, особенно со строны менеджера. Он указывает ей на то, что ее обязнностью является рационализация существующего производственного процесса, а не создание нового. Более того, он заявляет, что если бы проблемы с безопасностью действительно существовали, он бы узнал о них от отдела кадров.

Присутствующие на собрании инженеры говорят мало; они находятся под влиянием менеджера и, по всей видимости, собираются принять его позицию. Менеджер спрашивает инженеров, нарушает ли использование вещества «А» предписания OSHA; они отвечают, что, насколько им известно, никакие предписания не нарушаются. После этого менеджер предлагает продолжить использование вещества «А». Возражающих нет.

Задания для группы:

- Поставьте себя на место студентки-стажера. Как вам следует поступить в данной ситуации?
- Обоснуйте свою позицию аргументами и обсуждением в системе AGORA.

2. Richard's Radioactive Risk (see Russian translation below)

Online Ethics Center for Engineering 5/4/2006 National Academy of Engineering Accessed: May 9, 2011 www.onlineethics.org/Resources/Cases/richardrisk.aspx

Paul is an experienced technician working in Dr. Monson's laboratory. Over the past seven years, he has become Monson's close friend and confidant. Recently, Monson assumed additional administrative responsibilities within the department. Knowing that his time in the laboratory would be decreased, Monson privately asked Paul to begin to manage the laboratory's daily operations.

Lisa joined Monson's laboratory two years ago and is the only post-graduate researcher in the laboratory. Before Paul received his new assignment, Lisa and Paul worked very well together; however, after Lisa heard third-hand about Paul's new position of authority, she felt overlooked and offended. Lisa felt that because she has more formal education than Paul, she should have been asked to manage the laboratory.

Lisa concluded that discussing her feelings with Monson would negatively affect her future career options, so she decided not to speak with Monson. Lisa and Paul maintained a professional relationship for a short while; however, soon their interactions began to sour. Paul

sensed Lisa's resentment as a challenge to his position in the laboratory and began to exert greater authority over the lab equipment. Lisa responded by leaving the equipment dirty after using it. Over time, Lisa and Paul have stopped talking to each other and avoided interacting whenever possible. Nevertheless, when Monson is around, they try to put on a convincing facade of professional respect.

Richard is an undergraduate working in Monson's laboratory with Lisa. He has watched the development of the negative relationship between Paul and Lisa. Lisa has even confided in Richard that she believes that Paul is tampering with some of her experiments to make her look bad. To avoid the rapidly escalating conflict in the laboratory, Richard quietly and quickly performs his assigned duties each day and then leaves as early as possible. As time passes, the situation dramatically worsens.

The crucial incident

One evening Lisa asks Richard to stay a bit late and finish an incubation step in a protocol. He agrees, and Lisa goes home. Paul is still in the laboratory working, but he is unaware that Richard is there too. Richard's cubicle is positioned so that he can easily see Paul's bench and Lisa's cubicle. Paul puts on some gloves and begins to work at his lab bench. Richard has an important exam the next day, so he begins to study at his cubicle. Paul is still unaware that Richard is in the laboratory. After studying for a few minutes, Richard notices that Paul is doing something in Lisa's cubicle space. Richard cannot directly see what Paul is doing. Soon, Paul emerges from Lisa's cubicle. Richard sees that Paul is carefully holding a vial, which he sets on his bench; he cautiously discards his gloves and walks out of the lab.

Richard curiously goes to see what was in the vial. The vial is a well-marked radioactive container. He feels very uneasy. Before Paul returns to the laboratory, Richard quickly finishes the incubation and goes home.

After much thought and deliberation, Richard calls Lisa at home and explains what he saw. Lisa thanks him for alerting her. Lisa arrives at the lab early the next day and tests her cubicle for the presence of any radioactive residues. Lisa finds that her chair may be contaminated. Lisa contacts the Office of Laboratory Safety (OLS). An OLS worker comes to the lab and confirms that Lisa's chair is contaminated with some sort of radioactive compound. Lisa notifies Monson about the situation. After speaking with Monson, Paul confesses to putting the radioactive substance on Lisa's chair.

Tasks for group work:

Although this case may seem overly dramatic and even extreme, the fact that it did occur (reported here with minor interpretational modifications) poignantly demonstrates the powerful role of interpersonal relationship within a working context. How could this incident have been avoided? What were the proper and improper

actions of Lisa, Paul, Richard, Monson and the institution? Justify your position with regard to each of them by means of an AGORA argumentation. Take into account that Paul may be not the only person who should have accepted responsibility.

Ричард и риск радиации

Online Ethics Center for Engineering 5/4/2006 National Academy of Engineering Accessed: May 9, 2011 www.onlineethics.org/Resources/Cases/richardrisk.aspx

Пол – опытный специалист, работающий в лаборатории доктора Монсона. За последние 7 лет Пол стал его близким другом и доверенным лицом. Не так давно Монсон принял на себя дополнительные административные обязательства и, зная что он не сможет проводить достаточное количество времени в лаборатории, попросил Пола принять на себя руководство над некоторыми ежедневными лабораторными процедурами.

Лиза стала сотрудником лаборатории 2 года назад и является единственным исследователем-аспирантом. До тех пор, пока Пол не получил новое задание, он и Лиза прекрасно работали вместе, однако, после того, как Лиза узнала о новых полномочиях Пола, она почувствовала себя оскрбленной и недооцененной. Лиза считала, что, в силу более высокого уровня образования, руководство лабороторией должо было быть отдано ей.

Несмотря на это, Лиза решила не обсуждать свое мение непосредственно с доктором Монсоном, поскольку это могло негативно сказаться на ее карьере. Некоторое время Лизе и Полу удавалось поддерживать профессиональные взаимоотношения, однако, вскоре они начали портиться. Пол воспринял возмущение Лизы как оспаривание занимаемой им позиции и начал жестче устанавливать свой контроль над лабораторным оборудованием. В ответ на это, Лиза стала оставлять оборудование грязным после использования. Вскоре Пол и Лиза перестали разговаривать друг с другом и старались избегать любого взаимодействия. Несмотря на это, в присутствии доктора Монсона они старались как можно более убедительно изобразить уважительные взаимоотношения.

Ричард – студент-бакалавр, работающий в лаборатории вместе с Лизой. Он знает об ухудшении отношений между Лизой и Полом. Более того, Лиза однажды сказала Ричарду, что она подозревает Пола в фальсификации результатов ее эксперментов с целью повреждения ее репутации. Чтобы не стать замешанным в этом быстро- развивающемся конфликте, Ричард старается быстро выполнять всю свою работу и как можно раньше уходить из лаборатории. С течением времени ситуация продолжает ухудшаться.

Ключевой инциндент.

Однажды вечером Лиза попросила Ричарда задержаться на работе, чтобы закончить заключительную стадию протокола. Он соглашается, и Лиза уходит домой. Пол тоже всё еще находится в лаборатории, но он не знает о присутствии Ричарда. Рабочее место Ричарда расположено таким образом, что ему хорошо виден рабочий стол Пола и место Лизы. Пол, все еще не подозревающий о присутствии Ричарда, надевает перчатки и начинает работать за своим столом. Через несколько минут Ричард замечает, что Пол чем-то занимается на рабочем месте Лизы, но не видит, что именно он делает. Вскоре, Ричард видит, как Пол покидает место Лизы аккуратно держа в руках ампулу, и ставит ее на свой рабочий стол. Пол выбрасывает перчатки и выходит из лаборатории.

Ричард с любопытством решается посмотреть, что же находится в ампуле, и обнаруживает, что в ней – радиоактивное вещество. Это обстоятельство пугает Ричарда, он быстро завершает свою работу и уходит домой до возвращения Пола.

После некоторых раздумий, Ричард звонит Лизе и рассказывает об увиденном. На следующий день Лиза приходит на работу и первым делом проверяет свое рабочее место на наличие радиоактивных остатков. Она подозревает, что на ее стуле могли остаться следы радиоактивных веществ. Вызванный ею работник Отдела по Безопасности подтверждает ее предположения. Лиза докладывает о случившемся доктору Монсону. После разговора с Монсоном Пол признается в том, что это он принес радиоактивное вещество на рабочее место Лизы.

3. Supplying the Right Steel: A Mechanical Engineering Case (see Appendix)

2.2. Second Phase: Understanding stakeholder positions in “reasoned dialog”

Objective: Being able to understand the reasons behind a variety of given stakeholder positions on a controversial technology, and developing sensitivity and respect for ethically, culturally, religiously, and professionally diverse positions and concerns.

This learning goal will be approached by confronting each group of students with a different stakeholder position on the same controversial issue (each position might be developed in an article of about 10 to 15 pages, so students have to read the material before they come to class). The task for each group is to reconstruct and visualize the given justification for this position in an AGORA argument map. Student groups will work over several weeks on this task (overall about 5 hours). Again, the instructor needs to walk around to provide feedback and guide the group

activities. The results of the group work will then be presented in class. This way, students "re-enact" a societal controversy in the classroom. They experience a real debate and learn how to engage in reasoned dialog on a controversial issue, and how to overcome conflicts by developing alternatives or common ground, or at least how to clarify the conflicting positions.

Students will focus on one controversial case that is described from conflicting perspectives. To highlight the fact that the same issue can be framed from a variety of different vantage points, there will be no overarching description that combines or synthesizes the variety of perspectives in "one story." This is supposed to stimulate debate about the legitimacy of different needs, interests, values, and belief systems, about the shortcomings of these perspectives, about additional perspectives, about possible common ground, etc. Students are encouraged to search for additional information and material that they can use, and for further stakeholder positions.

The focus on a multitude of stakeholder positions requires a certain degree of complexity of the cases that can be used for the second learning phase. Most of the cases used in Engineering Ethics textbooks are too simple because they mostly tell the story in a one-dimensional way. Possible cases include the problem of nuclear energy (possible positions can refer to CO_2 reduction by expanding nuclear power in the context of global warming; the problem of how to store nuclear waste; risks of pollution, accidents, and terrorist attacks; local versus national interest, etc.); ethanol (reducing dependency on oil; driving up food prises; etc.); human space travel to Mars (knowing that a return will not be possible for the time being); Radio-frequency identification (RFID) technologies (tracking people and products; patient supervision and care; data security; privacy; human implantation; governmental control); and autonomous robots for the military (responsibility of designers; extending the battlefield; regulations about their usage).

In order to develop one exemplary controversial issue that fulfills the requirement of complexity, we describe here in some more detail how the controversy about genetically modified crops (GM crops) can be used in Phase 2. A report of the National Research Council describes the technology of **GM crops** as follows: "With the advent of genetic-engineering technology in agriculture, the science of crop improvement has evolved into a new realm. Advances in molecular and cellular biology now allow scientists to introduce desirable traits from other species into crop plants. The ability to transfer genes between species is a leap beyond crop improvement through previous plant breeding techniques, whereby desired traits

could be transferred only between related types of plants. The most commonly introduced genetically engineered (GE) traits allow plants either to produce their own insecticide, so that the yield lost to insect feeding is reduced, or to resist herbicides, so that herbicides can be used to kill a broad spectrum of weeds without harming crops. Those traits have been incorporated into most varieties of soybean, corn, and cotton grown in the United States" (http://www.nap.edu/catalog.php?record_id=12804, p. S-1).

The following sections introduce the stakeholder positions and themes that we identified with regard to the controversial issue of GM crops; each is presented with a main reading, described by an abstract, and additional back-up articles that could be used alternatively. All students in class should see this list and select one of the texts (or packages) as the main focus of their group project.

However, before each group starts working on one of these positions, we propose to introduce the class to the problem by mapping an argument that usually does not attract much scientific attention: the reasoning of someone who is principally skeptical about the direction the modern scientific-technological world is taking. Being suspicious based on intuitive or religious reasons often characterizes the thinking of "the common man." The text, however, that we suggest as an excellent example of this kind of thinking is a short lecture that Prince Charles gave as one of the Reith Lectures in 2000. This text can serve as a counterbalance for all the stakeholder positions that the student groups will reconstruct afterward.

0. Even if there is no scientific evidence that technologies are risky or damaging for the environment, the "spiritual dimension of our existence" should motivate a precautionary approach

Charles, HRH the Prince of Wales, "Reith Lecture 2000," in Michael Ruse and David Castle, *Genetically Modified Foods. Debating Biotechnology* (Amherst, N.Y.: Prometheus Books, 2002), pp. 11-15.

We suggest that students read this short piece at home and submit a homework before they come to class. In this homework, they should answer two questions: "What is the main claim of Prince Charles, or what are his main claims? What are the reasons that he provides for this claim or these claims?" In class, the instructor should initiate a discussion about the suggestions the students prepared at home. Together, the class should try to map these arguments more precisely—and based on critical reflections by all—by means of the AGORA software.

After this common class project, the students work in small groups of four on one of the following stakeholder positions.

1. About the duty to assist the third world by globally promoting GM plants

Lucy Carter, "A Case for a Duty to Feed the Hungry: GM Plants and the Third World," *Science and Engineering Ethics*, 13, 1 (Mar, 2007): 69-82.

Abstract by the author: "This article is concerned with a discussion of the plausibility of the claim that GM technology has the potential to provide the hungry with sufficient food for subsistence. Following a brief outline of the potential applications of GM in this context, a history of the green revolution and its impact will be discussed in relation to the current developing world agriculture situation. Following a contemporary analysis of malnutrition, the claim that GM technology has the potential to provide the hungry with sufficient nourishment will be discussed within the domain of moral philosophy to determine whether there exists a moral obligation to pursue this end if and only if the technology proves to be relatively safe and effective. By using Peter Singer's duty of moral rescue, I argue that we have a moral duty to assist the third world through the distribution of such GM plants. I conclude the paper by demonstrating that my argument can be supported by applying a version of the Precautionary Principle on the grounds that doing nothing might be worse for the current situation."

Back-up material :

Florence Wambugu, "Why Africa Needs Agricultural Biotech," in Michael Ruse and David Castle, *Genetically Modified Foods. Debating Biotechnology* (Amherst, N.Y.: Prometheus Books, 2002), pp. 304-308.

(as one package):

Economist, "Norman Borlaug, Feeder of the World," *Economist*, (Sep 17th 2009, 2009): 81-82.

Economist, "Feeding the World; Monsanto," *Economist*, (Nov. 21st, 2009): 14; 61-63; 71-73.

Economist, "A Special Report on Feeding the World: No Easy Fix Simply Using More of Everything to Produce More Food Will Not Work," *Economist*, (Feb 24th, 2011): 8-10.

2. Concern: The safety of GM food

A. Dona and I. S. Arvanitoyannis, "Health Risks of Genetically Modified Foods," *Critical Reviews in Food Science and Nutrition*, 49, 2 (2009): 164-75.

As genetically modified (GM) foods are starting to intrude in our diet concerns have been expressed regarding GM food safety. These concerns as well as the limitations of the procedures followed in the evaluation of their safety are presented. Animal toxicity studies with certain GM foods have shown that they may toxically affect several organs and systems. The review of these studies should not be conducted separately for each GM food, but according to the effects exerted on certain organs it may help us create a better picture of the possible health effects on human beings. The results of most studies with GM foods indicate that they may cause some common toxic effects such as hepatic, pancreatic, renal, or reproductive effects and may alter the hematological, biochemical, and immunologic parameters. However, many years of research with animals and clinical trials are required for this assessment. The use of recombinant GH or its expression in animals should be re-examined since it has been shown that it increases IGF-1 which may promote cancer.

Back-up material:

B. Fenton, K. Stanley, S. Fenton, and C. Bolton-Smith, "Differential Binding of the Insecticidal Lectin Gna to Human Blood Cells," *Lancet*, 354, 9187 (Oct, 1999): 1354-55.

A. G. Haslberger, "Codex Guidelines for Gm Foods Include the Analysis of Unintended Effects," *Nature Biotechnology*, 21, 7 (Jul, 2003): 739-41.

A. G. Haslberger, "Need for An "Integrated Safety Assessment" Of Gmos, Linking Food Safety and Environmental Considerations," *Journal of Agricultural and Food Chemistry*, 54, 9 (May, 2006): 3173-80.

H. A. Kuiper, G. A. Kleter, Hpjm Noteborn, and E. J. Kok, "Assessment of the Food Safety Issues Related to Genetically Modified Foods," *Plant Journal*, 27, 6 (Sep, 2001): 503-28.

H. A. Kuiper, Hpjm Noteborn, and Aacm Peijnenburg, "Adequacy of Methods for Testing the Safety of Genetically Modified Foods," *Lancet*, 354, 9187 (Oct, 1999): 1315-16.

3. Environmental benefits of GM crops: Improved water and soil quality

National Research Council (U.S.). Committee on the Impact of Biotechnology on Farm-Level Economics and Sustainability. "The Impact of Genetically Engineered Crops on Farm Sustainability in the United States." xx, 250 p. Washington, D.C.: National Academies Press, 2010. From the "Summary," p. S-6, and pp. 57-70. Available at http://www.nap.edu/catalog.php?record_id=12804.

In the United States, increased usage of GM crops is correlated to an increase of both an increase of soil conservation tillage and glyphosate usage, and a decrease of the use of other herbicides. In contrast to conventional tillage, conservation tillage reduces soil loss from erosion, increases water infiltration, and can improve soil quality and moisture retention, strengthens nutrient cycling and increases soil organic matter, a key component of soil quality. Additionally, studies have suggested that the use of glyphosate poses less risk to water quality than the use of other herbicides.

4. Concern: Pesticide Resistance in Weeds and Environmental Effects of GM plants

Neuman, W., & Pollack, A. (2010). Farmers Cope With Roundup-Resistant Weeds. *The New York Times*. Retrieved from http://www.nytimes.com/2010/05/04/business/energy-environment/04weed.html?pagewanted=all. Read also the comments under "Invasion of the Superweeds."

American farmers' broad use of the weedkiller glyphosphate — particularly Roundup, which was originally made by Monsanto — has led to the rapid growth in recent years of herbicide-resistant weeds. To fight them, farmers are being forced to spray fields with more toxic herbicides, pull weeds by hand and return to more labor-intensive methods like regular plowing. The problem is, as Scott M. Swinton put it, "Roundup Ready™ crops let corn and soybean farmers rely on a single weapon. A single weapon is predicable, and any warrior who is predictable is open attack by opponents that can adjust. Roundup resistant weeds have done just that."

Joe Cummins. "Wake-up Call: Glyphosate Resistance in Weeds." *The Institute of Science in Society*, 2010.

Increasing instances of herbicide-resistant weeds are getting the attention of experts from around the world. Glyphosate resistant weeds may spell the end of

patented herbicide tolerant crops, but can farmers exit the transgenic treadmill that's very profitable for Monsanto?

Mellon, M., & Rissler, J. (2003). Environmental Effects of Genetically Modified Food Crops --Recent Experiences. *Paper presented by Margaret Mellon at a conference, Genetically Modified Foods—the American Experience, sponsored by the Royal Veterinary and Agricultural University, Copenhagen, Denmark, June 12-13, 2003*. Retrieved from http://www.ucsusa.org/food_and_agriculture/science_and_impacts/impacts_genetic_engineering/environmental-effects-of.html

Starting with six kinds of potential risks that GM crops might pose for the environment, the authors focus on weaknesses of the U.S. regulatory system. They are using the debate on the effects of pollen from Bt corn on the monarch butterfly as an example.

Back-up material:

Ho MW. GM crops facing meltdown in the USA. Science in Society 46 (to appear).

Cherry B. GM crops increase herbicide use in the United States. Science in Society 45, 44-46, 2010

5. Economic and safety benefits of GM crops for farmers

National Research Council (U.S.). Committee on the Impact of Biotechnology on Farm-Level Economics and Sustainability. "The Impact of Genetically Engineered Crops on Farm Sustainability in the United States." xx, 250 p. Washington, D.C.: National Academies Press, 2010. From the "Summary," p. S-10-11, and pp. 135-157.

Available at http://www.nap.edu/catalog.php?record_id=12804.

The rapid adoption of GE crops since their commercialization indicates that the benefits to adopting farmers are substantial and generally outweigh additional technology fees for these seeds and other associated costs. The economic benefits and costs associated with GE crops extend beyond farmers who use the technology and will change with continuing adoption in the United States and abroad as new products emerge.

6. Monsanto: Making profits with GM seed production

Economist (2009). Briefing: Monsanto. The parable of the sower: The debate over whether Monsanto is a corporate sinner or saint. *The Economist*, Nov. 21, pp. 71-73.

Economist (2011). A special report on feeding the world. *The Economist*, Feb 24th, pp. 8-10.

The first article describes the potential that Monsanto sees in the development of genetically modified crops and the company's strategies to protect its intellectual property. Part of the discussion is Monsanto's decision to give away patents for seeds—and know-how—to NGOs working in Africa. The second article elaborates on one point mentioned in the first article: The significance of GM crops with regard to the problem of droughts and water supply.

Back-up or alternative material:

Marie-Monique Robin, *The World According to Monsanto: Pollution, Corruption, and the Control of the World's Food Supply* (New York: New Press : Distributed by Perseus Distribution, 2010).

7. How information policies about GM food violate the ethics of the consumer—food supplier relationship

Paul B. Thompson, "Why Food Biotechnology Needs an Opt Out," in B. Bailey and M. Lappé, *Engineering the Farm: Ethical and Social Aspects of Agricultural Biotechnology* (Washington, D.C.: Island Press, 2002), pp. 27-43 (Exc.: 27-31).

P. B. Thompson, "Food Biotechnology's Challenge to Cultural Integrity and Individual Consent," *Hastings Center Report*, 27, 4 (Jul-Aug, 1997): 34-38.

Thompson develops an ethical approach that is based on consumer sovereignty and respect for cultural, religious, and idiosyncratic identities.

Glossary for a GM crops project

BT crops: The report explains: "Bt toxins, which are produced by the soil-dwelling bacterium Bacillus thuringiensis, are lethal to the larvae of particular species of moths, butterflies, flies, and beetles and are effective only when an insect ingests the toxin. Therefore, crops engineered to produce Bt toxins that tar-

get specific pest taxa have had favorable environmental effects when replacing broadspectrum insecticides that kill most insects (including beneficial insects, such as honey bees or natural enemies that prey on other insects), regardless of their status as plant pests" (http://www.nap.edu/catalog.php?record_id=12804, p. S-7).

GE crops: "genetically engineered," sometimes used instead of "genetically modified"

Glyphosate: A most common herbicide. Most GM crops are glyphsate resistant so that glyphosate can be applied against weeds without damaging the crops.

GM crops: "With the advent of genetic-engineering technology in agriculture, the science of crop improvement has evolved into a new realm. Advances in molecular and cellular biology now allow scientists to introduce desirable traits from other species into crop plants. The ability to transfer genes between species is a leap beyond crop improvement through previous plant breeding techniques, whereby desired traits could be transferred only between related types of plants. The most commonly introduced genetically engineered (GE) traits allow plants either to produce their own insecticide, so that the yield lost to insect feeding is reduced, or to resist herbicides, so that herbicides can be used to kill a broad spectrum of weeds without harming crops. Those traits have been incorporated into most varieties of soybean, corn, and cotton grown in the United States" (http://www.nap.edu/catalog.php?record_id=12804, p. S-1).

HR crops: "herbicide resistant crops," another term for GM crops.

IR crops: "insecticide resistant crops."

2.3. Third Phase: Open-ended decision problems

Objective: Being able to develop a clear and convincing position to an open-ended decision problem.

Students will be confronted with a short description of a problem situation (up to one page) that ends with a question such as "What do you think should be done? Identify possible stakeholder positions and reconstruct for each position an argumentation so that you understand its legitimacy. Focus in particular on those stake-

holders who usually do not have a voice. Try to bring all positions into a reasoned dialog by using parts of one argumentation as counter-arguments for another. After that, formulate an answer to the question what should be done and justify your proposal by an argumentation that takes the arguments for other stakeholder positions into account. ”

According to my experience at Georgia Tech, students find it easier to develop their own arguments than reconstructing an argumentation from a text. The challenge here, however, is not only to develop an argumentation for one position, but a set of arguments for a variety of stakeholder positions.

The following is from a document “Problems of cutting edge technologies” that can be distributed for Phase 3 in class.

Problems of cutting edge technologies (this has been revised in Group projects on cutting-edge technologies)

Below you will find two cases that describe hypothetical situations in which you are called upon to make a decision. The situations are hypothetical because the technologies described therein are not yet available. But this refers to cutting-edge research, so a situation like this one might soon be very real.

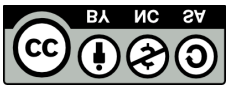
Both problems were prepared by the Georgia Tech-Emory-Georgia State Law-Morehouse School of Medicine 2009-2011 NSF EESE Project. The formulations of the tasks have been modified by Michael Hoffmann.

Problem: Bringing a Neanderthal to Life

Examining a fully analyzed Neanderthal genome might illuminate some of the genetic differences between Neanderthals and modern humans and their significance. But what if scientific curiosity extended to attempts—potentially successful—to bring a Neanderthal to life?

You are staffers for a senator in the state legislature who has heard that bringing a Neanderthal to life might be possible and that there are researchers within the state who are contemplating joining a research team to attempt the feat. These attempts, and, if the attempts were successful, the birth of a Neanderthal might occur within the state. The senator has asked you to prepare a presentation for her and fellow members of the state senate’s committee on scientific research and innovation.

She asks you to consider the potential value of such a project, and the ethical and policy issues associated it, including the possibility that there will probably successful and unsuccessful attempts. In order to do so, identify possible stakeholder positions and reconstruct for each position an argumentation so that you understand its legitimacy. Focus in particular on those stakeholders who usually do not have a voice. Try to bring all positions into a reasoned dialog by using parts of one argumentation as counter-arguments for another. After that, formulate your recommendation and justify it by an argumentation that takes the arguments for or against all the other stakeholder positions into account.



Problem: Patenting Genes and Life

Patents are property rights created by national governments. Patents grant inventors the right, for a limited period of time, to exclude others from using, selling, or distributing the patent holder's invention without permission—typically, in the form of a license in exchange for a fee to the patent holder. The chief policy justifications for issuing patents are: they promote investment in research and development to the benefit of the public by ensuring that inventors can reap the fruits of their labors, and because inventors are required to disclose detailed information about their inventions in exchange for the issuance of patents, patents benefit the public by encouraging the flow of potentially useful information during the term of the patent and the production and sale of less expensive versions of the invention after the conclusion of the patent term.

Many ethical and policy controversies surround the issuing of certain patents, including patents involving human genes. These concerns include whether these

patents are, on-balance, of benefit to the public given their potential effects on research and on the costs of and access to diagnostic tests and treatments. Concerns also surround the creation of property rights in parts of human beings.

Prepare findings, analysis, and recommendations regarding patents involving human genes. Should these patents be issued? If so, under what conditions. In order to justify your recommendation, identify possible stakeholder positions and reconstruct for each position an argumentation so that you understand its legitimacy. Focus in particular on those stakeholders who usually do not have a voice. Try to bring all positions into a reasoned dialog by using parts of one argumentation as counter-arguments for another. After that, formulate your recommendation and justify it by an argumentation that takes the arguments for or against all the other stakeholder positions into account.

Appendix

Задания для группы:

[this paragraph needs to be translated according to the modified version of the task in the English version above.]

Supplying the Right Steel: A Mechanical Engineering Case (see Russian translation below)

By William Jordan and Michael A. Latcha: http://ethics.tamu.edu/Nsfcases/meen/3/mech03.htm . Slightly modified by Michael Hoffmann.

Neal is a metallurgical engineer for Diamond Steel, Inc., a medium-sized but struggling steel company. Diamond Steel's largest client is Maypool Co., the third largest consumer appliance company in the United States. Diamond Steel is currently negotiating a new contract to supply Maypool sheet steel to be used to make the cores for a new design of a basic electric motor used in Maypool appliances. The specifications for the steel were written by engineers at Maypool's Research and Design Center (RDC), which is located 200 miles away from Maypools' Motor Production Facility (MPF) where the motor core plates will be stamped and assembled into appliance motors. The RDC specifications require UNS G10350 steel, rolled to 0.025 inches thick and heat treated to a minimum tensile strength of 100,000 psi.

In the course of his job at Diamond Steel, Neal has done a considerable amount of business with Maypool's MPF and personally knows several of the technicians who work there. In the process of discussing the upcoming contract, the MPF technicians have told Neal that the MPF presses can only reliably handle steel with Brinell hardness numbers less than 165 without jamming and ruining the workpieces. The MFP technicians suggest to Neal that a steel with a maximum Brinell hardness of 160 will "work just fine" in the motor and be easier to stamp into motor plates.

Based on Neal's calculations, he discovered that UNS G10350 steel with a tensile strength of 100 kpsi (as specified by the RDC engineers) has a Rockwell 30T hardness number of 78 and a Brinell hardness of 200. However, the steel recommended by the MPF technicians with an equivalent Brinell hardness number of 160 has a Rockwell 30T number of 72 and a tensile strength of 80 kpsi. The difference between these two data sets is too great for Neal to see a clear compromise.

The next day, a Friday, Neal decided to travel to the Maypool Research and Design Center to discuss the specifications with the project engineers. They assured him that their specifications are not arbitrary, but rather are based on a target efficiency for the new motor design. He was told that the characteristics of the same steel at a lower hardness would not satisfy the efficiency requirement.

The Maypool engineers also told Neal that the presses at their MPF are rated to process steel with ultimate strengths up to 220 kpsi. It was the opinion of the RDC engineers that the technicians at the Maypool MPF are incompetent. The engineers related several stories of product failures that were traced to improper manufacturing techniques at the MPF.

On his way home, Neal decided to stop ant Maypool's MPF. When questioned, the technicians told him that regardless of how the presses were rated, they have never

been able to process steel harder than 165 on the Brinell scale without unacceptable rejection rates. Neal was told that the presses had been recently overhauled by the manufacturer but still did not perform to their original specifications. The technicians then complained to Neal that they have had problems with the RDC engineers over-specifying and over-designing in the past. They again suggested to Neal that he just supply steel that they can easily use - no one would be the wiser and everyone would be happy.

When Neal finally got back to his desk late Friday afternoon, there was a note on his desk from the Diamond Steel Production Manager, Scott, asking for the Rockwell 30T numbers for the Maypool steel contract, which is now scheduled to be signed Monday morning.

Early Saturday morning, while preparing to play golf, it occurred to Neal that there may be a technical compromise to the problem. Depending on the characteristics of UNS G10350 steel, it may be possible to supply the steel in a soft condition for stamping, followed by heat treating to bring it up to the required tensile strength. However, he knows that the production plant does not have heat treatment facilities, therefore Maypool would have to pay extra to ship the plates to a heat treatment facility after stamping, then ship them back to their MPF for assembly.

Neal played golf that morning with his friend, Ed, a process engineer at a local polymer company. Ed's company is a much bigger supplier to the Maypool MPF than Diamond Steel is. During the round, the subject of the steel specifications in the new contract came up. Ed told Neal that the RDC engineers "have their head in the clouds" concerning technical specifications and new designs. He told Neal story after story of cases where the RDC engineers had to change to conventional designs, with lower grade materials, when their new designs failed to work out in production runs. Ed's advice to Neal was to follow the suggestions of the MPF technicians who actually had to produce the often-flawed designs of the RDC.

When Neal returned home that afternoon, he called Scott, the Diamond Steel Production Manager, at home and told him of the conflict between the Maypool RDC specifications and the recommendations from the MPF technicians. He also outlined his idea of a compromise. Scott reminded Neal that this contract was very important to the financial future of Diamond Steel and that he was not very concerned with the internal strife within Maypool. Scott had no objection to the proposed compromise, as long as the extra cost would not be borne by Diamond Steel. As a result, Scott insisted that Neal say nothing to Maypool until after the contract is signed on Monday morning.

Task:

What should Neal do? Before you answer this question, identify possible stakeholder positions and reconstruct for each position an argumentation so that you understand its legitimacy. Focus in particular on those stakeholders who usually do not have a voice. Try to bring all positions into a reasoned dialog by using parts of one argumentation as counter-arguments for another. After that, formulate an answer to the question what Neal should do and justify your proposal by an argumentation that takes the arguments for other stakeholder positions into account.

Поставка «правильной» стали: случай в машиностроительном бизнесе.

Уильям Джордан и Майкл А. Латча: http://ethics.tamu.edu/Nsfcases/meen/3/mech03.htm . Незначительные изменения внесены Майклом Хоффманном.

Нил – инженер-металлург, работающий в «Даймонд Стил Инкорпорэйшн», средних размеров сталелитейной компании, испытывающей определенные экономические трудности. Крупнейшим клиентом «Даймонд Стил» является компания «Мэйпул», третья по величине компания по производству бытовых приборов в Соединенных Штатах. В настоящее время «Даймонд Стил» ведет переговоры с компанией «Мэйпул» по поводу нового контракта о поставке этой компании листовой стали, которая предназначена для производства сердечников новой модели стандартного электромотора, устанавливающегося в приборах, производимых компанией «Мэйпул». Требования к техническим характеристикам стали были определены инженерами *исследовательского и дизайнерского Центра* компании «Мэйпул» (ИДЦ), расположенного в 200 милях от *Завода по производству моторов* (ЗПМ) той же компании, на котором должны будут штамповаться пластины сердечника и устанавливаться в моторы для приборов. Техническим характеристикам, установленным ИДЦ, соответствует сталь марки UNS G10350, раскатанная в лист толщиной 0.025 дюймов и закаленная до минимального предела прочности на растяжение в 100.000 *фунтов на квадратный дюйм* (фкд).

По своей работе в «Даймонд Стил» Нил множество раз имел дело с ЗПМ компании «Мэйпул». Он лично знает нескольких работающих там специалистов-техников. В процессе обсуждения предстоящего контракта специалисты ЗПМ сказали Нилу, что прессы их завода могут уверенно справляться со сталью, имеющей показатель твердости менее 165 пунктов по Бринеллю, без заклинивания и повреждения обрабатываемого изделия. Специалисты ЗПМ подсказывают Нилу, что если использовать сталь с максимальным показателем твердости 160 по шкале Бринелля, то она будет работать в моторе «просто отлично» и ее легче будет штамповать, превращая в моторные бляшки.

Основываясь на своих расчетах, Нил обнаружил, что сталь марки UNS G10350 с пределом прочности на растяжение в 100 тысяч фкд (согласно требованиям инженеров ИДЦ) имеет показатель твердости 78 по шкале Роквелла-30Т и 200 по шкале Бринелля. Однако сталь, рекомендованная специалистами ЗПМ, эквивалентная показателю твердости 160 по Бринеллю, имеет число твердости 72 по Роквеллу-30Т и предел прочности на растяжение в 80 тысяч фкд. Разница между этими двумя показателями кажется Нилу слишком большой для простого компромиссного решения.

На следующий день, в пятницу, Нил решил поехать в Центр по исследованиям и дизайну компании «Мэйпул», чтобы обсудить с инженерами проекта некоторые характеристики. Они убеждали его в том, что описанные ими технические требования не произвольны и ориентированы на планируемую эффективность мотора новой модели. Нилу было заявлено, что характеристики той же самой стали с низким показателем твердости не соответствовали бы требованиям эффективности.

Инженеры компании «Мэйпул» сообщили Нилу также, что формовочные прессы на ЗПМ рассчитаны на работу со сталью с максимальным показателем предела прочности в 220 тысяч фкд. Мнение инженеров ИДЦ сводилось к тому, что специалисты-техники в ЗПМ некомпетентны. В качестве примера инженеры привели несколько случаев выпуска некачественной продукции, причиной чего оказались некорректные производственные технологии на ЗПМ.

По дороге домой Нил решил заехать на ЗПМ. Отвечая на его вопросы, специалисты-техники сказали ему, что каким бы потенциалом ни обладали их прессы, они, работая со сталью, имеющей показатель твердости более 165 по шкале Бринелля, всегда выдавали недопустимое в процентном отношении количество брака. Специалисты ЗПМ сказали Нилу, что их прессы прошли недавно капитальный ремонт и были усовершенствованы производителем, но, тем не менее, они все еще не в состоянии демонстрировать свои первоначально заявленные характеристики. Затем техники пожаловались Нилу на то, что у них и в прошлом возникали проблемы с инженерами ИДЦ, которые предлагали им нереальные проектные характеристики и дизайнерские требования. Техники еще раз предложили Нилу, чтобы он поставил им тот тип стали, с которым они могли бы легко работать, – при этом никто не будет умнее остальных, и все будут счастливы.

Когда Нил в итоге вернулся к своему рабочему столу в конце второй половины дня в пятницу, он обнаружил на нем записку от Скотта, производственного менеджера «Даймонд Стил». В ней тот просил Нила представить показатели шкалы Роквелла-30Т, которые были необходимы для контракта с компанией «Мэйпул» по поставке им соответствующего типа стали. В записке также сообщалось, что контракт планируется подписать уже в понедельник утром.

Ранним субботним утром, когда Нил готовился идти играть в гольф, ему вдруг пришла в голову мысль, что возможен определенный технический компромисс, который помог бы решить проблему. В зависимости от характеристик стали UNS G10350, существует возможность поставить ее для последующей штамповки в более мягком состоянии с тем, чтобы закалить ее до требуемого предела прочности на растяжение уже после процесса штамповки. Однако ему было известно, что производственный завод не имеет оборудования, необходимого для закалки стали, поэтому компании «Мэйпул» придется нести дополнительные расходы по доставке отштампованных пластин сначала в цех закалки, а затем, после закалки, обратно на ЗПМ для последующей сборки.

В то утро Нил играл в гольф со своим другом Эдом, производственным инженером одной из местных компаний по производству полимеров. Компания Эда является намного более крупным поставщиком для компании «Мэйпул», чем «Даймонд Стил». Во время раунда как-то всплыла тема характеристик стали в связи с новым контрактом. Эд сказал Нилу, что инженеры ИДЦ «витают в облаках», когда речь идет о технических характеристиках и новых моделях. Он рассказал Нилу о раз за разом повторяющихся случаях, когда инженеры ИДЦ были вынуждены возвращаться к своим обычным моделям из более простых материалов, поскольку предлагаемые ими новые модели оказывались нефункциональными после производства. Эд посоветовал Нилу прислушаться к рекомендациям техников ЗПМ, которым приходится производить очень часто недоработанные модели, предлагаемые ИДЦ.

Когда Нил вернулся в тот день к себе, он позвонил Скотту, производственному менеджеру компании «Даймонд Стил», домой и рассказал о конфликте между техническими требованиями ИДЦ компании «Мэйпул» и рекомендациями специалистов-техников ЗПМ. Он также обрисовал в общих чертах свою идею компромиссного решения проблемы. Скотт напомнил Нилу о том, что данный контракт очень важен для финансового будущего компании «Даймонд Стил» и что его не очень заботят внутренние споры компании «Мэйпул». Скотт не возражал против предлагаемого Нилом компромиссного решения в том случае, если компания «Даймонд Стил» не будет нести дополнительных расходов. В итоге Скотт настоял на том, чтобы Нил ничего не сообщал компании «Мэйпул» до тех пор, пока контракт не будет подписан в понедельник утром.

Задание:

Как поступить Нилу? Аргументируйте ваше предложение. Вы можете также развить и подвергнуть критике различные аргументы с целью лучше понять проблемы, связанные с данным случаем. [this paragraph needs to be re-translated according to the modified version of the task in the English version above.]

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