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Expressions of Ethics in Reader Comments to Animal Experimentation and Climate Change Online Coverage

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Abstract

Although science presents ethical challenges to society, little is known about the ways in which adults express ethical concerns in everyday science-related situations. This study analyzed the ethical expressions in 1,079 reader comments to online news coverage of animal experimentation and climate change in Israel. Some forms of ethical concerns were expressed in many reader comments following animal experimentation (70%) and climate change (47%) coverage. Opposition to animal experimentation was primarily expressed emotionally, whereas comments supporting these experiments and complex stances towards them were mainly couched in ethical reasoning. Ethical expressions related to climate change primarily drew on ethical concepts. The importance of trust in scientific practice and institutions was evident in both issues. Formal ethics, as expressed by using ethical concepts or ethical reasoning, were found to be present in public discourse, suggesting it can serve as a foundation to enhance public engagement with bioethics.

Keywords: public engagement with science; bioethics; online discussions

Rationale

Science and technology have taken on an increasingly important role in Western societies. During the last few decades, scholars and commentators have drawn

attention to transformations that have led to the growing permeability of the boundaries between science and society (Bucchi & Trench, 2014). When science leaves the lab and reaches the public arena it tends to be conflated with features such as ethics and beliefs that shape the way the public approaches science-related issues (Torcello, 2016). This complex intersection of science and ethics is reflected in public engagement with science related issues. Similarly, in terms of scientific education, dealing with complex real world issues may involve a number of discrepant scientific, social or moral viewpoints (Zeidler, Sadler, Applebaum, & Callahan, 2009). Various science curricula call for an epistemic understanding of the nature of science, which includes ethics (e.g. National Research Council, 2013). However, little is known about the ways in which adults express ethical concerns in everyday science-related situations.

Bioethics is a form of "applied ethics". The broadest definitions of bioethics refer to moral, social and political questions that arise in the general context of biology which subsumes environmental ethics and animal ethics (Frey, 1998; Macpherson, 2016; Resnik, 2016).

Science communication investigates the dynamic interactions and relationships between science and society, where scholars and practitioners attempt to engage diverse audiences in dialogic and participatory activities involving science (Bucchi & Trench, 2008; Yuan et al., 2017). The 'public engagement with science' movement maintains that the scientific community needs to take greater notice of public concerns, in particular by relating and reacting to them. Public debates involving differing points of view enable democratic societies to express their views on controversial science-related issues (Zarefsky, 2011). The affordance of novel modes of public engagement and participation with science such as the internet provides a

model environment for exploring the use of scientific literacy by the wide public in daily life. In recent decades the narrow professionalism of bioethical discourse has opened up to public discourse and has repositioned "both science and bioethics as participative, democratic practices that affect, and are affected by a wide range of social agents" (Zylinska, 2009 p. 22). This "participatory turn" of public participation research perceives the public's views as contributing to bioethical debates (Schicktanz, Schweda, & Wynne, 2012).

This study examined the ethical components of reader comments to online news articles covering two prominent bioethical issues. The first is the classical medical ethics issue of the use of animals in research, where the bioethical dimensions are well established. The second is the environmental ethics issue of human responsibility for climate change, in which the public and political debate is relatively new and the ethical aspects are still in their formative stage (Macpherson, 2016; Resnik, 2016). These two issues were selected to provide very different examples of public engagement with science. It is important to note however that both issues revolve around the status of humans in the world, which can draw on several diverging concepts of the role of humankind. The anthropocentric approach maintains that only humans have intrinsic value and moral entitlement. By contrast, the biocentrism approach sees all living creatures as equal to humans, and the eco-centrism approach considers that the whole ecosystem has an intrinsic value (Shtessel, 2009).

In recent years the internet has become the public's main source of information about science and technology (National Science Board, 2016). These new media afford new venues for public engagement and participation with science which are increasingly shaping public engagement with science (Brossard, 2013). This makes the new media

an excellent model environment for exploring publics' use of ethics in science-related issues in daily life.

Science in the news media is delivered by diverse participants, which thus exposing the public to complex, contradictory and sometimes unreliable information, in particular via the internet (Brossard & Scheufele, 2013). Scientific ideas are often integrated in the media such as chat groups and forums with other types of knowledge and expertise, which influence audiences personally and can impact socially meaningful decisions (Feinstein, 2011). Studying ethics in this type of informal venue requires a new approach to account for non-formal and sometimes under-developed ideas. This can serve to better pinpoint the public's views and understandings of bioethics. In particular, bioethical formulations of controversial or contested science by non-experts may be a useful starting point for advancing dialogue with scientists. In the analysis described below, we examined:

- (1) In what ways are ethics being used by reader comments following news coverage of animal experimentation and climate change?
- (2) What are the relationships between different stances towards these bioethical issues and expressions of ethics in reader comments?
- (3) How do expressions of ethics in reader comments differ between the two bioethical issues?

Literature review

Bioethics and public engagement

A democratic approach to bioethical issues requires an appreciation of the contribution of public views to bioethics. These views can provide a broader picture

of ethical arguments and their motivational resources (Schicktanz et al., 2012). A productive dialogue considers that individuals' bioethical beliefs and stances regarding science-related issues are a product of science related knowledge and epistemologies, as well as ideologies, worldviews and sense of identity. These factors operate at the individual, community and social levels (Kahan, 2015).

In addition to barriers to effective public engagement with science (Brossard, 2013), public engagement with bioethics is also bounded by the demands of interdisciplinarity: it demands crosstalk between the sciences and the humanities, between scientific, philosophical and theoretical arguments, between practice and theory, and between the moral understandings of laypeople and specialists.

Within the academic world, Snow (1956) described a lack of communication between the "two cultures" of the sciences and the humanities. He considered this gap as a major hindrance to solving the world's problems. A half-century later, Nisbet et al. (2010) maintained that disparate disciplines must work together to bring many sources of specialized knowledge and experience to bear on societal engagement and solutions of realistic problems.

A second disparity concerns academic versus layperson understanding and application of bioethics. The moral questions raised by lay people in everyday life regarding biomedicine and technology are naturally different from the theoretical reasoning of professional ethicists. Toulmin (1982) pointed out that since the 1960's there has been a shift from philosophical abstract ethics toward practical ethics. He argued for the need to shift away from attempts to relate to general theories and rather adopt a more direct analysis of the interactions with medicine, law and other practices. Leibowitz (1987) differentiated between science and ethics by noting that science leads to conclusions while ethics leads to decisions. Conclusions inevitably require factual

data, while decisions are voluntary choices among alternatives. Science is based on previous experience and knowledge, which leads to contemporaneous conclusions, while ethics is based on future desires, meanings and results. A mistake in science does not reflect on the scientist's personality, unlike a moral mistake that reflects on both personality and behavior.

Science communication has gradually abandoned the 'public understanding of science' inspired by the deficit model that assumed direct links between the imparting of knowledge by scientists and the public's attitudes and support and has turned towards the more dialogical approach of 'public engagement with science' (Bucchi & Trench, 2008). This type of approach implies questions of trust (Bauer, 2008). Public trust in experts is based on the belief that researchers and other stakeholders involved in research are acting responsibly (Holzer, 2017). Dialogue can create new synergies between expert and lay knowledge by building an emotional basis for trust, and by recognizing the importance of lay values and perceptions (Robinson et al., 2014). Participatory approaches can thus lead to the construction of real life practical bioethical processes, enabling participation and deliberation based on practical considerations (Metselaar, Widdershoven, Porz, & Molewijk, 2017).

Analysis of ethics in everyday life

Bioethical analysis are traditionally based on theory-driven approaches such as ethical theories (Shapiro & Miller, 1994), ethical decision-making frameworks (Levitt, 2013), ethical sensitivity (Milliken, 2016), and argumentation skills (Zohar & Nemet, 2002) which are used to study ethics in formal settings (e.g. Tseng, 2018), and have a very specific theoretical focus. Empirical bioethics (Davies, Ives, & Dunn, 2015), on the other hand, seeks to combine philosophical and empirical analysis using empirical data about stakeholder values, attitudes, beliefs and experiences.

The ethical competencies of the general public have rarely been studied. Different ways in which the public approaches bioethics have been documented such as information seeking on social media for scientific and ethical information about gene therapy (Robillard et al., 2013).

Bioethical aspects of animal experimentation and climate change

This study examined reader comments in response to news coverage on two controversial and contested science related issues: animal experimentation and climate change. Animal experimentation (AE) has been a dominant topic in public and academic debates. It is one instance where acknowledgment of the perspectives of non-scientific organizations (the animal welfare perspective) has become commonplace, and has led to legal reforms in scientific practice (Lund, Morkbak, Lassen, & Sandoe, 2014). The ethical dilemma of animal experimentation has to do with the ethical approach to the animals involved. Utilitarianism inquires whether the benefits from animal experimentation outweigh the harm done. The deontological approach inquires whether animals have rights, and how these tally with human rights (Beauchamp & Walters, 1999). The animal rights movement (Regan, 1983; Singer, 1976) uses the term “right” to deny legitimization of the use of animals by humans, whereas the moral theory of Contractarianism, which claims that moral norms derive their normative force from the idea of contract or mutual agreement (Rawls, 1971), rejects animals from the moral community on the grounds that animals do not 'play the social game' (Cohen, 1997).

Climate change ethics is perceived as a defining symbol of the human relationship with the environment, and is influenced by high stakes and politicized deliberation (Boykoff, 2011). It derives from environmental ethics, which have emerged in

reaction to environmental crises since the industrial revolution. The ethical aspects of climate change are still in the formative stage. Macpherson (2016) maintained that "global climate change is the most complex and significant ethical issue of our time" (p.12). The bioethics community has only recently engaged with the ethical dimensions of climate change and the impact of bioethics on social norms and public policy is still unclear (Resnik, 2016).

The major environmental ethical issues in the climate change debate relate to equity and environmental justice, and include the attribution of impact, responsibility, costs and benefits (Ikeme, 2003). The utilitarian approach, for example, weighs costs vs. benefits concerning present versus future generations (Broome, 2008). Much of the current climate change ethical debate is focused on social choices about energy use, but individual behavior also plays a key role in the issue (Resnik, 2016).

Although both topics are popular in public discussions, they differ in many ways. Animal experimentation has a long history of public engagement. As early as 1824 the Royal Society for the Prevention of Cruelty to Animals, among other public organizations, lobbied for the Cruelty to Animals Act which was passed in 1876, and was the first animal protection law (Manning & Serpell, 2002). In contrast, climate change (first predicted in 1896 (Arrhenius, 1896)) only emerged on the public agenda in the late 1980s, though it became a major moral, social and political issue at the beginning of this century. While animal experimentation was debated long before the first computer was built, the climate change debate was born into a digital web 2.0 environment.

However, the common thread to both public debates is the focus on research methods. Animal experimentation is part of a research method, and much of the controversy

over climate change revolves around data collection and its analysis. The AE debate concerns actual experimental animals and their wellbeing, and elicits strong emotions such as anger and compassion. Climate change, on the other hand, addresses abstract phenomena involving molecules, concentrations, global ecosystems and complex models. Both issues are affected by economic considerations and involve many stakeholders, promoting different agendas, and climate change is also characterized by a high level of political involvement (Beauchamp & Walters, 1999; Broome, 2008).

Public attitudes towards animal experimentation.

Since the 1960s, as a result of the significant progress in animal welfare and animal rights, the moral tradeoff between the cost to animals and benefits to humans has dominated public as well as academic debates on animal research (Lund et al., 2014). A recent Pew Research Center (2015) poll found that although 89% of the American Association for the Advancement of Science (AAAS) members favor the use of animals in scientific research, only 47% of general American public holds this view.

Despite the multiplicity of websites, Facebook groups and blogs reflecting public engagement with the issue, the new media aspects of AE have rarely been studied. A study of reader comments on online news reporting of AE (Laslo, Baram-Tsabari, & Lewenstein, 2011) found that ethical concerns were present to a greater extent in reader comments than in the original news articles. In a different study, concerns about animal welfare, benefits, scientific validity, and the numbers of animals used influenced decisions on the acceptability of animal research in online forums (Schuppli, Molento, & Weary, 2015).

In Israel, where the current study took place, there are over 25 animal protection organizations and two academic forums devoted to animal experimentation¹. Resistance to AE largely depends on the purpose of the study: in a 2016 survey, only 17% of Israelis objected to life-saving experiments, but 27% opposed experiments to improve the quality of life and 39% were opposed to AE to improve human knowledge. The highest rate of opposition (72%) was to experiments for cosmetic purposes (Israeli Ministry of Science Technology and Space, 2016).

Public attitudes toward climate change. The public's attitudes to climate change falls along a continuum, and dozens of classifications have been used in research (Hine et al., 2014). In recent years the public debate has virtually ceased to focus on the existence of climate change, but rather its causes. The Pew Research Center (2015) found that 50% of those surveyed in a representative U.S. sample held the anthropogenic view (that humans are responsible for climate change), and another 23% thought that global warming was due to natural patterns. Although various assessments have shown that scientific community has reached a near-unanimous consensus (ranging between 97%-99.99%) that endorses the position of anthropogenic climate change (Van der Linden, Leiserowitz, Rosenthal, & Maibach, 2017) , only 27% of Americans are aware of this consensus (2016).

Recent studies have found that 87% of all Israeli adults agree that climate change is happening and of these 72% agreed that the cause is human actions (Israeli Ministry of Science Technology and Space, 2016), and 81.3% perceive climate change as a threat (Association of Environmental Justice in Israel, 2015).

¹<http://www.apal.org.il/>, www.weizmann.ac.il/IUF

Methodology

Approach to data collection: Reader comments on online coverage

Reader comments on online coverage can reveal some of the meaning readers ascribe to bioethical issues and the resources they tap to contribute to the ongoing online dialogue between science and society. This popular and widely used form of participatory journalism allows diverse readers to contribute actively and have their say with fewer limitations than other media. Most comments are authentic and spontaneous, and voice an opinion, elaborate, or correct a perceived error, usually within one day after an article appears. Hecht (2003) considered reader comments overall as a cultural catalyst that accelerates the movement of ideas between marginalized social groups and the mainstream, hence allowing more people to express their views in the public arena, which thus fosters greater equality, reciprocity and symmetry. However, uncivil blog comments contribute to the polarization of perceptions about an issue, and can change readers' interpretation of a news story (Anderson, Brossard, Scheufele, Xenos, & Ladwig, 2014). PopularScience.com, for example, decided to change its policy and no longer accept users' comments (LaBarre, 2013) as a result of this 'nasty effect'.

Collins and Nerlich (2015) analyzed forms of deliberation in readers' comments on *Guardian* climate change news articles. They made the case for the democratic potential of deliberation and the need for intense interactions in the climate change debate, and considered incivility to be marginal. Authors (Laslo et al., 2011) found that reader comments often provide a window onto public opinions about science which is not voiced otherwise.

Internet sites are the primary source of science related news for adult Israelis (Katz, 2016), and over half of all surfers read reader comments (2010). However, only 19% of surfers write comments. Therefore, comment writers do not represent the population as a whole.

Data source. At the time of sampling, *Ynet* was the most popular Israeli news site, and was ranked as the fourth most visited website after *Google*, *Facebook* and *YouTube* (TIM., 2013). During the data collection period (2009-2012) most news items on *Ynet* accepted anonymous reader comments. The comments were moderated at a superficial level by the site editors prior to publication. Today, commentators on *Ynet's* articles are usually logged in through *Facebook*, which makes them far less anonymous, thus making more recent data less authentic.

Data collection and Sampling. Reader comments on ten articles were included in the analysis, five for each bioethical topic.

Animal experimentation: In the course of one year (July 15, 2009 - July 15, 2010) all the related sections in *Ynet* were examined for animal experimentation-related coverage. Fifteen articles associated with 1,906 comments dealt directly with AE (an average of 106 comments with a range of 44-257 comments per article). The sample did not include 13 science articles which approached the AE issue solely as a research method in the context of new studies or applications of science (for example, "Successful Genetic Therapy for Color Blindness in Monkeys", published December 30, 2009).

Five articles were selected by quota sampling to ensure variety in the article types for analysis. These included the experimental aspects of alternative methods, legislation, a factual piece about the extent of experimentation, the use of animals for teaching,

and items presenting anti-vivisection positions with a strong emotional tonality. One article representing each facet was selected, followed by 542 comments, all of which addressed the AE issue. Four of these articles were originally published in *Ynet's* "animal" section, and the fifth in the "science" section of the site.

Climate change: All sections of *Ynet* were examined for climate change-related coverage between October 2011 and March 2012. The coverage yielded 22 articles followed by 1,059 reader comments (an average of 48 comments with a range of 2-239 comments per article). The five articles with the highest number of reader comments referring to climate change were chosen for analysis, as an indicator of high public interest. These articles prompted 635 comments in total, of which 554 comments (89%) referred specifically to climate change. Off-topic reader comments were excluded; these involved related discussions on topics such as evolution, politics, and the personality of the author of the article. This sampling procedure resulted in 554 reader comments about climate change and 525 comments addressing animal experimentation.

Data analysis.

Given the tension between formal bioethics and empirical analysis, we used abductive content analysis (Krippendorff, 2012), which commences with a real-life phenomenon and observation characterized by an ongoing negotiation between theory and empirical study (Spens & Kovács, 2006).

RQ1. Ethics used in reader comments

Codebook development. As stipulated in the abductive approach, the authors' theoretical knowledge guided real world observations of all the ethical content identified in the raw texts. The process of theory matching resulted in a codebook of

types of ethical statements, which was then applied to the texts. The codebook and its categories are described in RQ1. Inter-coder reliability was evaluated using Cohen's Kappa based on independent coding of at least 10% of the items by two coders with an academic background in science and bioethics. The reliability of the identification of ethical content was 0.89. Classification of ethical statement reliability was 0.90. The rest of the data was coded by a single coder.

To better assess the disparity between theory and practical ethics, ethical categories in reader comments were also characterized in light of ethical theory, similar to Mercer's analysis of climate change public online content use of Popper's philosophical ideas (Mercer, 2016). Conceptualization and reasoning were described based on Beauchamp's (Beauchamp & Walters, 1999) depiction of ethical and bioethical theory infrastructure. References to ethics as an authoritative set of rules were associated with ethical codes, laws (e.g. Israeli Knesset law, 5754-1994), or religion (e.g. Jakobovits, 1975). Differences in terminology and the meaning of concepts between normative ethics and informal expressions were considered.

RQ2. Expressions of ethics in reader comments voicing opposing positions:

To better understand the relationship between the ways ethics was used and stances towards the issue, the ethical categories (RQ1) were examined according to the commentator's position, as detailed in Table 1. Although climate change attitudes are described today as a continuum, here we considered only three major groups: accepting the scientific consensus (anthropogenic), opposing the scientific consensus (skeptics and deniers), and a complex stand. This decision was made for methodological reasons since the dataset did not allow for a fine differentiation between positions. Cohen's Kappa for classification of positions towards AE was 0.85, and climate change was 0.87.

Table 1. Distribution of positions expressed towards animal experimentation (AE) and anthropogenic cause of climate change in 1,079 reader comments addressing five animal experimentation and five climate change articles

Issue	Position	Frequency	Exemplary reader comment
Animal experimentation (n = 542)	Support	17%	"Do you ever take medication? After all, they are tested on animals. Then why is it okay to take them???"
	Oppose	64%	"We must protest against this cruelty!!!!"
	A complex stand on AE	3%	"We need to differentiate between luxuries and life-saving medicine. In the first category there is no justification (or need) for animal experiments, the other is justified by saving lives, but we can reduce the use of animals"
	No opinion expressed	16%	"The article is based on unreliable sources"
Climate change (n = 554)	Anthropogenic impact	40%	"People have released an unimaginable amount of greenhouse gases for decades, this will tip the balance"
	Skeptical or denial	%83	"The climate is chaotic, uncontrollable and has low predictability"
	A complex stand	%6	"The world was much warmer in the past and much colder as well, the big question is how much we affect climate change"
	No opinion	%61	"I also have no idea whether or not the Earth is getting warmer "

RQ3. Expressions of ethics in comments addressing different bioethical issues:

The frequencies of ethical categories in animal experimentation and climate change comments were compared. Chi-square tests were used to identify significant differences between distributions of positions in comments to AE/climate change and between positions. The effect size measure used Cramer's V.

Findings

RQ1. Ethics used in reader comments:

Ethics were expressed in 70% of the 542 animal experimentation comments and in 47% of the 554 comments on climate change articles. Using the abductive approach, five categories of ethical expressions emerged from the comments: (a) Three types of cognitive ethical expressions (using ethical concepts, referring to ethical rules or authority, and formal ethical reasoning). (b) Emotional or behavioral expressions (for examples see Table 2).

Cognitive ethical expressions:

(1) Ethical conceptualizations - using phrases expressing principles or values (AE 30%, climate change 39%). This included concepts of values such as truth and justice, virtues such as respect or egotism, and principles such as human or animal rights. These types of comments echoed formal bioethical ideas, such as fundamental references to principles (morality, humanism, truth/lies, and in/justice), deontology and rights-based discourse (animal/human rights, deprivation of rights, freedom of expression, limitations of freedom), virtue ethics (animal welfare, dis/respect for human life); personality traits and virtues (greed, modesty, lack of conscience, hypocrites), health and environmental values (health concerns and respect for the environment, environmental benefits, saving the world, saving lives), social and economic values (depravity, charlatanism and incitement, economic corruption, financial gain and dominance, bribery and financial interests).

(2) *Ethical authority rules* established by codes of ethics, laws, or religions (AE 19%, climate change 1%). Most of these rules were attributed to ethical codes, supervision, and laws.

In the AE comments the most common rules expressed were enforcement and supervision by the authorities. Some comments also referred to laws, and specifically to the Israeli law (5754-1994). A few commentators referred to 'the three Rs' as a framework for animal experimentation ethics (Monamy, 2000) which stands for (a) 'replacement' of animals by animals less closely related to humans or by alternative methods, (b) 'refinement' by decreasing inhumane procedures, and (c) insistence on a 'reduction' in the number of animals.

The climate change comments mentioned a few rules and their enforcement by ethical codes or supervision.

(3) *Ethical reasoning* - using patterns of ethical thinking (AE 21%, climate change 5%). This included descriptions of a conflict of values, such as animal compassion vs. saving human lives, benefits (AE is purpose- dependent), or consideration of rights (animal vs. human rights). These comments echoed formal bioethical reasoning patterns, such as the advantages and disadvantages of using animals in experiments, which corresponds to the utilitarian approach such as the benefits of animal experimentation in minimizing human pain. Another axis referred to animal status and the question of animal rights [46, 47].

In ethical comments addressing climate change, the dominant philosophical approach was utilitarian. Liability was also taken into account. Other arguments included the rights approach and the individual's right to choose, or the common-good approach

oriented toward the good of the community. Conflicts between values also appeared in the comments (e.g. human vs. animal rights).

Emotional or behavioral expressions:

(4) *Emotional expression of ethical concerns* (AE 29%, climate change 2%), described mental states such as depression or love, or emotional reactions: "cruelllll!!!!!!", occasionally using multiple exclamation points or question marks.

(5) *Behavioral ethics*, which refers to personal practical involvement to promote an ethical agenda (AE 3%, climate change less than 1%). Examples are personal actions such as recycling or avoiding products tested on animals.

Comments often expressed several categories. All categories used in each comment were tabulated. The ethical expressions were not ranked hierarchically, although it is clear that conceptualizations and the operationalization of thinking skills may lead to a more formal expression of ethics since day to day ethics do not necessarily require theoretical or reflective skills (Warnock, 1978). Therefore, ethical awareness and a development of a "moral sense" were also assessed. Comments such as "Stop!!!!" could in some cases reflect a deep sense of injustice. Similarly, ethical behavior reflected by a statement such as "I recycle" should not be seen as necessarily superior to a protest against animal suffering.

Table 2. Examples of five categories of ethical expressions in 1,079 reader comments addressing five animal experimentation and five climate change articles

	Supporting animal experimentation N=89	Opposing animal experimentation N=336	Climate change: Anthropogenic view N=222	Climate change: Skeptic or denialism view N=210
Emotional expressions	N=3 Emotional coping with commenters' position: "As a researcher, I suffer" or: "I love animals, but	N=153 Negative emotions: Accusations: "it's horrible", "I'm in shock" Emotions: "depressing",	N=3 Expressing responsibility to the planet: "Care!!!!" Emotions towards the skeptical	N=1 Feelings of distrust: "Lie!!!!!!!!!!!!!!!!!!!!!!", "They scared us enough!"

	..."	"cannot bear it" Blaming scientists: "heartless monsters" Multiple exclamation points or question marks: "cruellll!!!!!!"	positions: "Not sure we would survive the century. But you continue to scoff and claim conspiracies"	
Conceptualizations of the ethical position (values, virtues and principles)	N=13 Values and principles: "saving lives", "hypocrites", "human rights", "disrespect for human life", and "moral".	N=82 Concepts: "cruelty to animals", "animal welfare", Personality traits: "egoism" Principles: "morality", "injustice", "animal rights"	N=79 Mostly positive values or virtues: truth, moral, modesty, health concerns, respect for the environment Social and economic values: "saving the world" A few negative values: depravity, charlatanism and incitement.	N=111 Mostly negative values and virtues: "economic corruption", "lies", "deprivation of rights", "crimes against humanity". A few positive values: "truth", "environmental benefits", "freedom of expression" and "saving the world".
Ethical reasoning	N=27 Utilitarianism: "Isn't it better to save lives and advance science by using some animals?" Human rights: "Human lives are worth more than the lives of animals"	N=39 Utilitarianism: "most animal trials are completely unnecessary and without benefit" Animal rights: "Who gave us the right to abuse the helpless??"	N=11 Utilitarianism: "If the Greens are wrong, the worst is that we will get a little less polluted world. But if you are wrong or misled, the world of our children and grandchildren will be over. With all due respect, I would not bet on the only world we have".	N=10 Rights: "Everything is one big trick in order to deprive citizens of their rights!" Common-good: "The question is where to direct the budgets and other limited resources. And for this there is still no clear answer" Conflict between values: "The world uses expensive energy and costly solutions pretexting preservation, but in practice, millions of people suffer from hunger because biodiesel is made from grain and corn and so on"
Ethical authority rules	N=14 Enforcement and supervision:	N=67 Enforcement and supervision: "Fair and neutral"	N=4 Rules: "You cannot achieve this through so	N=0

(Law, ethical codes, religion)	<i>"Supervision is highly professional" or "Supervision has caused difficulties in animal trials"</i>	<i>supervision is required"</i> Laws: <i>"The law caused legal abuse", "require use of alternatives"</i>	<i>few rules and nearly zero enforcement".</i> Implications: <i>"Nowadays there are extreme weather conditions in many countries, due to the lack of regulation of air pollution twenty years ago".</i>	
Behavioral ethics	N=0	N=11 Behavioral aspects: <i>"I am a member and donate to an animal organization", or: "What can we do? Be a vegetarian, donate, feed cats, and be careful on the road" and: "Protest!!!". "Look for the rabbit icon. I do not use products tested on animals!" or: "I do not buy drugs!".</i>	N=3 Personal behavior: <i>"I recycle bottles so I'm okay with the community".</i>	N=0 Nine claimed that practical actions will not help.

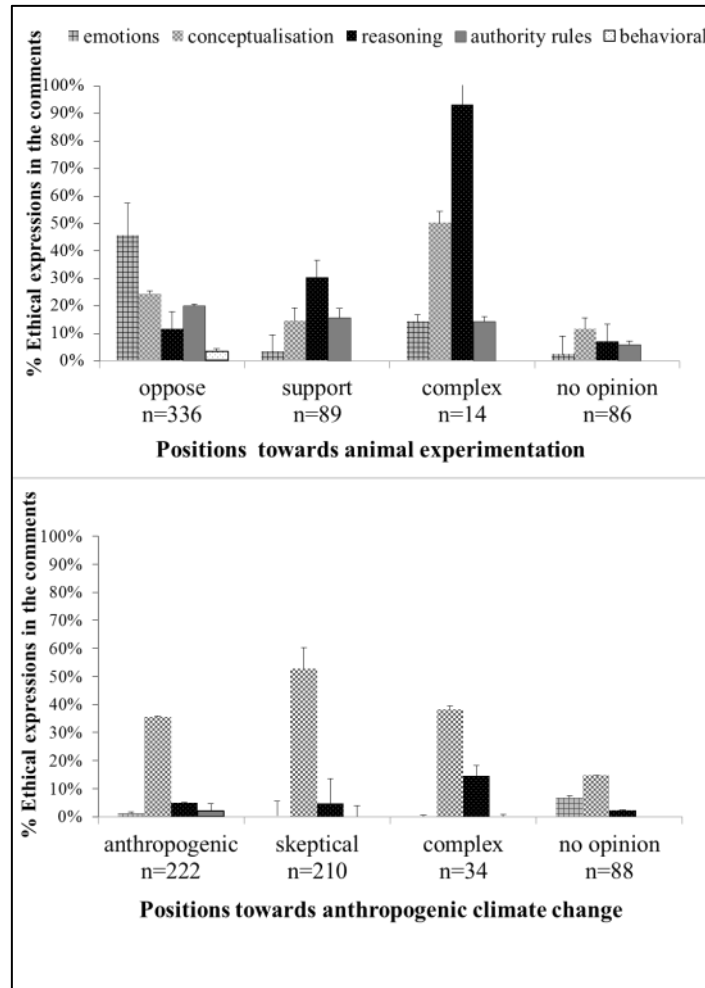
RQ2. Expressions of ethics in reader comments voicing different positions:

Different patterns of ethical expressions were found in comments voicing different positions (Table 2). Two patterns were found in the AE comments (Figure 1). Those supporting AE and expressing complex positions emphasized ethical reasoning and minimized emotional expressions. Comments opposing AE exhibited the opposite trend of emotional expressions and minimal use of reasoning ($\chi^2_{(4)}=62.99, p<0.001, V=0.387$). Comments that did not state a clear opinion usually expressed few ethical stances. Those opposing AE manifested a significantly different pattern from all other stances (oppose vs. support $\chi^2_{(4)}=60.41, p<0.001, V=0.402$; oppose vs. complex

$\chi^2_{(4)}=81.63$, $p<0.001$, $V=0.544$; oppose vs. no opinion $\chi^2_{(4)}=15.51$, $p<0.01$, $V=0.198$).

Other pairs of stances did not present significant differences in terms of patterns.

Figure 1: Expressions of ethics in reader comments following animal experimentation and climate change articles sorted by their position. Significant differences: Animal experimentation: oppose vs. support $p<0.001$; oppose vs. complex $p<0.001$; oppose vs. no opinion $p<0.01$. Climate change: significant difference between clear and unclear position $p<0.001$.



Ethical responses towards climate change focused on conceptualizations such as "respect for the environment". Patterns were similar for all positions, but the skeptical comments showed slightly but not significantly higher use of ethical concepts than the anthropogenic comments (שגיאה! מקור ההפניה לא נמצא). All those with clear positions showed a significantly higher use of ethics than comments with no clear opinion (skeptical vs. no opinion: $\chi^2_{(4)}=38.9$, $p<0.001$, $V=0.445$, anthropogenic vs. no

opinion: $\chi^2_{(4)}=19.23$, $p<0.001$, $V=0.312$, and complex vs. no opinion: $\chi^2_{(4)}= 32.93$, $p<0.001$, $V=0.408$).

Ethical content in conflicting reader comments on animal experimentation coverage

Anti- AE comments expressed lack of trust, which was reflected in all ethical forms of expression. This contrasted with the AE supporters who expressed moral support and trust in researchers, organizations and economic systems. The differences in the ethical content in each ethical category are illustrated in Table 2 and described below.

(1) *Conceptualizations*: Those opposing AE used concepts describing their positions towards actions ("*animal welfare*"), using personality traits ("*lack of conscience*"), and making fundamental references to principles ("*morality*"). They indicated a lack of trust in scientists, companies and authorities. The supporting comments expressed ethical values ("*human rights*" and "*saving lives*") apparently reflecting their motivations.

(2) *Ethical rules*: Commentators expressing all AE positions referred to regulations governing enforcement and supervision. The framework of the 3 R's was used in comments expressing all positions. Only one (an anti-AE) comment referred to laws.

(3) *Ethical reasoning*: Comments advocating both positions used more ethical reasoning, such as benefits and aims, and status and rights than other comments.

(4) *Emotional expression of ethical concerns*: Most comments opposing AE referred negatively to animal experimentation, scientists, economic entities and supporters of AE. These included many accusations, description of emotions ("*depressing*"), mental states ("*I cannot stop crying!*") and blaming scientists for their cruelty ("*heartless monsters*"). In contrast, comments supporting AE revealed few emotions, and those

that did referred to their emotional coping with their challenging position ("*I love animals, but ...*").

(5) *Behavioral features*: These were only found in anti-AE comments. These included the concrete activities of the responders as members of animal organizations ("*protest!!*").

Ethical content in in conflicting reader comments on climate change

Most ethical expressions in the climate change comments were conceptualizations, with very few expressions of other ethical categories (Figure 1). Differences between positions primarily focused on trust (Table 2). While the skeptical comments primarily expressed distrust in scientists and the authorities, the anthropogenic advocates expressed more confidence in scientific systems and responsibility for the environment:

(1) *Conceptualization*: These mainly included values. The anthropogenic comments referred mainly to positive values and virtues, especially towards the environment and science ("*respect the environment*"). The skeptical comments referred mostly to negative values and virtues, mainly concerning the accountability of the scientific community and authorities ("*crimes against humanity*").

(2) *Ethical rules*: Only the anthropogenic comments referred to rules and their enforcement by ethical codes or supervision.

(3) *Ethical reasoning*: The main philosophical approach in the anthropogenic comments was utilitarian, along with accountability considerations. Skeptical ethical reasoning covered a range of tactics: the rights approach, common-good approach, and conflict of values.

(4) *Emotional expression of ethical concerns:* Anthropogenic comments used statements that expressed their responsibility towards the planet ("*care!!!!*"). In contrast, the skeptical comments drew on other feelings of distrust ("*lie!!!!*") or being threatened and deceived, and expressions of emotional manipulation such as "*insult is a demagogical tool*". Some comments referred to emotions, but did not express them (e.g. "*All the allegations made by Al Gore have been shown to be fictions and an attempt at emotional manipulation*").

(5) *Behavioral features:* Only three personal behavior expressions were found in the anthropogenic climate change comments. Nine skeptical comments claimed that practical actions will not help.

RQ3. Expressions of ethics in comments addressing different bioethical issues:

Generally speaking, reader comments regarding AE expressed more ethics than climate change comments (70% and 47% respectively). These expressions presented different patterns (Figure 1). Whereas climate change comments mainly expressed ethical concepts, with a quantitative difference between opposing positions, animal experimentation presented a wider range of content. In general, comments opposing AE used more emotions, whereas comments supporting AE showed more ethical reasoning. The AE content focused on evaluation of the scientific output in AE, along with trust in AE agents. Climate change ethical claims focused on the honesty and integrity of scientists and policymakers along with responsibility towards the environment. Thus trust in science and its institutions appears to have been a main concern for both issues.

Discussion

This study examined reader comments to online articles on animal experimentation and climate change to explore the bioethical constructions of controversial or contested science by non-experts. An abductive analysis of unstructured, non-formal ideas, using themes emerging from the comments themselves to create categories enabled us to tie real-world discourse with normative ethics. The ethical expressions were found to be issue-dependent both in scope (70% AE comments, 47% climate comments) and types (concepts, emotions and reasoning), and echoed some formal ethics. The positions were mostly dichotomous, and generally presented a lack of complexity (Table 2, Figure 1). These stances varied in terms of the number, type and content of the ethical expressions with the major differences between positions found mainly for content. For example, the anthropogenic comments referred mainly to positive environmental and pro-science values or virtues, whereas the skeptical comments referred mostly to negative values that expressed distrust in scientists and decision-makers. Trust emerged as a focal point in both of these controversies.

Alvarez suggested that an empirical context requires empirical investigation rather than normative philosophical reasoning (Alvarez, 2001), whereas Ives and Dunn (Ives & Dunn, 2010) pointed to the gap between theoretical philosophical bioethics and practically oriented bioethics in public spaces. Incorporation of empirical data into ethical theorizing may achieve a contextual understanding associated with meaning (Ives & Draper, 2009). However, some comments expressed features that echoed formal ethics. These included reasoning about values and ethical principles, and ethical rules and law. Most of the common principles, values, ethical rules and laws in the literature were found in some form or another in the comments. Ethical reasoning was high in the relatively rare complex positions, and appeared in 93% of

the complex AE comments, and in 15% of the complex climate change comments. This informal public use of bioethical reasoning suggests it could perhaps be used as a launch pad for an expert-layperson dialogue to promote public engagement with science.

Unlike surveys, reader comments are produced by an involved and attentive population. However, they are not representative of public opinion. In fact, the stances towards animal experimentation in our sample were much more negative than found in public opinion polls (e.g. Israeli Ministry of Science Technology and Space, 2016; Pew Research Center, 2015). Climate change positions were split almost equally (Table 2), which is in line the Pew Research Center (2015) survey.

Responders who opposed the scientific consensus on both AE and climate change expressed distrust in the scientific process, economic institutions and authorities, and grounded their distrust in bioethical claims. Jasanoff (2014) argued that people need to understand when to accept the scientific consensus, when to trust experts and when to assert values that seem contrary to those held by scientists. Trust becomes the basis for decisions when other affordances are not available and (experience-based) confidence is lacking (Midden & Huijts, 2009; Orr & Baram-Tsabari, 2018).

The pro-animal experimentation comments showed solidarity with the scientific community. Since the issue of animal testing is fundamental to the advancement of biological- medical knowledge, it is part of the personal experience of many life science students. This points to the role of acculturation into the culture of science and biology education in forming bioethical decisions. Anti-AE comments strongly reflected messages by animal rights organizations (Laslo et al., 2011), which suggest that the non-academic public sphere was these responders' source of knowledge.

Similarly, the exposure of adults to the climate change issue was mediated by the media, and the political and economic arena rather than formal education. Kahan (2015) reported a high correlation between climate risk perceptions and political outlook. He suggested that the question of “whose side are you on?” has much greater impact than “what do you know?” The context in which knowledge is acquired is an important factor, not just for determining the amount and type of scientific knowledge learned, but also for creating a sense of solidarity with the scientific community.

The differences in percentages of ethical responses to the two issues (70%, 47%) can be attributed to the perception of the issue as an ethical dilemma to begin with. Whereas AE is well established as an ethical issue, the bioethical dimensions of climate change are still in the formative stage. Discussing animal experimentation and climate change involves different content areas (e.g. ecology, medicine) and different levels of abstraction. AE is tangible and visual, and concrete examples of AE are emotionally charged. In climate change, the public refers to an abstract and complex phenomenon. The issue of AE does not display scientists in a positive light, and is depicted as contrary to values of compassion. In contrast, the scientific consensus goes hand in hand with environmental values in the climate change issue. These factors may have been behind many of the differences in reader comments to the coverage of the two issues. The two morally challenging stances; namely, failure to help save the planet or stop animal suffering, required more rhetorical effort on the part of commentators. This may explain why supporters of AE used more reasoning, whereas climate change skeptics were more likely to use concepts than their opposition.

Research limitations. An analysis of reader comments is challenging for various reasons. Typically, there are no demographic data to help contextualize the comments,

which tend to be short, and sometimes ambiguous. Participants in online discussions represent a self-selected segment of the population; namely, people who have internet access and who are interested in climate change or AE issues and who are inclined to comment on online news items. Some responders might even be paid to comment and some responders might write several comments under different names. Anonymity, while an advantage since responders can express themselves freely, prohibits a more precise characterization of the research sample. Moreover, as noted by Baker , anonymity frees the responder from social and personal accountability (Baker, 2014), which might affect the reliability of the content . Therefore, this study can only describe the range of expressions of ethics in the comments but cannot say much about the level of ethical literacy in the population. The abductive approach involving a bottom up and top down process of coding may have helped avoid researcher bias.

This study was conducted in a specific context of one online news site in Israel on two bioethical issues. It is likely that research in other contexts would yield different findings. However, we believe that the methods and insights developed here could lay the groundwork for other researchers and science educators to study how the public engages with science. Controversial issues require dialogue, and our results may suggest possible starting points that could lead to guidelines for designing environments, or educational programs promoting public engagements with bioethical issues.

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