Supplemental Materials:

Determinants of Lateral Attitude Change:

The Roles of Object Relatedness, Attitude Certainty, and Moral Conviction

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Pre-Test 1

The purpose of Pre-Test 1 was to determine which attitude objects were viewed as proximally, medially, and distally related to genetically modified organisms (GMOs; i.e., the focal object) for Experiments 1 and 2 reported in the main text. Toward this end, we asked a sample of Mechanical Turk (MTurk) workers to indicate how related they viewed GMOs and each of 14 social issues.

Method

Participants were recruited via MTurk to participate in a study on social and political issues. Of the 311 participants who initially began the study, 305 completed all relevant measures and are included in the analyses (154 women, 151 men; M_{age} = 35.75 years, SD_{age} = 12.99 years). Participants were asked to "rate how closely [they] feel Genetically Modified Organisms (GMOs) are related to" each of 14 different topics (i.e., artificial preservatives, low-calorie sweeteners, color additives, herbicides/ pesticides, growth promoting hormones, nanotechnology, antibiotics for food-producing animals, vegetarian diet, vegan diet, gluten-free diet, paleo diet, eat local movement, plant-based whole foods diet, free-range farming). Participants indicated their responses on 7-point rating scales ranging from 1 (*not at all related*) to 7 (*extremely related*). These items were included at the end of an unrelated study. Participants received $0.50 (USD) for completing the study.

Results

Descriptive statistics for participants' responses were obtained to determine the proximally, medially, and distally related attitude objects for Experiments 1 and 2 reported in the main text (see Table S1). Results indicate that the proximal, or most closely related, attitude object was the use growth-supporting hormones in agricultural products (M = 5.13, SD = 1.93).

The medial, or moderately related, attitude object was the Eat Local Movement (*M* = 3.20, *SD* = 2.03). Lastly, the distal, or least related, attitude topic was the paleo diet (*M* = 2.65, *SD* = 1.67).

Pre-Test 2

The purpose of Pre-Test 2 was to determine which attitude objects were viewed as proximally, medially, and distally related to growth-promoting hormones (i.e., the focal object) for Experiment 3 reported in the main text.

Method

As in Pre-Test 1, participants were recruited via MTurk to participate in a study on social and political issues. Of the 337 participants who initially began the study, 311 completed all relevant measures and are included in the analyses (155 women, 137 men; M_{age} = 36.84 years, SD_{age} = 12.80 years; demographics not provided by 19 participants). Participants were asked to "rate the relationship between growth-promoting hormones used in the production of agricultural products (such as beef and dairy)" and each of 14 different topics (i.e., artificial preservatives, low-calorie sweeteners, color additives, herbicides/pesticides, genetically modified organisms, nanotechnology, antibiotics for food-producing animals, vegetarian diet, vegan diet, gluten-free diet, paleo diet, eat local movement, plant-based whole foods diet, free-range farming). Participants indicated their responses on 7-point rating scales ranging from 1 (*not at all related*) to 7 (*extremely related*). These items were included at the end of an unrelated study. Participants received $0.50 (USD) for completing the study.

Results

Descriptive statistics for participants' responses were obtained to determine the proximally, medially, and distally related attitude objects for Experiment 3 reported in the main text (see Table S2). Results indicate that the proximal, or most closely related, attitude object was the use of antibiotics for food-producing animals (M = 4.97, SD = 1.73). As mentioned in the main text, two medially related objects were included in Experiment 3 due to an experimenter error: the use of nanotechnology in food production (M = 3.35, SD = 1.90) and the Eat Local Movement (M = 3.56, SD = 1.90). Lastly, the distal, or least related, attitude topic was the gluten free diet (M = 2.82, SD = 1.77).

Test of Generalization Function

The results of Experiments 1-3 presented in the main text suggest that attitude change toward a focal attitude object generalizes to closely related objects, but not to more distally related objects. An open question regarding LAC effects is whether generalization occurs as an all-or-nothing phenomenon or whether generalization linearly decreases as attitude objects become more removed from each other. Although the current research was not designed to address this question directly, we ran additional analyses to assess whether attitude change toward the focal object and the proximally related objects were significantly different. A significant difference between attitude change toward the focal and proximally related objects would be consistent with a linear function of attitude generalization, while symmetrical attitude change for the two objects would be consistent with an all-or-nothing function of generalization.

Experiment 1

In line with the analyses presented in the main text, responses on the attitude items were recoded such that higher scores reflect more favorable attitudes toward a given object. The resulting scores were submitted to a 2 (Time: pre vs. post) × 2 (Object: focal vs. proximally related) × 2 (Article: pro vs. contra) mixed ANOVA with the first two factors varying within-subjects and the latter varying between-subjects. There were significant main effects of Object, $F(1, 280) = 106.98$, $p < .001$, $\eta_p^2 = .276$, and Article, $F(1, 280) = 203.76$, $p < .001$, $\eta_p^2 = .421$. These main effects were qualified by a significant two-way interactions between Object and Article, $F(1, 280) = 54.56$, $p < .001$, $\eta_p^2 = .163$, and between Time and Article, $F(1, 280) = 80.29$, $p < .001$, $\eta_p^2 = .223$. Both two-way interactions were qualified by a three way interaction between Article Direction, Time, and Attitude Object, $F(1, 280) = 36.26$, $p < .001$, $\eta_p^2 = .115$. To decompose this interaction, we examined the two-way interaction between Article Direction and Time at each level of Attitude Object.

For the focal object, there was a significant two-way interaction between Article Direction and Time, $F(1, 280) = 110.40$, $p < .001$, $\eta_p^2 = .283$. There was also a significant two-way interaction between Article Direction and Time for the proximally related object, but the size of this interaction was substantially weaker, $F(1, 280) = 19.64$, $p < .001$, $\eta_p^2 = .066$. In line with the results reported in the main text, these interactions suggest that participants who initially opposed GMOs become more favorable toward both GMOs and Hormones after reading pro-GMO arguments. Conversely, participants who initially supported GMOs become more opposed toward both GMOs and Hormones after reading anti-GMO arguments.

Experiment 2

In line with the analyses conducted for Experiment 1, participants' recoded attitude scores were submitted to a 2 (Time: pre vs. post) × 2 (Object: focal vs. proximally related) × 2 (Article: pro vs. contra) mixed ANOVA with the first two factors varying within-subjects and the latter varying between-subjects. There were significant main effects of Object, $F(1, 411) = 157.34$, $p < .001$, $\eta_p^2 = .277$, Article, $F(1, 411) = 48.25$, $p < .001$, $\eta_p^2 = .105$, and Time, $F(1, 411) = 11.61$, $p = .001$, $\eta_p^2 = .027$. These main effects were qualified by two-way interactions between Time and Object, $F(1, 411) = 10.00$, $p < .002$, $\eta_p^2 = .024$, Time and Article, $F(1, 411) = 469.53$, $p < .001$, $\eta_p^2 = .533$, and Object and Article, $F(1, 411) = 11.56$, $p = .001$, $\eta_p^2 = .027$. Finally, these two-way interactions were qualified by a significant three-way interaction between Article Direction, Time, and Attitude Object, $F(1, 411) = 115.76$, $p < .001$, $\eta_p^2 = .220$. To decompose this interaction, we examined the two-way interaction between Article Direction and Time at each level of Attitude Object.

For the focal object, there was a significant two-way interaction between Article Direction and Time, $F(1, 411) = 556.67$, < .001, $\eta_p^2 = .575$. There was also a significant two-way interaction between Article Direction and Time for the proximally related object, but the size of this interaction was substantially weaker, $F(1, 411) = 145.20$, < .001, $\eta_p^2 = .261$. In line with the results reported in the main text, these interactions suggest that participants who initially opposed GMOs become more favorable toward both GMOs and Hormones after reading pro-GMO arguments. Conversely, participants who initially supported GMOs become more opposed toward both GMOs and Hormones after reading anti-GMO arguments.

Experiment 3

In line with the analyses conducted for Experiments 1 and 2, participants' recoded attitude scores from Experiment 3 reported in the main text were submitted to a 2 (Time: pre vs. post) × 2 (Object: focal vs. proximally related) × 2 (Article: pro vs. contra) mixed ANOVA with the first two factors varying within-subjects and the latter varying between-subjects. There was a significant main effect of Article, $F(1, 250) = 147.44$, $p < .001$, $\eta_p^2 = .371$, which was qualified by significant two-way interaction between Article and Time, $F(1, 250) = 60.66$, $p < .001$, $\eta_p^2 = .195$, and between Article and Object, $F(1, 250) = 7.52$, $p = .007$, $\eta_p^2 = .029$. These two-way interactions were qualified by a significant three-way interaction between Article Direction, Time, and Attitude Object, $F(1, 250) = 54.41$, $p < .001$, $\eta_p^2 = .179$. To decompose this interaction, we examined the two-way interaction between Article Direction and Time at each level of Attitude Object.

For the focal object, there was a significant two-way interaction between Article Direction and Time, $F(1, 250) = 109.66$, < .001, $\eta_p^2 = .305$. There was also a significant two-way interaction between Article Direction and Time for the proximally related object, but the size of this interaction was substantially weaker, $F(1, 250) = 4.99$, = .026, $\eta_p^2 = .020$. In line with the results reported in the main text, these interactions suggest that participants who initially opposed Hormones become more favorable toward both Hormones and Antibiotics after reading pro-Hormones arguments. Conversely, participants who initially supported Hormones become more opposed toward both Hormones and Antibiotics after reading anti-Hormones arguments.

LAC and Meta-Cognitive Facets of Attitudes toward Proximally Related Objects

A potential limitation of the analyses regarding the effects of attitude certainty and moral conviction on LAC presented in the main text is that they focused solely on meta-cognitive facets of attitudes toward the focal object. It is possible that attitude certainty and moral conviction with regard to the proximally related object is systematically related to attitude certainty and moral conviction with regard to the focal object. Additionally, it is possible that the analyses presented in the main text failed to find support for displacement effects because displacement depends on the meta-cognitive facets of attitudes toward both the focal and proximally related attitude objects. Specifically, displacement might occur when attitude certainty (or moral conviction) is high for the focal object but low for the proximally related object. To test this possibility, we conducted a multiple regression analysis predicting attitude change for the proximally related object from attitude change toward the focal object, attitude certainty (or moral conviction) toward the focal object, attitude certainty (or moral conviction) toward the proximally related object, and their interactions. The possibility that displacement might occur when attitude certainty (or moral conviction) is high for the focal object but low for the proximally related object would be supported by a significant three-way interaction between attitude change toward the focal object, attitude certainty (or moral conviction) toward the focal object, and attitude certainty (or moral conviction) toward the proximally related object. Specifically, this interaction should indicate that the association between attitude change for the proximally related object and attitude change for the focal object should be stronger when certainty (or moral conviction) is high for both attitude objects than when certainty (or moral conviction) is high for the focal object but low for the proximally related object. The analyses presented below provided a test of this hypothesis.

Experiment 1

Attitude certainty and moral conviction with regard to the focal object was indeed correlated with the same facets with regard to the proximally, medially, and distally, related attitude objects (see Tables S3 and S4). Additionally, to test whether displacement occurs when attitude certainty or moral conviction toward the focal object is high but the same facet with regard to the proximally related object is low, we ran multiple regression analyses predicting proximal attitude change from focal attitude change, attitude certainty (or moral conviction) toward the focal object, attitude certainty (or moral conviction) toward the proximally related object, and their interactions.

Attitude certainty. The multiple regression predicting proximal attitude change from focal attitude change, attitude certainty toward the focal object, attitude certainty toward the proximally related object, and their interactions revealed a significant main effect of focal attitude change, $\beta = .35$, $t(292) = 6.37$, $p < .001$. This main effect was qualified by a three-way interaction between all three predictors, $\beta = .05$, $t(296) = 2.34$, $p = .020$. In line with the hypothesis that displacement occurs when attitude certainty is high for the focal object but low for the proximally related object, decomposing this interaction suggested that the association between focal attitude change and attitude change for the proximally-related object was stronger when certainty was high for both the focal and proximally related objects, $\beta = .58$, $t(292) = 5.87$, $p < .001$, than when attitude certainty was high for the focal but low for the proximally related object, $\beta = .20$, $t(292) = 1.66$, $p = .098$.

Moral conviction. The multiple regression outlined above was repeated for moral conviction. This analysis revealed a significant main effect of focal attitude change, $\beta = .35$, $t(292) = 6.37$, $p < .001$, which was qualified by an interaction between focal attitude change and moral conviction with regard to the focal object, β = .35, $t(292) = 6.37$, $p < .001$. Finally, this interaction was qualified by a three-way interaction between all three predictors, β = .35, $t(292) = 6.37$, $p < .001$. In line with the hypothesis that displacement occurs when moral conviction is high for the focal object but low for the proximally related object, decomposing this interaction suggested that the association between focal attitude change and attitude change for the proximally-related object was stronger when moral conviction was high for both the focal and proximally related objects, β = .63, $t(292) = 7.18$, $p < .001$, than when moral conviction was high for the focal but low for the proximally related object, β = .29, $t(292) = 1.93$, $p = .055$.

Experiment 2

As in Experiment 1, attitude certainty and moral conviction with regard to the focal object was indeed correlated with the same facets with regard to the proximally, medially, and distally, related attitude objects (see Tables S5 and S6). Following the analyses for Experiment 1, we ran multiple regression analyses predicting proximal attitude change from focal attitude change, attitude certainty (or moral conviction) toward the focal object, attitude certainty (or moral conviction) toward the proximally related object, and their interactions.

Attitude certainty. The multiple regression for attitude certainty revealed significant main effects of focal attitude change, β = .35, $t(405) = 7.08$, $p < .001$, and attitude certainty with regard to the proximally related object, β = .08, $t(405) = 2.01$, $p = .045$. These main effects were qualified by an interaction between focal attitude change and attitude certainty with regard to the proximally related object, β = -.08, $t(405) = -2.46$, $p = .014$. However, counter to the hypothesis that displacement occurs when attitude certainty is high for the focal object but low for the proximally related object, the critical three-way interaction between all three predictors was not significant, β = .01, $t(405) = 0.60$, $p = .546$.

Moral conviction. The multiple regression for moral conviction revealed a significant main effect of focal attitude change, β = .35, $t(405) = 7.50$, $p < .001$, which was qualified by a two-way interaction with moral conviction with regard to the proximally related object, β = -.09, $t(405) = -2.49$, $p = .013$. Additionally, there was a two-way interaction between moral conviction with regard to the focal object and moral conviction with regard to the proximally related object, β = .06, $t(405) = 2.58$, $p = .010$. However, counter to the hypothesis that displacement occurs when moral conviction is high for the focal object but low for the proximally related object, the critical three-way interaction between all three predictors was not significant, β = .02, $t(405) = 0.84$, $p = .400$.

Experiment 3

As in Experiments 1 and 2, attitude certainty and moral conviction with regard to the focal object was indeed correlated with the same facets with regard to the proximally, medially, and distally, related attitude objects (see Tables S7 and S8). Following the analyses for Experiments 1 and 2, we ran multiple regression analyses predicting proximal attitude change from focal attitude change, attitude certainty (or moral conviction) toward the focal object, attitude certainty (or moral conviction) toward the proximally related object, and their interactions.

Attitude certainty. The multiple regression for attitude certainty revealed a significant main effect of focal attitude change, β = .28, $t(261) = 4.64$, $p < .001$. Additionally, there was a main effect attitude certainty with regard to the focal object, β = -.13, $t(261) = -2.32$, $p = .021$, which was qualified by a significant interaction with attitude certainty with regard to the proximally related object, β = .05, $t(261) = 1.98$, $p = .049$. However, counter to the hypothesis that displacement occurs when attitude certainty is high for the focal object but low for the proximally related object, the critical three-way interaction between all three predictors was not significant, β = .03, $t(261) = 1.31$, $p = .190$.

Moral conviction. The multiple regression for moral conviction revealed only a significant main effect of focal attitude change, β = .28, $t(261) = 4.77$, $p < .001$. Counter to the hypothesis that displacement occurs when attitude certainty is high for the focal object but low for the proximally related object, the critical three-way interaction between all three predictors was not significant, β = .02, $t(261) = 0.87$, $p = .384$.

Pro-GMO Article

Benefits of Genetically Modified Foods Underestimated, Scientists Say

By Andrew Higgins FEB. 15, 2016

Americans are divided about many issues, but hardly any topic has led to a wider division than genetically modified organisms (GMO). In an open letter published this week in Nature, 814 scientists from all over the world are fighting opposition against genetic modification of crops, citing evidence for its benefits for human health, the environment, and farmers. The letter refers to dozens of long-term animal feeding studies concluding that various genetically modified crops are as safe as traditional varieties. Statements from science policy bodies, such as those issued by the American Association for the Advancement of Science, the U.S. National Academy of Sciences, the World Health Organization, and the European Commission for Public Health, uphold this conclusion.

Not only is the safety of GMO's widely accepted within the scientific community, the social and economic benefits are undeniable, the researchers argue. Dr. Andrew Benson, an agricultural and environmental scientist at Harvard University who signed the letter, said in an interview that the benefits of GM crops greatly outweigh the health risks, which so far remain theoretical. The use of GM crops "has lowered the price of food," Benson says. "It has increased farmer safety by allowing them to use less pesticides. It has raised the output of corn, cotton and soy by 30 percent, allowing some people to survive who would not have without it. If it were more widely adopted around the world, the price of food would decrease, and fewer people would die of hunger."

Benefits to Human Health

In the developing world, 840 million people are chronically undernourished, surviving on fewer than 2000 calories per day. Approximately 1.3 billion people are living on less than $1 U.S. dollar a day and do not have secure access to food. In addition, the world's population is predicted to double over the next 40 years, with over 95% of these individuals being born in developing countries. It is estimated that, to meet these increased demands, food production must increase by at least 40% in the face of decreasing fertile lands and water resources.

GM plant technologies are one of a number of different approaches that are being developed to combat these problems. Several studies are currently under way to genetically modify plants to increase crop yields and/or directly improve nutritional content.

For example, scientists could save millions of children from malnutrition by infusing Asia's rice paddies with vitamin-A, creating so-called "Golden Rice". Severe vitamin-A deficiency results in blindness, and half of the roughly half-million children who are blinded by it die within a year. Golden Rice has the potential to significantly reduce vitamin-A deficiencies, which are responsible for 1.9 to 2.8 million preventable deaths annually, mostly of women and children under 5 years. Golden Rice was developed for farmers in the poorest countries with the aim to provide the technology free of charge (which required the negotiation of more than 100 intellectual and technical property licenses). Golden Rice will be given to subsistence farmers with no additional conditions and is an impressive example of a health solution that can be offered by plant biotechnology.

Benefits to the Environment

From 1996 to 2011, biotech crops have collectively reduced global pesticide applications by 1.04 billion pounds. A study published in the peer-reviewed journal Environmental Science assessing the global economic and environmental impacts of biotech crops for the first seventeen years (1996-2012) of adoption showed that the technology has reduced pesticide spraying by 503 million kg and has reduced environmental footprint associated with pesticide use by 18.7 percent. The technology has significantly reduced the release of greenhouse gas emissions from agriculture equivalent to removing 11.9 million cars from the roads.

Many of the alleged risks of the large-scale growth of genetically modified (GM) plants on the environment have been discredited. These include concerns that GM plants will affect local wildlife populations, or will sexually hybridize with non-GM plants through the transfer of pollen.

In 2001, a highly publicized study claimed that GM genes from GM maize had, by cross-pollination, contaminated wild maize in Mexico, the global center for biodiversity of this species. The validity of this work was disputed at the time of publication, and later studies have also failed to detect any evidence of transgene spread to Mexican maize growing in the wild.

In 1999, another scientific paper claimed that maize engineered to express the insecticidal Bt toxin was harmful to the larvae of the Monarch butterfly, an iconic species in American culture. It was claimed that larvae reared on their staple diet of milkweed, dusted with pollen from Bt maize, ate less, grew more slowly and suffered higher mortality rates. A number of long-term studies have since investigated the likelihood of Monarch butterfly larvae being exposed to sufficient quantities of Bt maize pollen in nature to illicit a toxic response. None of these studies found significant effects.

Benefits for Farmers

The vast majority of American farmers embrace GMO seeds. Roughly 90 percent of corn, cotton, and soybeans grown in the U.S. are improved using biotechnology to help farmers manage devastating insects, weeds, and weather conditions. Farmers are also choosing biotechnology to grow crops such as alfalfa, papaya, sugar beets, squash and canola. Technology allows farmers to produce more food, using less land and fewer chemicals, while conserving soil, water, and on-farm energy.

USDA estimates that the adoption of herbicide tolerant seeds is associated with an increase in off-farm household income as more efficient production practices allow farm families to pursue other sources of income. Globally, farmers choosing to grow GMOs have seen net economic benefits at the farm level amounting to $18.8 billion in 2012
and $116.6 billion between 1996 and 2012. Of the total farm income benefit, 60 percent has been due to yield gains, with the balance arising from reductions in production costs, such as money saved on fuel and crop production.

Farmers in the developing world, just like those in the U.S., use GMO seeds. In 2013, the crops produced by these seeds were grown in 27 countries (19 of which are developing countries) by more than 18 million farmers. For farmers in developing countries, efficiencies associated with biotechnology increase farm incomes and free up time to pursue education or hold other jobs – a significant benefit for women farmers in Africa.

Contra-GMO Article

Risks of Genetically Modified Foods Underestimated, Scientists Say

By Andrew Higgins FEB. 15, 2016

Americans are divided about many issues, but hardly any topic has led to a wider division than genetically modified organisms (GMO). In an open letter published this week in Nature, 814 scientists from all over the world are fighting to end genetic modification of crops, citing evidence for its risks to human health, the environment, and farmers. The letter refers to dozens of long-term animal feeding studies concluding that various genetically modified crops are much more dangerous than commonly assumed. Statements from science policy bodies, such as those issued by the American Association for the Advancement of Science, the U.S. National Academy of Sciences, the World Health Organization, and the European Commission for Public Health, uphold this conclusion.

Not only are the risks of GMO’s widely accepted within the scientific community, the social and economic downsides are undeniable, the researchers argue. Dr. Andrew Benson, an agricultural and environmental scientist at Harvard University who signed the letter, said in an interview that the risks of GM crops greatly outweigh the benefits, which so far remain theoretical. The use of GM crops “has not only serious hazards by itself,” Benson says. “It also led to a dramatic increase in the use of herbicides and pesticides, which poses a serious health risk to farmers and consumers.” Together with the other scientists who signed the letter, he is “unsettled and extremely concerned” about the risks GMOs pose to human health and animal health.

Risks to Human Health

Biotech companies claim that genetic modification yields more precise control over artificial selection. Studies funded by the industry consistently demonstrate safety, but only over the short term. As more and more independent scientists have completed long-term studies, a very different picture is emerging about the safety of GMOs and their many other drawbacks. Studies that are not funded by industry tend to show an uncontrollable, uncontainable, and dangerous technology with serious health hazards.

For example, a study published in the Journal Reproductive Toxicology in 2011 has identified the presence of pesticides associated with genetically modified foods in maternal, fetal and non-pregnant women's blood. They also found the presence of Monsanto's Bt toxin. The fetus is considered to be highly susceptible to the adverse effects of xenobiotics (foreign chemical substance found within an organism that is not naturally produced). The study emphasizes that knowing more about GMOs is crucial, because environmental agents could disrupt the biological events that are required to ensure normal growth and development.

Other findings suggest that DNA from GMO's could be transferred into the humans who eat them. In a new study published in the peer-reviewed Public Library of Science (PLOS), researchers emphasize that there is sufficient evidence that meal-derived DNA fragments carry complete genes that can enter into the human circulation system through a hitherto unknown mechanism. Although it does not mean that GMOs can enter into human cells, it is a possibility that cannot be ruled out at this point.

Risks to the Environment

In a recent publication, the Center for Food Safety (CFS) states the environmental impacts of GMOs will include an "uncontrolled biological pollution, threatening numerous microbial, plant and animal species with extinction, and a potential contamination of all non-genetically engineered life forms with novel and possibly hazardous genetic material."

An example of the detrimental effects of GMO's on the environment is the infestation of "superweeds" in the United States. Weeds are developing resistance to herbicides, because the modified seeds can tolerate greater use of certain herbicides and pesticides. Genetically modified canola (engineered to withstand Round-Up) is now spreading as an uncontrollable, invasive weed in California. More and more

varieties of "superweeds" are becoming increasingly resistant to any known weed killers. The infestation of superweeds has more than doubled since 2009, according to Dow Chemical, which also states that an estimated 70 million acres of U.S. farmland are infested with pesticide-tolerant weeds that cost roughly $1 billion in damages to crops so far.

In July 2011, the superweeds were becoming so powerful that farmers were being forced to use older, more toxic chemical sprays, more frequently and in heavier volumes. According to the CFS, one of the greatest promises of the biotech industry — that GMO crops would reduce the use of chemicals — is sadly untrue: pesticide use has increased by 404 million pounds from the time genetically engineered crops were introduced back in 1996, to the year 2011.

Risks to Farmers

The costs of genetically modifying food are also paid by farmers. They face the threat of GMO contamination, pesticide runoff, soil degradation, and higher seed prices. The same crops that become genetically modified become more expensive, in all of their varieties GM and Non-GM. In an attempt to manipulate the market, biotech corporations have been buying seed companies for some time. These purchases allow biotech companies to increase the prices of non-genetically modified, and to make them more difficult to obtain after they genetically modified a particular crop such as corn.

The higher cost of genetically modified “super seeds” is typically out of the range of what small farmers and farmers in developing countries are able to afford, thus widening the gap between wealthy and poor, well-fed and hungry. In addition to higher prices, all of the new genetically engineered plant technologies and resulting GM plants and seeds have been patented. As a result, farmers in the US who agreed to a “better future through GMO crops” and signed contracts with Monsanto must pay royalty fees, licensing fees, and trade fees in addition to the higher cost of GMO seeds they are then required to plant on their farm.

These are typically not one-time costs. The generations-old practice of cleaning and saving a portion of seeds from one year’s crop to be replanted next year is no longer possible, because it is considered illegal patent infringement in terms of Monsanto’s contract. Farmers are therefore required to buy fresh seed every single year, and new laws against “seed cleaning” businesses are causing these service providers to go out of business — but not before Monsanto obtains their account records in order to track down farmers who are still cleaning and saving seeds.

Pro-Hormones Article

The Effects of Growth Hormones in Food

By Andrew Higgins FEB. 15, 2016

Currently, six different steroidal hormones are approved by the FDA for use in "food animals". These are the natural hormones estradiol, progesterone, testosterone, and the synthetic hormones trenbolone acetate, progestin melengestrol acetate, and zeranol, all of which make animals grow faster and/or produce leaner meat for food. Additionally, dairy cattle are often treated with recombinant bovine growth hormone (rBGH) to increase milk production.

The use of supplemental hormones has been scientifically proven as safe for consumers and is approved by the US Food and Drug Administration (FDA). In addition to the FDA, other prestigious bodies such as the WHO, UN Food and Agriculture Organization, and Health Canada agree that hormones can be safely used in agricultural animals. For those still in question, let's further examine the science supporting these facts.

No harm to human health

Growth hormones in beef are primarily administered using a small pelleted implant that is designed to release the hormone slowly over time into the bloodstream. This ensures that hormone concentrations remain constant and low. Since implant doses are low, the use of implants in cattle has very little impact on hormone levels in beef. Every one pound (500 grams) of beef from an implanted steer contains approximately 7 nanograms of estrogen compared to 5 nanograms of estrogen from non-implanted beef.

There are many common foods that are naturally much higher in estrogen than implanted beef. For example, 500 grams of tofu contains 16,214,285 times the amount of estrogen compared to the same amount of implanted beef. Additionally, according to the US Department of Agriculture (USDA), a person would need to eat over 13 pounds of beef from an implanted steer to equal the amount of estradiol naturally found in a single egg. One glass of milk contains about nine times as much estradiol as a half-pound of beef from an implanted steer. And remember, it's not just animal products that contain hormonally active chemicals. A half-pound potato has 245 nanograms (ng, or 1 billionth of a gram) of estrogen equivalent, compared with 1.3 ng for a quarter pound of untreated beef and 1.9 ng for beef from an implanted steer.

Some consumers question whether consuming beef implanted with hormones can cause cancer or early puberty in children. Hormone implanted beef has never been implicated with adverse health effects in humans. However, height, weight, diet, exercise and family history have been found to influence age of puberty. Furthermore, the amount consumed in implanted beef is negligible compared to the amount the human body produces each day. A pound of beef raised using estradiol contains approximately 15,000 times less of this hormone than the amount produced daily by the average man and about 9 million times less than the amount produced by a pregnant woman.

Benefits to the environment

Beyond this reassuring history, there are enormous environmental benefits to be gained from use of these products. Increased feed use efficiency, reduced land requirements, and reduced greenhouse gas emissions per pound of beef produced have all been conclusively demonstrated.

Comparing conventional beef production to an alternative grass-based beef production system using an economic/production model created by scientists at Iowa State University shows that growth promoting hormones decrease the land required to produce a pound of beef by two thirds, with fully one fifth of this gain resulting from growth enhancing pharmaceuticals.

Whereas grass-based organic beef requires more than 5 acre-days to produce a pound of beef, less than 1.7 acre days are needed in a grain-fed feedlot system using growth promotants.

Grain feeding combined with growth promotants also results in a nearly 40 percent reduction in greenhouse gases (GHGs) per pound of beef compared to grass feeding (excluding nitrous oxides), with growth promotants accounting for fully 25 percent of the emissions reductions. In short, growth promoting implants safely and responsibly allow humanity to produce more beef from less feed, using less land, and creating less waste.

Improved quality of life for all

A University of Minnesota Extension Service study found that growth promotants improve cattle growth rates and feed conversion efficiency, increasing annual U.S. beef production by more than 700 million pounds while saving more than 6 billion pounds of feed. In addition, if the beef production practices from 1955 were used today, 165 million more acres of land—an area almost the size of Texas—still could not equal today's beef production according to an expert analysis.

The efficiency in today's agriculture means that American consumers spend only 6.8% of their income on food. This compares to elsewhere in the world where 18-48% of consumers' income goes toward the purchase of food. Improvements in cattle production technologies including the use of growth promotants have helped provide a growing population with the lean beef they demand while using fewer resources.

Contra-Hormones Article

The Effects of Growth Hormones in Food

By Andrew Higgins FEB. 15, 2016

Currently, six different steroidal hormones are approved by the FDA for use in "food animals". These are the natural hormones estradiol, progesterone, testosterone, and the synthetic hormones trenbolone acetate, progestin melengestrol acetate, and zeranol, all of which make animals grow faster and/or produce leaner meat for food. Dairy cattle are often treated with recombinant bovine growth hormone (rBGH) to increase milk production.

"More people are realizing there's a myriad of chemicals in conventionally produced food," says Craig Minowa, environmental scientist with the Organic Consumers Association, a nonprofit advocacy group. "Many of these chemicals have the potential to be very damaging to humans if they are exposed to high concentrations, or to low concentrations over an extended period of time."

The risk to human health

Numerous studies have also pointed to the dangerous effects of growth promotants on human health. Unnaturally high levels of hormones in the bloodstream caused by these promotants can lead to a long list of long term, life threatening health issues. Take cancer for example. It has long been known that breast cancer risk increases with higher lifetime exposure to estrogen. These facts have led many to question whether the continued use of synthetic estrogens in livestock is safe.

The amount of hormone that enters a person's bloodstream after eating hormone-treated meat is small compared with the amount of estrogen a person produces daily. However, even low levels of hormones can have strong effects on some body processes, and the extent of these effects can vary between people depending on other risk factors. For example, those with family histories of certain types of cancer almost double their risk of developing cancer with sustained hormone-treated beef consumption.

Children, pregnant women, and developing embryos are thought to be most susceptible to negative health effects from added hormones. For example, hormone residues in beef have been examined as a cause of lower sperm counts in boys. The use of rBGH in dairy cows was linked in one study to increases in human twin and triplet birth

Hormone-treated meat has also long been suspected of contributing to early puberty in children, although the link has not been entirely proven. There's no question that the age of puberty has been decreasing in the U.S., and some suggest that is due to improved nutrition and health, not to second helpings of hormones in children's diets. However, scientists contributing to these studies believe whole-heartedly that the correlations between earlier puberty and increased use of growth hormones is no coincidence. The results of these studies have been convincing enough that some countries have banned the use of at least some growth hormones. In fact, the entire European Union has outlawed specific types of U.S. produced beef hormones.

The risk to the environment

Growth-promoting hormones not only remain in the meat we consume, but also pass through the cattle to be excreted in manure. A study of cows treated with melengestrol acetate (one of the artificial growth hormones approves for use in the U.S.) revealed that residues of this hormone were traceable in soil up to 195 days after being administered to the animals. Scientists are increasingly concerned about the environmental impacts of this hormone residue as it leaks from manure into the environment, contaminating soil, and surface and groundwater.

These problems are not isolated to land and soil. Aquatic ecosystems are particularly vulnerable to hormone residues. Recent studies have demonstrated that exposure to hormones has a substantial effect on the gender and reproductive capacity of fish. The transfer of these hormones to aquatic life increases threat to human health but is also contributing to sharp declines in wildlife populations. Further, the staggering impact on reproduction is leading to severe deformities in aquatic life, decreased biodiversity, and threats to entire eco-systems. These declines are especially effecting developing countries that rely primarily on aquatic sources of food where vital fish supplies have decreased by almost 25% in the last decade.

Diminished quality of life for all

Opponents in the farm community said that by increasing milk supplies, the growth hormones used by large companies, like Monsanto, would lower prices for agricultural behemoths and put thousands of family-owned dairy farms out of business. Further, some opponents of growth hormones have pointed out concerning conflicts of interest in growth promotant research.

A 1991 report by Rural Vermont, a nonprofit farm advocacy group, revealed that rBGH-injected cows that were part of a Monsanto-financed study at the University of Vermont suffered serious health problems, including an alarming rise in the number of deformed calves and dramatic increases in mastitis, a painful bacterial infection of the udder, which causes inflammation, swelling, and pus and blood secretions into milk. These findings are supported by Health Canada’s 1998 report, which concluded that the use of rBGH increases the risk of mastitis by 25 percent, affects reproductive functions, increases the risk of clinical lameness by 50 percent, and shortens the lives of cows.

Table S1.

Means and standard deviations for participants' perceived relatedness between growth-promoting hormones and other attitude objects, Pre-Test 1

Attitude Object	$M_{\text{relatedness}}$	$SD_{\text{relatedness}}$
Artificial Preservatives	4.02	2.09
Low-Calorie Sweeteners	3.64	2.04
Color Additives	3.78	2.15
Herbicides/ Pesticides	4.75	2.04
Growth-Promoting Hormones	5.13	1.93
Nanotechnology	3.72	1.99
Antibiotics for Food-Producing Animals	4.66	1.97
Vegetarian Diet	2.99	1.92
Vegan Diet	2.85	1.87
Gluten-Free Diet	2.76	1.72
Paleo Diet	2.65	1.67
Eat Local Movement	3.20	2.03
Plant-Based Whole Foods Diet	3.18	1.97
Free-Range Farming	3.08	2.08

Note. Higher mean values represent more perceived relatedness between growth-promoting hormones and the respective attitude object.

Table S2.

Means and standard deviations for participants' perceived relatedness between growth-promoting hormones and other attitude objects, Pre-Test 2

Attitude Object	$M_{relatedness}$	$SD_{relatedness}$
Artificial Preservatives	3.86	1.95
Low-Calorie Sweeteners	3.34	2.00
Color Additives	3.50	1.99
Herbicides/ Pesticides	4.36	2.02
Genetically Modified Organisms	4.83	1.94
Nanotechnology	3.35	1.90
Antibiotics for Food-Producing Animals	4.97	1.73
Vegetarian Diet	3.05	1.97
Vegan Diet	2.95	2.04
Gluten-Free Diet	2.82	1.77
Paleo Diet	3.38	1.86
Eat Local Movement	3.56	1.90
Plant-Based Whole Foods Diet	3.13	1.99
Free-Range Farming	3.71	2.02

Note. Higher mean values represent more perceived relatedness between growth-promoting hormones and the respective attitude object.

Table S3.

Correlations between attitude certainty with regard to focal and related objects, Experiment 1 (N = 300)

Attitude Object	2	3	4
1. Focal Object	r = .41, p < .001	r = .27, p < .001	r = .21, p < .001
2. Proximally Related Object	-	r = .24, p < .001	r = .25, p < .001
3. Medially Related Object	-	-	r = .30, p < .001
4. Distally Related Object	-	-	-

Note. P-values for two-tailed tests reported. Higher scores indicate greater attitude certainty.

Table S4.

Correlations between moral conviction with regard to focal and related objects, Experiment 1 (N = 300)

Attitude Object	2	3	4
1. Focal Object	$r = .57$, $p < .001$	$r = .42$, $p < .001$	$r = .31$, $p < .001$
2. Proximally Related Object	-	$r = .41$, $p < .001$	$r = .36$, $p < .001$
3. Medially Related Object	-	-	$r = .46$, $p < .001$
4. Distally Related Object	-	-	-

Note. P-values for two-tailed tests reported. Higher scores indicate greater moral conviction.

Table S5.

Correlations between attitude certainty with regard to focal and related objects, Experiment 2 (N = 413)

Attitude Object	2	3	4
1. Focal Object	r = .23, p < .001	r = .12, p = .010	r = .20, p < .001
2. Proximally Related Object	-	r = .22, p < .001	r = .26, p < .001
3. Medially Related Object	-	-	r = .21, p < .001
4. Distally Related Object	-	-	-

Note. P-values for two-tailed tests reported. Higher scores indicate greater attitude certainty.

Table S6.

Correlations between moral conviction with regard to focal and related objects, Experiment 2 (N = 413)

Attitude Object	2	3	4
1. Focal Object	$r = .37$, $p < .001$	$r = .43$, $p < .001$	$r = .30$, $p < .001$
2. Proximally Related Object	-	$r = .38$, $p < .001$	$r = .43$, $p < .001$
3. Medially Related Object	-	-	$r = .35$, $p < .001$
4. Distally Related Object	-	-	-

Note. P-values for two-tailed tests reported. Higher scores indicate greater moral conviction.

Table S7.

Correlations between attitude certainty with regard to focal and related objects, Experiment 3 (N = 269)

Attitude Object	2	3	4	5
1. Focal Object	$r = .23$, $p < .001$	$r = .59$, $p < .001$	$r = .34$, $p < .001$	$r = .24$, $p < .001$
2. Proximally Related Object	-	$r = .33$, $p < .001$	$r = .26$, $p < .001$	$r = .27$, $p < .001$
3. Medially Related Object 1	-	-	$r = .28$, $p < .001$	$r = .18$, $p < .001$
4. Medially Related Object 2	-	-	-	$r = .32$, $p < .001$
5. Distally Related Object	-	-	-	-

Note. P-values for two-tailed tests reported. Higher scores indicate greater attitude certainty.

Table S8.

Correlations between moral conviction with regard to focal and related objects, Experiment 3 (N = 269)

Attitude Object	2	3	4	5
1. Focal Object	r = .39, p < .001	r = .60, p < .001	r = .47, p < .001	r = .41, p < .001
2. Proximally Related Object	-	r = .36, p < .001	r = .44, p < .001	r = .45, p < .001
3. Medially Related Object 1	-	-	r = .43, p < .001	r = .40, p < .001
4. Medially Related Object 2	-	-	-	r = .50, p < .001
5. Distally Related Object	-	-	-	-

Note. Note. P-values for two-tailed tests reported. Higher scores indicate greater moral conviction.