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Naturalness judgments by lay Americans: Process dominates content in judgments of food or water acceptability and naturalness

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Abstract

This study directly tests the hypothesis that, at least within the domains of food and drink for Americans, the judgment of naturalness has more to do with the history of an object, that is the processes that it has undergone, as opposed to its material content. Individuals rate the naturalness and acceptability of a natural entity (water or tomato paste), that same entity with a first transformation in which a natural substance is added (or some part removed), and then a second transformation in which the natural additive is removed (or the removed part is replaced). The twice transformed entity is stipulated to be identical to the original natural entity, yet it is rated much less natural and less acceptable. It differs from the original entity only in its history (the reversed processes it has experienced). The twice transformed entity is also rated as less natural than the once-transformed entity, even though the former is identical to the original natural entity, and the latter is not. Therefore, naturalness depends heavily on the process-history of an entity.

Keywords: natural, genetic engineering, process, content, preference.

1 Introduction

"Natural" is an attribute that seems to generally improve the perception of the entity to which it is applied. This may be a manifestation of what Kellert and Wilson have described as "biophilia," an innate desire for the experience of the human ancestral environment (Wilson, 1984; Kellert & Wilson, 1993).

Natural foods are generally considered more desirable, and worth more, than corresponding "non-natural", "artificial" or "processed" alternatives (Rozin et al., 2004). This is perhaps most obvious in the food domain, but natural preference extends to other entities, including fabrics, medicines (in some cases), and environments.

The appeal of "natural" may be universal or almost universal, in some domains. There is direct evidence for its appeal in Western cultures in the food domain. For example, in five European countries and the United States, free associations to the word "natural" are almost entirely positive (Rozin, Fischler, & Shields-Argeles, 2006).

There has been some attention to matters related to "natural" in the psychology and risk literatures. Much of this has been motivated by opposition to genetic engineering, particularly of foods. Naturalness, or perception of naturalness, has been identified in a number of lines of research, much of it based on the framings of risk and toxins provided by Slovic (e.g., Slovic, 1987). Psychometric studies on the attributes of varied technologies confirm that a two-dimensional description of familiarity and dread account for much of the variation in response to food risks (e.g., Fife-Schaw & Rowe, 1996, 2000), and there are indications that some of the opposition to technologies are based on fundamental concerns about the propriety and dangers of tampering with nature (e.g., Slovic, 1987; Frewer et al., 2004; Bredhal, 1999; Sparks & Shepherd, 1994). The focus of the literature has been on public assessment of health risks, and in this regard, there has been appropriate concern for the value of education of the public and involvement of the public in decision making, and understanding reasons for public distrust of relevant government and industry statements and regulations (Frewer et al., 2004). There has also been interest in identifying public attitudes to technology and more broadly, the natural world, that might predict which individuals are most opposed to modification of foods (Kellert, 1997; Siegrist, 1999).

There are two types of justifications for "natural preference": instrumental and ideational (Rozin et al., 2004). Instrumental reasons refer to specific advantages of natural entities: they are more attractive/appealing, healthier, and/or kinder to the environment. It is this type of justification that has been the focus of most past research. Ideational reasons come down to the claim that natural is inherently better, in moral and/or aesthetic senses. We have found that although Americans usually justify their natural preference in instrumental terms, when these are neutralized (for example, by the claim that for a partic-

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ular comparison, the natural and non-natural entities are chemically identical), natural preference usually remains substantially intact (Rozin et al., 2004). When challenged on their instrumental accounts, many informants acknowledge that natural is "just better."

An analysis of the properties of the concept "natural" for lay Americans suggests that naturalness is relatively uncompromised by mixing of like natural entities, or changes in physical state (such as freezing or crushing) (Rozin, 2005). On the other hand, changes in substance, as by boiling or additions or subtractions of entities changes naturalness substantially. When something is added to (or subtracted from) a natural entity, the violation of its naturalness could result from the change in material substance, and/or the process of intervention. There are suggestions that process may be more important than change in content. Domestication, which involves major changes in substance, violates naturalness less than the trivial substantial change of replacing a single gene with another. For example, a cocker spaniel is rated as only modestly less natural than a wolf, whereas a single gene insertion (replacement) in a variety of species has a massive effect on naturalness (Rozin, 2005). The gene replacement, a process that involves "direct" manipulation of the genome but minimal substantial change, has a much more destructive effect on naturalness than extensive selective breeding, which produces a much larger change in both appearance and the genome.

The idea that process is more important than content in judgments of naturalness needs further evidence and explication. The ideal comparison (not carried out in previous research) involves changes that only involve process, or only content. Although it is not possible to imagine a change in content that is human-induced, but does not involve a process, it is possible to imagine action of human-caused processes, but with no change in substance. This is accomplished if something (natural or unnatural) is added to a "natural" entity, and then that same additive is removed, leaving the twice processed entity chemically identical to its natural origin form. The same can be accomplished by removal of something from a natural entity, and then having this subtracted entity replaced.

In this study, we explore judgments of naturalness, similarity, and acceptability of water and one food exemplar (tomato paste) which undergo this set of double manipulations (addition then subtraction, or subtraction and then addition).

2 Method

2.1 Participants

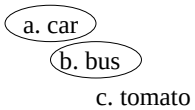
The participants were adults waiting at the main Philadelphia train station (30th Street). Individuals who were alone were approached and asked to complete a short (two sides of one page) anonymous questionnaire. Completion of the questionnaire took five to ten minutes for most respondents. One of two questionnaires was offered to each person. The "Water" questionnaire was completed by 97 individuals (57 male), with a mean age of 33.1 years (range 18-80 years). The "tomato paste" questionnaire was completed by 99 individuals (43 male), with a mean age of 31.3 years (range 16-76 years). All but 5 of 196 participants had completed high school.

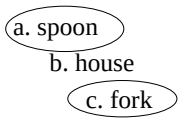
2.2 Questionnaires

The questionnaire was kept very brief so the disturbance to the participants would be minimal, and because most participants were waiting for trains. The present data were part of two separate questionnaires. The principal aim of both questionnaires was understanding of reasons for rejection of recycled water. Both had the same set of demographic questions, and information about water drinking habits and reactions to different types of water. One included, along with other questions about water, the items relevant to this study on water processed in various ways. The other questionnaire included other questions about water, and the items about tomato paste described below.

In the water form, participants rated acceptability ("0 = not acceptable under any conditions to 100 = completely acceptable") and naturalness ("0 = not natural at all [like a plastic toy model of a car] to 100 = completely natural [like a tree growing on a mountain peak that has never been visited by humans]") of six types of water, in two sets of three. The precise descriptions of the waters, in the sequence presented, are indicated in Table 1. The first set involved rating of natural water with minerals, removal of minerals, and their replacement. The second set involved rating of natural water with no minerals, addition of natural minerals, and then their removal. In addition, participants made similarity judgments on the same two sets of triads. The instructions read as follows:

> You will be presented with sets of THREE items. In each case, you are to circle the TWO items that are MOST similar in your opinion. For example:





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a. pure water from a natural spring containing no minerals

b. same as a. but with .1% natural minerals added

c. same as a. but with .1% natural minerals added and then removed

a. pure water from a natural spring containing .1% minerals

b. same as a. but with .1% natural minerals removed

c. same as a. but with .1% natural minerals removed and then added back

The "tomato paste" items were conceptually parallel to the water items. The same acceptability and naturalness scales were used. Both of the triads (listed in Table 1) began with the same "natural" tomato paste made only of crushed organic tomatoes. In the first case (addition) natural sugar (1%) was added and then removed. In the second case (subtraction) some of the sugar in the natural tomato paste (10%) was removed, and was then replaced.

A parallel similarity measure was made, but in this case, only for the add then subtract triad. With the same instructions as for the water questionnaire, the relevant tomato paste item was:

A. tomato paste made from organically grown tomatoes

B. tomato paste A made with 1% natural beet sugar (sucrose) added

C. tomato paste B after the 1% natural beet sugar is removed

2.3 Study design and hypotheses

The design of the study involves four triads of substances, WSA: water subtraction then addition; WAS: water addition then subtraction; TAS: tomato paste addition then subtraction; and TSA: tomato paste subtraction then addition. For each of these triads, there are data on naturalness and acceptability of each member. There are also similarity judgments for three of the four triads (one was left out of the questionnaire, in error), in which the most different entity of the three in the triad is identified. The presentation of results is organized in terms of two hypotheses, each of which is tested in each of the four triads. The similarity results are treated separately, at the end.

The most critical results are the ratings of naturalness. However, ratings of acceptance, insofar as naturalness determines acceptability, should parallel the naturalness ratings. The four triads generate 11 exemplars (not 12 because the original tomato paste was the same for the two sets of tomato paste transformations). For each of these, we correlate acceptance and naturalness ratings across all participating respondents. The mean of the resulting Pearson rs is .56, with a range from .48 to .70. Hence, in the framework of the exemplars and orders of item presentation used in this study, naturalness is strongly related to acceptability. Ratings of similarity provide a different view of respondents' conception of the triads. Insofar as perceived similarity may be a basis for relative ratings of naturalness and acceptability, then the item selected as most different should inform the ratings of naturalness.

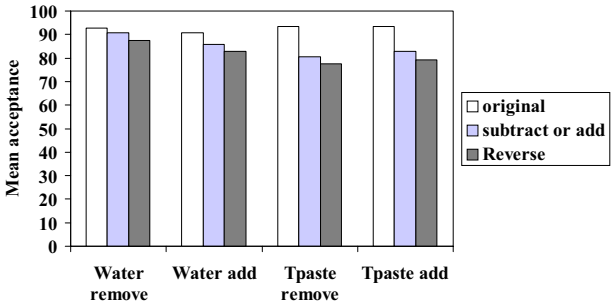

Figure 1: Mean acceptability ratings for each of the three versions for four transformation triads.

Process Sufficient Hypothesis. If two entities are identical in substance, but one endured two canceling processes to reach this identical state, then the doubly processed entity will be rated as less natural (and perhaps, less acceptable, and most dissimilar) than the original entity. That is, processing alone, with identical content, is sufficient to reduce naturalness.

Process dominates content hypothesis. An entity that has endured two human-induced transformations which reverse each other, such that its content matches the original content, will be rated as less natural (and perhaps less acceptable and most dissimilar) than an entity that has endured one transformation but is different in content (on account of a single additive or "subtractive" process) from the original entity.

3 Results

The results are presented in Table 1, and Figures 1 and 2, organized by triad, to highlight the design, while the results in text are presented by hypothesis. A participant's data were excluded from a particular triad and specific rating scale (acceptability or natural) if any of the three (acceptability or naturalness) ratings was missing, or in a few cases, where the acceptability or naturalness of the original natural water or tomato paste was less than or equal to 20. (11 cases were eliminated.) Such a low rating

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Table 1: Mean acceptability, naturalness and similarity ratings (with s.d.) for four transformation triads.

Condition	Acceptable (0-100)	Natural (0-100)	Most different # (%)
WSA: Water, removing natural minerals (.1%)	N=88	N=77	
1. Consider water A that comes out of a natural spring. This water contains .1% minerals.	92.9 (13.2)	96.4 (8.1)	12 (17.6%)
2. Imagine that water A goes to a processing plant, and the minerals are removed, so it is now pure water.	90.6 (19.9)	69.6 (28.5)	21 (30.9%)
3. Imagine that after the minerals are removed in the processing plant, the same minerals are put back in, so that the water has .1% minerals, like water A, that came out of the spring.	87.4 (22.2)	67.5 (28.7)	35 (51.5%)
WAS: Water, adding natural minerals (.1%)	N = 83	N=75	
4. Consider water B that comes out of a natural spring. This water contains no minerals.	90.8 (16.6)	94.3 (12.1)	19 (23.8%)
5. Imagine that water B goes to a processing plant, and that .1% minerals, extracted from other spring water, are added.	85.7 (21.4)	70.0 (25.6)	25 (31.2%)
6. Imagine that after the minerals are added in the processing plant, the same minerals are then removed, so that the water has no minerals, like water B, that came out of the spring	82.9 (24.4)	63.0 (31.1)	36 (45.0%)
TAS: Tomato paste, adding sugar (1%)	N = 85	N=85	
1T. Consider tomato paste A made just from crushed, organically grown tomatoes.	93.3 (14.0)	89.7 (15.4)	19 (24.0%)
2T. Imagine that 1% natural beet sugar (sucrose) is added to the tomato paste.	82.3 (25.8)	76.8 (26.0)	37 (46.8%)
3T. Imagine that after the 1% beet sugar is added to the tomato paste, it is then removed, so the tomato paste has the same amount of beet sugar as the original tomato paste (A).	78.8 (28.5)	70.2 (29.4)	23 (29.1%)
TSA: Tomato paste, removing sugar (10%)	N=85	N=85	
*1T. Consider tomato paste A made just from crushed, organically grown tomatoes.	93.3(14.0)	89.7 (15.4)	
4T. Consider another batch of tomato paste A made just from crushed, organically grown tomatoes. Now suppose 10% of the sugar (sucrose) in the paste is removed.	79.9 (23.8)	73.8 (25.1)	
5.T Now imagine that this same 10% is added back to the tomato paste, so the tomato paste has the same amount of beet sugar as the original tomato paste (A)	77.2 (26.5)	68.6 (29.6)	

* First item for TAS and TSA is the same, labeled as 1T

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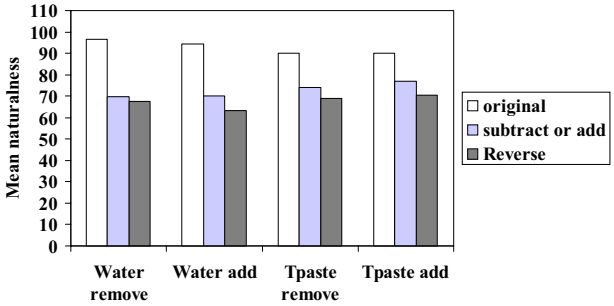

Figure 2: Mean naturalness ratings for each of the three versions for four transformation triads.

was hard to interpret, and as well allowed little room for degradation of quality by the transformations presented. Analyses including all participants did not materially affect the results reported below.

3.1 Naturalness and acceptability

Testing the Process Sufficient Hypothesis. For the WSA (water subtraction then addition) condition, the most direct test of the Process Sufficient hypothesis is supported. The doubly-transformed (add, then subtract) water was rated a mean of 29.0 scale points less natural than the original water t(76)=8.669, p<.001). For the WAS (water add-subtract) triad, the doubly transformed water was rated a mean of 31.3 points lower than the original (t(74)=8.980, p<.001). For TAS (tomato paste: addition then subtraction), twice transformed tomato paste was rated 19.5 scale points below the original (t(84) = 6.666, p<.001). Finally, for the TSA (tomato paste: subtraction then addition), the twice transformed paste is a mean of 21.2 below the original (t(84) = 7.192, p<.001). Hence, all four direct tests with naturalness ratings are in the predicted direction and highly significant. These results support the process sufficient hypothesis: process changes without content changes produces substantial drops in naturalness.

Acceptability ratings mirror the naturalness results, but the effects are smaller and not always significant. The drop in acceptability from original to second transform is a mean of 5.5 for WAS (paired t-test, t(87)=2.467, p<.05), 7.8 for WSA (t(82) = 3.001, p<.01), 14.5 for TSA (t(84)=5.113, p<.001) and 16.1 for TAS (t(84)=6.243, p<.001). All effects were in the predicted direction but only three were significant at p<.01 or better.

Testing the Process Dominant Hypothesis. The claim is that the twice-processed entity (third in the triad) that is chemically identical to the original entity will be rated less natural than the second member of the triad, which had only one transformation but also differs in content from the original. The Process Dominant hypothesis is supported by the results, but not as consistently and robustly as the Process Sufficient hypothesis. For the WAS condition, the twice-transformed (add, then subtract) water was rated a mean of 2.1 scale points less natural than the once-transformed water (t(76)=0.897, n.s.). For the WSA (water add-subtract) triad, the twice-transformed water was rated a mean of 7.0 points lower than the once-transformed original (t(74) = 3.157, p<.01)). For TAS (tomato paste: addition then subtraction), twice-transformed was rated 6.6 scale points below the once-transformed (t(84) = 3.098, p<.01). Finally, for the TSA (tomato paste: subtraction then addition), the twice-transformed is a mean of 5.3 below the once transformed (t(84) = 2.359, p<.05). Hence, all four direct tests of the process dominance hypothesis produce effects in the predicted direction, with two of these effects meeting our criterion of significance (p<.01, two tailed).

As with the first hypothesis, the acceptability ratings mirror the naturalness results, but the effects are smaller and are less significant. The drop in acceptability from once to twice transformed is a mean of 3.2 for WAS (t(87)=1.293, n.s.), 2.8 WSA (t(82)=1.193, n.s.), 3.6 for TSA (t(84)=1.963, n.s.) and 2.7 for TAS (t(84)=1.644, n.s.). All effects were in the predicted direction but none was significant at p<.01 or better.

3.2 Similarity

Similarity judgments (which two of the three exemplars in the triads are most similar) offer the opportunity to explore the relative roles of substance and process in judgments of similarity. (By an error, the fourth similarity triad, for TAS, was omitted from the questionnaire.) Insofar as these results match the findings on naturalness, there is an argument that overall similarity judgments contribute to naturalness judgments. It is, of course, possible that similarity judgments are quite different, e.g., dominated by substance similarity as opposed to processing history. For ease in presentation, we convert the similarity judgment into a difference judgment: which of the three exemplars is most different from the other two?. The results of this tabulation are presented in the last column of Table 1. Surprisingly, in all three triads, the original, untouched natural entity receives the fewest endorsements as most different (18%, 24% and 24%, respectively). The twice-processed entity was rated as most different for the two water triads, at 52 and 45%, supporting the Process Dominant hypothesis (most processed was most different). For tomato paste, the once-transformed had the highest endorsement, arguing for substance sensitivity in this case, since the one item differing in substance was identified as most different. So, overall, the similarity results provide a mixed verdict on the link be-

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tween similarity and naturalness judgments. Oddly, the simple division of natural (original) and not-natural (the two transformed members of the triads) was the least popular choice.

4 Discussion

The results of this study are highly consistent across four sets of data and two groups of participants. The first finding is for naturalness, and supports our Process Sufficient hypothesis with strong evidence across all cases. Water or tomato paste twice transformed from its natural state so that it returns to its original state is rated substantially less natural than the original entity. Two processes applied by humans that leave original substance unchanged produce a substantial decrease in naturalness. Hence, processing alone, without substantial change, can degrade naturalness. Chemical identity does not guarantee naturalness.

Our second finding relates to the Process Dominant hypothesis and indicates that once transformed water or tomato paste, different in substance from the original, natural form, is more natural than a twice transformed version of the original which is identical in substance to the original. Thus, in many respects, under the conditions tested here, process dominates substance. The effects we report that support the second hypothesis are always in the predicted direction, but not always significant. The data on acceptability follow this same pattern, but more weakly. In general, across the four triads, acceptability is substantially related to naturalness, with correlations across 11 data sets averaging .56.

Considering all of our results on ratings of acceptability and naturalness of four triads of exemplars, as illustrated in Figures 1 and 2, there is an inviolable order in which the original natural entity scores highest, followed by the once transformed entity, followed by the twice transformed entity which is chemically identical to the original entity. The similarity results provide support for the view that process is important, since in two of three cases, the twice processed form is considered most different from the original form, even though chemical identity has been stipulated.

These findings are in accord with our prior results, which suggested the process over content hypothesis. Genetically modified organisms with single allele replacements, almost identical in content to the wild type, are rated less natural than highly domesticated species that are physically very different from their wild progenitors (Rozin, 2005). The prior studies suggest that it is not just "process" but type of process that is critical. Domestication involves a great deal of human intervention, with selective breeding, but does not involve the intrusive process of poking directly into the genome. This seems to be a potent denaturalizing agent, way out of line with its effects in terms of changing the physical appearance, structure, or composition (that is, content) of the modified organism.

In the present study, changes in acceptability and naturalness were quite small, in spite of additions and subtractions of substances, in comparison to the effects of direct deletion and addition of single alleles. Furthermore, again suggesting the relative lack of importance of content, in our prior study, we found that the unnaturalness of animals or plants with gene insertions was only very slightly affected by the source (content) of the replacing gene: the same species, a similar species, or a species from the "opposite" kingdom (plant genes for animals, or animal genes for plants) (Rozin, 2005).

As we have presented it, the idea of process is related to the history of an entity. Two currently identical entities may differ in the path they took to their present status, this involving history and a sequence of processes. In our prior work (Rozin, 2005), we suggested the importance of the idea of contagion in understanding naturalness. That is, even brief contact with unnatural entities can be very destructive to naturalness (Rozin & Nemeroff, 1990). Now contact is, of course, a process, but by the lay conception of contagion, the actual material makeup of the contaminated object may be permanently altered (Nemeroff & Rozin, 1994). Thus, in an important sense, two physically "identical" items may not be psychologically identical, if one contacted a "contagious" entity. Thus, human contact, even though it may leave no physical trace that a physicist could detect, may be perceived as altering content.

The importance of the history of an object in its valence and characterization assigned by humans is generally under-rated. It has received relatively little attention in the primarily instrumentally-oriented analyses of public perception of the risks of new technologies, as reviewed in the introduction. Of course, that literature is appropriately oriented to changing public attitudes, and ideationally oriented opinions about past history and essence are probably much less malleable than either beliefs about health risks or trust in institutions. It is not clear how to modify the natural preference of an individual who believes that natural entities are inherently better.

In an interesting parallel to our finding, Bloom (1996) argues that the conception of "artifact"by lay humans is deeply connected to past history, including the intention of the creator of an object. Further research will have to explore the complexities of contagion, the ideas of material and spiritual essence (Nemeroff & Rozin, 1994), and the perceived history of an object, including perhaps the intention of the producer of an object. As well, from the point of view of understanding lay attitudes to natural, it will be important to extend the approach presented in this

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study to entities other than food and drink, and to non-Western-developed cultures.

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