

# Additivity dominance: Additives are more potent and more often lexicalized across languages than are “subtractives”

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## Abstract

Judgments of naturalness of foods tend to be more influenced by the process history of a food, rather than its actual constituents. Two types of processing of a “natural” food are to add something or to remove something. We report in this study, based on a large random sample of individuals from six countries (France, Germany, Italy, Switzerland, UK and USA) that additives are considered defining features of what makes a food not natural, whereas “subtractives” are almost never mentioned. In support of this, skim milk (with major subtraction of fat) is rated as more natural than whole milk with a small amount of natural vitamin D added. It is also noted that “additives” is a common word, with a synonym reported by a native speaker in 17 of 18 languages, whereas “subtractive” is lexicalized in only 1 of the 18 languages. We consider reasons for additivity dominance, relating it to omission bias, feature positive bias, and notions of purity.

Keywords: natural, additive, food, medicine.

## 1 Introduction

There is no question that the concept of natural is of psychological and commercial importance in the modern developed world. It is clearly a positive attribute, especially when applied to foods. In recent years, some studies have shed light on the lay meanings of natural. One particular feature of lay meanings is of relevance to the present paper. It appears that the naturalness of something is related more to its history of contact with humans than it is to actual chemical composition (Rozin, 2005, 2006). Understandably, Americans rate spring water or natural tomato paste as much more natural than those same entities after a small amount of a natural substance (e.g., natural minerals or sugar) has been added to them. This action involves both a process (adding) and a change in content. What is striking is that if it is stipulated that all of the additives are subsequently removed, the resultant substance is rated less natural than the substance with the additive (Rozin, 2006). The substance that had an additive that was then removed has been subjected to two “processes” but is now identical in content to the orig-

inal “natural” substance. This set of results (confirmed with the opposite sequence of removing a component of a natural substance, and then replacing the removed component [Rozin, 2006]) argues strongly for the importance of process as opposed to content in natural judgments.

While human contact and agency has been identified by a number of authors as enhancing perceptions of risk (e.g., Baron & Ritov, 1993; Kahneman et al., 1993; Sjöberg, 1980), it may be that the type of contact is critical. Domestication of plants or animals is associated with intensive human involvement, and major changes in genotypes and phenotypes, yet domesticated species are rated only slightly less natural than their wild equivalents (Rozin, 2005). On the other hand, insertion of a single gene into a wild species is rated as producing a very large decrease in naturalness (Rozin, 2005). Perhaps, there is something about going “inside” to produce changes that lead to judgments of unnaturalness.

In the present paper, we add another feature to lay naturalness judgments, which we believe points to a more general asymmetry in judgments. We had not anticipated the finding we report in advance of the studies described. In a broad large survey of individuals from six countries about their attitudes to food and health (generally summarized in Fischler & Masson, 2008), we included a number of questions about naturalness, including an open-ended item asking for a definition of naturalness. In analyzing these results, we discovered the major importance of “no additives” as a feature of naturalness and the very rare mention of removal of substances (“sub-

\*The survey on which this paper is based was funded by OCHA (Observatoire CNIEL des Habitudes Alimentaires) or CNIEL Food Habits Observatory, <http://www.lemangeur-ocha.com>, a social science research and documentation unit of CNIEL. CNIEL is an acronym for the French dairy industry’s national association (Centre National Interprofessionnel de l’Economie Laitière). The authors wish to thank Maggy Bieulac-Scott for her help and support. Address: Paul Rozin, Department of Psychology, University of Pennsylvania, 3720 Walnut St., Philadelphia, PA 19104–6241. Email: [rozin@psych.upenn.edu](mailto:rozin@psych.upenn.edu).

tractives”). These and some other results from this survey are presented here, as illustrations of additivity dominance in judgments of naturalness, and perhaps a more general additivity dominance. We follow the main results with a cross language survey which confirms the greater salience of additives over subtractives.

## 2 Method

The results we report came from the second and third phases of a large study, originating in France, and funded by OCHA (Observatoire des Habitudes Alimentaires), a part of the National Cross-Industry Centre for the French Dairy Sector French Dairy Industry’s Center for Information and Documentation (CNIEL). The six countries were France, Germany, Italy, Switzerland, the United Kingdom and the United States. The data were collected in the period from 2000–2002. Details of the procedures are described in other publications (Fischler & Masson, 2008). The surveys were carried out on the telephone by a professional survey agency. The first phase involved focus groups which helped to inform the writing of questions for the second and third phase. In the second phase, representative samples from the six countries completed a 45 minute telephone survey. There were approximately 180 individuals from each country, 1/3 representative laymen, one third teachers, and one-third doctors. The second iteration included open-ended questions. In the second phase, the Swiss sample was entirely from French Switzerland. The third phase involved a 15 minute telephone survey of 900 representative lay people from each country, except for 1500 from the United States. In the third phase, the Swiss sample included all of Switzerland, and none of the questions was open-ended.

## 3 Results

### 3.1 Open ended definitions of naturalness

In phase two, we collected approximately 1,000 definitions of natural, which were transcribed verbatim by the interviewer, in real time. We developed a coding scheme for the definitions of “natural.” Any definition could be scored as positive for any number of codings, if the appropriate criterion was met. Over the entire sample, the most common features mentioned were “no chemicals” (247 mentions), “no alterations” (228), and “no additives” (172). We grouped these features conceptually, forming larger categories such as a general “no additive” category (no additives, no pesticides, no preservatives, no chemicals) or a no processing category (including no alterations, no contact with humans, no industrial intervention, etc.). The largest category was now “no process-

ing” (687 instances) followed by “no additives” (604 instances). No other collapsed category had more than 300 mentions. The no-additives and no-processing categories are the most frequently cited in all countries.

Compared to the 604 cases that we coded as including no additives in the broader sense, there were only 11 cases in which there was any reference to removing of anything.

### 3.2 Naturalness judgments

Two items in phase three asked about the naturalness of two milk products, rated on a “0 not natural at all to 10 completely natural” scale. The items were: “Milk with natural vitamin D supplement” and “Milk with all fat removed” (skim milk). The vitamin D supplement would presumably involve a small amount of additive while the skim milk represents removal of a major part of milk. In spite of this major difference in substance change, the skim milk was rated as more natural (mean of 5.88, SD = 2.86) than the vitamin D supplemented milk (mean = 5.35, SD = 2.78;  $t[6017] = 12.609$ ,  $p < .001$ ). However, for only the American sample, vitamin D supplemented milk was rated as more natural than skim milk. This difference may be related to the long history of vitamin D supplemented milk in the United States, such that for many American individuals, “milk” may mean the same thing as vitamin D supplemented milk, as may also be the case for iodized salt.

## 4 A follow-up cross language study

The finding of “additivity dominance” with respect to naturalness suggests that, more generally, additives may be more salient or important than “subtractives”. Since languages, and in particular lexicalization, bears some relation to frequency of use, we thought it of interest to explore the lexicalization of “additive” and “subtractive” across languages. This exploration was prompted by our awareness that in English, “additive” is a word, and even a fairly common word, but there is no word meaning “subtractive”. Is this an anomaly in English, or a more general phenomenon? We arranged to interview 22 people, a convenience sample, in the University of Pennsylvania community. All were native speakers of a language other than English, but also fluent in English. Generally, we interviewed one person to represent each language, but our sample included two speakers of Portuguese, two speakers of Mandarin, and three of Korean. The multiple informants for these three languages agreed in their judgments except that one Korean disagreed with the other two. We took the majority opinion. The languages sampled were Portuguese, Spanish,

French, Swedish, Czech, Bulgarian, Albanian, Romanian, Russian, Amharic, Tamil, Hindi, Bengali, Tagalog (Philippines), Cantonese, Mandarin, Korean, Japanese, and, of course, English. The cross language study was part of a larger study about the lexicalization of a variety of psychologically relevant words (e.g., craving, addiction) in different languages. For the case of additives, participants were asked if they were familiar with the word “additive” in English. All avowed familiarity. Participants were then asked to define additives, and all gave an adequate definition. They were then asked if there was a synonym for additive in their language, and the synonym was recorded. We then asked if there was a word in their language for the opposite of additive, something that was removed from an entity. We indicated that the word would probably be “subtractive” in English, but that there was no such word in English. We recorded respondents answer to this question, and if a word was forthcoming, we recorded it.

Of the 19 languages considered, including English, respondents offered a synonym for additive in 13 cases. Of these 13, 5 were cognates of the English word, each beginning with “additiv...” For only one of the languages (Hindi) was a synonym offered for the opposite of additive (“subtractive”). Hence, there is a major asymmetry in the lexicalization of “additive” versus “subtractive.” We don’t know at this time whether this linguistic difference is cause, effect or both, in what we predict to be greater sensitivity to additions than removals.

## 5 Discussion

The greater potency of additives as opposed to subtractives seems obvious to us in retrospect, but it did not appear in our prior work or the work of others. Indeed, this asymmetry was not obvious in a previous study (Rozin, 2005), in which we obtained paired naturalness ratings of symmetrical additive/subtractive examples, e.g., peanut butter with 50% of the fat removed or with 50% fat (peanut oil) added. However, in these cases, the symmetry of the addition and removal was salient. Also, this study was entirely with American respondents, the only group in this study that did not show additivity dominance in the milk vitamin D supplement versus skim milk contrast.

We do not have a satisfactory explanation of additivity dominance. We indicate five different possible accounts here.

First, the judgment-decision literature consistently indicates that people are much more concerned about harm from actions than from omissions (Baron & Ritov, 2009), and in some sense, it is possible that addition can be thought of as more like a commission than is subtract-

tion (as originally suggested by Spranca, 1992). However, the mapping from omission to subtraction is questionable, since subtracting is an action.

Second, additivity dominance may be an example of what has been called the feature positive effect (e.g., Newman, Wolff & Hearst, 1980; this reference and possibility was suggested to us by Jonathan Baron). Under a wide variety of conditions, both animals and humans have been shown to be much better at learning discriminations or concepts when the critical variable is present on positive (rewarded) trials, as opposed to when it is present on non-rewarded trials. There is no accepted explanation of this effect, but the case for aligning additive with a positive trial and subtractive with a negative trial appears to us more persuasive than the corresponding matchup with omission and commission.

A third account of additivity dominance relates it to the idea of purity. Purity is a common feature of natural definitions and free associations to “natural” (Rozin, Fischler & Shields-Argelès, submitted). By their nature, additives reduce purity, since they are by definition not the same as what they are added to. On the other hand, if we remove something from what is taken to be pure, it could reasonably be held to retain its purity. There is nothing “foreign” in the resulting product. Skim milk might be considered to be “pure” milk.

A fourth account of additivity dominance also relates to purity, and the fragile state that it represents. It is easy to destroy purity and hard to attain it, a manifestation of negativity dominance (Rozin & Royzman, 2001). Adding a negative entity to a positive entity makes the combined entity negative, and this contagion effect is dose insensitive (Rozin & Nemeroff, 2002). Positive additives have very little effect on the valence of the product. In the food and medicine worlds, additives usually imply something negative; indeed, in English there is a separate word, “supplement”, which seems to imply a positive additive. There is yet another English word, “fortified” which also seems to imply a positive additive. Both of these words may have been introduced to neutralize the negative impact of “additives”. On this fourth account, adding anything negative will have more potent effects (not just on naturalness, but on goodness, healthfulness etc.) than removing of either negative or positive components.

A fifth account (suggested by a reviewer) is that additivity dominance may operate only when the initial entity is not considered an integrated whole. As the reviewer notes: “Or, perhaps, your results show that natural entities are not perceived holistically. If they were, then subtraction would change the whole as much as addition. To take some examples, if you remove an object from a famous painting, it is no longer the same, so paintings are thought of as wholes. That is probably just as bad as adding something. If you cut lines or scenes out of a long

play, it is still the same play, but if you add lines it is not, right? Thus, plays are not thought of holistically.”

As indicated in the introduction, human agency and views about human malevolence has figured in many analyses of risk perception. It is conceivable that addition is seen as more “agentic” than subtraction, but, in fact, subtraction usually involves more human intervention. It is easier to add salt to something than to remove it.

We think additivity dominance is worth recording in the literature, because it is a substantial effect. The fact that additives are a major aspect of food and medical products, and that they are sometimes designed to add health value, raises interesting questions about how to understand lay decisions about these products. Furthermore, it is quite possible that additivity dominance, especially given the language results, extends beyond the domains of food and medicine, and may point to a more general asymmetry in thinking.

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