CROSS-CULTURAL PERCEPTIONS OF NATURAL FOOD

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Department of Anthropology
Abstract

of

CROSS-CULTURAL PERCEPTIONS OF NATURAL FOOD

by

Jordan Serin

This thesis seeks to investigate the influence of evolved human cognitive mechanisms on contemporary perceptions and categorizations of food with a particular focus on the meaning of “natural”. The first research question of this thesis asks whether people prefer natural foods in two different cultural contexts, the United States and Mexico. The second research question of this thesis builds upon prior evolutionary studies by asking whether perceptions of natural food offer evidence to support the position that people in all cultures think about living things in the same special ways. The study found that study participants in both cultures prefer natural over commercial forms of food, and that preferences and perceptions differ between males and females. Natural food preferences and perceptions differ for plant- and animal-based foods. Different genetically modified variants also received significantly different naturalness ratings depending on whether the modification involved the mixing of taxonomically related or distant genes. These results contradict Rozin’s (2005) findings and suggest that biological ‘content’ appears to have as much (or more) of an influence as ‘process’ on people’s preferences and perceptions of natural food.
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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Acknowledgments</th>
<th>v</th>
</tr>
</thead>
<tbody>
<tr>
<td>List of Tables</td>
<td>ix</td>
</tr>
<tr>
<td>List of Figures</td>
<td>x</td>
</tr>
</tbody>
</table>

1. **Chapter 1 – INTRODUCTION** ................................................................. 1
   - Statement of the Problem ........................................................................ 1
   - Research Questions .............................................................................. 2

2. **BACKGROUND** .................................................................................... 4
   - Overview ............................................................................................... 4
   - Evolutionary Psychology ....................................................................... 7
   - Categorization and Concepts ............................................................. 10
   - Folkbiology ......................................................................................... 14
     - Approaches and History ................................................................... 14
     - Special-Purpose and General-Purpose Taxonomies ....................... 17
     - Primacy of the Generic Rank ......................................................... 21
     - Naïve Biology .................................................................................. 25
     - Causal Understanding and Natural Kinds ....................................... 29
     - Essentialism .................................................................................... 35
   - Artifact Concepts ................................................................................ 38
     - Design Stance .................................................................................. 38
     - Functional Fixedness ....................................................................... 41
     - Biological Artifacts ......................................................................... 43
   - The Food Domain ................................................................................ 45
     - Nonhuman Primates ......................................................................... 46
     - Human Food Acceptance and Rejection ........................................ 51
Categorization and Food Choices ................................................................. 56
Perceptions of Natural in the Food Domain ............................................... 60
The Preference for Natural ....................................................................... 60
The Meaning of Natural .......................................................................... 63
Interpersonal Differences in Naturalness Judgments ............................ 67
An Evolutionary Perspective .................................................................... 69
Study Predictions ..................................................................................... 73
3. PILOT RESEARCH .................................................................................. 82
  Overview .................................................................................................. 82
  Materials and Methods ........................................................................... 83
  Results ..................................................................................................... 85
  Discussion ............................................................................................... 88
4. PRINCIPAL RESEARCH .......................................................................... 91
  Overview .................................................................................................. 91
  Materials and Methods ........................................................................... 92
  Results ..................................................................................................... 97
    Demographics ........................................................................................ 97
    Prediction 1 .......................................................................................... 102
    Prediction 2 .......................................................................................... 115
    Prediction 3 .......................................................................................... 126
    Prediction 4 .......................................................................................... 132
    Prediction 5 .......................................................................................... 141
    Prediction 6 .......................................................................................... 144
    Prediction 7 .......................................................................................... 154
5. DISCUSSION .......................................................................................... 164
  Do people have a preference for natural food? ...................................... 164
  Do preferences and perceptions of natural food show evidence of
  categories that are “natural” to the human mind? ................................ 172
    Natural Food Judgments and the Domain of Folkbiology ................. 172
Differences Between Animals and Plants ......................................... 172
Essentialism and Genetic Modification ............................................ 177
Inferences, Causal Reasoning, and Modes of Construal ................... 185
Perceptions of Food and the Domain of Artifacts .............................. 196
Process versus Content ................................................................. 196
Naturalness Judgments of Basic and Processed Foods .................... 199
The Essence of Artifacts and Perceptions of Processed Foods......... 202
Conclusion ............................................................................................... 209

Appendix A. Request for Review by the CSUS Committee for the Protection
of Human Subjects .................................................................................. 218
Appendix B. Pilot Research: Consent to Participate in Research .................. 221
Appendix C. Pilot Research: Questionnaire .................................................. 222
Appendix D. Principal Research: Consent to Participate in Research (Spanish) .. 231
Appendix E. Principal Research: Questionnaire, Version A ....................... 232
Appendix F. Principal Research: Questionnaire, Version B ......................... 241
Appendix G. Principal Research: Questionnaire, Version A (Spanish) ........... 250
Appendix H. Principal Research: Questionnaire, Version B (Spanish) .......... 258
Literature Cited ......................................................................................... 266
# LIST OF TABLES

<table>
<thead>
<tr>
<th></th>
<th>Table 3-1</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.................................................................................................</td>
<td>86</td>
</tr>
<tr>
<td>2</td>
<td>Table 3-2</td>
<td>86</td>
</tr>
<tr>
<td>3</td>
<td>Table 4-1</td>
<td>107</td>
</tr>
<tr>
<td>4</td>
<td>Table 4-2</td>
<td>108</td>
</tr>
<tr>
<td>5</td>
<td>Table 4-3</td>
<td>109</td>
</tr>
<tr>
<td>6</td>
<td>Table 4-4</td>
<td>109</td>
</tr>
<tr>
<td>7</td>
<td>Table 4-5</td>
<td>116</td>
</tr>
<tr>
<td>8</td>
<td>Table 4-6</td>
<td>117</td>
</tr>
<tr>
<td>9</td>
<td>Table 4-7</td>
<td>121</td>
</tr>
<tr>
<td>10</td>
<td>Table 4-8</td>
<td>122</td>
</tr>
<tr>
<td>11</td>
<td>Table 4-9</td>
<td>128</td>
</tr>
<tr>
<td>12</td>
<td>Table 4-10</td>
<td>133</td>
</tr>
<tr>
<td>13</td>
<td>Table 4-11</td>
<td>134</td>
</tr>
<tr>
<td>14</td>
<td>Table 4-12</td>
<td>134</td>
</tr>
<tr>
<td>15</td>
<td>Table 4-13</td>
<td>135</td>
</tr>
<tr>
<td>16</td>
<td>Table 4-14</td>
<td>157</td>
</tr>
<tr>
<td>17</td>
<td>Table 4-15</td>
<td>158</td>
</tr>
<tr>
<td>18</td>
<td>Table 4-16</td>
<td>160</td>
</tr>
<tr>
<td>19</td>
<td>Table 4-17</td>
<td>162</td>
</tr>
<tr>
<td>20</td>
<td>Table 4-18</td>
<td>162</td>
</tr>
<tr>
<td></td>
<td>Figure 3-1</td>
<td>Page</td>
</tr>
<tr>
<td>---</td>
<td>---------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>2</td>
<td>Figure 3-2</td>
<td>88</td>
</tr>
<tr>
<td>3</td>
<td>Figure 4-1</td>
<td>99</td>
</tr>
<tr>
<td>4</td>
<td>Figure 4-2</td>
<td>100</td>
</tr>
<tr>
<td>5</td>
<td>Figure 4-3</td>
<td>103</td>
</tr>
<tr>
<td>6</td>
<td>Figure 4-4</td>
<td>104</td>
</tr>
<tr>
<td>7</td>
<td>Figure 4-5</td>
<td>105</td>
</tr>
<tr>
<td>8</td>
<td>Figure 4-6</td>
<td>106</td>
</tr>
<tr>
<td>9</td>
<td>Figure 4-7</td>
<td>111</td>
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<tr>
<td>10</td>
<td>Figure 4-8</td>
<td>111</td>
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<td>Figure 4-9</td>
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<td>Figure 4-10</td>
<td>111</td>
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<td>Figure 4-11</td>
<td>112</td>
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<td>14</td>
<td>Figure 4-12</td>
<td>112</td>
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<td>Figure 4-13</td>
<td>112</td>
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<td>16</td>
<td>Figure 4-14</td>
<td>112</td>
</tr>
<tr>
<td>17</td>
<td>Figure 4-15</td>
<td>113</td>
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<td>18</td>
<td>Figure 4-16</td>
<td>113</td>
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<td>19</td>
<td>Figure 4-17</td>
<td>113</td>
</tr>
<tr>
<td>20</td>
<td>Figure 4-18</td>
<td>113</td>
</tr>
</tbody>
</table>

x
43. Figure 4-41 ................................................................. 140
44. Figure 4-42 ................................................................. 140
45. Figure 4-43 ................................................................. 146
46. Figure 4-44 ................................................................. 149
47. Figure 4-45 ................................................................. 151
48. Figure 4-46 ................................................................. 152
Chapter 1

INTRODUCTION

STATEMENT OF THE PROBLEM

This thesis seeks to investigate the influence of evolved human cognitive mechanisms on contemporary perceptions and categorizations of food. The analysis focuses most closely on evolutionary approaches to the meaning of “natural” as a desirable attribute in food. Paul Rozin (2005) has suggested that preferences for natural food and the meaning of the desirable attribute “natural” may be universal as a result of strong intuitions that people have about the contaminating effect of human contact with food. Rozin (2006) found that a food’s history of contact with humans reduces its perceived naturalness. He proposed that perceived violations of naturalness reflect people’s judgments about the processes a food item has undergone rather than judgments about the actual content of the food entity. Evolutionary anthropologists address assertions about universal human psychology and behavior with cross-cultural studies, and by considering evolutionary mechanisms and hypothetical scenarios that would explain the existence of shared human traits. Presumably, the structure of the mind with regards to food reflects past selection pressures on food-related behaviors. Recent efforts in the field of psychology to understand cognitive architecture and shared patterns of human conceptual development reveal that humans have innate ways of construing phenomena in the living world, which are different from the ways human-made objects, or artifacts, are conceptualized (Atran, 1990; Keil, 1989). Food presents a challenge to researchers who tend to focus on one or the other of these apparently distinct cognitive
domains, perceptions of the living world or representations of artifacts. Most foods are derived from living things that undergo physical and chemical transformations. As a result of these transformations or processes, a food acquires functional and symbolic characteristics that represent the desires and intentions of the people who created it. Thus, on one hand, food may be perceived in terms of where it comes from in the living world and, on the other hand, in terms of its history of contact with humans, including the processes underlying its creation and its intended uses. The first goal of this thesis is to conduct a cross-cultural test of the “natural preference”. The second goal is to assess the extent to which innate ways of representing living things and artifacts influence perceptions of natural food.

**RESEARCH QUESTIONS**

The principal study for this thesis addresses two research questions. The first question asks whether people show a preference for foods that are natural. Given that previous studies have documented a “natural preference”, the second research question asks if people’s preferences and perceptions of natural food show evidence of natural categories, which is a universal aspect of folkbiology and suggestive of evolved cognition about foods in the natural world. The first question seeks to describe preferences for natural food in two different cultures and among males and females. The second question moves beyond describing preferences and is more experimental in asking how cognition works. To answer these questions, the study instrument was designed to test seven predictions derived from theories in cognitive psychology and evolutionary anthropology.
The seven predictions are organized according to the two research questions, and are justified in the following chapter at the conclusion of the literature review. The principal study was conducted among university undergraduates in Sacramento, California and undergraduate and graduate students in Mexico City.
Chapter 2

BACKGROUND

OVERVIEW

Researchers working with subjects in Western societies have begun to use systematic techniques to demonstrate a preference for foods that are considered to be “natural” (Rozin et al., 2004; Rozin, 2005). Efforts to collect and interpret such data tend to be concentrated within the field of psychology. Anthropological research can help to document and describe preferences for natural food in more diverse contexts, such as in countries of low socioeconomic status. A portion of the survey instrument used in Rozin et al. (2004) to measure people’s preferences for natural food was replicated in the pilot study and the principal study for this thesis. The first research question of this thesis seeks to build upon prior psychological studies by asking whether people prefer natural foods in two different cultural contexts, the United States and Mexico, and by comparing the food preferences of males and females. Describing cross-cultural patterns and sex differences are steps toward determining whether an evolutionary perspective may inform our understanding of the “natural preference”.

Hypotheses about the evolutionary selection pressures and innate cognitive biases responsible for the emergence of a concept of natural in the domain of food are implicit in interpretations of results from prior studies. However, this work has not received significant input from the field of evolutionary anthropology. The second research question of this thesis seeks to build upon prior evolutionary studies by asking whether perceptions of natural food offer evidence to support the position that people in all
cultures think about living things in the same special ways. A shared interest among anthropologists and psychologists in people’s categorizations and concepts of living things has resulted in many cross-cultural and developmental studies, which are generally referred to as ethnobiology, folkbiology, and naïve biology. Other programs of research seek to understand the unique ways in which people conceptualize and categorize artifacts in developmental and cross-cultural contexts. The predictions of this thesis address positions already taken in the literature with regards to categories and concepts of living kinds and artifacts that have not yet been directly tested in the domain of food or in relation to the concept of natural food.

Many anthropological studies about food concepts tend to take the perspective of the standard social science model that emphasizes the culturally constructed nature of food. On the other hand, evolutionary anthropological models that are drawn from studies of non-human animals tend to avoid psychological and cultural concepts of food in favor of strict biological measures of caloric content and energetic and reproductive returns. Ever since Darwin (1859) presented the theory of evolution by natural selection anthropologists have attempted to explain culturally embedded concepts of food from materialist and adaptationist perspectives, particularly concepts of contamination and pollution in food taboos (Douglas, 1966; Fessler and Navarrete, 2003). Recent investigations of food taboos reflect efforts to explain cross-cultural patterns in food concepts from a perspective that considers the influences of biological and cultural adaptations on one another. In testing for shared cross-cultural perceptions of contemporary foods, the proposals presented in this thesis are not intended to suggest that
attitudes toward a novel food technology, such as genetic modification, specifically evolved as a result of natural selection. Rather, shared cross-cultural perceptions and attitudes will be interpreted as evidence that the human brain was designed to attend to certain features of living things and artifacts – and will “naturally” perceive boundaries to exist among such things - in predictable ways as a result of selection pressures on higher order levels of conceptualization and categorization.

There are many factors to consider in examining the relative influences of innate mental hardware and culturally acquired information on human perceptions of their physical and social environments. Perceptions of food are particularly challenging. Human beliefs that living kinds have standard origins and a predictable set of properties may signify an evolved preparedness in learning that promotes the development and transmission of a concept of “natural” as well as an evolved preference to consume basic foods that are perceived to retain their naturalness. In addition, innate reasoning faculties that evolved to deal specifically with living things may bias expectations about food entities whose biological origins are known. Alternatively, perceptions of food may be so deeply embedded within representational systems of artifacts that perceived violations of naturalness are the default, particularly since so many foods are culturally constructed entities. This is increasingly the case with the spread of complex, industrially processed foods. The “natural” concept and the “natural preference” in the domain of food may simply be a response to particular socioeconomic and technological conditions that are relatively unique to Western-developed cultures, but which are rapidly spreading
throughout the world. This thesis anticipates that an evolutionary perspective can inform our understanding of the meaning of natural as a desirable attribute in food.

The first section of this chapter reviews the basic principles of evolutionary psychology. Next, I briefly review categorization and concepts from the perspective of cognitive psychology, which is the basis for in-depth discussions in the following sections on folkbiology and artifacts. Other cognitive structures and mechanisms discussed in this chapter include taxonomy, category-based reasoning, inferences, and essentialism. In the final two sections of this chapter I review various aspects of human psychology and behavior in the domain of food, including evidence that the preference for natural food is very strong in contemporary Western settings where it has been studied so far. This thesis does not address the naturalistic fallacy, which characterizes logical errors in the way people think about the ethical implications of evolved behaviors. The naturalistic fallacy is outside the parameters of this investigation, but is a significant factor to evaluate in subsequent research. I will conclude with an explanation and rationale for the study predictions.

**EVOLUTIONARY PSYCHOLOGY**

Evolutionary psychology is a school of thought in the application of evolutionary theory to human behavior (Cartwright, 2000). The approach is concerned with cognitive adaptations. According to evolutionary psychology, modern humans possess cognitive mechanisms that were evolutionarily designed to function in ancestral environments. This “environment of evolutionary adaptedness” (EEA) is generally presumed to have
existed during the Pleistocene (200 thousand years ago), but it has also been interpreted more broadly to encompass various time frames over the past two million years, depending on the traits under investigation. The EEA is characterized by a hunter-gatherer way of life, the environment of small-scale foraging economies, and social networks and communities that persisted over most of human evolutionary history (Foley, 1995). Current human behavior is considered a product of contemporary environmental influences acting upon ancestral and innate mental hardware.

This theoretical approach assumes that adaptations of the human body and adaptations of the human brain are similar insofar as the evolutionary processes responsible for their biological designs and functions are concerned. The structure of the human body into thousands of different parts that each performs a specialized function is a structural design known as massive modularity (Hagen, 2005). The evolution of bodily structures according to this design is an indication that the evolution of complex cognitive adaptations by natural selection is also likely to have produced a modular organization of the human mind. The modular structure of the human brain reflects its functions and the environmental selection pressures to which the brain was adapted. In evolutionary terms, the functionality of a trait refers to the survival and reproductive advantages conferred to individuals who inherited and developed a certain design of the trait among various possible alternatives (Cosmides and Tooby, 1994). Our cognitive architecture is functionally organized into specialized structures as a result of the highly structured and heterogeneous components of the environment in which humans evolved. Human ancestors who were successful in promoting their own reproduction and that of
close kin possessed genetically transmitted adaptations designed to resolve a diverse range of evolutionarily recurrent problems.

These problems may have been ecological, social, or technical in nature. As a result of selection pressures within the social domain, human ancestors developed cognitive adaptations for language acquisition, the avoidance of cheaters in social exchanges, coalition formation and cooperation (Cosmides and Tooby, 1992). Selection pressures within the ecological domain would have favored individuals who could form mental models of the spatial distribution of resources and those whose responses to predators maximized survival and future reproduction. The diverse set of challenges mentioned here represents just a small number of the varied competences required of ancestral humans living in hunter-gatherer contexts. Evolutionary psychologists argue that since each challenge would have required a specialized set of mental facilities, one would expect to find that information gathering processes, inference systems, and decision-making operations would be clustered into discrete modules. This organization of functionally distinct cognitive mechanisms is known as domain-specificity (Cosmides and Tooby, 1994).

The evolution of domain-specificity occurred as a result of the need for ancestral humans to produce different solutions to different adaptive problems. The activation of each module will depend on the specific problem at hand. Evolutionary psychologists reason that domain-specific architecture is designed to be sensitive to different social contexts and environmental stimuli. This sensitivity explains how people regulate behaviors and learning processes. Thus, researchers who are concerned with
reconstructing human evolutionary history examine how domain-specific mechanisms and content-dependent processing systems of the human mind give rise to concepts, preferences, and behaviors such as incest avoidance, mate choice, predator avoidance, and food aversions (Barrett, 1999; Buss, 1989; Fessler and Navarrete, 2003).

CATEGORIZATION AND CONCEPTS

A basic premise of evolutionary psychology is that the nervous system and the rest of the human body have been shaped by adaptive solutions to problems faced by our ancestors that were, on average, better than alternative solutions. In the course of a lifetime, or even a single day, a human is likely to encounter an innumerable array of stimuli and challenges. Humans recognize that many stimuli can be thought about and responded to in familiar ways because many objects and events are alike in some important respects (Smith and Medin, 1981). Thus, Rosch (1978) proposes that cognitive economy underlies the formation of human categorization systems. The principle of cognitive economy describes the trade-off between, on one hand, the need to distinguish many different stimuli as precisely as possible and, on the other hand, the need to reduce one’s information load to levels that are cognitively manageable and behaviorally relevant. Rosch (1978) asserts that categorization systems serve to maximize information with the least amount of cognitive effort.

In developing her argument, Rosch (1978) points out that people perceive material objects of the world to possess a high correlational structure. The co-occurrence of perceived attributes in various objects supports the recognition of patterns. Rosch’s
principles of categorization are consistent with an evolutionary framework in that the types of attributes that an organism can perceive in an entity are species-specific.

A category may include various objects that are considered more or less equivalent at a particular conceptual level, and humans generally designate these by names (e.g., *dog, animal*) (Rosch, 1978). Rosch (1978) explains that categories of objects are arranged vertically and horizontally within a taxonomy. The vertical arrangement of categories denotes different levels of abstraction such that an object within the lowest category is also included in the higher or more general categories. For instance, a poodle is a dog and is also an animal; however, most things that belong to the animal category are not dogs. Thus, categories arranged vertically are referred to as different classes of inclusion.

The horizontal dimension of a taxonomy denotes how people determine category membership. Since categories do not tend to have clear-cut boundaries, or to be discontinuous, Rosch (1978) summarizes a few possible mechanisms that people use to maintain separateness and clarity when making categorical judgments. The “classic” and more formal view is that people refer to necessary and sufficient criteria (i.e., feathers and wings) to determine category membership (i.e., bird). Prototypes are another categorical judgment mechanism, which differs from the classic view. To make category judgments based on prototypicality generally means that clear and uncontroversial instances of a category member are referred to as the ideal against which other objects can be compared. Prototypical judgments reflect the degree of membership in a category based on a subject’s rating of how well a particular item fits one’s idea or image of the
category to which the item belongs. The notion of prototypes is therefore intrinsically linked with the view that there is a graded structure to category judgments (Rosch, 1999). Rosch (1978, 1999) and Smith and Medin (1981) discuss the implications of a prototype view on the structure and functions of a “concept”.

According to the prototype view, all of the items within a category possess different gradations of membership, and so the particular details and imagery associated with the prototype are not common to all members of the category. Rosch (1999) reviews prior studies that reject the “classic” view’s notion that people refer to necessary and sufficient attributes when classifying items into categories. She goes on to suggest that the prototype/graded structure view of category judgments receives significant empirical support and is consistent with the notion that a less formal system of concepts can provide rich sets of information. Keil (1994:234) agrees that, “[m]ere tabulations of feature frequencies and correlations grossly undetermine concept structure.” Smith and Medin (1981) discuss how concepts with one-word names are used to classify things. In this sense, and according to Millikan (1998), a concept is a mental representation of something for purposes of information gathering and storage, inference, and behavioral regulation.

Western scientists have long recognized a commonality between their pragmatic interests in constructing biological taxonomies and the purposes of classifying living and inanimate objects in the “folk” sense. Gilmour (1940:465) notes that, “the purpose of all classification is to enable the classifier to make inductive generalizations”. In their discussion of children’s acquisition of concepts, Gelman et al. (1994) argue that making
predictions and providing explanations about the perceived world are abilities that emerge while learning to classify individual entities.

Classification systems, in which concepts are embedded, generally represent larger belief systems that resemble theories (Carey, 1985; Gelman et al., 1994). Theory, in the commonsense or folk sense of the term, is a thought pattern by which people explain phenomena with reference to unobservable cause and effect relationships between perceivable entities. Rosch (1999) explains that this view of theories came to be different from the “classic” and prototype/graded structure views of category formation.

The “theory theory” is an attempt to account for the inductive strength of a good categorization system. It raises questions as to how and why people come to perceive that certain attributes and feature clusters occur as they do (Keil, 2003; Murphy and Medin, 1985).

Diverse and robust evidence has accumulated in support of the “theory theory” or “concepts in theories” view (Gopnik and Wellman, 1994). Studies indicate that features with the strongest influence on people’s concepts or categorizations of an object are those that causally explain the existence of other attributes of that object (Ahn, 1998; Keil, 1995). Thus, if people perceive that a group of items are similar and that these similarities are due to shared causal relations among their perceived properties, then categories and concepts can be said to derive from causal-explanatory understandings (Keil, 1995). Keil (2003) notes that since causal relations are central to science, and most of folk science, the “theory theory” raises questions about variations in how people
perceive and weigh different possible types of causal understanding in constructing and using categories.

These three views of category formation—necessary and sufficient features, prototype/graded structure, and “theory theory”—have each been operationalized and tested in cross-cultural and developmental studies of folkbiology and in experiments on artifact concepts. As an evolutionary psychological framework would predict, support for one view over another has varied depending on the domain under investigation and according to the developmental stage of experimental subjects. Thus, the anthropological treatment of folkbiology and artifact studies through the lens of evolutionary theory has offered new insights into the structure and function of categorization systems and conceptual development.

FOLKBIOLOGY

Approaches and History

The question as to whether humans impose a learned discriminating grid upon our perceived environment or whether we possess an inherent conception of the separateness of “things” has been a topic of philosophical debates and scientific inquiries for centuries (Atran, 1990; Leach, 1964). The view that emphasizes the social construction of reality is much different from the view that stresses universal patterns of thought across all cultures. And more specifically, to view structural patterns in the natural world as responsible for similar folkbiological taxonomic systems across cultures is different from the view that humans universally possess an *a priori* cognitive architecture and a
preparedness in learning about the natural world (Berlin, 1992). Psychological, biomedical, and ethnographic evidence has accumulated in support of the notion that sets of innate mental hardware with bounded conceptual systems specify what expectations we have, and how humans think, about certain things. As an example, preschoolers in different cultures constrain their use of the predicate “grow” to plants and animals; the notion that rocks or other nonliving things can grow does not make any sense to children (Keil, 1979). In another example, Greif and colleagues (2006) demonstrate that, when prompted to ask questions about novel artifacts and animals, children seek different information about these different kinds of things, such as the function and potential behaviors of artifacts and the locations, eating habits, and reproduction of animals.

Clinical studies of human patients suffering from brain injuries offer evidence that information is stored and processed in a domain-specific manner with divisions among the conceptual systems for inanimate objects, animals, and plants (Caramazza et al., 1994). For example, Gainotti (2005) found that the location of brain lesions affects an individual’s ability to distinguish between biological and non-living categories. McCarthy and Warrington (1985) reported on a patient whose trauma to a small region of the brain prevented him from defining animals (e.g., pig) using more specific information than its life-form connotation (e.g., mammal); the patient, on the other hand, was able to provide detailed descriptions of an artifact (e.g., lighthouse). Research among patients recovering from brain injuries also indicates that there are sex differences in specialized cognitive abilities. Laiacona and colleagues (2006: 158) report “disproportionate plant-knowledge deficits are restricted to males, whereas disproportionate animal-knowledge
deficits are rare in both sexes” (also see Gainotti, 2005). Biomedical evidence of “category-specific” deficits, therefore, corroborates results from ethnographic and psychological studies that indicate a specialized biological domain of thought.

Research focused on the nature of biological thought, as a distinct domain of cognition, is known as folkbiology (Medin and Atran, 1999). Folkbiology is an interdisciplinary research program with historical roots in anthropology and cognitive psychology. Ethnobiology is a more general term to denote studies dealing with the relationships of plants and animals to human societies (Berlin, 1992). Anthropology’s long history of studying people’s beliefs and uses of the natural world in different cultural contexts is representative of the foundations of ethnobiology (Castetter, 1944; Harrington, 1947). The original phase of research, characterized by descriptions of culturally, or more specifically economically, significant plants and animals was followed by a focus on the study of human conceptualization and classification of the natural world (Berlin, 1992).

The emergence of cognitive anthropology and American ethnoscience in the 1950s and 1960s was marked by attempts to provide detailed analyses of entire systems of biological categories in various cultural contexts, notably non-literate societies (Berlin, 1992; Coley et al., 1999). In revealing universal principles underlying folkbiological category organization, anthropology drew the attention of cognitive psychologists interested in laws or generalizations about how the mind works. In terms of method, anthropology takes environmental and cultural contexts into consideration when revealing the richness of folkbiological thought, whereas the strengths of cognitive
psychology are its focus on systematic controlled comparisons and its interest in children and human development (Medin and Atran, 1999).

A significant finding in the 1960s and 1970s was that the groupings of organisms into folkbiological taxonomic systems are largely based on gross morphological similarities and differences rather than functional considerations, such as, for example, their cultural utility (Berlin, 1973). Levi-Strauss (1966) was one of the first authors to challenge the utilitarian view, arguing that ‘primitive’ people’s extreme familiarity with the biological environment represented a universally shared intellectual need to classify the natural world and to satisfy an inherent demand for order. A shift occurred among ethnobiologists from focusing on cataloguing and describing the most economically valuable aspects of the natural world to taking greater interest in the classification systems themselves. These differences in the relative importance of economic and cognitive factors in ethnobiological studies led to finer-scaled investigations as to how and why people classify nature in the ways that they do (Berlin, 1992).

**Special-Purpose and General-Purpose Taxonomies**

Several different sorts of “special-purpose” folkbiological classifications can be found in any single culture, and these were the initial focus of ethnobiological research. Since categories such as family and genus are rather abstract and fixed, many early ethnobiologists presumed that the living-kind categories of folk represent an indefinite number of classes according to their uses for medicine, agriculture, dress, food, and other purposes (Atran, 1990). The standard view of the historical processes that have led to
modern, Western systematics presumes that the distinction between useful and noxious organisms is the so-called ancestral state of human biological knowledge. According to this view, development of the system is presumed to occur as a result of greater description, such that ‘plants with edible roots’ are a separate category from ‘herbs that are good in love potions’. Increased awareness over time is said to lead people to recognize that certain plants with large roots and certain ‘herbs’ may belong to a single group characterized by common kinship, and that membership in the group is independent of utility for immediate material needs. Early researchers in the field assumed that folk who lack Western scientific expertise, including all members of traditional subsistence cultures, are in the early stages of this progression from a special-purpose to a general-purpose folkbiological system. Rather than relying on similarities and differences in the overall morphology of organisms to make distinctions among living things, folk were presumed to assemble the biological world into categories according to just a few culturally relevant features of the natural world. The range of uses for any functionally organized classification is restricted, and therefore considered “special purpose” (Berlin et al., 1966).

With regards to how people organize biological knowledge, Berlin and colleagues (1966) reported on cross-cultural similarities among the folkbiological structures of Tzeltal Mayan peoples in southern Mexico, Hanunoo peoples in the Phillipines, and the organization of biological knowledge in Western science, known as systematics. These and most other folkbiological systems that have been studied are similar in that categories of organisms are organized conceptually as a taxonomic hierarchy. A taxonomic
hierarchy is the vertical arrangement of categories, where each category represents a different rank or, according to Rosch (1978), different classes of inclusion. Berlin (1992) has established the standard terminology for folk-biological ranks as follows: the “folk-kingdom” rank (e.g., animal, plant), the “life-form” rank (bug, fish, bird, mammal, tree), the “generic” rank (gnat, shark, robin, dog, oak), the “folk-specific” rank (poodle, white oak), and the “folk-varietal” rank (toy poodle, spotted white oak). This cross-culturally universal hierarchical and ranked structure of folkbiological knowledge is referred to as a “general-purpose” taxonomy (Atran, 1985; 1990; 1998).

The existence of a universally shared “general-purpose” folkbiological taxonomy reflects that people in all cultures spontaneously partition the categories “animal” and “plant” into generic species in a virtually exhaustive manner (Atran, 1998). Berlin (1999) explains that people expect a newly encountered, unidentifiable organism to belong to a named generic species based on a known named taxa that it resembles. This observation is consistent with a general principle of ethnobiological classification, known as naturalness. Naturalness implies that folkbiological classification reflects “the order inherent in nature, not an order arbitrarily laid on nature by humans’ economic or symbolic concerns” (Berlin, 1999: 71). In this way, the inductive validity of such a system is also established. In the face of uncertainty, a fairly rigid hierarchy of inclusive groups of organisms, or taxa, supports systematic reasoning about the properties of living kinds (Atran, 1998).

This system of ranks within a hierarchy is unique to the domain of living kinds. The cognitive domain of artifacts has a hierarchical structure whereby chairs are
considered a type of furniture and cars are a type of vehicle, but there is no ranked system of artifacts. Chairs and cars cannot be linked within some larger framework into an artifact species grouping that spans both objects. The significance of rank to folkbiological taxonomy relates to the partitioning of living kinds into mutually exclusive taxa that are each composed of an inherent nature (Atran, 1998). This is not the case for an artifact such as a mug, which may or may not belong to a more general category, such as a cup, or which may or may not actually be used as a mug depending on the social context. Unlike artifacts, each plant or animal will belong uniquely to a generic species. And, unlike hierarchies of artifact concepts, the existence of each hierarchical rank in a folkbiological taxonomy represents a different level of reality.

Researchers have attempted to understand the nature of each hierarchical rank, or level, within folkbiological taxonomies. Atran (1985) examines differences as to how groups of taxa at the “generic” rank and “life-form” rank are named, differences as to which biological properties are privileged in categorizing taxa at each rank, and differences between the psychological intentions that are satisfied in classifying taxa at each rank. For instance, group members at the life-form level are diverse, subsuming any number of generics that exhibit a broad fit of morphology (e.g., skin covering) and behavior (e.g., locomotion) to habitat (e.g., air, land, water) (Atran, 1985; 1998). A defining biological feature shared by members of a taxon at the “folk-generic” level is their ability to interbreed with one another, but not with members of any other taxon at that rank. This aspect of folkbiology resembles the principle of reproductive isolation in modern biological sciences. Berlin et al. (1973) point out the linguistic or nomenclatural
criterion of rank affiliation, specifically that life-form and generic classes tend to be labeled by primary lexemes (e.g., tree or bird; oak or robin) whereas specific classes are always labeled by secondary lexemes or “binomial labels” (e.g., white oak). These patterns are observed cross-culturally among ethnobiological classifications, indicating that biological ranks are universal, though the taxa they contain are not.

**Primacy of the Generic Rank**

The folk “generic” rank (also known as the level of generic species) is the core of any folkbiological taxonomy, and it contains the most numerous taxa in any folkbiological system (Atran, 1998, 1999; Berlin, 1992). Whereas a generic grouping of plants or animals can be recognized without close study, subdivisions into species that can be recognized and named often require expert examination (Cain, 1956). The smallest fundamental biological discontinuities that are easily recognizable in a given habitat form the basis of plant and animal groupings into generic ‘kinds’. Cain (1958) argues that the ability to identify different generic categories without close study leads humans to consider such categories worthy of distinctive simple names. Berlin (1992) supports this claim in his review of dozens of ethnobotanical studies where, in nearly every case, generic names of taxa are the first terms informants provide.

Stross (1973), living among Tzeltal peoples in Mexico, conducted a study among twenty-five children from whom he asked the names of plants along the course of a trail. Whether or not they knew the specific or varietal name, the majority of children first responded by giving a plant generic name. The number of plants that a child could
specify below the generic level increased with age, suggesting that children learn generic names before learning specific and varietal names for plants.

Coley et al. (1997; see also Atran et al. 1997; Atran, 1998) provide further evidence that the folk generic rank is at the core of folkbiological taxonomies in an experiment to test which taxonomic rank best supports inductive inferences about biologically relevant information. Lowland Maya and Midwestern American subjects were provided with a premise statement about the biological properties of a group of living organisms and then asked whether “all”, “few”, or “no” members of a higher-level (conclusion) category also possessed that property. Each premise statement referred to one of four levels, either life-form (e.g., bird), generic-species (e.g., vulture), folk-specific (e.g., black vulture), or varietal (e.g., red-headed black vulture). The conclusion category was always drawn from a higher-level category. The results show a sharp decline in strength of inferences to taxa ranked higher than generic-species (e.g., generic-species to life-form, life-form to kingdom) whereas a relatively high and nearly identical percentage of participants from both cultures indicate that “all” generic-species (e.g., squirrels) would possess a property that a folk-specific counterpart (e.g., red squirrels) has. Atran (1998:10) argues that ecologically inexperienced Americans, despite their inability to tell the difference between beech trees and elm trees, “expect that biological action in the world is at the level of beeches and elms and not tree”. Thus, these subjects share a preference with Lowland Mayans for the generic-species rank when making biological inferences.
Atran (1998:11) raises the possibility that “humans are disposed to take tight clusters of covariant perceptual information as strong indicators of a rich underlying structure of biological information”. In earlier discussions, Hunn (1977) proposed treating generic taxa as inductively formed categories that exist as a result of observations of organisms whose perceptual pattern is induced; for example, a common pattern is induced from multiple observations of different raccoon individuals, which is uniquely labeled ‘raccoonness’. Atran (1985) explains that the experience of many instances may form a whole-image pattern that comes to represent the generic concept. Although a given pine tree may not have its cones, pines are still conceptualized as having cones “by nature”. This presumption that a unique underlying nature, or essence, links together the members of a biological species while distinguishing them from another species represents the concept of an essential kind. Evidence of a human predisposition to infer that something “inside” tigers causes them to become large, carnivorous, striped, and roaring animals under natural conditions lends support for the idea that the concept of generic species represents a basic level of reality that human cognitive architecture is configured to recognize in our environment.

The results of Coley et al. (1997; see also Atran et al., 1997) raised the question as to how Midwestern Americans come to prefer generic species for induction when they are highly incapable of identifying living things other than in reference to their life-form connotation. For instance, only the name “tree” was used to identify 75% of the species on a nature walk with American subjects. Though the distinctions between species of trees are not perceptually obvious to Midwestern Americans, the process of learning that
the trees in fact live, look, grow, and die differently leads subjects to conceptualize the
trees as belonging to different, nonoverlapping categories at the folk generic species
level. The difference between Midwestern Americans and Itzaj Mayans with respect to
their upbringings and experiences around the natural world have resulted in differences
between the taxonomic levels of reality at which each cultural group is comfortable
identifying living things. The finding that both groups preferred the generic species rank
for induction, Atran (1998) argues, is evidence of shared biological concepts that are at
the root of biological categorization and reasoning processes. Perceptions of the living
world may vary widely among people, but the folk generic species concept is stable
under different learning environments, which explains the existence of fundamental
categorization processes and universal biological taxonomy.

The *a priori* existence of folk generic species categories in the human mind is
evidence of domain specific cognitive mechanisms. Itzaj Mayans, whose lifestyles and
environments demand constant observation of the natural world, may induce concepts of
folk generic species from their ongoing interactions with living things and apply such
concepts in their dealings with new or unfamiliar instances of natural kinds. This could
conceivably be the case if category-formation was a function of a general cognitive
mechanism that operates by clustering stimuli without constraints. As Atran (1998)
explains, however, there is little evidence to suggest that Midwestern Americans
construct folk-generic categories in an unconstrained manner according to the stimuli
provided, but rather they assume that categories at this level of reality already exist.
Midwestern Americans, therefore, determined that labels of living things at the folk
generic level, though unfamiliar, were loci “of a ‘deep’ causal nexus of biological properties and relationships” (Atran 1998: 12).

Having the ability to recognize living things at the life-form rank (e.g., tree) and using the a priori taxonomic structure of folkbiological knowledge, Midwestern Americans could consider which types of properties would distinguish members of different categories from one another and then use such expectations to establish boundaries between them. Thus, Atran (1998) makes the distinction between, on one hand, domain-general perceptual heuristics, and on the other hand, conceptual assumptions of domain-specific learning mechanisms. Past cognitive studies asked people to perform similarity-based tasks to identify a “basic level” in artifact category hierarchies where people listed many common features and where the category name was the first one to come to mind in the presence of an object (Rosch et al., 1976). As Atran (1998) explains, domain-general mechanisms could generate such results in any number of cognitive domains, but evidence of a preferred level of induction is specific to the domain of folk biology.

**Naïve Biology**

Inagaki and Hatano (1996) draw the distinction between folkbiology, which is the investigation of biological understanding among people, mostly adults, living in small communities without modern science and technology, and naïve biology, which is understood through developmental studies with children in technologically advanced societies. The main difference between folkbiology and naïve biology is in the level of
experience with biological kinds that exists between children and adults. Naïve biology reflects concepts, categorizations, and judgments about living kinds that exist without a broad experiential database to draw from, and therefore makes strong suggestions about a priori, domain-specific modules of cognition. For instance, Inagaki and Hatano (1996) found that children under 6 years old grasp that growth patterns are common to plants and animals, but not to artifacts. Children 5 years of age are also more likely to extend given properties (e.g., growth) about a known animal or plant to other unknown living things when a context is provided (e.g., by taking in energy from food and water), but this inductive projection does not occur for nonliving things. Inagaki and Hatano (1996) interpret this to mean that children already possess a category of living things that holds animals and plants together according to a priori biological concepts. These interpretations reflect the ongoing concern within this program of research as to whether, and to what extent, perceptions of living kinds are guided conceptually (Hatano and Inagaki, 1999).

Gelman and Markman (1987) provide evidence that young children refer to expectations of category membership in order to infer the properties of living kinds even in the absence of labels for things and even when appearances of things are difficult to discern. Children, 3 and 4 years of age, were taught a fact about a target object and then asked whether this fact was true of other objects, which were either labeled differently or which differed in appearance, or both. Even when pictures of living things are shown without a label, children seem to try to figure out category membership. Participants were able to draw as many or more inferences to pictures of living things that were from the
same category as the target but with different appearances than to pictures that looked similar to the target but from a different category. The strong role of categories in guiding children’s expectations about which properties of living kinds are generalizable indicates that similarities in category formation are linked with a rudimentary understanding that “categories reflect more than a superficial set of features, and include deeper, nonobvious properties as well” (Gelman and Markman 1987:1540).

Theory-based knowledge appears to be very important in category structure and conceptual development (Carey, 1985; Murphy and Medin, 1985; Gelman et al., 1994). For instance, Gelman and Markman (1987) demonstrated that children, like adults, remain committed to the idea that an object is a member of its kind despite violations in perceptual cues due to the belief that “deeper”, more explanatory properties still hold despite changes in external appearance. As another example, Opfer and Seigler (2004) studied the broad categorical distinctions between animals and plants in a developmental context to understand why preschoolers fail to conclude that plants, like animals, are living kinds under certain circumstances (also see Stavy and Wax, 1989). They found that 5-year-old children, upon learning that certain plants engage in goal-directed movement, infer that novel plants also act teleologically, just as they presume animals to behave. In addition to changing their concepts of plants upon learning this information, preschoolers will reclassify plants to be more like living things and less like artifacts. Opfer and Seigler (2004) explain that this process of conceptual change in children regarding plants occurred as a result of their prior belief that goal-directed behavior in animals serves the function of maintaining life, which leads to the conclusion that goal-directed behavior in
plants signals their status as living things. Acquiring the knowledge that plants act teleologically had a stronger effect on this change in children’s inferences and classifications than did learning about other biological properties of plants. The capacity for goal-directed, autonomous movement, therefore, plays a central role in children’s construction of a biological concept of life. The authors of this study suggest that data limitations, rather than conceptual limitations, guide development of the living things concept in the folkbiological domain.

Hickling and Gelman (1995) conducted a study to look specifically at children’s beliefs about seeds and growth in the folkbotanical domain. Children between 4 and 5 years of age responded to questions about the origins of seeds, the mechanisms potentially responsible for seed-plant growth onset, the association between seeds and plants, and the plant growth cycle. The results suggest that an emerging concept of species occurs during the fifth year of life, since older 4-year-old children consistently judged seeds to originate from same-species plants whereas younger children judged that a type of seed could originate from different-species plants. Older 4-year-olds in the same study demonstrated a grasp of the cyclical nature of plant growth, which the authors find similar to children’s understanding of maturation in animals. Hickling and Gelman (1995:872) state that children between 4 and 5 years old realize that growth in living things “honors dramatic yet predictable patterns or sequences of change”.
Causal Understanding and Natural Kinds

Gelman and Hirschfeld (1999) refer to the study by Hickling and Gelman (1995) in arguing that the children’s responses reflect a commitment to a belief in the innate potential of living things. This is a belief in underlying causal relations whereby the effects of nature are stronger than those of the nurturing environment. Though no signs of certain biological characteristics of living things are present at birth, a set of such attributes is nevertheless expected to unfold with maturation. Just as Gelman and Wellman (1991) demonstrate that children expect a kangaroo raised by goats to be good at hopping and to have a pouch, Hickling and Gelman (1995) are said to have demonstrated that children expect a seed to develop in accordance with the parent species, and that such innate potential is expected to overcome a powerful environment.

From their studies with children between 3 and 8 years of age and with college students, Gottfried and Gelman (2005) conclude that children distinguish between animals and inanimate objects in terms of the causes of their behaviors. More specifically, by preschool years children have an abstract notion that animal processes, such as growth and movement, are caused by “something” that is inherent and non-obvious, and that the causal mechanism is independent of any physical, internal part of the organism. When asked whether a machine or an animal uses specific internal parts (i.e., brain, muscles), or “its own insides”, or “its own energy” to accomplish various tasks, all participants demonstrated a domain difference in endorsing internal causes more for animals than for machines. This domain difference increased as the level of abstraction increased from “insides” to “energy”. For each of the behavior prompts
(movement, sitting still, and growth/production), college students endorsed all internal causes significantly more for animals than machines. Whereas older children endorsed “insides” and “energy” significantly more for animals than machines, the younger children (4 years old) only showed a significant domain difference in endorsing “energy” more for animals than for machines. This endorsement of “energy” to explain animal movement is significant given that 4-year-old children are aware of specific internal parts that exist in animals. Early expectations that animal behavior will accord with category identity appears to exist in conjunction with a belief in some kind of an inherent mechanism that is necessary to cause the specific animal behavior. Gottfried and Gelman (2005) consider these to be core tenets of a folkbiological theory that are firmly in place by preschool years.

This question as to what causes an object to be what it is and to act as it does has led to numerous studies to determine which types of transformations to an object alter its identity. These studies are generally designed according to whichever of the three views of category formation—necessary and sufficient features, prototype/graded structure, or “theory theory”—is being tested. For instance, many experiments were designed to determine the specific features, or in some cases, the relative weights of different features, that are necessary and sufficient for people to define natural kinds and artifacts. Results indicate that category judgments of animals do not change when perceptual appearances are altered, or when transformations occur as a result of forces external to the organism, such as exposure to a chemical hazard (Keil, 1989; Rips, 1989). On the other hand, transformations to natural kinds that occur as a result of internal processes,
such as maturation or molecular changes, do matter for natural kind membership (Barton and Komatsu, 1989; Rips, 1989). Artifact cues lead to different results. Perceptual changes in artifacts affect the object’s function and therefore alter category membership; artifact categories are more likely to be defined in terms of extrinsic features than natural kinds (Barr and Caplan, 1987; Keil, 1989). Presumably, the defining features of natural, or living, kinds are internally based.

Ahn (1998:138) prefers a theory-based approach to explain this “category-feature interaction”, and she considers whether concepts and category membership reflect how people reason about the causal relations among richly structured features rather than a set of unrelated or independent features. Domain-specificity predicts that different theories underlie categorical judgments of different kinds of things, such as living things and artifacts. Certain features of living things are central to the theory underlying their category membership; different features are central to the theory underlying category membership of artifacts (Murphy and Medin, 1985). Since theories reflect expectations and assumptions about causal relations, Ahn (1998) looks at whether the causal status of a feature determines the feature’s centrality in categorical judgments of living things and artifacts. As an example, adult participants in one study were told that a disease occurs in people 75% of the time when symptoms A, B, and C are present, and that symptom A causes symptom B, which in turn causes symptom C. When given descriptions of different objects that each lacked a different one of these symptoms, participants estimated that the item missing the most fundamental cause was least likely to belong to
the target category. As the causal status hypothesis predicts, the feature with the highest causal status had the most influence on categorical judgments.

In a series of follow-up experiments with college undergraduate students, Ahn (1998) demonstrated this point using real-life objects and categories, and also by manipulating the causal relations among object features to see the effects on categorical judgments. She found a strong correlation between the importance of features in determining categorical judgments and the causal status of those features. As an example, the ‘genetic code’ (molecular feature) of a goat, a horse, and a tree received among the highest categorization ratings of all the features provided for the various items used in the experiment. This was determined by asking “Would a [goat] still be a [goat] if it were in all ways like a [goat] except that it did not have [a goat’s genetic code]?” Participants answered this question two additional times by substituting the molecular feature for a functional feature (e.g., gives milk) and a physical feature (e.g., has four legs). Molecular features had the strongest influence on categorical judgments for natural kinds.

Participants were also asked to tell how true or false they judged the statement “A because of B” where A and B was substituted with the molecular feature, functional feature, and physical feature to test ideas about the causal relations among them in different types of objects. For each of the living things (e.g., goat, horse, tree), the molecular feature also received the highest causal judgment ratings. Thus, participants deemed molecular features as being most fundamental in causing the other attributes of living things and also weighed molecular features most heavily in categorizing living
things. Ahn (1998) found this same correlation between causal status and feature centrality for functional, rather than molecular or physical, features in artifacts. A set of follow-up experiments presented participants with artificial stimuli that were manipulated so that the causal status of features in natural kinds and artifacts were the same. Indeed, the causal status of a feature, regardless of the feature type and object type, determines feature centrality in categorical judgments of artifacts and natural kinds.

The concept of a natural kind has not yet been defined in this discussion, but it requires attention because natural kinds include subjects of folkbiological thought that are not necessarily living things, but which are conceptualized similarly in terms of causal explanatory theories and essentialist beliefs. Gold and water are two of the most frequently cited examples of non-living natural kinds, which were used in Ahn (1998). Keil (1995) addresses the question as to what makes gold and water similar to goats and trees so that all are considered natural kinds. He states that natural kinds are meaningful classes of things because their properties are causally related, and therefore highly intercorrelated. The existence of a few important properties in natural kinds increases the likelihood of many others being present. For example, many of the gross anatomical features of giraffes are causally related to one another and to its various behaviors, such as long necks, the ability to eat vegetation that no other animal can reach, valves in the circulatory system, the ability to see predators in unique ways, and social habits. Over time, this pattern of homeostasis results in the clustering of properties into a stable kind. Boyd (1990) refers to this as property homeostasis.
Keil (1995) says that property homeostasis may be the theory-like structure in which natural kind concepts are embedded. A person’s experience with, or perception of, a few properties and the relations among these properties may suggest that a certain causal pattern is responsible for stability of that kind. In this case, the pattern might be used as the basis for abstract inferences about the general nature of that kind. The existence of “causal homeostatic property clusters” in the real world may explain why natural kinds allow learning and induction to succeed as well as they do (Keil, 1995:239). In contrast, a class of items that weigh 30 pounds would not be considered a natural kind grouping because no set of causal links cluster around having this specific weight. This grouping does not provide much real structure and information with which we can potentially make inferences and learn about its members.

As with Ahn (1998), Keil (1995) says that predisposed expectations of causal powers may be independent of local kinds and categories. This view reflects Ahn’s (1998) preference to explain the causal-status hypothesis in terms of a domain-general mechanism, which represents a higher-order regularity in early notions of all things. However, Keil (1995) remains committed to a domain-specific stance, in that the causal powers of types of properties vary as a function of the category, or mode of construal, which is invoked by the type of object being perceived. According to this latter view, people are predisposed to develop certain types of causal understanding. For living things, thinking about the purposes that properties serve, and the causal forces behind the emergence of these properties, converges back inside the organism itself. In the giraffe example, each property increases the odds of the organism’s survival, and the likelihood
of all other properties is increased through its survival. In contrast, for an artifact the causal forces responsible for its properties converge outside the object to the goals of an outside intentional agent. Thus, Keil (1995:250) asserts that the difference between early notions of the living and artificial worlds is in “how we view the patterns of causal convergence”. Property homeostasis and the internal convergence of causal patterning for living things give rise to intuitions of essences and/or vital forces.

**Essentialism**

Essentialism is a way of representing the world as though things possess an underlying nature that makes them what they are, and treats such things as though their properties result from this essence (Barrett, 2001; Medin, 1989). Opinions differ as to what minimally suffices as evidence for the existence of essentialist thoughts and representations. In their proposal of what they call psychological essentialism, Medin and Ortony (1989) describe their view that people act as if properties are the result of essences in the absence of explicit beliefs about what essences actually are. They introduce the notion of an “essence placeholder”. Since an essence has a central role in causing a thing to be one of its kind, kind-specific properties may be diagnostic of an essence, but such kind-specific properties are not necessary for the essence to exist. Barrett (2001) clarifies by suggesting the use of the term “essentialized” properties to denote those that are expected to result from an essence, but which may be absent from a group member that nevertheless retains its kind membership. He provides the example of a creature that has wings and is considered to be a bird, but which does not fly like all
other birds. Hence, Strevens’ (2000) minimalist claim that category membership alone is representative of essentialist assumptions. There is general agreement, however, that essentialism goes beyond correlated sets of features or lists of necessary and/or sufficient features to represent a kind concept, but rather “entails a distinct representational style, or format, that ties various essentialized features causally to a central representational node” (Barrett, 2001:4; emphasis his). This is referred to as executive causation.

Barrett (2001) examines evidence for the evolutionary origins and biological basis of essentialism from an evolutionary psychological perspective. He proceeds to address the implications of finding that the assumption of executive causation functions in a cognitive and behavioral sense to guide people towards making correct predictions and decisions about certain entities in the world. Thus, the assumptions of executive causation and rich inductive potential are the foci of an adaptationist approach to understanding the origins of essentialist thought as an evolved feature of human cognition. Evidence that essentialist representations are constrained to those kinds of things in the world for which such assumptions are an appropriate fit would support claims regarding the functional origins of essentialism. If essentialist thought tends to operate on a variety of categories of things in the world, then multiple kinds or modes of essentialism are expected to exist. A set of essentialist assumptions that produce valid inferences about an animal is unlikely to produce valid inferences for gold.

Atran (1998) argues that the ability to conceptualize and predict the properties that link together generic species and distinguish them from others would have been necessary for the survival of our ancestors. Distinctions made between biological taxa or
generic species tend to be based on the folkbiological notion that members of separate species have different essences. People conceive of something intrinsic and imperceptible that is responsible for the surface similarities among members of the same species. Keil and Richardson (1999) consider the possibility that the notion of an essence is most cognitively compelling in the domain of living things because their property clusters are assumed to be extremely stable as the result of a fixed physical causal source. Essentialism permits variation to exist among members of a species and even changes to occur within an individual member of the species without disrupting the archetypical concept of the generic species. Origins of living things in reproduction provide a powerful basis for assumptions of executive causation and rich inductive potential. A common preference among peoples to use the folk-generic level of reality to serve as a reference point for partitioning the biological world in a way that facilitates making predictions and learning about living things is thus considered a survival mechanism, and is consistent with the argument that essentialism of living kinds is an evolved cognitive representational system (Atran, 1985).

Living things satisfy the core essentialist assumptions of executive causation and rich inductive potential, as well as three other conditions that Barrett (2001) considers to be necessary in order for an essentialism particular to a specific kind of thing to have evolved. First, living things existed in human ancestral environments. Second, inferences and decisions about living things had fitness consequences. And third, the principle that makes inferences about living things valid (i.e., reproduction) is specific to their kind, and this principle could have selected for a specific essentialist architecture.
Adaptationist arguments seek to portray essentialist representations as ecologically rational, content-dependent, and domain-specific.

**ARTIFACT CONCEPTS**

**Design Stance**

Symptoms of an essentialist mode of construal specific to artifacts are also well documented. People’s sensitivity to information about the origins of an artifact when determining an artifact’s membership in a particular kind category resembles the general system employed in the biological domain. However, an artifact is a product of a human intentional agent and it is designed to have features that serve the particular goals of its creator. Mental representations of the kind status of artifacts reflect this difference between the intentional origins of artifacts and the reproductive origins of living things. Bloom (1996: 163) referred to this bias as the “intentional-historical” theory when he explained that, “the essences of artifacts are social and psychological”. This approach to artifact concepts is most commonly referred to as the “design stance” (Dennett, 1987). Different concepts of living things and artifacts also reflect the distinction between representing causal-explanatory relations that converge internally for living things and externally for artifacts. For example, Keil (1994) explains that children as young as 3 years old tend to view a living thing, such as a rose, as having self-serving properties (e.g., thorns) and judge that an artifact, such as barbed wire, has its properties (e.g., barbs) for the good of others.
Research conducted among adults in different cultural contexts provides empirical support for the design stance, and suggests that such a representational system may be a universal feature of human cognition. In the first cross-cultural study of the design stance hypothesis, Barrett and colleagues (2008) presented adult participants in the United Kingdom and adult members of indigenous Shuar society in Ecuador with vignettes describing the history of various artifacts, which explained the original intended function of each object and the circumstances leading up to the use of each item by a person other than the designer for a different purpose than for which it was intended. For instance, a string artifact created and used for the purposes of fishing by one person is found by a different person and used as a hammock. Members of each population were presented with two types of scenarios, a standard condition and a community condition. These scenarios differed in that the new use was either a matter of individual preference to the new user (standard condition) or a matter of cultural consensus in the community of the new user (community condition). For each scenario, participants were forced to choose whether they preferred to label, or categorize, the target object based on the original intended function or the new, alternative use. Across both conditions, the two populations showed a significant preference for the category identified as that of the original intended use. And, despite the reduction in the percentage of participants who chose the original artifact category under the community condition, the community norms scenario did not have a significant effect on responses in either population. The results indicate that the Shuar share a pattern of artifact categorization with Western subjects, a
pattern that was previously found to support the design stance when tested on Western
participants alone (Matan and Carey, 2001).

While Matan and Carey (2001:2) support the notion that an essentialist mode of
construal is a likely component of our system for representing artifacts, Barrett (2001)
does not agree to such an extent that artifacts would be a part of the proper domain of
essentialism from an evolutionary-adaptationist standpoint. Though knowledge of an
artifact’s origins in the intention of its designer may allow one to potentially induce many
properties of an artifact, Barrett (2001) considers it unlikely that the inductive benefits of
assuming an artifact essence are very strong. Keil (1995:248) would agree with Barrett
(2001), yet asserts that, “perceiving some things in functional terms, and looking at their
properties as if they have purposes, is a powerful way of organizing them and
understanding their properties”. Barrett (2001) explains that artifacts are, therefore,
expected to be categorized according to origin, but not necessarily essentialized.
Categorization of artifacts by origin is, however, consistent with the assumption of
executive causation given that an artifact’s features are causally tied to a central node,
that being the manufacturer’s intended use of the item.

German and colleagues (2007) address the possibility that our system for
representing artificial kinds may be sensitive to different types of information when, on
one hand, determining artifact function and, on the other hand, categorizing or
symbolizing artifacts. German and colleagues (2007) also indicate that the minimal
effect of information about community norms on decisions about artifact categories in
adults reflects a specific stage of conceptual development, and that children are more
sensitive to such conventions. Using similar methods as those employed by Barrett and colleagues (2008), they demonstrate that adults, under standard and community conditions, tend to assign both function and category labels to artifacts based on the function assigned by the maker. Children, on the other hand, show mixed results in assigning function under standard and community conditions, but their judgments of category tend to be based on the original intended function when the current function varies from that intended by the maker. The results signal that information about design is critical for categorization, and the authors argue that to intentionally refer to an artifact category using a different label is a more serious violation to the conceptual system than it is to intentionally use an object to achieve a goal other than that which it was designed to perform.

**Functional Fixedness**

The results of these verbal tasks are consistent with findings from problem solving tasks in cross-cultural settings, and highlight the phenomenon known as functional fixedness. Functional fixedness occurs when the priming of a typical use for an object makes it more difficult to envision an alternative use of the object to solve a task-related problem. German and Defeyter (2000) demonstrated that five-year-old children showed no evidence of functional fixedness, whereas older children and adults were slower in reaching a solution that involved using an object for a different purpose than was originally demonstrated. This finding is consistent with the idea that younger children are less likely than adults to assign function to an artifact strictly based on that
which the original design suggests. German and Barrett (2005) found that for Shuar adolescents whose cultural environment fosters the use of objects for multiple purposes, functional fixedness nevertheless occurs during problem-solving tasks under experimental conditions.

From an evolutionary perspective, the challenge is to address what may appear to be cognitive biases that are suboptimal for flexible problem solving. This requires a consideration of what the conditions and selection pressures would have been like for these conceptual systems in the artificial domain to have originally evolved (Barrett et al., 2008). With regards to functional fixedness, German and colleagues (2007:75) propose that such a tendency promotes “rapid deployment of mechanical knowledge in cases where artifacts are used for typical purposes”. Presumably, while ingenuity and creative uses for artifacts would have provided benefits to a new user, such idiosyncrasy may have posed, on average, many more risks. Though speculative, employing objects for the purposes they were originally intended would have likely averted most instances that posed a potential threat to the survival of human ancestors. Sperber (2007) simply points out that the need to perform very similar tasks again and again leads people in traditional social and ecological settings to take advantage of a type of artifact already devised and produced to perform that function. German and colleagues (2007) also note that children, from the end of the first year, begin to imitate the everyday uses of objects, and that attending to the current uses for objects is their best means for learning their functions, particularly since they have limited access to historical information about design and possibly few observations of artifacts actually being made. And finally, Barrett and
colleagues (2008:18) point out that while the design stance among adults was “unlikely to have developed under pressure to identify definitive categories”, some of the more probable adaptive functions would include organizing manmade items for a given purpose, forming inductive inferences about their functionality, their mechanical organization, and/or their social significance.

**Biological Artifacts**

Though the reproduction of artifacts occurs through different processes than the reproduction of whole organisms, Dawkins (1982) and others have pointed out that artifacts are biological in origin to the extent that they are products of the evolutionary process referred to as the “extended phenotype” of our species. In comparison, beaver dams are parts of the extended phenotypes of beavers, as spider webs and bee hives are for their respective organisms (Barrett, 2001). Sperber (2007) explores this notion of the extended phenotype in his discussion of biological artifacts, such as domesticated plants and animals, which simultaneously have biological, cultural, and artifactual functions. Plants and animals that are used by humans are atypical artifacts, yet their use for a variety of purposes and the human workmanship and modification that is invested in them make them artifacts by any reasonable definition. Sperber (2007) begins to address the problem that arises when we resort to the question, ‘What is its function?’ as a point of distinction to separate our prototypical notions of an artifact from our concept of the biological world. Biological artifacts are those that exploit the biological properties of a biological item, and in doing so, also achieves a person’s intended effect, or in other
words, performs an artifactual function. As an example, leeches that are used for the medicinal purpose of letting blood are performing a biological function that (in nature) contributes to its own survival and reproduction, and meanwhile serves the intended function of its user. Leeches, in this context, are biological artifacts that serve a cultural teleofunction in the sense that their use is passed on from one user to the next as a result of achieving an intended effect.

As Sperber (2007) explains, leeches are not typical biological artifacts in the same way that cultivated cereal seeds are. The cultivation and domestication of plant grains represented the use of a biological artifact to promote the main standard biological function of seeds, which is to disperse and reproduce the plant. While humans exploit a biological property to produce an intended effect (food production) through the process of cultivation, the plants take biological advantage of their cultural function and benefit as an effect of human thought and action. Human adaptation to cereal biology occurs alongside the plant’s adaptation to human culture. It is not clear, however, to what extent biological artifacts have been intentionally made. The question remains whether mental representations of biological artifacts differ from those of prototypical artifacts to reflect this difference. Sperber (2007:136) wonders if the result of the biotechnological revolution, with direct manipulation of genes, will “render biological functions of biological artifacts less relevant to their cultural becoming”. Earlier, Keil (1995:249) raised the question: how are people handling the increasingly blurred lines between living things and artifacts “as domestication of plants and animals becomes ever more sophisticated through genetic engineering”?
Sperber (2007) doubts that the usual prototypes (e.g., bracelets, jars, hammers) can continue to serve as the basis for developing a theoretically useful notion of artifacts. He suggests that researchers engage more with psychological concepts of biological artifacts in order to arrive at a more complete explanation of the complexity of artifacts, given that so many of them are not clearly intended for a purpose nor thoroughly designed by humans. Artifacts of biological origin that show clear signs of intentional design, such as genetically engineered plants and animals, may offer new insights as to which features of human cognition are more or less plastic with regards to concepts of nature and culture. Our understanding of mental representations across these domains raises questions about the interplay of cultural and biological evolutionary processes that have shaped human cognition and material culture since the Paleolithic era, a time when people only had simple inert tools as artifacts (Sperber, 2007).

**THE FOOD DOMAIN**

The intentional modification and manipulation of inanimate objects and living things appear to have very deep roots in human evolutionary history. The earliest identifiable flaked stone tools appear in the archaeological record about 2.5 million years ago (mya) (Schick and Toth, 1993). By 1.8 mya there is evidence that early hominids at Olduvai Gorge in East Africa were using tools for the purposes of defleshing the carcasses of large animals (Bunn and Kroll, 1986). Stone tools have been found in association with baked earth and with burned fossil bones at sites that date to 1.6 mya at Koobi Fora in East Africa and at Swartkans Cave in South Africa (Boyd and Silk, 2006).
The earliest archaeological site offering evidence of the control of fire, dating back 790,000 years ago, comes from Gesher Benot Ya’aqov in Israel, where olives, barley, and grapes were among the plant species found burned (Goren-Inbar et al., 2004). Meat eating and cooking are two behavioral traits that appear to be coincident with two of the most recent speciation events that led to the emergence of modern humans, according to evidence from fossil skeletons (Aiello and Wheeler, 1995; Wrangham and Conklin-Brittain, 2003; Wrangham, 2009). These derived behavioral traits increased diet breadth and altered the anatomy and social relations of *Homo erectus* and *Homo sapiens sapiens*. Whether humans evolved concrete cognitive adaptations that were designed specifically in response to the selection pressures associated with these dietary transitions and that are expressed in a manner specific to the domain of food in contemporary contexts remains a significant and challenging research problem.

**Nonhuman Primates**

In searching for clues as to how these dietary transitions affected perceptions, concepts, categorization, and decision-making mechanisms in the food domain of ancestral human populations, evidence can be drawn from studies of apes and monkeys, our closest living relatives. The evidence suggests that nonhuman primate food discrimination, evaluating food edibility and the different qualities of foods, operates at the sensory level in terms of food perception, but also that these sensory cues may support abstract mental representations and concepts of food in higher apes. Through the process of association, mature primates learn and memorize cues that mean “inedible”,

such as the visual recognition of insect damage that produces dead vegetal tissue (Dominy et al., 2001). Rapaport and Brown (2008) have reviewed the strong role of social influences on young nonhuman primates when learning what, where, and how to eat. They note that food transfer, synchronization of feeding, and imitation are components of socially mediated feeding strategies that are crucial for young nonhuman primates, particularly apes, when learning about novel and difficult-to-acquire and difficult-to-process foods, such as hard-shelled fruits, fruits attached to thorny branches, and in chimpanzees, meat. Memorization, imitation, and socially mediated learning allow apes to pursue complex foraging and generalist feeding strategies that pose many potential threats, such as exposure to toxins and nutrient deficiencies. However, further evidence of abstract cognitive features in apes and monkeys is being pursued in order to suggest that clues about the selection pressures and evolutionary origins of categorical thinking, causal understanding, and conceptual judgments specific to the domains of living things, artifacts and food in pre-modern humans can be found in studying nonhuman primates.

For instance, Santos and colleagues (2001) attempted an experiment to examine how free-ranging rhesus macaques categorize novel food objects in the absence of training. The results suggest that the monkeys selectively attend to the color, rather than the shape, of a known food item and then generalize that color to novel objects in classifying and recognizing them as potential foods. In their discussion, these authors note that these monkeys use distinct vocalizations to communicate the presence of high quality versus low quality food objects (Hauser and Marler, 1993). This would indicate
that the category “food” is a superordinate category rather than a basic level category, and that the monkeys find a lower level of abstraction most useful when categorizing foods (Santos et al., 2001).

Bovet and Vauclair (1998) claim that it is not surprising to find categorical abilities in various animals, particularly the grouping of objects in food and nonfood categories, because of the obvious ecological significance of this adaptation. Their experiment demonstrated that baboons functionally categorize food and nonfood items, and that baboons can generalize this ability to novel objects. Furthermore, the baboons demonstrated some ability to establish correspondence between photographs and the actual objects they represent, and thus categorized actual objects and their representations in a similar way. A relevant component of this experiment was the use of natural and manmade cues that the baboons, when appropriate, classified together as nonfood objects.

Thompson and Oden (2000) discuss additional examples of experiments that demonstrate nonhuman primate abilities to discriminate both natural and artificial categories based on functional resemblance rather than physical resemblance. Savage-Rumbaugh and colleagues (1980) demonstrate that chimpanzees who acquire a concept of “food” and “tool” that is functionally based and symbolically encoded produce much different results in categorization tasks when compared to a chimpanzee that only learns the arbitrary symbols (lexigrams) for these objects. Thompson and Oden (2000) explain that evidence of chimpanzees matching an apple with a banana and a water glass with a pottery bowl indicate that judgments are based on functional resemblance (abstract
functional relations) or are the result of forming associations, for instance an association with a physiological response to the food items.

Support for the notion that chimpanzees, and certain apes, represent items in a more abstract conceptual manner comes from evidence of their capacity for analogical reasoning. Such evidence comes in the form of matching half an apple to half a glass of water and a whole apple to a full glass of water. This demonstrates the ability to establish a relationship between two elements and then to seek that same relationship between two different elements. This abstract relational concept is considered to be totally ‘portable’ and is arguably the basis for making logical inferences. Thompson and Oden (2000) argue that evidence of analogical reasoning in certain apes is related to adaptations to selection pressures in the social domain, including the ability to map abstract mental states from one mind to another, and to perceive the relations-between-relations within a social group. Thompson and Oden (2000) conclude by noting that a fundamental criterion for analogical thinking is concilience, which is a philosophical concept to denote the spontaneous transfer of knowledge from one domain to another. Apes, unlike monkeys, demonstrate evidence of this conceptual ability.

Living apes have been used as models to help infer ancestral hominid psychology and behavior, and they serve as a point of comparison and contrast with modern human capacities. This is especially the case in trying to resolve debates over the relative influence of selection pressures in the social/psychological and physical domains with regards to the evolution of human intelligence. To determine chimpanzee intelligence in the physical domain investigators make observations of their uses of tools and conduct
experiments to test the extent to which they possess causal understanding of the properties and behaviors of inanimate objects. Chimpanzee tool use includes employing stones as hammers and anvils for nut-cracking activities, and the use of sticks to collect insects (Keller, 2004). Visalberghi and Tomasello (1998:195) report that nonhuman primates’ skillful use of tools is achieved by learning “to associate an antecedent event with a consequent event, instead of having a causal understanding of the sequence of events”. Meanwhile, the authors agree with the claim made by other investigators that there is no evidence that nonhuman primates are better at causal reasoning in the social than in the physical domains. According to these authors, nonhuman primates lack causal reasoning skills when it comes to reading the intentional behavior of other beings in terms of an integrated process comprised of goals, behavioral means, and perceptual monitoring. As with Thompson and Oden (2000), however, Visalberghi and Tomasello (1998) argue for the primacy of the social domain in the evolution of human cognition. The latter authors also agree with Keller (2004) in that the capacity of nonhuman primates to form schematic representations to govern tool use and other food modification procedures is a more reasonable explanation for these behaviors than is the capacity for conceptual or cultural principles.

The nonhuman primate research is lacking in tests to demonstrate whether monkeys and apes categorize difficult-to-process foods according to their status in terms of being processed (edible) versus not processed. There is also a lack of experimental evidence to indicate whether nonhuman primates categorize environmental cues in an abstract manner such that difficult-to-process foods are distinct from those that do not
require processing. In developing his fruit-habitat hypothesis of ape cognition, Potts
(2004) attempts to link environmental selection pressures, such as shifts in the intensity
and timing of seasonal variation, food source uncertainty, and greater reliance on fallback
foods with derived cognitive adaptations of late hominids and modern humans, such as
mental representations that ascribe attributes to physical entities (i.e., phonological
qualities of trees). Further efforts to understand the nature of nonhuman primate
cognition in the domain of food and food procurement may reveal a component of causal
reasoning and intentionality that is missing from studies that consider the psychological
and the physical domains separately.

The lack of such considerations in nonhuman primate research is likely due to
there being evidence that sensory cues primarily guide monkeys and apes toward
achieving their nutritional needs and avoiding the ingestion of harmful substances in
familiar environments, much more so than is the case for humans. Within a single
species of nonhuman primate there are much fewer differences in food preferences and
procurement strategies than there are among individual humans and among different
cultural groups, with the exception of chimpanzee groups that differ in their use of certain
tools (Matzuzawa and Yamakoshi, 1996).

Human Food Acceptance and Rejection

Human food selection at an individual level in terms of variable dietary needs,
preferences, and disgusts is a very widely studied phenomenon, as are the cultural
traditions and meanings of foods in terms of culinary and technological practices, taboos,
and rituals. As omnivores, humans face the dilemma of needing to ingest a wide range of foods while facing the risk of ingesting toxic foods or imbalanced diets (Rozin, 1976). Rozin (1990) explains that, among the wide range of objects in the environment, many if not most are nonnutritive, toxic, and/or nutritive but lacking in essential nutrients, and there is no way of predicting the exact nature of these threats based on external sensory information alone. Human evolutionary theory, however, does correctly predict certain learning strategies, attitudes and selection behaviors in the domain of food and may help to explain the evidence for universal features of human food cognition (Cashdan, 1994; Galef, 1996; Rozin, 1990).

For instance, human hedonic responses to gustatory stimulation by sugars, fat, and salt and our various motivations to seek out certain flavors that are associated with these substances was of adaptive value in an ancestral environment where these nutritional elements were hard to come by (Williams and Nesse, 1991). Investigators have borrowed methods for analyzing patterns of human food choice from behavioral ecology to successfully predict which food sources traditional foraging peoples will pursue based on the probability of encounter, the acquisition costs, and net energy gains (Winterhalder and Smith, 1981). And finally, the disgust emotion that is elicited in response to certain universal environmental cues, even as a result of mental representations and thoughts of such cues apart from their physical presence, indicates to evolutionary psychologists that this emotion and abstract cognitive effect is an innate quality with an evolved adaptive function (Curtis and Biran, 2001). This latter trait is a component of a cognitive and
emotional mechanism that Rozin and Fallon (1980) believe enables humans to assign objects into food and non-food categories.

Research into the classification of edibles and inedibles among adults in the United States led Rozin and Fallon (1980) to conclude that there are three basic reasons for accepting or rejecting potential foods: sensory-affective factors, anticipated consequences, and ideational factors. With respect to the first reason, many foods are accepted or rejected in response to liking or disliking their sensory aspects: taste, smell, texture, or appearance. The second reason, anticipated consequences, refers to people’s beliefs about the negative or positive consequences of ingestion, which may be immediate, as in the satiation of hunger, or delayed, as in a conditioned aversion or a positive belief that an item is “good for you”. The third reason, ideational factors, refers to people’s responses to knowing where an item comes from (origins), what it is, and its symbolic meaning. This knowledge plays a stronger role in rejecting food than in accepting it. According to Rozin and Fallon (1980), items that are rejected on ideational grounds can be categorized as either inappropriate or disgusting. Inappropriate substances do not elicit an offensive response, but they are just not considered to be food, which accounts for most items in the world: sand, grass, and paper. Disgusting items, on the other hand, are considered offensive, are likely to elicit nausea, and are contaminants in the sense that contact of a disgusting item with a food substance is perceived to render it inedible. Knowledge of origins is a strong component of the disgust factor, and almost all disgusting items are animal or animal products, with feces as the apparent universal disgusting substance (Angyal, 1941; Rozin and Fallon, 1987).
The rejection of a good food item that has been contaminated through contact with a disgusting entity illustrates a more general principle, known as the sympathetic magical law of contagion (Frazer, 1890/1959; Mauss, 1902/1972; Rozin and Nemeroff, 1990; Tyler 1871/1974). This law was proposed to explain the fundamental belief observed in traditional cultures that, “when two things make contact, their properties are exchanged and they may be permanently affected” (Rozin, 1990:560). Rozin and colleagues (1986) demonstrate that contagion operates in the beliefs and attitudes of educated American adults who reject food substances that come in contact with items that are considered to be disgusting despite knowing that the perceived contaminant is either sterilized or safe to ingest. Rozin and Nemeroff (1990) invoke essentialist thought in explaining these observations, and they argue that contagion is dose insensitive because a complete essence transfer is perceived to occur as a result of only brief or minimal contact between two objects. Brief contact of a sterilized cockroach to a glass of juice may impart “cockroachness” to a beverage just as a small amount of sugar added to food imparts “sugarness” to the substance (Rozin et al., 1996).

Curtis and Biran (2001) develop the ideas proposed by Nesse and Williams (1995) and Pinker (1997) in support of the argument that disgust is an adaptation crafted by natural selection to distance people from contagion, particularly the threat of disease. This argument is supported by evidence that bodily secretions are among the items that universally elicit the disgust response, and these substances are common vectors of infectious disease. Our ancestors who were motivated to avoid these substances and also certain living creatures, such as worms, would have had a selective advantage.
and Fallon (1987), on the other hand, rejected the hypothesis that disease prevention was the prime target of selection, and instead argued more specifically that the disgust response may have been a mechanism to avoid spoiled food.

In a comparative review of food taboos across 78 cultures, Fessler and Navarrete (2003) found that meat is a principal target of proscriptions. They consider this finding to be consistent with the argument that heightened sensitivity to the risk of pathogen transmission had selective advantages that resulted in a stronger disgust response and aversion to animal products than to plant products and other food substances. While developing their argument, Fessler and Navarrete (2003) refute symbolic explanations of animal taboos, such as Leach’s (1964), Douglass’ (1966), and more recently, Sperber’s (1996) arguments regarding the psychological and cultural treatment of animals that are categorically ambiguous, peripheral, and anomalous.

There are many unique threats that ingestion of animal food products pose, including the fact that harmful organisms can easily spread from one animal meat product to another. There also may be few detectable signals of toxicity in meat compared to plants, and cooking meat only eliminates the risk of pathogen transmission if it cooked thoroughly and if hands and implements are disinfected prior to consumption (Fessler and Navarrete, 2003). These findings are consistent with Rozin and Fallon’s (1987) initial claim that almost all disgusting items are animals or animal products. Sherman and Hash (2001) believe that meat is a stronger medium for growth of harmful microorganisms than are cooked and leftover vegetables, which would explain why traditional meat-based recipes call for more seasoning with spices than vegetable-based recipes. Their work
supports the adaptationist argument that one of the most important beneficial uses of spices is the reduction of food-born illnesses (Sherman and Billing, 1999). Sherman and Hash (2001) view the cultural transmission of this adaptive use of spices as part of the ongoing coevolutionary race against food-born microorganisms, which they infer began when human ancestors began scavenging or hunting large carcasses that could not be entirely consumed at one time. Fessler and Navarrete (2003) point out that nonhuman primates that engage in hunting (e.g., chimpanzees, white-faced capuchins, baboons) do not scavenge meat from the carcasses of dead animals, indicating a strategy to avoid an otherwise desirable food substance by representing meat in this context as inedible (Stanford, 1999).

**Categorization and Food Choices**

Research on human food decision-making has helped to specify the different aspects and properties of foods that people take into account when choosing among foods to eat, and has facilitated debate regarding the decision-making processes that might operate to guide individual food choice behaviors. Evidence of people’s tendency to dichotomize food as either “good” or “bad” indicates categorical thinking, which Rozin and colleagues (1996) describe as a monotonic bias. They explain that a monotonic approach wherein the food world is divided into healthy/safe and unhealthy/unsafe categories is an effective heuristic. Heuristics have been described as empirical rules of thumb that work reasonably well (“good enough”) and are “fast and frugal” given the
assumption that decision makers have limited time and computational resources (Gigerenzer and Goldstein, 1996; Roering et al., 1986).

Scheibehenne and colleagues (2007) tested the idea that food choices are based on simple heuristics by asking adult participants in Germany to perform two tasks. First, from a sample of 20 different lunch dishes participants were asked to repeatedly choose between pairs of options, and second, participants rated the same 20 different lunch dishes on nine different factors: convenience, ethical concerns, familiarity, health, mood, natural content, price, and weight control. The experiment demonstrated that predictions of food choice based on each participant’s most important factors are as accurate as predictions that take all of the factors into account using a more complex weighted additive model. The authors claim that a surprisingly small amount of information and very simple rules of thumb explain and predict everyday food choices, which tend to reflect the option that fulfills a person’s most important need at a particular moment. The results are not interpreted to mean that a given person’s choices can always be predicted on the same attribute since the importance of different factors is highly context dependent.

Blake and colleagues (2007) demonstrated this latter point by asking adults in the United States to sort 59 cards labeled with food names into categories of their choosing four different times to represent four different eating contexts, including an open context (undefined), a family/friends context (non-work), a work eating context, and an eating alone context. The findings demonstrate that the same food is classified into different categories with different labels and meanings depending on the context. Referring to the
types of categories that resulted from the card sorting tasks, the authors derived three
general groups according to their classification bases - personal experience (e.g., well-
being), context (e.g., meal/time), or the food (e.g., physical characteristics). For all of the
card sort contexts, the personal-experience-based and the context-based category types
were used more frequently than the food-based types.

Nevertheless, the study by Blake and colleagues (2007) and Scheibehenne and
colleagues (2007) indicate that properties and characteristics specific to a food item play
an important role in people’s attitudes and eating behaviors. The nine factors that
participants rated in the study by Scheibehenne and colleagues (2007) were borrowed
from an instrument that is commonly used to identify the types of information that guide
food selection and eating behaviors, known as the food choice questionnaire (FCQ),
which includes 36 survey items (Steptoe et al., 1995). Pilot studies conducted during the
development of the FCQ recorded people’s responses to 68 survey items that were
chosen based on existing literature and advice from nutritionists and health psychologists.
The 36 survey items included on the final version were tested on multiple samples with
358 adult participants in London to measure its reliability and internal consistency.
These survey items are representative of the food quality and attribute factors that best
predict food choice.

In another multiple part project with over 300 adult participants in the United
States, Aikmen and colleagues (2006) sought to identify the factors and information that
influence food attitudes. Various factors are found on both study instruments composed
by Steptoe and colleagues (1995) and Aikmen and colleagues (2006), which is predicted
by multiple studies that demonstrate relationships between food attitudes and dietary intake (Mooney and Walbourn, 2001; Pollard et al., 1998; Scheibehenne et al., 2007).

Among the factors shared between the two instruments, natural content of food is one that stands out as being an abstract cognitive quality (Aikmen et al., 2006). Natural content on these instruments reflects attitudes toward the use of additives and the selection of ingredients that are considered to be natural. The re-test reliability and internal consistency was highest for natural content ratings compared to the other factors in the original FCQ (Steptoe et al., 1995) and in the modified German version used by Scheibehenne et al. (2007). Natural content showed significant positive intercorrelations with health, mood, sensory appeal, weight control, and ethical concern, and for both sexes, there is a significant positive correlation between age and natural content (Steptoe et al., 1995; also see Rozin et al., 2004). Steptoe and colleagues (1995:281) note that health ratings and natural content ratings showed certain deviations, and therefore, the “general health-promoting aspects of nutrition are perceived as distinct from concerns related to toxins and the ingestion of unnatural ‘non-foods’ added for cosmetic reasons”. They suggest that further research be conducted to determine whether people in other cultures with less cynicism towards the food industry have such a positive view of natural ingredients and the absence of additives.
PERCEPTIONS OF NATURAL IN THE FOOD DOMAIN

The Preference for Natural

The number of consumer products that are labeled “natural” has increased rapidly in recent years. Though an “all-natural” label on food is not the same as an “organic” label, growth in the total sales of organic food from $23 billion in 2002 to $53 billion in 2008 is representative of increased consumer demand for food that is perceived to be healthier, better tasting, and higher quality (Daunfeldt and Rudholm, 2010). The United States Department of Agriculture (USDA) has recently begun to investigate the food industry to determine whether foods labeled “natural” meet criteria outlined by the agency, though the agency’s definition does not exclude such foods as animal products raised with the use of artificial hormones or genetically modified organisms (www.fsis.usda.gov). In the meantime, the Food and Drug Administration (FDA), which regulates food products, does not have a definition for the term and, therefore, cannot technically forbid the “natural” label from being used on most types of products. For instance, pressure from a public health watchdog group, rather than from the FDA, is responsible for the recent decision by Ben and Jerry’s Ice Cream to phase out its “All-Natural” claims on products that contain processed or artificial ingredients (Black, 2010). Though the opinions of the general public are important considerations for agricultural policy, consumer protections, marketing, and for our general understanding of human food psychology, only a small number of studies have addressed attitudes towards and preferences for natural food among consumers (Rozin, 2005, 2006; Rozin et al., 2004).
A growing body of research into the preference for natural food exists alongside studies documenting a “natural preference” in various other domains, such as inanimate materials (i.e., wood) and landscapes (Kellert and Wilson, 1993). Experiments that seek to measure perceptions of naturalness across domains tend to be carried out using so-called pencil and paper techniques, such as questionnaires, which can involve a number of different scales or tasks. Overvliet and colleagues (2008) indicate that various methods to document naturalness measurements are highly correlated. Their comparison of methods included a Spanish-translated version of a labeled category scaling used by Rozin (2005). Documentation of the preference for natural food by Spranca (1992) and by Rozin and colleagues (Rozin, 2005; Rozin et al., 2004) has been followed up by various other studies to specify the factors and psychological mechanisms that might explain naturalness judgments and the acceptance or rejection of certain food products and technologies. Some of these studies have considered the role of risk perceptions (Seigrist, 2008; Siegrist et al., 2006), additivity dominance and perceptions of contagion (Rozin et al., 2009), and the effects of labeling on information processing (Tenbult et al., 2007). Numerous studies that document overwhelming rejections of genetically modified food oftentimes are not specifically designed to address the natural preference, however, these studies are valuable in identifying evidence of shared perceptions of food, and shared perceptions of the relationships between food and people, and food and the natural world.

When provided with definitions for foods that are “natural” and “commercial”, people in the United States indicate a preference to choose the natural form when other
factors, including cost of the different forms, are stipulated as being the same (Rozin et al., 2004). In a pair of studies conducted by Rozin and colleagues (2004), a “natural” food item was defined as “one that had not been changed in any significant way by contact with humans. It could have been picked or transported, but it was chemically identical to the same item in its natural place”. A “commercial” food item was defined as “one that had been grown with fertilizers or pesticides and that might contain additives or preservatives to enhance its taste”. Overall, study participants indicated whether they prefer the natural or commercial versions of 19 different substances organized into four groups: raw foods (e.g., peaches, lettuce), processed foods (e.g., peanut butter, cereal), food/medicine (e.g., vitamins), and medicine (e.g., antibiotic). Participants could also indicate indifference for either the natural or commercial form. Study participants were also asked to indicate which form (natural or commercial) they thought was healthier (foods) or more effective (medicine). Rozin and colleagues (2004) found that a preference for natural is stronger for foods than for medicines. Raw foods are preferred in their natural state more often than processed foods even though there is only a minimal difference in healthiness ratings between these two categories.

Rozin and colleagues (2004) explain that a combination of four instrumental and two ideational beliefs may account for the preference for natural in the domain of food. The category of instrumental beliefs includes the reasoning that human intervention always or almost always causes damage to nature, that natural entities are healthier, that the sensory properties of natural entities are superior, and that natural entities are safer as a result of their purity. The ideational bases for the natural preference include the belief
that the normative order of things is best, where natural represents a certain state prior to human intervention, or the belief that natural is inherently better, whether or not it is prior.

Across the 19 substances used in the study, there was a 0.86 Pearson correlation between the rated health/effectiveness of items and the natural preference for them. Thus, certain instrumental concerns, such as perceived healthiness/effectiveness, appear to be a determinant of natural preference. However, in the second part of their study with college undergraduates in the U.S. and adults from the Philadelphia County Jury Pool, Rozin and colleagues (2004) demonstrate that the natural preference across product categories (raw foods, processed foods, medicines) is supported by ideational factors. For this study, participants were asked whether they prefer the natural or commercial form of a product (e.g., apple), or are indifferent, when various attributes (e.g., healthiness/effectiveness, taste) of the two forms are stipulated as being the same, and where the final condition stipulates that both forms are chemically identical (e.g., “taste the same and have the same health value”). Evidence of a continued preference for natural even when chemical identity is stipulated is interpreted to mean that the natural preference is mostly motivated by moral or ideational/aesthetic reasons.

**The Meaning of Natural**

In what he calls “a first attempt to define what Americans mean by ‘natural”, Rozin (2005:652) asked college undergraduates and a jury group in the U.S. to provide naturalness ratings of a variety of entities (i.e., water, peanuts, oranges, milk, steak)
before and after they underwent different types of transformations. Comparisons between these before and after ratings support four hypotheses. First, the results support the hypothesis that small amounts of an “additive” with some negative or nonnatural characteristic will have large effects on naturalness. For instance, the addition of 0.001% purified minerals to water reduced naturalness 50.7%, and the addition of a single gene to an animal from a different species reduced naturalness by an average of 54.1%. Rozin (2005) argues that this is evidence of the strong role of contagion, and the related principle of dose insensitivity, in naturalness judgments. Second, the results support the hypothesis that chemical transformations (i.e., pasteurization, boiling, gene transfers) cause greater reductions in naturalness than physical transformations (i.e., freezing and thawing, grinding, juicing). Third, the results support the hypothesis that a transformative process is more potent than a change in content in reducing naturalness of a food item. For instance, content change is less for genetic engineering (a single gene transfer) compared to domestication (multiple genes and changes in appearance and behavior), yet the reduction in perceived naturalness caused by genetic engineering is much greater. Furthermore, Rozin (2005) found that the lowest naturalness rating for a genetically engineered item (a pig with a cow gene) was not very different from the one receiving the highest rating (corn with a different plant gene). These results lead Rozin (2005) to suggest that opposition to genetic engineering is ideational, and that the level at which humans intervene is critical to naturalness judgments. Fourth, the results support the hypothesis that mixing similar natural entities has a minimal effect on naturalness (i.e.,
peanuts from different sources), in contrast to adding trace amounts of an unlike natural entity to a substance (i.e., calcium to orange juice).

In two follow-up studies, Rozin (2006) and colleagues (Rozin et al., 2009) conducted further tests of two hypotheses pertaining to the concept of natural food. The first hypothesis is that process is more important than content. Rozin (2006) explains that naturalness judgments of a food product based on the processes it has undergone reflect people’s beliefs and attitudes regarding the history of the object. For this study, nearly 200 Americans read the descriptions of three variants of either water or tomato paste and were asked to choose the two variants from the triad that were most similar. Respondents also rated the acceptability and naturalness of all three variants. There were two triads in each questionnaire. The first included (1) a pure substance, (2) the same substance with a small amount of additive, and (3) the same substance following the addition and subsequent removal of the additive. The second triad included (1) a substance with a small amount of additive, (2) the same substance following removal of the additive, and (3) the same substance following the removal and subsequent replacement of the additive. In each triad, the first and third cues are chemically identical where the only difference between them is the process. Across all sets of triads, participants rated the twice-transformed entity as being substantially less natural than the original entity despite the identical content of the two substances. Hence, processing alone changes naturalness. The results of the similarity judgments are more ambiguous in demonstrating support for the hypothesis. Whereas in both water triads, the twice-processed entity was considered most different from the other cues, results from the tomato paste triad indicate that the
once-transformed entity was considered most different. This latter case indicates greater sensitivity to substance (content) than to process in similarity judgments, and thus provides a mixed verdict on the link between similarity and naturalness judgments.

Rozin and colleagues (2009) subsequently reported on findings from five European countries and the U.S., which they argue provide further support for the hypothesis that the principle of contagion accounts for much of the reduction in naturalness following additions, as stated in Rozin (2005). The responses to an open-ended item asking for a definition of naturalness across six countries revealed a major asymmetry between the importance placed on “no additives” when compared to the very rare mention of removal of substances (“subtractives”). A category of “no processing” responses (687) was the most popular followed by “no additives” (604) in people’s definitions of “natural. There were only 11 cases in which respondents made any reference to the removal of anything. In the following phase of the study respondents from all countries except the U.S. rated skim milk (a “subtractive” process) more natural than milk supplemented with vitamin D (an “additive”). The evidence indicates that additives are more salient or important than “subtractives” with respect to naturalness, which the authors refer to as “additivity dominance”. The authors proceed to explain that evidence of this “additivity dominance” was also found by interviewing 22 native speakers of a language other than English (who were also fluent in English) and asking them for synonyms of the word “additive” and “subtractive” in their language, noting that “subtractive” is not a proper English word. Out of 19 languages, a synonym for “additive” was provided in 13 cases whereas only one synonym was provided to denote
its opposite (“subtractive”). To account for this phenomenon with respect to naturalness, Rozin and colleagues (2009) refer back to the contagion effect and dose insensitivity as plausible explanations. Oakes (2004) found similar results with respect to health ratings in his study, whereby adding disreputable ingredients to food reduced or completely negated people’s perceptions of the positive components (e.g., vitamins and minerals) that were present in the “pure” version. Foods are not only perceived to acquire negative characteristics as a result of the addition of a small amount of a disreputable ingredient, but also the food loses positive components. Oakes (2004) interprets the findings as evidence of stereotypical thinking about food in terms of being either ‘good’ or ‘bad’ (also see Rozin et al., 1996).

**Interpersonal Differences in Naturalness Judgments**

In addition to differences between naturalness perceptions across product category types, there is also interpersonal variation in perceptions of, and preferences for, natural food and food that is labeled “organic”. Individual factors include gender differences, differences in people’s supernatural beliefs (Saher, 2006) and differences between people as to the types of food risks, either familiar or unobservable hazards, they are more concerned about (Siegrist et al., 2006).

A number of studies in Europe and Australia have identified gender biases with females expressing stronger preferences for natural food and organic food consumption (Dickson-Spillman et al., 2011; Lockie et al., 2004; Roinenen et al., 1999). Rozin and colleagues (2004) found that females showed a stronger preference than males for natural
food, but the difference between numerical natural preference scores was not significant. In other studies, females tend to have more negative perceptions of genetically modified foods (Hursti and Magnusson, 2003), are more concerned about genetic engineering (Hoban et al., 1992), and are more opposed to pesticide residues in foods (Dunlap and Beus, 1992) than males.

There is evidence that differences between males and females in their preferences for natural food may be explained by differences in risk perception. Davidson and Freudenburg (1996) surveyed the literature to test various hypotheses that may account for the robust finding that females express higher levels of concern about potential environmental and technological risks than do males. They found the most support for the ‘Safety Concerns Hypothesis’, which holds that health and safety are more salient to females than to males, which is reflected in females’ higher levels of concern about a given level of environmental risk. Results from Davidson and Freudenburg’s (1996) literature review did not support the hypothesis that knowledge differences explain different levels of environmental risk concern between sexes. Similarly, Hursti and Magnusson (2003) found that people with different levels of knowledge about genetic modification showed no significant differences in their opinions of genetically modified or organic foods.

Evidence of the relationship between risk perceptions and concerns for ‘natural’ in food run counter to the proposal that ideational/moral beliefs explain preferences for natural food better than do instrumental concerns. Rozin and colleagues (2004) note that Americans appear to be more inclined to provide instrumental as opposed to ideational
accounts of their preferences, possibly due to the view that scientific and rational justifications are easier to defend and more widely accepted. This is the reason why Rozin and colleagues (2004) elicited responses that would lead to their inference of ideational preferences, rather than explicitly asking respondents to explain specific preferences. Again, Rozin (2005) explains that ideational factors include the belief that natural is inherently better, more moral, more aesthetic, or simply “right”. Wilson (1984) presented a related and more general form of this proposal, known as “biophilia”, stating that humans have an innate desire to experience our ancestral environment. Many of these types of justifications are evident in statements to oppose genetic engineering (Kniazeva, 2005). And, many of them represent various versions of the allegedly mistaken moral argument known as the naturalistic fallacy (Curry, 2006).

**An Evolutionary Perspective**

People tend to have strong opinions regarding the types of foods humans ought to eat. Knowledge and beliefs about evolved human behavioral adaptations can influence people’s conclusions about the choices we make and how we live today. The behaviors humans are presumed to have exhibited in the past, and which are observed today in some modern foraging societies, may be wrongfully construed as a model for a ‘natural’ human lifestyle. The application of evolutionary models to construct hypothetical diets of our prehistoric ancestors has popular appeal in efforts to address contemporary health concerns. The argument that people ought to eat foods that resemble prehistoric human diets may be considered a version of the naturalistic fallacy (Curry, 2006). Regardless of
people’s different reasons for judging whether a food is natural or not, there appears to be a tendency in the United States to believe that such a thing as natural food exists and that eating natural food is better than eating food that is not natural.

Based on what can be archaeologically reconstructed and inferred about the environment of evolutionary adaptedness (EEA) of human food cognition, evolutionary anthropologists try to determine a baseline ancestral diet, one that many people would regard as “natural”. Research into contemporary perceptions and concepts of natural food may address a question that has not been asked: would we expect humans to have a unified concept and positive judgment of food that is representative of a diet that our ancestors ate?

A preference for foods that were natural in the EEA could possibly have had devastating outcomes if naturalness equated to a lack of processing (Wrangham, 2009). Unprocessed foods throughout prehistory and prior to plant and animal domestication would have been much more fibrous, would have contained more toxins and, therefore, would have required our living ancestors to possess more physiological adaptations than we possess today to make them edible. For instance, plants produce compounds that are toxic in order to deter animals from eating them, and in turn, animals (including humans) have evolved chemical sensory receptors that provide the crucial message of unpalatability (Harborne, 1988). People in traditional societies are explicit about their intentions of processing plant foods in order to detoxify them and make them more palatable, and this knowledge is easily transmitted from one generation to the next (Johns and Kubo, 1988; Johns, 1994). Physiological and technological changes through the
course of human evolution indicate that food processing techniques played an important role in the emergence of modern humans.

As demonstrated by Rozin and colleagues (2004), the natural preferences for food in contemporary Western contexts appear to differ depending on the food type or product category. What appears to be conflicting, however, is that preferences for natural are strongest for the most basic foods, such as fruits and vegetables that are “chemically identical to the same item in its natural place”, and such unprocessed foods presumably would have posed the greatest threats and challenges in the EEA prior to domestication and agriculture.

Rozin’s (2005, 2006) research concluded that the perception of a food item as being natural, and therefore favorable, largely depends on processes underlying the food’s existence and production. The findings from Rozin’s (2005) study that indicate significantly different effects of physical versus chemical transformations of foods on perceived reduction in naturalness may be consistent with predictions from an evolutionary psychological perspective. Physical transformations, such as grinding, would have been the earliest forms of food processing, and would be expected to have little to no effects on perceptions of the essential nature of a food substance.

An evolutionary account of human food cognition, however, may predict the co-existence of certain innate conceptual traits and innate sensory motivations to seek foods that are heavily processed since these foods contain high caloric value and are universally more appealing to human as well as nonhuman primate sensory systems (Wobber et al., 2008; Wrangham, 2009; Wrangham and Conklin-Brittain, 2003). The evolution of
cooking had resounding impacts on the anatomy, physiology, and social organization of ancestral humans, and presumably shaped human psychological traits as well (Wobber et al., 2008; Wrangham, 2009). Ancestral food “packages” consisting of food relatively removed from its biological context and altered from its original state (i.e., cooked) would have created novel food-sharing scenarios, constraints on visual cues to determine the individual components of a “dish” or “meal”, and increasing reliance on knowledge of food preparation techniques and familiarity with the individuals involved (Wrangham et al., 1999). The development of increasingly complex food processing techniques may have been responsible for changes in the conceptualization, categorization, and reasoning facilities employed in food-related contexts. Contemporary food judgments and consumption decisions that indicate biased concerns about the history of human contact and processing may not be so surprising from an evolutionary perspective. However, these hypotheses derived from evolutionary anthropology have not yet been tested.

Prior research has raised many questions regarding the relationship between human food cognition and the domains of folkbiology and artifacts. Future studies can help determine whether the “natural” concept is a useful guide or parameter for understanding these relationships, and whether this concept is more meaningful in certain cultural contexts, for certain types of foods, or for certain types of food-related transformations.
STUDY PREDICTIONS

Research Question 1: Do people have a preference for natural food?

Prediction 1: There is a preference for natural over commercial foods.

In the studies conducted for this thesis, preferences for natural food are expected to follow the same pattern as in Rozin et al. (2004), in which the majority of respondents preferred natural over commercial foods. Rozin et al. (2004) interpreted these findings as evidence of an ideational-moral motivation for the natural preference based on some perceived superiority of nature rather than an instrumental motivation based on concerns about the potential consequences of consumption (i.e., health). Therefore, I also predict that only a small number of people will shift their preference for natural food to indifference when the conditions change from stipulating that natural and commercial forms of food cost the same, taste the same, and are equally health, to the condition stipulating that both forms are chemically identical. I also anticipate a direct relationship between ratings of favorability and ratings of naturalness for different variants of basic foods.

Prediction 2: More females than males prefer natural over commercial foods, and females perceive greater violations of naturalness in modified foods than do males.

Prior research that has controlled for gender differences in consumer perceptions of food and the environment indicates that females tend to express greater concern about the health and safety implications of genetic engineering and other technologies (Davidson and Freudenburg, 1996). More specific studies addressing preferences for
natural food and organic food consumption have identified gender biases in Europe and Australia (Dickson-Spillman et al., 2011; Lockie et al., 2004; Roininen et al., 1999). Therefore, I predict that preferences for natural food and perceptions of natural food will be gendered, with (a) more females preferring natural over commercial foods and (b) females rating modified foods less natural than males.

Research Question 2: Do people’s preferences and perceptions of natural food show evidence of categories that are “natural” to the human mind, as outlined in folkbiology?

Prediction 3: The natural preference is stronger for animal-based foods than for plant-based foods, and modifications to animal-based foods lead to lower naturalness ratings.

A vegetable and a meat will each be used as targets in different sets of questions and in different versions of the study instrument. The goal is to test whether cognitive mechanisms responsible for perceived differences between animals and plants operate in the domain of food to produce different types of preferences and perceptions with regards to naturalness. Similar modifications are expected to have different effects on preferences and the perceived naturalness of foods derived from either animals or plants.

Though there are no known reports of a stronger natural preference for animal products compared to plant products, documented levels of acceptance of genetic engineering, in general, are higher for plants than for animals, and there are some reports that this is the case when genetic modification specifically targets food production (Beckwith et al., 2003; Gaskell et al, 2007; Hursti and Magnusson, 2003). Rozin and
Fallon (1987) found that almost all food items that are universally rejected as a result of a disgust response based on knowledge of their origins are meat or other animal products. In developing Rozin and Fallon’s (1987) argument that the disgust response evolved as a mechanism to avoid spoiled food, Fessler and Navarrete (2003) summarize how and why this response and aversion specifically to animal products may have resulted from a heightened sensitivity to the risk of pathogen transmission. They also point out that animals and animal-based food products are more commonly tabooed than are plants and plant-based foods. This prior work demonstrating that instrumental concerns about health and safety are more likely to be triggered by animal-based cues rather than by plant-based cues is one reason for this prediction in the principal phase of research. To test this prediction, I will analyze the percentages of people who shift their preferences for natural to indifference under varying conditions and I will compare the mean favorability and naturalness ratings of plant- and animal-based foods.

Prediction 4: Genetically modified foods are perceived to be the least natural among the variants tested.

Three out of the six food variants used in each version of the principal study instrument will be genetically modified in order to test whether these are perceived to be less natural than variants whose modifications are induced by chemicals or environmental factors. Folkbiological studies have investigated whether people perceive that a living thing retains its identity or maintains certain properties despite alterations in other characteristics. These studies indicate that changes to specific essentialized properties of
a living thing, or changes to defining features of living things that are internally based, cue for categorical changes from one kind to another. Food variants modified at the level of the gene are expected to receive lower mean naturalness ratings than variants modified under other conditions. This prediction is consistent with the idea that subjects conceive of a central cause (e.g., genes) underlying categorical distinctions and kind-specific properties of living things, which follows from the principle of psychological essentialism (Barrett, 2001). This finding would suggest a strong role for essentialist representations of living things in shaping perceptions and categorizations of food and food production technologies in terms of naturalness. The prediction assumes that college students in both cultures consider genes to be representative of a living kind essence, and also that variation in perceived naturalness of food is a useful measure for changes in the perceived attributes or identities of foods.

**Prediction 5: Relative differences among naturalness ratings of genetically modified foods reflect perceived violations of natural categories between species-like groups.**

Different combinations of species were chosen when formulating the genetically modified food variants to be included on the study instruments in order to test whether naturalness judgments are sensitive to the taxonomic relationships among living things. Essentialist assumptions underlie people’s spontaneous recognition and expectation of the distinctions among living things that look, behave, and reproduce differently. Atran (1998:1) refers to these as “essence-based species-like groups”. In order to address whether perceived violations of naturalness reflect violations of natural categories at this
species-like level, this thesis will examine whether perceptions of genetically modified foods differ depending on the types of biological taxa involved in the modification process.

Rozin (2005) did not observe significant differences between naturalness ratings of genetically modified food variants when the only difference was in the kind of genes inserted. These findings substantiated his claim that process is more important than content in perceived naturalness of food. The principal research for this thesis will reconsider Rozin’s (2005) proposal and replicate this test in two different cultures.

I anticipate that genetically modified food variants comprised of genes from vastly different taxa will receive lower naturalness ratings. This finding would suggest that biological content and natural species-like categories, as outlined in folkbiological studies, play a role in shaping perceptions of natural food. The alternative finding - that genetically modified food variants inserted with genes from vastly different taxa receive similar naturalness ratings - would suggest a stronger role for shared processing history and a weaker role for living kind considerations in people’s categorical thinking about genetically modified foods in terms of naturalness. Since the living things included in the study instrument are such basic and well-known kinds, this prediction assumes that respondents will be able to identify taxonomic relationships among them.
Prediction 6: Naturalness ratings correspond with people’s expectations of:

a) the behavioral attributes of living things from which foods are derived

b) the health and safety properties of foods

Categorization allows people to make judgments about novel entities and facilitates decision-making and behavior modification. There is evidence that food is categorized in various ways that are related to the perceived internal and external properties of food substances, people’s eating contexts, and abstract mental concepts (Blake et al., 2007; Steptoe et al., 1995). These studies indicate that the natural content of food may be an abstract quality that plays a significant role in people’s attitudes and eating behaviors (Aikmen et al., 2006). The classification of food as natural or non-natural has been studied with the purpose of understanding the significance of a natural concept to perceptions of health and safety (Dickson-Spillman et al., 2011; Siegrist et al., 2006). Any correlation between naturalness judgments of basic foods and inferences about living kind properties has not yet been explored. The living kind properties used in the principal study for this thesis are behaviors that pertain to the organisms’ abilities to defend themselves or their offspring.

The principal study instrument was designed to examine whether categories of natural and non-natural food are consistent with, or possibly support, inferential reasoning about the behaviors of living things from which food is derived, and the health and safety properties of the food itself. The naturalness ratings of the different variants will provide a reference point to determine whether perceived naturalness corresponds
with people’s expectations about these properties. Variants that are less natural than other variants are expected to be less ‘likely’ to possess the target properties.

Food is generally not considered a ‘natural’ kind in the cognitive science literature because there is not much inductive strength in inferring that the known properties of one food type extend to a related or similar, but lesser known, food type. Evidence that naturalness judgments and food preferences correspond with people’s inferences about the attributes of living things from which the foods are derived may indicate just how strong of a role folkbiology plays in shaping these perceptions.

Prediction 7: Similarity judgments involving basic foods are based on shared biological content whereas similarity judgments involving complex processed foods are based on shared processing history or shared function.

Foods may be considered intermediate between living kinds and artifacts and, therefore, they have been referred to as ‘biological artifacts’ (Sperber, 2007). Similarly, foods may be considered to be substances, which are viewed as being distinct from living kinds and artifacts when it comes to essentialist modes of construal (Barrett, 2001; Millikan, 1998). There is experimental evidence to suggest that different assumptions about food substances and living things are representative of an ontological boundary between animate and inanimate things, which is crossed when death initiates the process of a plant or animal becoming a basic food item (Barrett, 2004).

People make the commonsense assumption that all living things possess some internal causal nature, or essence. This hidden essence is a stable internal placeholder that
may be credited with driving a living thing to carry out its basic life functions and maintain its identity in ways that are unique to its kind and independent of external, environmental factors (Barrett, 2001).

The history of use and the intended function of an object are defining features that determine the category to which an artifact is assigned (Bloom, 1996). Categorizations of food may indicate that people attend to the processing history and intended uses of food more than they attend to the actual content and inherent makeup of food, which would indicate a stronger role for innate representation of artifacts than that of folkbiology in shaping food cognition.

By asking people to make similarity judgments involving modified and unmodified versions of basic foods, processed foods, food substances, and artifacts, the principal study for this thesis will investigate the relative influences of concepts of living things and artifacts on people’s categorizations of food. Rozin et al. (2004) and Tenbult et al. (2005) have shown that naturalness judgments and natural preferences vary between food product categories based on their amount of processing. Respondents are expected to privilege similar biological content and living kind status over similar types of modifications when making comparative judgments involving basic foods. More specifically, they are expected to overlook an external environmental factor in agreeing that two variants of the same kind of basic food growing in different environments have more in common with one another as a result of shared biological content (i.e., lemons) than do two different kinds of basic foods that grow in similar environments. Similarly, respondents are expected to judge that a basic food item that has undergone only minimal
processing (i.e., potato diced into cubes) is more similar to its living kind counterpart than to a slightly more processed food item of the same kind (i.e., dried potato starch). More complex processed foods (i.e., high fructose corn syrup), however, are expected to cue for an artifact psychology. Therefore, I expect participants to judge that complex foods are more similar to substances and artifacts than they are to living kinds. For these types of foods, respondents are expected to privilege similar functional properties or designed attributes of foods over similar biological content when making comparative judgments. These results would indicate that living kind status is weighted less heavily when thinking categorically about complex foods than when thinking categorically about basic foods.
A pilot study for this thesis was conducted to test whether two different sections of a questionnaire would be meaningful to university students in Sacramento. While testing these methods, the pilot study was also an opportunity to test Rozin’s (2005) proposal that process is more important than content in people’s perceptions of natural food.

One section of the study instrument tested whether people demonstrate a preference for natural forms of foods and medicine over their commercial counterparts. This section of the questionnaire to test the “natural preference” replicated a portion of a questionnaire used by Rozin and colleagues (2004).

The other section of the pilot study was designed to test whether people judge that various unmodified and modified forms of foods differ in terms of naturalness. This portion of the study instrument used a naturalness scale similar to the one used by Spranca (1992) and Rozin (2005). Based on a review of literature about natural categories in the folkbiological domain, I predicted that genetically modified food items that involve the mixing of genes across distant taxa violate perceived naturalness in food significantly more than genetic modifications that cross genes between similar kinds of living things. Rozin’s (2005) results reportedly failed to meet this prediction, which was the reason for replicating this test in the pilot study. Specifically, the pilot study sought evidence that relative differences among naturalness ratings of genetically modified foods
reflect perceived violations of natural categories between species-like groups. As predicted, the results of the pilot study contradicted Rozin’s (2005) proposal. The results suggested that a research question in the principal study should focus on the roles of folkbiological categories and other domain-specific concepts in shaping naturalness judgments of food.

**MATERIALS AND METHODS**

Permission to conduct the pilot study was obtained from the Human Subjects Committee at California State University, Sacramento (CSUS) in April 2008 upon the committee’s final approval of a “Request for Review by the CSUS Committee for the Protection of Human Subjects” (Appendix A). In accordance with the University’s guidelines for conducting research with human subjects, each study participant signed a document entitled “Consent to Participate in Research” (Appendix B).

Ninety-eight anthropology students volunteered to participate, and completed an anonymous questionnaire (Appendix C). Nine participants were eliminated due to incomplete data, leaving a total of 89 respondents. The 89 respondents had a mean age of 21.2 years (SD 2.8) and a mean education level of 14.3 (SD 1.2) years. Of the students who completed the survey, 37 (41.6 %) were male and 52 (58.4 %) were female.

The first section of the study instrument asked participants to rate the naturalness of four variations of oranges (a basic food), and nine variations of orange juice (a basic food product) as follows: 1 = not natural at all, 2 = slightly natural, 3 = moderately natural, 4 = very natural, 5 = completely natural (Figures 3-1 and 3-2). No definition of
“natural” was provided so that respondents’ ratings would reflect whether each food variant upheld or violated personal ideas of what it means for food to be “natural”.

The second section of the study instrument replicated a design used by Rozin and colleagues (2004) to study preferences for natural food. Study participants were asked to make categorical choices about a basic food (potatoes) and a common medicinal category (antibiotics) in terms of preference of each in its natural form, its commercial form, or indifference to natural or commercial categorization (indifferent) (Tables 3-1 and 3-2).

Respondents were instructed to define “natural” and “commercial” as:

“A natural food is one that has not been changed in any significant way by contact with humans. It could have been picked or transported, but it is chemically identical to the same item in its natural place. A commercial food is one that has been grown or produced with fertilizers or pesticides and might contain additives or preservatives to enhance its taste. A natural medicinal item is one that has been extracted from plants or animals. A commercial medicinal item is one that has been synthesized in a chemical/pharmaceutical laboratory.”

Four probes were used for each food or substance. For example:

“Think of a natural potato and a commercially grown potato that cost the same. Which would you prefer to eat (circle your preference)? Now assume that both the natural and commercial potatoes taste exactly the same. Which would you prefer to eat? Now assume that both the natural and commercial potatoes are equally healthy, containing exactly the same nutrients, whether or not they have the same taste. Which would you prefer to eat? Now assume that both the natural and commercial potatoes are chemically identical, and thus taste the same and have the same health value. Which would you prefer to eat?”

The probe referring to taste was changed in the antibiotic exemplar to one stipulating that both forms of antibiotic have the same side effects. The probe referring to healthfulness was changed to one stipulating that both forms of antibiotic are equally effective.
The data collected for the pilot study was interpreted using descriptive statistics to calculate a mean naturalness score for the various items in the first section of the questionnaire, and a Chi-square test was used to analyze the distribution of respondent choices between “natural”, “commercial”, and “indifferent” forms of food and medicine in the second section of the questionnaire. All statistical analyses were carried out in SPSS 11.

RESULTS

The first aspect of people’s perceptions of natural that the pilot study examined was the “natural preference” for food and medicine (Rozin et al., 2004). For each of the probes for potatoes and antibiotics, the number of respondents who preferred “natural” was significantly greater than the number of respondents who chose “indifferent” (Tables 3-1 and 3-2). This was the case for all categories even though the questions were designed such that the indifferent choice was always a logically correct category. The number of respondents who showed a preference for natural potatoes and natural antibiotics varied in response to changes in the stipulated conditions. The number of respondents who preferred natural potatoes was greater when natural and commercial forms cost the same than when the two forms were stipulated as being chemically identical. The number of respondents who were indifferent about natural and commercial potatoes was greater when the two forms were stipulated as being chemically identical than when they cost the same. The number of respondents who were indifferent about
antibiotics was also greater when the natural and commercial forms were stipulated as being chemically identical than when they cost the same.

**Table 3-1. Indifference vs. Natural Preference for a Basic Food**

<table>
<thead>
<tr>
<th></th>
<th>cost the same?</th>
<th>taste the same?</th>
<th>are equally healthy?</th>
<th>are chemically identical?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural</td>
<td>76</td>
<td>72</td>
<td>61</td>
<td>55</td>
</tr>
<tr>
<td>Indifferent</td>
<td>8</td>
<td>16</td>
<td>25</td>
<td>32</td>
</tr>
<tr>
<td>Commercial</td>
<td>5</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Observed N</td>
<td>89</td>
<td>89</td>
<td>89</td>
<td>89</td>
</tr>
<tr>
<td>Chi square (df), p value</td>
<td>108.70 (2)</td>
<td>94.40 (2)</td>
<td>57.79 (2)</td>
<td>47.62 (2)</td>
</tr>
<tr>
<td></td>
<td>p = 0.000</td>
<td>p = 0.000</td>
<td>p = 0.000</td>
<td>p = 0.000</td>
</tr>
</tbody>
</table>

**Table 3-2. Indifference vs. Natural Preference for a Medicine**

<table>
<thead>
<tr>
<th></th>
<th>cost the same?</th>
<th>have the same side effects?</th>
<th>are equally effective?</th>
<th>are chemically identical?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural</td>
<td>39</td>
<td>43</td>
<td>48</td>
<td>45</td>
</tr>
<tr>
<td>Indifferent</td>
<td>16</td>
<td>19</td>
<td>28</td>
<td>30</td>
</tr>
<tr>
<td>Commercial</td>
<td>34</td>
<td>27</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>Observed N</td>
<td>89</td>
<td>89</td>
<td>89</td>
<td>89</td>
</tr>
<tr>
<td>Chi square (df), p value</td>
<td>9.87 (2)</td>
<td>10.07 (2)</td>
<td>20.79 (2)</td>
<td>16.20 (2)</td>
</tr>
<tr>
<td></td>
<td>p = 0.007</td>
<td>p = 0.007</td>
<td>p = 0.000</td>
<td>p = 0.000</td>
</tr>
</tbody>
</table>

The second objective of the pilot study was to determine whether people perceive differences in the “naturalness” of unmodified and modified variants of a basic food (oranges) and a basic food product (orange juice). For oranges and orange juice, the unmodified variants received significantly higher “naturalness” ratings than all other variants (Figures 3-1 and 3-2). The unmodified variants were described as having been
grown organically (without added fertilizer or pesticide). For both oranges and orange juice, variants involving the insertion of a gene from a different organism were rated significantly lower. Food variants involving the insertion of a gene from an animal were rated lowest of all, and lower than insertion of a plant gene. Variants of oranges and orange juice involving the insertion of a different plant gene received similar naturalness ratings as variants that lacked genetic modification, but which involved the use of chemical fertilizers and pesticides.

**Figure 3-1.** Perceptions of naturalness in a basic food (fruit). Means derived from 5-point naturalness scale (1 = not natural at all, 2 = slightly natural, 3 = moderately natural, 4 = very natural, 5 = completely natural) are reported. Error bars represent two standard error intervals from the mean.
DISCUSSION

The results of the pilot study in support of the “natural preference” indicate that food preferences are motivated by a perceived quality of naturalness, and the results suggest a strong role for categorical thinking. The finding that participants in this pilot study gave significantly different naturalness ratings for different types of genetically modified variants suggests that the content of certain foods is at least as important as the process in people’s perceptions of natural food. The discussion of the pilot study results will provide an interpretation of these findings from the perspective of domain-specificity and natural category violations in folkbiology.
Study participants showed a consistent preference for natural forms of a basic food and a medicinal category even though the costs and properties of commercial forms of these items were stipulated as being the same as their natural counterparts. Participants demonstrated some logic when considering these alternatives. That is, when the comparable products are chemically identical more people choose the logically correct indifferent option, than when they are considering merely the cost difference. However, overall there is clear evidence that favorable perceptions of natural food far outweigh logical reasoning in this group of students. Our finding that “natural” foods and medicines are perceived to be more acceptable than commercial alternatives regardless of health consequences or side effects is consistent with the results of Rozin and colleagues (2004). We interpret these results as being suggestive of an underlying cognitive mechanism that motivated study respondents to prefer certain plant-based foods and medicines over others based on a perceived quality of naturalness. Categorical thinking in the domain of food with respect to naturalness appears to motivate preferences to such an extent that people will discount information that conflicts with assumptions about the instrumental benefits of natural food.

Modifications of basic plant foods (and medicines) in terms of commercial additives (fertilizer, pesticides, vitamins) and addition of genes from different organisms were rated as significant departures from naturalness by study respondents. We interpret these results as consistent with participants perceiving such modifications as violating natural categories. The departure from naturalness was most marked where the category violation was cross-taxon i.e. an animal gene in a plant. These results suggest that
perceptions of the natural world, in terms of plant foods and substances, are bounded in ways that are analogous to essential categories (Gelman and Hirschfeld, 1999). These categorizations are further suggestive of evolved cognitive domains related to foods, and indicate that further research of these natural category violations may yield insights into the evolved cognitive structures underlying perceptions of the natural world.

The pilot study and prior research by Rozin and colleagues (2004) indicate the need to conduct cross-cultural tests of natural food preferences and perceptions, which take different plant and animal foods into account as well as sex differences. The pilot study raised questions as to the role that an evolved cognitive domain specific to artifacts plays in naturalness perceptions of food. Rozin (2006) suggested that future research about preferences and perceptions of natural food consider the role of the artifact domain. These considerations were incorporated into the principal phase of this thesis research.
Chapter 4

PRINCIPAL RESEARCH

OVERVIEW

Three hundred and thirty five CSUS undergraduate students in anthropology and one hundred and fifty five undergraduate and graduate students in Mexico City from a state-operated College of Diet and Nutrition participated in this study by volunteering to complete an anonymous questionnaire. The questionnaire was designed to test seven predictions that are organized according to two principal research questions.

The first research question asks: do people have a preference for natural food? The study found that university students in Sacramento and Mexico City favor different variants of the same basic food according to perceived naturalness, and they prefer natural over commercial foods. There is evidence from both countries that preferences for natural food and perceptions of natural food are gendered with more females preferring natural over commercial foods and females rating modified foods less natural than males.

The second research question asks: do people’s preferences and perceptions of natural food show evidence of categories that are “natural” to the human mind? The results demonstrate that natural preferences and perceptions differ for plant- and animal-based foods. Different genetically modified variants also received significantly different naturalness ratings depending on whether the modification involved the mixing of taxonomically related or distant genes. Biological ‘content’ appears to have as much (or more) of an influence as ‘process’ on people’s perceptions of natural, preferences for natural, and causal reasoning about certain properties of basic foods and the living things
they originate from. The results suggest that living kind status tends to be weighted less
heavily when thinking categorically about complex processed foods than when thinking
categorically about basic unprocessed foods. Therefore, the study results provide some
support for Rozin’s (2005) notion that judgments about food are based on process rather
than content.

MATERIALS AND METHODS

Permission to conduct the final phase of this thesis research was obtained from
the Human Subjects Committee at CSUS in March 2009. My colleague, Jiapsy Arias
Gonzalez (MA, PhD Candidate, Anthropology), in Mexico City followed corresponding
procedures for gaining permission to conduct human subjects research at the College of
Diet and Nutrition. Multiple anonymous reviewers assisted in the translation of the
Spanish language version of the “Consent to Participate in Research” (Appendix D) that
was distributed to participants in Mexico City.

Participants completed one of two versions of the final questionnaire, Version A
and Version B (Appendices E and F). Jiapsy Arias Gonzalez, along with multiple
anonymous reviewers, assisted with the Spanish language translation of both versions of
the final questionnaire to be used in Mexico City (Appendices G and H). Each version
was comprised of four parts. Part I of the questionnaire was the same for all participants,
which surveyed demographic information, including age, gender, and educational
background, and additional factors such as body mass index, dietary restrictions, eating
habits, and self-rated body image.
Part II of the questionnaire was comprised of five questions. The first question asked participants to rate how favorable it would be to eat each of six different variants of a food item. Participants were instructed to use a rating scale as follows: 1 = strongly unfavorable, 2 = unfavorable, 3 = neutral, 4 = favorable, 5 = strongly favorable. Version A included six variants of corn as follows: (1) Corn that has been genetically modified with the insertion of a gene from wheat, (2) Corn that has been grown with chemical fertilizers and pesticides, (3) Corn that has been genetically modified with the insertion of a gene from oranges, (4) Corn that has been harvested from a field with fresh manure, (5) Corn that has been genetically modified with the insertion of a gene from a cow, (6) Corn that has been grown indoors. Version B included six variants of chicken as follows: (1) Chicken that has been genetically modified with the insertion of a gene from a duck, (2) Chicken that has been injected with hormones, (3) Chicken that has been genetically modified with the insertion of a gene from a cow, (4) Chicken that forages in manure for insects and worms to eat, (5) Chicken that has been genetically modified with the insertion of a gene from corn, (6) Chicken that has been raised indoors. The types of variants included in the questionnaire were chosen to test for the effects of three general types of modifications on people’s perceptions: genetic (internal), chemical additives (external), and environmental (external/contextual).

The second question of Part II asked participants to rate the naturalness of each of the six variants listed above using the following naturalness scale: 1 = not natural at all, 2 = slightly natural, 3 = moderately natural, 4 = very natural, 5 = completely natural. This labeled category scale is a slightly modified version of the scale used by Rozin.
Overvliet et al. (2008) translated a similar scale into Spanish for European subjects and found that the results were highly correlated with other tools to measure perceived naturalness.

Questions 3 to 5 in Part II of the questionnaire also elicited ratings for the same sets of variants listed above. Participants indicated whether or not they expect each of the six modified variants on their respective versions of the questionnaire to possess specified health, safety, and behavioral properties. On Version A participants read premise statements about these three different properties of corn and were then asked to rate how likely it is that the same statement is true for each of the six variants of corn. Version B used the same structure, but included premise statements about the health, safety, and behavioral properties of chickens. The rating scale was as follows: 1 = not likely at all, 2 = unlikely, 3 = likely, 4 = very likely, 5 = certainly. The following example was provided for all participants to see:

**Premise:** Brown sugar dissolves when you put it in water.

**Question:** How likely is it that the following item also dissolves in water?

_____ White sugar cubes

Participants were instructed to write the number (1 to 5) that corresponds to their answer on the line next to each item.

Part III of the questionnaire included two questions that were the same on Versions A and B. These questions followed the same design used by Rozin and
colleagues (2004) and replicated in the pilot research. Study participants were asked to make categorical choices about two basic foods (potatoes and beef) in terms of preference for each in its natural form, its commercial form, or indifference to natural or commercial categorization (indifferent). Respondents were instructed to refer to the same definitions of “natural” and “commercial” food as were provided by Rozin and colleagues (2004), and which were provided in the pilot study for this thesis. The four probes for potatoes used in the principal study were the same as those used by Rozin and colleagues (2004) and replicated in the pilot research. The four probes for beef were as follows:

“Think of natural beef and commercially raised beef that cost the same. Which would you prefer to eat (circle your preference)? Now assume that both the natural and commercial meats taste exactly the same. Which would you prefer to eat? Now assume that both the natural and commercial meats are equally healthy, containing exactly the same nutrients, whether or not they have the same taste. Which would you prefer to eat? Now assume that both the natural and commercial meats are chemically identical, and thus taste the same and have the same health value. Which would you prefer to eat?”

Part IV of the questionnaire was also the same on Versions A and B. Study participants read ten different comparative statements about modified and unmodified versions of basic foods, processed foods, living things and artifacts, and were asked to make similarity judgments using a Likert scale as follows: 1 = strongly disagree, 2 = disagree, 3 = neither fully agree nor fully disagree, 4 = agree, 5 = strongly agree. Each statement was structured similarly to include three items, and respondents were asked to indicate whether they agreed or disagreed that the first item was more similar to the second item than it was to the third item (Tables 4-14 to 4-18). For example:
“Genetically modified chickens are more like free-range chickens than they are like rubber chickens.”

The Spanish language version of the questionnaire included “pollos de rancho” to serve as a translation for “free-range chickens” and also used “un pastelito Marinela” as a culturally appropriate substitution for “twinkie”. These translations were made in consultation with native Spanish speakers in Mexico.

The data collected for the principal research was interpreted using descriptive statistics to calculate mean favorability ratings, mean naturalness ratings, and mean likelihood ratings (health, safety, behavior) for the various items in Part II of the questionnaire. Mean naturalness ratings were plotted against each of the other mean ratings in order to calculate coefficients of determination. Kruskal-Wallis tests were used for non-parametric repeated measurements when making comparisons among mean naturalness and mean favorability ratings. Since the nature of the data is ordinal (ranking) and not numeric, non-parametric tests were used to make interpretations based on differences among the ratings. Chi-square tests were used to analyze the distribution of respondent choices between “natural”, “commercial”, and “indifferent” forms of potatoes and beef in Part III of the questionnaire. Responses to Part IV of the questionnaire were analyzed using Kolmogorov-Smirnov tests to indicate whether the responses to each statement were significantly skewed towards either agreement or disagreement, or had a normal or uniform distribution around the median choice of “neither fully agree nor fully disagree”. All statistical analyses were carried out in SPSS 18.
RESULTS

Demographics

The proportions of males and females were essentially the same in Sacramento and Mexico City (p=0.632). The sample of respondents from Sacramento (n=335) was composed of 64% females (n=215) and 36% males (n=120). The sample of respondents from Mexico City (n=155) was composed of 62% females (n=96) and 38% males (n=59). The average respondent age in Sacramento was 20.8 (S.D. 5.8), and the average respondent age in Mexico City was 26.5 (S.D. 7.6). These represent significant mean age differences between the samples (p=0.00). Similarly, the educational levels of respondents were significantly different between the samples (p=0.00). The Sacramento sample consisted of a larger proportion of students within their first four years of college compared to the Mexico City sample, which consisted of a larger proportion that completed post-baccalaureate education. Among respondents from Sacramento, 88% (n=94) completed three years of college or less, 12% (n=41) completed four years of college or more, and no respondents had completed post-baccalaureate education. Among respondents from Mexico City, 74% (n=115) completed three years of college or less, 18% (n=27) completed four years of college or more, and 8% (n=13) completed post-baccalaureate education.

Among respondents in Sacramento, 17% (n=56) reported following a special diet, listed here in descending order of frequency: “other” (n=25), vegetarian (n=21), red meat restricted (n=5), raw foods (n=2), vegan (n=1), macrobiotic (n=1), and kosher (n=1). Due to cultural differences, the question referring to dietary restrictions in Mexico City
simply asked if respondents were vegetarian, and provided the option to list or describe any other types of special diets. Among the respondents, 3% (n=4) reported being vegetarian and 2% (n=3) reported that they do not eat red meat in Mexico City. Thus, 3.3% more of the respondents in Sacramento are vegetarian or red meat restricted compared to Mexico City, in addition to the significantly higher proportion of respondents in Sacramento with other dietary restrictions.

The study instrument included items from the questionnaire used by Rozin, et al. (2004) to collect data about Body Mass Index (BMI) and to measure levels of dissatisfaction with body image (current versus ideal figures rated on a 9-figure scale). The average BMI among respondents in both Sacramento (n=331) and Mexico City (n=151) was 24.4, which the National Institute of Health considers normal weight (www.nhlbi.nih.gov). The samples from both countries shared a similar range of BMI measures (S.D. in Sacramento was 4.7; S.D. in Mexico City was 3.1). The BMI of males was slightly higher than that of females in both groups, but this difference was not significant. In both countries, the mean BMI of individuals who preferred the natural forms of potatoes and beef was not significantly different from the mean BMI of individuals who either chose the commercial form or indifference when both forms were stipulated as being chemically identical. However, respondents in Sacramento who preferred natural beef under this condition had a numerically lower mean BMI compared to those who chose indifference (Figure 4-1; n=330, p=0.099). There was no correlation between BMI and naturalness ratings of the different variants of corn and chicken in Sacramento or Mexico City.
Figure 4-1. BMI means of respondents in Sacramento across the three preference categories for beef when natural and commercial forms were stipulated as being chemically identical (n=330).

The mean body image ratings were 5.9 in Sacramento and 5.5 in Mexico City, which are significantly different (p=0.021). In both countries, the mean body image rating of individuals who preferred the natural forms of potatoes and beef was not significantly different from the mean body image rating of individuals who either chose the commercial form or indifference when both forms were stipulated as being chemically identical. However, under the condition stipulating chemical identity of
natural and commercial forms of beef, respondents in Sacramento who preferred natural tended to have higher body image ratings than those who chose indifference (Figure 4-2; n=330, p=0.68). This result is consistent with the finding that, in Sacramento, BMI and body image rating showed a strong inverse relationship. This relationship between BMI and body image rating was not nearly as strong in Mexico City. There was no correlation between body image ratings and naturalness ratings of the different variants of corn and chicken in Sacramento or Mexico City.

Figure 4-2. Mean body image ratings of respondents in Sacramento across the three preference categories for beef when natural and commercial forms were stipulated as being chemically identical (n=330).
Finally, the study instrument included questions taken from Rozin et al. (2004) to gather data about the frequency of food control behaviors and reactions (dieting, feeling guilty, concern about weight, and holding back at meals). On average, respondents in Sacramento reported that they are “rarely” on a diet (n=332), “occasionally” feel guilty about what they eat (n=334), “occasionally” feel concerned about their weight (n=332), and “rarely” hold back from eating at meals (n=332). Respondents in Mexico City reported that they are “rarely” on a diet (n=153), “rarely” feel guilty about what they eat (n=149), “occasionally” feel concerned about their weight (n=149), and “occasionally” hold back from eating at meals (n=148). In comparing the mean numerical values along a labeled category scale used for these questions, the results indicate that respondents in Sacramento - while feeling more satisfied with their current body figures – are significantly more likely to feel guilty about what they eat, are significantly more likely to feel concerned about their weight, and are significantly less likely to hold back from eating at meals compared to respondents in Mexico City.

Among the demographic variables tested, age was the primary difference between the Sacramento and Mexico City samples. Ninety-two percent of the entire Sacramento sample was under 25 years old, whereas only forty-seven percent of the entire Mexico City sample was under 25 years old. To account for this difference, a subsample of respondents from Mexico City was used in post hoc tests of the study’s predictions. This subsample consisted of all respondents from Mexico City who were under 25 years old (n=73). The mean age (20.51) and median age (20.00) of respondents in this subsample were essentially the same as those of the entire Sacramento sample.
(mean= 20.54, median= 20.00). Similarly, the proportions of males (34%) and females (66%) in this subsample remained essentially the same. The “Mexico City Subsample” is identified as such in the sections below to specify the results of these post hoc tests. Presentation and discussion of the results from the entire Mexico City sample generally precede those of the “Mexico City Subsample”.

**Prediction 1: There is a preference for natural over commercial foods.**

Preferences for natural food were expected to follow the same pattern as in Rozin et al. (2004) and in the pilot study, in which the majority of respondents preferred natural over commercial foods. The study instrument was designed to survey preferences for natural food using two sets of questions. The responses to these two sets of questions were consistent and support this prediction. University students in Sacramento and Mexico City favor different variants of the same basic food according to perceived naturalness, and they prefer natural over commercial foods when given the choice.

One set of questions did not rely on specific definitions of “natural”, but in separate tasks asked study participants to rate the favorability and the naturalness of six variants of a basic food, either corn or chicken. This set of questions allowed for a correlation analysis to test the relationship between naturalness and favorability ratings. As expected, the results in Sacramento demonstrate a strong positive and linear relationship between perceived naturalness and favorability of corn (n=166, \( r^2=0.863 \), df=1, F=25.3, p=0.007) (Figure 4-3).
The results in Mexico City demonstrate that the two variants of corn with the highest mean naturalness ratings were rated significantly more favorable than the other four variants that received low naturalness ratings, and the results overall indicate a positive relationship (n=68, \( r^2=0.671 \), df=1, F=8.1, p=0.046) (Figure 4-4). The Mexico City Subsample of respondents less than 25 years old showed similar results for the relationship between naturalness and favorability of corn (n=32, \( r^2=0.824 \), df=1, F=18.8, p=0.012), which more closely approximated the results from Sacramento.
The data from Sacramento failed to show a linear relationship between ratings of naturalness and favorability for chicken \( (n=167, r^2=0.251, df=1, F=1.3, p=0.311) \), but they varied in the same positive direction as the other results (Figure 4-5). Respondents in Sacramento rated the chicken that forages in manure as being the most natural, yet this variant received very low favorability ratings. Whereas a relatively high mean naturalness rating corresponded with a relatively high mean favorability rating in Mexico City for the chicken that forages in manure, respondents in Sacramento rated this variant as
‘unfavorable’. This was a major difference between the samples in Sacramento and Mexico City. When the chicken that forages in manure is removed from the analysis, respondents in Sacramento demonstrate a very strong positive and linear relationship between ratings of naturalness and favorability for chicken \( (n=167, r^2=0.919, \text{df}=1, F=34.2, p=0.010) \). Mean naturalness and favorability ratings for chicken in Sacramento did not change significantly when respondents with dietary restrictions were excluded from the analysis.

**Figure 4-5.** Mean naturalness ratings and favorability ratings for six variants of chicken in Sacramento \( (n=167) \). (GM= genetically modified)
Ratings from Mexico City involving variants of chicken demonstrated the strongest evidence of a direct linear relationship between perceived naturalness and favorability \((n=82, r^2=0.936, \text{df}=1, F=58.7, p=0.002)\) (Figure 4-6). The results were similar for the Mexico City Subsample \((n=41, r^2=0.885, \text{df}=1, F=30.9, p=0.005)\).

![Figure 4-6. Mean naturalness ratings and favorability ratings for six variants of chicken in Mexico City \((n=82)\). (GM= genetically modified)](image)

In a separate set of questions study participants were asked to repeatedly indicate preferences for natural or commercial alternatives of a basic food, or indifference, based on definitions provided. Respondents made these categorical choices in terms of
preference under varying conditions, each stipulating that a certain property or cost of the natural and commercial variants was the same. I predicted that the stipulation that natural and commercial foods are chemically identical would produce only a small shift from natural preference to indifference, and that respondents would consistently choose the natural category more often than the commercial category across the four conditions.

As expected, for each of the conditions for potatoes and beef, the number of respondents in Mexico City who preferred natural was greater than the number of respondents who chose indifferent or commercial (Tables 4-1 and 4-2). This was the case for each stipulated condition even though the questions were designed such that the indifferent choice was always a logically-correct category. The distributions of responses from the Mexico City Subsample were essentially the same as those of the larger Mexico City sample as a whole.

Table 4-1. Frequency of “natural”, “commercial”, or “indifferent” categories chosen by Mexico City respondents when asked about preferences for potatoes under four different conditions (n=155).

<table>
<thead>
<tr>
<th>Would you prefer to eat a “natural” or a “commercially grown” potato, given that they . . .</th>
<th>cost the same?</th>
<th>taste the same?</th>
<th>are equally healthy?</th>
<th>are chemically identical?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural</td>
<td>126</td>
<td>104</td>
<td>94</td>
<td>99</td>
</tr>
<tr>
<td>Indifferent</td>
<td>25</td>
<td>47</td>
<td>52</td>
<td>47</td>
</tr>
<tr>
<td>Commercial</td>
<td>4</td>
<td>4</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Observed N</td>
<td>155</td>
<td>155</td>
<td>155</td>
<td>155</td>
</tr>
<tr>
<td>Chi square (df), p value</td>
<td>62.57 (2)</td>
<td>27.94 (2)</td>
<td>14.48 (2)</td>
<td>17.36 (2)</td>
</tr>
<tr>
<td></td>
<td>p = 0.000</td>
<td>p = 0.000</td>
<td>p = 0.001</td>
<td>p = 0.000</td>
</tr>
</tbody>
</table>
Table 4-2. Frequency of “natural”, “commercial”, or “indifferent” categories chosen by Mexico City respondents when asked about preferences for beef under four different conditions (n=155).

<table>
<thead>
<tr>
<th>Would you prefer to eat “natural” or “commercially raised” beef, given that they . . .</th>
<th>cost the same?</th>
<th>taste the same?</th>
<th>are equally healthy?</th>
<th>are chemically identical?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural</td>
<td>118</td>
<td>108</td>
<td>98</td>
<td>103</td>
</tr>
<tr>
<td>Indifferent</td>
<td>28</td>
<td>35</td>
<td>46</td>
<td>42</td>
</tr>
<tr>
<td>Commercial</td>
<td>9</td>
<td>12</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>Observed N</td>
<td>155</td>
<td>155</td>
<td>155</td>
<td>155</td>
</tr>
<tr>
<td>Chi square (df), p value</td>
<td>42.97 (2), p = 0.000</td>
<td>24.79 (2), p = 0.000</td>
<td>14.56 (2), p = 0.001</td>
<td>19.90 (2), p = 0.000</td>
</tr>
</tbody>
</table>

Similar results were found in Sacramento where the number of respondents who preferred natural was greater than the number of respondents who chose indifferent or commercial across all of the conditions for beef and across three of the conditions for potatoes (Tables 4-3 and 4-4). The number of respondents who chose indifferent was greater than the number of respondents who preferred natural when the two forms of potato were stipulated as being chemically identical. Nonetheless, among 197 respondents in Sacramento who preferred the natural form of potato under the condition stipulating equal health, 77% of them continued to prefer natural under the condition stipulating chemical identity.
Table 4-3. Frequency of “natural”, “commercial”, or “indifferent” categories chosen by Sacramento respondents when asked about preferences for potatoes under four different conditions (n=335).

<table>
<thead>
<tr>
<th>Would you prefer to eat a “natural” or a “commercially grown” potato, given that they . . .</th>
<th>cost the same?</th>
<th>taste the same?</th>
<th>are equally healthy?</th>
<th>are chemically identical?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural</td>
<td>262</td>
<td>260</td>
<td>197</td>
<td>152</td>
</tr>
<tr>
<td>Indifferent</td>
<td>47</td>
<td>64</td>
<td>116</td>
<td>170</td>
</tr>
<tr>
<td>Commercial</td>
<td>26</td>
<td>11</td>
<td>22</td>
<td>13</td>
</tr>
<tr>
<td>Observed N</td>
<td>335</td>
<td>335</td>
<td>335</td>
<td>335</td>
</tr>
<tr>
<td>Chi square (df), p value</td>
<td>106.70 (2), p = 0.000</td>
<td>107.43 (2), p = 0.000</td>
<td>25.87 (2), p = 0.000</td>
<td>64.77 (2), p = 0.000</td>
</tr>
</tbody>
</table>

Table 4-4. Frequency of “natural”, “commercial”, or “indifferent” categories chosen by Sacramento respondents when asked about preferences for beef under four different conditions (n=330).

<table>
<thead>
<tr>
<th>Would you prefer to eat “natural” or a “commercially raised” beef, given that they . . .</th>
<th>cost the same?</th>
<th>taste the same?</th>
<th>are equally healthy?</th>
<th>are chemically identical?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural</td>
<td>242</td>
<td>250</td>
<td>208</td>
<td>168</td>
</tr>
<tr>
<td>Indifferent</td>
<td>51</td>
<td>62</td>
<td>100</td>
<td>149</td>
</tr>
<tr>
<td>Commercial</td>
<td>37</td>
<td>18</td>
<td>22</td>
<td>13</td>
</tr>
<tr>
<td>Observed N</td>
<td>330</td>
<td>330</td>
<td>330</td>
<td>330</td>
</tr>
<tr>
<td>Chi square (df), p value</td>
<td>73.47 (2), p = 0.000</td>
<td>89.62 (2), p = 0.000</td>
<td>31.92 (2), p = 0.000</td>
<td>45.96 (2), p = 0.000</td>
</tr>
</tbody>
</table>

In Mexico City and Sacramento, for both potatoes and beef, the number of respondents who showed a preference for natural varied in response to changes in the stipulated conditions (Tables 4-1 to 4-4). The number of respondents who preferred the natural forms was greater when natural and commercial forms cost the same than when the two forms were stipulated as being chemically identical. The number of respondents
who were indifferent about natural and commercial forms was greater when the two forms were stipulated as being chemically identical than when they cost the same. Chi-square tests of the results from both samples and for both food types indicate that the observed distributions of responses across the preference categories were significantly different from a hypothetical outcome in which the natural, commercial, and indifferent choices are expected to occur with equal probabilities (Figures 4-7 to 4-22). The observed distributions support the prediction that people prefer natural over commercial foods, and these choices were not made randomly. Some participants shifted their responses to the logically correct indifferent option when the condition changed from stipulating equal cost to chemical identity. However, among the respondents in both samples who prefer the natural forms of potato and beef when cost is not a factor, more than 50% of them maintain this natural preference even when the natural and commercial alternatives are chemically identical. Thus, overall there is clear evidence that a cognitive bias to prefer food categorized as “natural” outweighs logical reasoning among students in Sacramento and Mexico City.
Figures 4-7 to 4-10. Chi square analysis rejects the hypothesis that Sacramento respondents choose natural, commercial, and indifferent preference categories for potatoes with equal probability when cost (4-7), taste (4-8), health (4-9), and chemical identity are the same (4-10).
Chi square analysis rejects the hypothesis that Sacramento respondents choose natural, commercial, and indifferent preference categories for beef with equal probability when cost (4-11), taste (4-12), health (4-13), and chemical identity are the same (4-14).
Chi square analysis rejects the hypothesis that Mexico City respondents choose natural, commercial, and indifferent preference categories for potatoes with equal probability when cost (4-15), taste (4-16), health (4-17), and chemical identity are the same (4-18).
Chi square analysis rejects the hypothesis that Mexico City respondents choose natural, commercial, and indifferent preference categories for beef with equal probability when cost (4-19), taste (4-20), health (4-21), and chemical identity are the same (4-22).
Prediction 2: More females than males prefer natural over commercial foods, and females perceive greater violations of naturalness in modified foods than do males.

I predicted that preferences for natural food and perceptions of natural food would be gendered, with (a) more females preferring natural over commercial foods and (b) females rating modified foods less natural than males. The results from Sacramento support both of these predictions. There is no evidence of gendered preferences for natural food in Mexico City. However, the results from the Mexico City Subsample of respondents less than 25 years old support the second prediction that females perceive modified foods to be less natural compared to the naturalness ratings of males.

Pearson chi-square tests were conducted to compare the distributions of male and female responses across preference categories when choosing either natural or commercial forms of basic foods, or indifference. Chi-square values and p values were calculated for each of the four conditions that each stipulated a similarity between the natural and commercial choices. The percentage within each gender that chose natural in each of the four conditions is presented below for the two food types (potatoes and beef) in each of the two samples (Sacramento and Mexico City).
Table 4-5. Percentage of males and females in Sacramento who prefer natural potatoes in four different conditions.

<table>
<thead>
<tr>
<th></th>
<th>Percentage of males and females in Sacramento who prefer natural when “natural” and “commercially grown” potatoes…</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>cost the same</td>
</tr>
<tr>
<td>Female % within gender</td>
<td>85.1%</td>
</tr>
<tr>
<td>Male % within gender</td>
<td>65.8%</td>
</tr>
<tr>
<td>Chi square (df) p value</td>
<td>16.897 (2) p = 0.000</td>
</tr>
</tbody>
</table>

Figure 4-23. Percentage of males and females in Sacramento who prefer natural potatoes in four different conditions.
Table 4-6. Percentage of males and females in Sacramento who prefer natural beef in four different conditions.

<table>
<thead>
<tr>
<th>Gender</th>
<th>% within gender</th>
<th>cost the same</th>
<th>taste the same</th>
<th>are equally healthy</th>
<th>are chemically identical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>77.8%</td>
<td>80.7%</td>
<td>67.0%</td>
<td>53.8%</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>65.3%</td>
<td>66.9%</td>
<td>55.9%</td>
<td>45.8%</td>
<td></td>
</tr>
</tbody>
</table>

Chi square (df) p value
- Female: 8.260 (2) p = 0.016
- Male: 7.947 (2) p = 0.019
- Female: 4.429 (2) p = 0.109
- Male: 2.416 (2) p = 0.299

Figure 4-24. Percentage of males and females in Sacramento who prefer natural beef in four different conditions.
As expected, a numerically higher percentage of females compared to males chose natural across all four conditions for both food types in Sacramento. Females in Sacramento demonstrated a significantly higher preference for natural compared to their male counterparts in three out of the four conditions for potatoes (Table 4-5 and Figure 4-23), and in two out of the four conditions for beef (Table 4-6 and Figure 4-24). The difference between the percentage of females and the percentage of males in Sacramento who chose natural was higher when the natural and commercial forms cost the same than when the natural and commercial forms were stipulated as being chemically identical.

As expected, the naturalness ratings provided by females tended to be lower than those of males in Sacramento, and a couple of statistically significant differences were observed between their means (Pearson chi-square tests unless noted otherwise). Gender differences in mean naturalness ratings in Sacramento were more apparent among the variants of chicken than among the variants of corn (Figures 4-25 and 4-26). Though there were no significant gender differences in mean naturalness ratings of corn, the means for females were all numerically lower than those for males with the exception of the variant receiving the highest overall mean naturalness rating (corn harvested from a field with fresh manure) (Figure 4-25). The corn variant demonstrating the largest gender difference was genetically modified with a gene from a cow ($x^2=8.101$, df=4, p=0.088; Kruskal-Wallis Test $p=0.032$), and this was the corn variant rated the least natural overall in Sacramento. Among the naturalness ratings of chicken in Sacramento, the means for females were all numerically lower than those for males (Figure 4-26). The chicken variants demonstrating the largest gender differences were chicken that forages in manure...
(x^2=13.801, df=4, p=0.008), genetically modified chicken with a duck gene (x^2=11.675, df=4, p=0.020), and chicken injected with hormones (x^2=9.256, df=4, p=0.055; Kruskal-Wallis Test p=0.18).

Figure 4-25. Male and female mean naturalness ratings of corn in Sacramento, presented on the X axis in the order they appeared on the study instrument (Version A). (GM= genetically modified)
No significant differences were observed between male and female preferences for natural food in Mexico City. A numerically higher percentage of females compared to males in Mexico City preferred natural potatoes in three out of the four conditions, but these differences were not significant (Table 4-7 and Figure 4-27). And, unexpectedly, a numerically higher percentage of males compared to females in Mexico City preferred natural beef in three out of the four conditions, but these differences were not significant (Table 4-8 and Figure 4-28). The results of the Mexico City Subsample of respondents less than 25 years old were essentially the same in failing to demonstrate gender differences with regards to the natural preference.

Figure 4-26. Male and female mean naturalness ratings of chicken in Sacramento, presented on the X axis in the order they appeared on the study instrument (Version B). (GM= genetically modified)
Table 4-7. Percentage of males and females in Mexico City who prefer natural potatoes in four different conditions.

<table>
<thead>
<tr>
<th></th>
<th>% within gender</th>
<th>cost the same</th>
<th>taste the same</th>
<th>are equally healthy</th>
<th>are chemically identical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female % within gender</td>
<td>84.4%</td>
<td>69.8%</td>
<td>58.3%</td>
<td>65.6%</td>
<td></td>
</tr>
<tr>
<td>Male % within gender</td>
<td>76.3%</td>
<td>62.7%</td>
<td>64.4%</td>
<td>61.0%</td>
<td></td>
</tr>
<tr>
<td>Chi square (df) p value</td>
<td>1.584 (2)</td>
<td>2.699 (2)</td>
<td>1.232 (2)</td>
<td>1.952 (2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>p = 0.453</td>
<td>p = 0.259</td>
<td>p = 0.540</td>
<td>p = 0.377</td>
<td></td>
</tr>
</tbody>
</table>

Figure 4-27. Percentage of males and females in Mexico City who prefer natural potatoes in four different conditions.

Condition for Natural and Commercial Potatoes
Table 4-8. Percentage of males and females in Mexico City who prefer natural beef in four different conditions.

<table>
<thead>
<tr>
<th></th>
<th>Female % within gender</th>
<th>Male % within gender</th>
<th>Chi square (df)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>cost the same</td>
<td>79.2%</td>
<td>71.2%</td>
<td>2.083 (2)</td>
<td>p = 0.353</td>
</tr>
<tr>
<td>taste the same</td>
<td>67.7%</td>
<td>72.9%</td>
<td>1.022 (2)</td>
<td>p = 0.600</td>
</tr>
<tr>
<td>are equally healthy</td>
<td>60.4%</td>
<td>67.8%</td>
<td>1.068 (2)</td>
<td>p = 0.586</td>
</tr>
<tr>
<td>are chemically identical</td>
<td>62.7%</td>
<td>68.8%</td>
<td>3.211 (2)</td>
<td>p = 0.201</td>
</tr>
</tbody>
</table>

Figure 4-28. Percentage of males and females in Mexico City who prefer natural beef in four different conditions.
There were also no significant differences between naturalness ratings of males and females in Mexico City when the entire sample is included in the analysis. Unexpectedly, females in Mexico City gave numerically higher mean naturalness ratings for four out of the six variants of corn, though none were significantly higher than the mean ratings provided by males. Females in Mexico City did give numerically lower mean naturalness ratings for five out of the six variants of chicken, but again, no statistically significant gender differences were observed.

The naturalness ratings of the Mexico City Subsample of respondents less than 25 years old, on the other hand, support the prediction that females perceive greater violations of naturalness in modified foods than do males (Pearson chi-square tests unless noted otherwise). Similar to the results from Sacramento, gender differences in mean naturalness ratings from the Mexico City Subsample were more apparent among the variants of chicken than among the variants of corn. Mean naturalness ratings were numerically lower in four out of six corn variants (Figure 4-29). The corn variants demonstrating the largest gender differences were corn harvested from a field with manure ($x^2=5.227$, df=4, p=0.265; Kruskal-Wallis Test p=0.051; ANOVA p=0.040) and corn genetically modified with a gene from a cow ($x^2=5.873$, df=3, p=0.118; Kruskal-Wallis Test p=0.122; ANOVA p=0.042). Among the naturalness ratings of chicken, the means for females were all numerically lower than those for males (Figure 4-30). The chicken variants demonstrating the largest gender differences were chicken injected with hormones ($x^2=8.404$, df=3, p=0.038; Kruskal-Wallis Test p=0.025; ANOVA p=0.006)
and genetically modified chicken with a cow gene ($x^2=8.096$, df=4, p=0.088; Kruskal-Wallis Test p=0.028; ANOVA p=0.006).

Figure 4-29. Male and female mean naturalness ratings of corn in Mexico City Subsample (<25 yrs. old), presented on the X axis in the order they appeared on the study instrument (Version A). (GM= genetically modified)

The predictions that preferences for natural and perceptions of natural would be gendered were strongly supported in Sacramento where more females preferred natural over commercial foods and females rated modified foods less natural than males. Neither of these predictions was confirmed in Mexico City when tested on the entire sample. However, post hoc tests indicate that there are significant gender differences in perceived naturalness among students less than 25 years old in Mexico City where females rated modified foods less natural than males.
Students of similar ages in Mexico City and Sacramento, therefore, resemble one another in terms of demonstrating gendered perceptions of natural despite there being evidence that preferences for natural are not gendered in Mexico City. In both countries, it is more apparent that males and females have different perceptions of natural food when considering animal-based foods rather than plant-based foods.
Prediction 3: The natural preference is stronger for animal-based foods than for plant-based foods, and modifications to animal-based foods lead to lower naturalness ratings.

The results of this study support the prediction that compared to plant-based foods, animal-based foods (1) elicit stronger natural preferences and (2) receive lower naturalness ratings.

I predicted that a smaller percentage of people would shift their natural preference to indifference for a meat compared to a vegetable when the condition changed from stipulating equal cost, taste, and health for natural and commercial variants to the condition stipulating chemically identical. As expected, 14.9% of the respondents in Sacramento with a natural preference for beef shifted to indifference with a change in condition from equal health to chemical identity, compared to 22.8% who shifted from natural preference to indifference for potatoes (Tables 4-3 and 4-4). Similarly, 11.4% less of the respondents in Sacramento shifted from natural preference to indifference for beef compared to potatoes when the condition changed from stipulating equal cost to chemical identity. Respondents in Mexico City demonstrated slightly different results. The change in condition from equal health to chemical identity actually caused a 5% increase in natural preference for both potatoes and beef. However, as anticipated, 12.7% of the respondents in Mexico City with a natural preference for beef shifted to indifference or commercial preference with a change in condition from equal cost to chemical identity, compared to 21.4% who underwent this shift in preferences for potatoes (Tables 4-1 and 4-2). In both countries, a larger percentage of respondents
demonstrate a natural preference for beef compared to potatoes under the condition stipulating chemical identity for natural and commercial foods. A greater difference between preferences for animal-based and plant-based food types is observed in Sacramento, where 50.9% prefer natural beef and 45.4% prefer natural potatoes, compared to Mexico City where 66.5% prefer natural beef and 63.9% prefer natural potatoes when the condition stipulates chemical identity of the natural and commercial alternatives.

I also predicted that the mean favorability ratings and naturalness ratings for chicken (Questionnaire Version B) would demonstrate a more precise linear fit in an explanatory model than would the corresponding ratings for corn (Questionnaire Version A). The results from Mexico City indicate that variation in favorability ratings for chicken are better explained by corresponding naturalness ratings ($n=82, r^2=0.936$) than is variation in favorability ratings for corn ($n=68, r^2=0.671$) (Figures 4-4 and 4-5). As a result of the outlying data point in Sacramento representing the low mean favorability rating for chicken that forages in manure, responses there did not demonstrate a stronger linear fit between favorability and naturalness for chicken compared to corn.

Each of the six variants of corn (Questionnaire Version A) and chicken (Questionnaire Version B) were designed to correspond to one another with the intention of drawing comparisons across pairs of responses for a plant-based food and an animal-based food (Table 4-9). For example, Variant 1 on Version A was genetically modified corn with the insertion of a gene from wheat, and Variant 1 on Version B was genetically modified chicken with the insertion of a gene from a duck. Thus, Variant 1 on each
Table 4-9. Variants of corn (Version A) and chicken (Version B) used on the study instruments in Sacramento and Mexico City.

<table>
<thead>
<tr>
<th>Variant Number</th>
<th>General Variant Type</th>
<th>Version</th>
<th>Description on Study Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Genetically Modified (GM) with a gene from a similar species</td>
<td>A</td>
<td>Corn that has been genetically modified with the insertion of a gene from wheat.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B</td>
<td>Chicken that has been genetically modified with the insertion of a gene from a duck.</td>
</tr>
<tr>
<td>2</td>
<td>With chemical additives</td>
<td>A</td>
<td>Corn that has been grown with chemical fertilizers and pesticides.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B</td>
<td>Chicken that has been injected with hormones.</td>
</tr>
<tr>
<td>3</td>
<td>Genetically Modified (GM) with a gene from the same kingdom, different species</td>
<td>A</td>
<td>Corn that has been genetically modified with the insertion of a gene from oranges.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B</td>
<td>Chicken that has been genetically modified with the insertion of a gene from a cow.</td>
</tr>
<tr>
<td>4</td>
<td>Grown or raised in manure</td>
<td>A</td>
<td>Corn that has been harvested from a field with fresh manure.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B</td>
<td>Chicken that forages in manure for insects and worms to eat.</td>
</tr>
<tr>
<td>5</td>
<td>Genetically Modified (GM) with a gene from a different kingdom (different species)</td>
<td>A</td>
<td>Corn that has been genetically modified with the insertion of a gene from a cow.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B</td>
<td>Chicken that has been genetically modified with the insertion of a gene from corn.</td>
</tr>
<tr>
<td>6</td>
<td>Grown or raised indoors</td>
<td>A</td>
<td>Corn that has been grown indoors.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B</td>
<td>Chicken that has been raised indoors.</td>
</tr>
</tbody>
</table>

version of the questionnaire represented the target food type genetically modified with the insertion of a gene from a similar species. I predicted that, within each pair of variants, chicken would receive lower favorability ratings than its plant-based counterpart, and that lower favorability ratings for chicken would correspond with lower naturalness ratings.

Figure 4-31 shows that, in Sacramento, the mean favorability ratings of chicken were significantly lower than those of corn in three out of six pairs of variants: Variant 1 \( (x^2=30.490, \text{ df}=4, \ p=0.000) \), Variant 3 \( (x^2=40.372, \text{ df}=4, \ p=0.000) \), and Variant 4.
(x^2=92.993, df=4, p=0.000). Figure 4-32 indicates that, in Sacramento, these same three pairs of variants were those in which chicken received significantly lower mean naturalness ratings than corn: Variant 1 (x^2=50.081, df=4, p=0.000), Variant 3 (x^2=51.100, df=4, p=0.000), and Variant 4 (x^2=63.104, df=4, p=0.000). Thus, there is evidence from Sacramento that similar types of modifications to a plant-based food and an animal-based food have different effects on their perceived favorability, with more negative attitudes toward the animal-based food. Where favorability was significantly lower for an animal-based food, naturalness was also significantly lower than the plant counterpart.

One exception to this finding in Sacramento was Variant 5, representing genetic modification across different taxonomic kingdoms, in which the chicken received a significantly higher mean favorability rating than the corn counterpart (x^2=22.622, df=4, p=0.000), though both received similar mean naturalness ratings. The other exception was for corn grown indoors and chicken raised indoors (Variant 6), which received similar mean favorability ratings, though the chicken counterpart received a significantly lower mean naturalness rating (x^2=9.914, df=4, p=0.042). This latter statistical difference in mean naturalness ratings, however, is not upheld when vegetarian, vegan, and red meat restricted respondents are excluded from the analysis. Otherwise, dietary restrictions did not have an effect on significance tests in Sacramento when analyzing for differences in favorability and naturalness ratings between chicken and corn within each variant type.

Figure 4-33 shows that, in Mexico City, the mean favorability ratings of chicken
Figure 4-31. Mean favorability ratings of corn (Version A) and chicken (Version B) in Sacramento, grouped into corresponding pairs of Variants (1 to 6).

Figure 4-32. Mean naturalness ratings of corn (Version A) and chicken (Version B) in Sacramento, grouped into corresponding pairs of Variants (1 to 6).
Figure 4-33. Mean favorability ratings of corn (Version A) and chicken (Version B) in Mexico City, grouped into corresponding pairs of Variants (1 to 6).

Figure 4-34. Mean naturalness ratings of corn (Version A) and chicken (Version B) in Mexico City, grouped into corresponding pairs of Variants (1 to 6).
were significantly lower than those of corn in three out of six pairs of variants: Variant 1 ($x^2=10.176$, df=4, p=0.038), Variant 3 ($x^2=14.037$, df=4, p=0.003), and Variant 6 ($x^2=17.298$, df=4, p=0.002). Figure 4-34 demonstrates that the chicken received numerically lower mean naturalness ratings in each of these same pairs; however, respondents in Mexico City did not perceive the chicken to be significantly less natural. Perceived naturalness was only significantly different between the food types paired together under Variant 2, in which chicken injected with hormones was perceived to be less natural than corn grown with chemical fertilizers and pesticides ($x^2=10.856$, df=4, p=0.028).

Overall, the results support the prediction that the natural preference is stronger for animal-based foods than for plant-based foods, and that people perceive animal-based foods to be less natural than plant-based counterparts. Despite a few exceptions, the data show clear evidence of this in Sacramento and Mexico City when observed from various perspectives.

**Prediction 4: Genetically modified foods are perceived to be the least natural among the variants tested.**

Three out of the six food variants used in each version of the study instrument were genetically modified in order to test whether these are perceived to be less natural than variants whose modifications are induced by chemicals or environmental factors.

This prediction is partially supported. Genetically modified variants of chicken received lower mean naturalness ratings than the other three chicken variants in
Sacramento (Table 4-10). In Mexico City, the genetically modified variants of corn received lower mean naturalness ratings than the other three corn variants (Table 4-11). However, in Sacramento, corn grown with chemical fertilizers and pesticides was rated less natural than one of the genetically modified corn variants (Table 4-12), and in Mexico City chicken that has been injected with hormones was rated less natural than one of the genetically modified chicken variants (Table 4-13).

**Table 4-10.** Mean naturalness ratings of chicken in Sacramento (n=168). (* = genetically modified)

<table>
<thead>
<tr>
<th>Variant of Chicken (in order of increasing naturalness)</th>
<th>Mean Naturalness Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicken that has been genetically modified with the insertion of a gene from a cow.</td>
<td>1.23*</td>
</tr>
<tr>
<td>Chicken that has been genetically modified with the insertion of a gene from a duck.</td>
<td>1.38*</td>
</tr>
<tr>
<td>Chicken that has been genetically modified with the insertion of a gene from corn.</td>
<td>1.45*</td>
</tr>
<tr>
<td>Chicken that has been injected with hormones.</td>
<td>1.66</td>
</tr>
<tr>
<td>Chicken that has been raised indoors.</td>
<td>2.55</td>
</tr>
<tr>
<td>Chicken that forages in manure for insects and worms to eat.</td>
<td>2.87</td>
</tr>
</tbody>
</table>
Table 4-11. Mean naturalness ratings of corn in Mexico City (n=68).
(* = genetically modified)

<table>
<thead>
<tr>
<th>Variant of Corn (in order of increasing naturalness)</th>
<th>Mean Naturalness Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn that has been genetically modified with the insertion of a gene from oranges.</td>
<td>2.19*</td>
</tr>
<tr>
<td>Corn that has been genetically modified with the insertion of a gene from a cow.</td>
<td>2.21*</td>
</tr>
<tr>
<td>Corn that has been genetically modified with the insertion of a gene from wheat.</td>
<td>2.38*</td>
</tr>
<tr>
<td>Corn that has been grown with chemical fertilizers and pesticides.</td>
<td>2.52</td>
</tr>
<tr>
<td>Corn that has been grown indoors.</td>
<td>3.04</td>
</tr>
<tr>
<td>Corn that has been harvested from a field with fresh manure.</td>
<td>3.28</td>
</tr>
</tbody>
</table>

Table 4-12. Mean naturalness ratings of corn in Sacramento (n=164).
(* = genetically modified)

<table>
<thead>
<tr>
<th>Variant of Corn (in order of increasing naturalness)</th>
<th>Mean Naturalness Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn that has been genetically modified with the insertion of a gene from a cow.</td>
<td>1.36*</td>
</tr>
<tr>
<td>Corn that has been genetically modified with the insertion of a gene from oranges.</td>
<td>1.82*</td>
</tr>
<tr>
<td>Corn that has been grown with chemical fertilizers and pesticides.</td>
<td>1.85</td>
</tr>
<tr>
<td>Corn that has been genetically modified with the insertion of a gene from wheat.</td>
<td>2.05*</td>
</tr>
<tr>
<td>Corn that has been grown indoors.</td>
<td>2.79</td>
</tr>
<tr>
<td>Corn that has been harvested from a field with fresh manure.</td>
<td>4.11</td>
</tr>
</tbody>
</table>
Table 4-13. Mean naturalness ratings of chicken in Mexico City (n=82). (* = genetically modified)

<table>
<thead>
<tr>
<th>Variant of Chicken (in order of increasing naturalness)</th>
<th>Mean Naturalness Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicken that has been genetically modified with the insertion of a gene from a cow.</td>
<td>1.90*</td>
</tr>
<tr>
<td>Chicken that has been genetically modified with the insertion of a gene from a duck.</td>
<td>1.95*</td>
</tr>
<tr>
<td>Chicken that has been injected with hormones.</td>
<td>2.01</td>
</tr>
<tr>
<td>Chicken that has been genetically modified with the insertion of a gene from corn.</td>
<td>2.39*</td>
</tr>
<tr>
<td>Chicken that has been raised indoors.</td>
<td>2.71</td>
</tr>
<tr>
<td>Chicken that forages in manure for insects and worms to eat.</td>
<td>3.26</td>
</tr>
</tbody>
</table>

While non-parametric tests indicate that, in Sacramento and Mexico City, the distribution of naturalness ratings across all of the variants within each food type are significantly different, the only set of responses in which the three genetically modified variants were all significantly lower than the other variants occurred in Sacramento for ratings of chicken (Figures 4-35 to 4-38).
Figure 4-35. Mean naturalness ratings of corn in Sacramento, presented on the X axis in the order they appeared on the study instrument (Version A).

Figure 4-36. Mean naturalness ratings of chicken in Sacramento, presented on the X axis in the order they appeared on the study instrument (Version B).
Figure 4-37. Mean naturalness ratings of corn in Mexico City, presented on the X axis in the order they appeared on the study instrument (Version A).

Figure 4-38. Mean naturalness ratings of chicken in Mexico City, presented on the X axis in the order they appeared on the study instrument (Version B).
Within each food type, respondents in Sacramento and Mexico City gave the three genetically modified variants significantly lower naturalness ratings than the variants grown or raised indoors and the variants grown or raised in manure.

For each variant of corn and chicken, the mean naturalness ratings in Sacramento were lower than they were in Mexico City, with the exception of corn harvested from a field with fresh manure, which received a significantly higher mean rating in Sacramento (Figures 4-39 and 4-40). Mean naturalness ratings of the genetically modified corn variants with a gene from oranges and with a gene from a cow were also significantly lower in Sacramento than they were in Mexico City. However, none of the corn variants received mean naturalness ratings that were significantly different between Sacramento and the Mexico City Subsample of respondents younger than 25 years old (Figures 4-39 and 4-41). The mean naturalness ratings of genetically modified chicken variants in Sacramento were all significantly lower than the corresponding ratings from Mexico City and lower than those from the Mexico City Subsample (Figures 4-40 and 4-42). Whereas the Mexico City sample as a whole considered two out of the three genetically modified chicken variants as being the least natural, the Mexico City Subsample considers the variant injected with hormones as being relatively less natural than the genetically modified variants inserted with a gene from a duck and inserted with a gene from corn. Thus, none of the samples fully support the prediction that genetically modified entities are the least natural among the variants tested. There is some support for this prediction when it comes to perceived naturalness of corn variants in Mexico City and perceived naturalness of chicken variants in Sacramento.
Figure 4-39. Mean naturalness ratings of corn (Version A) in Sacramento and Mexico City, presented on the X axis in ascending order of mean values from Sacramento.

Figure 4-40. Mean naturalness ratings of chicken (Version B) in Sacramento and Mexico City, presented on the X axis in ascending order of mean values from Sacramento.
Figure 4-41. Mean naturalness ratings of corn (Version A) in the Mexico City Subsample (<25 years old), presented on the X axis in ascending order of mean values.

Figure 4-42. Mean naturalness ratings of chicken (Version B) in the Mexico City Subsample (<25 years old), presented on the X axis in ascending order of mean values.
Prediction 5: Relative differences among naturalness ratings of genetically modified foods reflect perceived violations of natural categories between species-like groups.

Preliminary findings from the pilot research for this thesis demonstrated that variants inserted with genes from taxonomically similar living kinds receive nearly equivalent naturalness ratings as variants that lack genetic modification, but which are exposed to a chemical additive. Variants whose modification involves the insertion of taxonomically distant genes, however, receive significantly lower naturalness ratings. The results from Sacramento and from the Mexico City Subsample continue to support this prediction and suggest that folkbiological categories play a role in shaping perceptions of natural in the domain of food.

The mean naturalness ratings of different genetically modified corn variants in Sacramento meet this prediction and are consistent with the results of the pilot study (Table 4-10 and Figure 4-39). Respondents in Sacramento gave corn inserted with a gene from a cow (different kingdom) significantly lower naturalness ratings than the variant inserted with a gene from an orange (same kingdom, distant taxa) \( (n=166, \ p=0.000, \ x^2=55.537) \), which in turn, was rated significantly less natural than the corn variant inserted with a gene from wheat (more closely related taxa) \( (n=165, \ p=0.000, \ x^2=23.439) \). Genetically modified corn with a wheat gene received a relatively higher naturalness rating than corn grown with chemicals, but this difference was not significant. Thus, both genetically modified corn variants inserted with another plant gene received nearly equivalent naturalness ratings as a variant that lacks genetic modification, but which was exposed to a chemical additive.
The effect of taxonomic relatedness on naturalness ratings of genetically modified corn variants was not as strong in Mexico City (Table 4-12 and Figure 4-39). Genetically modified corn inserted with a gene from a cow received a nearly equivalent mean naturalness rating as the variant inserted with a gene from an orange, but both received relatively lower mean naturalness ratings than the variant inserted with a gene from wheat. Genetically modified corn with a gene from an orange received a significantly lower naturalness rating than the variant grown with chemicals \(n=69, \ p=0.025, \ x^2=5.0\) whereas corn inserted with a gene from wheat received a nearly equivalent naturalness rating as corn grown with chemicals.

Post hoc tests demonstrate that the Mexico City Subsample of respondents under 25 years old attributed naturalness ratings to the different genetically modified corn variants in a manner consistent with the predicted outcome (Figure 4-41). Respondents in this subsample gave corn inserted with a gene from a cow (different kingdom) a relatively lower naturalness ratings than the variant inserted with a gene from an orange (same kingdom, distant taxa) \(n=31, \ x^2=1.00, \ p=0.317\), which in turn, was rated relatively less natural than the corn variant inserted with a gene from wheat (more closely related taxa) \(n=32, \ x^2=1.923, \ p=0.166\). The genetically modified corn variant inserted with a gene from a cow received a significantly lower mean naturalness rating than the corn variant inserted with a gene from wheat \(n=31, \ x^2=5.556, \ p=0.018\). Thus, similar to the Sacramento samples from the pilot study and the principal study, this representative sample from Mexico City perceived that a genetically modified plant-based food inserted with the gene from a different plant is similar in terms of naturalness to a variant that
lacks genetic modification, but which was exposed to a chemical additive. And meanwhile, both of these variants received significantly higher mean naturalness ratings than the plant-based food variant inserted with a gene from an animal.

As expected, among respondents in Sacramento, genetically modified chicken inserted with a gene from a cow (same kingdom, distant taxa) received a significantly lower mean naturalness rating than the variant inserted with a gene from a duck (more closely related taxa) (n=168, p=0.000, x²=13.37) (Table 4-11 and Figure 4-40). This was not the case in Mexico City, where these variants received nearly equivalent naturalness ratings (Table 4-13 and Figure 4-38). However, the Mexico City Subsample of respondents less than 25 years old perceived relative differences in naturalness between these variants, which approached significance and show some support for the prediction (n=40, x²=3.267, p=0.071) (Figure 4-42).

The naturalness ratings of genetically modified chicken inserted with a gene from corn were similar in Sacramento and Mexico City in an unexpected way. In both samples, chicken inserted with a gene from corn was perceived to be significantly more natural than chicken inserted with a gene from a cow (Sacramento: n=168, p=0.000, x²=17.789; Mexico City: n=83, p=0.001, x²=11.255) (Tables 4-11 and 4-13; Figures 4-36 and 4-38). In Mexico City, the chicken variant inserted with a gene from corn also received a significantly higher naturalness rating than the chicken variant genetically modified with a gene from a duck (n=83, p=0.004, x²=8.333).

Overall, these findings are suggestive of a role for folkbiological species-like categories in shaping naturalness judgments of genetically modified foods. Perceived
violations of naturalness occur to different degrees in different genetically modified variants. These violations tend to reflect taxonomic distance and their corresponding notions of species boundaries. The findings also offer folkbiological data that may be useful in reassessing previously tested hypotheses regarding the effects of mixing like and dislike natural entities on naturalness ratings (Rozin, 2005; Evans et al., 2010).

Prediction 6: Naturalness ratings correspond with people’s expectations of
(a) the behavioral attributes of living things from which foods are derived and
(b) the health and safety properties of foods.

The principal study instrument was designed to examine whether categories of natural and non-natural food are consistent with, or possibly support, inferential reasoning about different properties. A premise statement stipulated that unmodified forms of the basic food item possess a “target” property, and participants used a 5-point scale to rate how likely it is that each modified food variant would maintain that same property. These are referred to as “likelihood ratings”. The premise statements were designed to include three specific target properties that could be classified more generally as a living kind behavioral property, a health property, and a safety property.

This study examined people’s expectations about the ways in which a living corn plant and a living chicken would behave. These living kind behavioral properties pertain to the organisms’ abilities to defend themselves or their offspring. The study instruments probed people’s inferences about these goal-directed behaviors specifically because prior studies have indicated that teleological actions that serve the function of maintaining life
are essentialized properties, and these actions are strong signals for the status of things as being alive (Barrett, 2001; Opfer and Seigler, 1994).

The naturalness ratings of the different variants serve as a point of reference to determine whether perceived naturalness corresponds with people’s expectations of: a) the behavioral attributes of living things from which basic foods are derived and b) the health and safety properties of unmodified basic foods. I anticipated that differences between the mean likelihood ratings for the three properties of the variants would correspond similarly with differences between their mean naturalness ratings. In other words, variants that are less natural than other variants are expected to be less ‘likely’ to possess the target properties. Specifically, if respondents consider a variant to be less than ‘moderately natural’ (rating < 3), then respondents are expected to consider it less than ‘likely’ (rating < 3) to possess the target properties. The results of this study from Sacramento and Mexico City support the prediction that perceived naturalness of a plant-based food (i.e., corn) corresponds with expectations about a behavioral attribute of its biological source in the living world. The results from both samples also support the prediction that perceived naturalness of an animal-based food (i.e., chicken) corresponds with expectations about the food’s health and safety properties.

Prior studies have demonstrated correlations between natural food preferences, food perceptions, and concerns about health and safety (Dickson-Spillman et al., 2011; Siegrist et al., 2006; Tenbult et al., 2005). However, the results of this study generally failed to support the prediction that naturalness ratings of corn correspond with perceptions of health. Instead, inferences about the living kind behavioral properties of
the corn variants corresponded more closely with the perceived naturalness of these variants. This was the case in Sacramento and Mexico City. Whereas the results pertaining to chicken variants were mixed in Sacramento, the perceptions of chicken in Mexico City support the hypothesis that perceived naturalness corresponds with people’s expectations of living kind behavioral properties along with perceptions of health and safety. Thus, the results are further suggestive of perceived differences between plant- and animal-based foods. People’s inferences about the behavioral attributes of the variants used in this study may help to explain how folkbiological biases influence the perceived naturalness of basic foods.

**Figure 4-43.** Mean likelihood ratings for three properties of corn (Version A) in Sacramento, presented on the X axis in order of increasing mean naturalness scores.
Sacramento: Corn

Genetically modified corn inserted with a cow gene was perceived to be less than ‘moderately natural’ (<3). This variant was also perceived to be less than ‘likely’ (<3) to maintain each of the three properties: behavioral, health, and safety. In contrast, corn from a field with manure was perceived to be more than ‘moderately natural’ (>3) as well as more than ‘likely (>3) to possess each of the three properties. These differences between the two extreme cases appear to support the general prediction that perceptions of all three properties vary directly with changes in perceived naturalness from one variant to another (Figure 4-43). However, in looking across all six corn variants in Sacramento for evidence that different ratings of naturalness vary directly with different likelihood ratings for these properties, the results show that the mean likelihood ratings for the behavioral property showed more consistency with the predicted pattern ($r^2=0.748$) than did ratings for the health ($r^2=0.646$) and safety ($r^2=0.534$) properties. In Sacramento, three out of the five corn variants that were less than ‘moderately natural’ were also less than ‘likely’ to maintain a living kind behavioral attribute. In contrast, only two out of the five corn variants that were less than ‘moderately natural’ were also less than ‘likely’ to maintain their health and safety properties. The two corn variants genetically modified with genes from other plants (GM corn with wheat gene and GM corn with orange gene), which received nearly equivalent naturalness ratings, received similar mean likelihood ratings for all three properties. Both of these variants received unexpectedly high mean likelihood ratings for health and safety, but on the other hand, they were less than ‘likely’ to maintain the behavioral property as predicted. All of the mean likelihood ratings of the
genetically modified variants inserted with plant genes were significantly higher than the corresponding mean likelihood ratings of the variant genetically modified with a gene from an animal. Overall, there was a noticeable direct positive relationship in Sacramento between mean naturalness ratings of the six corn variants and their mean likelihood ratings for the behavioral property. Also, there is support in Sacramento for the prediction that those corn variants perceived to be less than ‘moderately natural’ would also be perceived to be less than ‘likely’ to maintain the living kind behavioral property. The results are less clear in demonstrating support for this prediction with regards to the health and safety properties of corn.

**Mexico City: Corn**

Inferences about the safety and behavioral properties of the six corn variants in Mexico City showed some consistency with the predicted pattern, whereas ratings for the health properties generally did not (Figure 4-44). For instance, there was a much more direct linear relationship between mean naturalness ratings and mean likelihood ratings for the behavioral ($r^2=0.945$) and safety ($r^2=0.885$) properties than for the health property ($r^2=0.020$). There is partial support for the prediction that those corn variants perceived to be less than ‘moderately natural’ would also be perceived to be less than ‘likely’ to maintain the living kind behavioral property. This was the case for the two corn variants receiving the lowest mean naturalness ratings (GM corn with orange gene and GM corn with cow gene). Surprisingly, the two other corn variants that were perceived to be less than ‘moderately natural’ were nevertheless considered ‘likely’ to maintain all three
properties (health, safety, behavior). In summary, genetically modified corn with an orange gene and genetically modified corn with a cow gene were less than ‘likely’ to maintain a behavioral property while genetically modified corn with a wheat gene, corn grown with chemical additives, and corn grown indoors were ‘likely’ to maintain a behavioral property, and finally, corn from a field with manure was more than ‘likely’ to maintain a behavioral property. In contrast, only one corn variant was perceived to be less than ‘likely’ to maintain a safety property although four variants were considered less than ‘moderately natural’. And, whereas the less than ‘moderately natural’ corn variant genetically modified with a cow gene is perceived to maintain the health property,
the more than ‘moderately natural’ corn variant from a field with manure is considered less than ‘likely’ to maintain a health property. These responses may indicate different concepts of health related properties in foods from what was expected based on an understanding of the relationship between perceived naturalness and health in the United States. However, the results clearly demonstrate stronger support in Mexico City for the prediction that perceived naturalness of corn corresponds with expectations about behavioral attributes of living things compared to the same predictions regarding people’s expectations about health and safety properties.

Sacramento: Chicken

Despite a relatively direct linear relationship between mean naturalness ratings and mean likelihood ratings for the behavioral property of chicken variants in Sacramento ($r^2=0.740$), the results were not consistent with the prediction that variants perceived to be less than ‘moderately natural’ would also be less than ‘likely’ to possess this target property (Figure 4-45). Five out of the six chicken variants received ratings less than ‘moderately natural’, yet all six variants were considered ‘likely’ or more than ‘likely’ to maintain the behavioral property. Respondents in Sacramento inferred that all of the chicken variants are more likely to maintain a behavioral property than either a health or safety property. Although variation in the mean likelihood ratings for the health and safety properties of chicken did not correspond strongly with variation in the mean naturalness ratings ($r^2=0.515$ for health; $r^2=0.319$ for safety), these ratings were somewhat consistent with one another since the four variants receiving very low mean
naturalness ratings also received low mean likelihood ratings for the health and safety properties. According to respondents in Sacramento, all of the chicken variants, except the variant that is raised indoors, are significantly less than ‘likely’ to maintain health or safety properties. This strongly contrasts with the perception in Sacramento that all of the chicken variants are ‘likely’ or significantly more than ‘likely’ to maintain the behavioral property.

**Figure 4-45.** Mean likelihood ratings for three properties of chicken (Version B) in Sacramento, presented on the X axis in order of increasing mean naturalness scores.

Overall, ratings of chicken are mixed in Sacramento with respect to the hypothesis tested. Although mean naturalness ratings and mean likelihood ratings for the behavioral property of chicken corresponded with one another as predicted, the results do not
support the prediction that those chicken variants perceived to be less than ‘moderately natural’ would also be perceived to be less than ‘likely’ to maintain the living kind behavioral property. For chicken variants that received low naturalness ratings, respondents in Sacramento tended to infer that healthy and safety were less than ‘likely’ to be maintained.

Figure 4-46. Mean likelihood ratings for three properties of chicken (Version B) in Mexico City, presented on the X axis in order of increasing mean naturalness scores.

**Mexico City: Chicken**

Mean likelihood ratings for all three properties of the six chicken variants in Mexico City generally followed the predicted pattern (Figure 4-46). The variation in mean likelihood ratings for health across the six chicken variants demonstrated the most
direct linear relationship with corresponding changes in mean naturalness ratings ($r^2=0.946$), followed closely by the relationship between mean likelihood ratings for the behavioral property and mean naturalness ratings ($r^2=0.905$). The mean naturalness ratings and mean likelihood ratings for the safety property of the six chicken variants in Mexico City did not demonstrate as direct of a relationship, however, these values did generally correspond as predicted ($r^2=0.781$). In Mexico City, the three chicken variants (GM chicken with cow gene, GM chicken with duck gene, and chicken with hormones) that received the lowest mean naturalness ratings (all less than ‘moderately natural’) were perceived to be the least likely to possess each of the three target properties. Thus, three out of the five chicken variants that were rated less than ‘moderately natural’ were also considered less than ‘likely’ to maintain each of the properties.

To summarize, the results in Sacramento support the prediction that perceived naturalness of a plant-based food corresponds with expectations about a behavioral attribute of its biological source in the living world. The results in Sacramento did not support the prediction that perceived naturalness of a plant-based food correspond with inferred health and safety properties. On the other hand, in Sacramento, inferences about health and safety properties of an animal-based food appear to correspond with perceived naturalness more so than do inferences about a behavioral attribute of its living kind counterpart. In fact, respondents in Sacramento do not demonstrate the expectation that a behavioral property of an animal will change as a result of the modifications presented in this study. Similar to the results from Sacramento, responses from Mexico City clearly demonstrate stronger support for the prediction that perceived naturalness of a plant-
based food corresponds with expectations about a behavioral attribute of the living counterpart compared to the same prediction applied to people’s expectations about health and safety properties of the food. On the other hand, the results in Mexico City support the overall hypothesis that naturalness ratings of an animal-based food correspond with people’s expectations about a behavioral attribute of the living kind counterpart from which it is derived, in addition to corresponding with expectations about the health and safety properties of the food itself.

**Prediction 7: Similarity judgments involving basic foods are based on shared biological content whereas similarity judgments involving complex processed foods are based on shared processing history or shared function.**

Rozin et al. (2004) demonstrated that when college undergraduates are given a choice between natural and commercial forms of a raw unprocessed food, students strongly prefer to eat the natural version; however, this natural preference is not as evident when the same choice is provided for a processed food. Similarly, Tenbult et al. (2005) found that basic food products have more at stake than processed foods when it comes to losing their perceived naturalness and favorability as a result of genetic modifications. Since naturalness judgments and natural preference have been shown to vary across food product categories, the principal study asked participants to make similarity judgments that test the influence of living kind status and biological content against the influence of processing history and function in categorical thinking about basic and processed foods. Respondents also indicated whether basic and processed foods
are judged to be more similar to closely related biological cues than they are to other food substances and artifacts. Participants used a 5-point Likert scale to indicate agreement or disagreement with ten statements.

The pattern of responses from participants in Mexico City indicated problems with the translation of this section of the study instrument. For every statement, respondents in Mexico City disagreed or strongly disagreed significantly more often than they agreed or strongly agreed. This pattern of responses to all of the statements from a single sample indicates that study participants were not formulating answers that were consistent from one statement to the next. The results are not presented here, but the discussion in the following chapter suggests how to avoid the translation problem by redesigning this section of the study instrument for future research.

In Sacramento, Kolmogorov-Smirnov tests (significance level .05) indicated that responses to each statement were significantly skewed towards either agreement or disagreement, and therefore, none of the sets of responses had a normal or uniform distribution around the median choice of “neither fully agree nor fully disagree”. For a sub-sample of participants in Sacramento (n=35), the structure of each statement was reversed so that cues were presented in the opposite order than they were for the rest of the Sacramento sample (n=300). The responses of this small sub-sample mirrored those of the larger Sacramento sample in six out of the ten statements. For instance, where the larger Sacramento sample showed significantly more disagreement with the statement that “A twinkie is more like a stalk of wheat than it is like a plastic bag”, the subsample showed significantly more agreement with the statement that “A twinkie is more like a
plastic bag than it is like a stalk of wheat”. This consistency between responses from the small subsample and the larger sample in Sacramento indicates that the order in which cues were presented within each statement should not have had a large effect, if any, on the outcome of the results. The responses from the subsample (n=35) were reversed (i.e., “strongly disagree” was changed to “strongly agree”) and included with analysis of the larger Sacramento sample.

Subjects were expected to agree that a modified and an unmodified variant of the same kind of basic food (i.e., genetically modified chicken and free-range chicken) are more similar to one another than either is to a variant of a different kind of basic food (i.e, genetically modified fish). In other words, respondents were expected to privilege similar biological content and living kind status over similar types of modifications when making comparative judgments involving basic foods. The results from Sacramento did not support this prediction when it comes to judgments about basic foods that have been genetically modified or treated with a chemical additive. Respondents in Sacramento tended to distinguish genetically modified and non-genetically modified versions of living things and basic foods from one another according to their types of modification or their lack of modification rather than according to their biological content and status as living things (i.e., chicken, fish, apples) (Table 4-14). This was also the case in similarity judgments involving a basic food that was injected with hormones (Table 4-14). Respondents tended to disagree with these statements in which modified and unmodified versions of the same kind of living thing were said to be more similar to one another than either was to a modified or unmodified version of a different kind of living thing.
Contrary to the prediction that similarity judgments involving basic foods are based on shared biological content, these findings offer evidence in support of the notion that shared history or type of intervention is more important than shared biological content or living kind status in shaping food perceptions of basic foods that have been genetically modified or treated with chemical additives.

Table 4-14.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Disagree or Strongly Disagree</th>
<th>Neither fully Agree nor fully Disagree</th>
<th>Agree or Strongly Agree</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genetically modified chickens are more like free-range chickens than they are like genetically modified fish.</td>
<td><strong>127</strong></td>
<td><em>39.5%</em></td>
<td>30.1%</td>
<td>98</td>
</tr>
<tr>
<td><strong>41.6%</strong></td>
<td></td>
<td></td>
<td></td>
<td>322</td>
</tr>
<tr>
<td>Organic free-range chickens are more like genetically modified chickens than they are like organically grown apples.</td>
<td><strong>133</strong></td>
<td><em>41.6%</em></td>
<td>28.4%</td>
<td>96</td>
</tr>
<tr>
<td><strong>41.6%</strong></td>
<td></td>
<td></td>
<td></td>
<td>320</td>
</tr>
<tr>
<td>Meat from a chicken injected with growth hormones is more like meat from a free-range chicken than it is like steak from a cow injected with growth hormones.</td>
<td><strong>156</strong></td>
<td><em>48.9%</em></td>
<td>26.3%</td>
<td>79</td>
</tr>
<tr>
<td><strong>48.9%</strong></td>
<td></td>
<td></td>
<td></td>
<td>319</td>
</tr>
</tbody>
</table>

Whereas the effects of genetic modification and use of hormones appear to be very strong, respondents tended to overlook an external environmental factor in agreeing that two variants of the same kind of basic food growing in different environments have
more in common with one another as a result of shared biological content (i.e., lemons) than do two different kinds of basic foods that grow in similar environments (Table 4-15). Similarly, respondents tended to judge that a basic food item that has undergone only minimal processing (i.e., potato diced into cubes) is more similar to its living kind counterpart than to a slightly more processed food item of the same kind (i.e., dried potato starch) (Table 4-15). Therefore, responses to these two statements offer conditional support for the prediction that similarity judgments involving basic foods are based on shared biological content.

Table 4-15.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Disagree or Strongly Disagree</th>
<th>Neither fully Agree nor fully Disagree</th>
<th>Agree or Strongly Agree</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lemons grown inside a greenhouse are more like lemons grown outdoors than they are like kiwis grown inside a greenhouse</td>
<td>86</td>
<td>27.0%</td>
<td>32.4%</td>
<td>129</td>
</tr>
<tr>
<td>A potato diced into cubes is more like a potato growing in a field outdoors than it is like dried potato starch</td>
<td>84</td>
<td>26.2%</td>
<td>32.4%</td>
<td>133</td>
</tr>
</tbody>
</table>

More complex processed foods (i.e., high fructose corn syrup), however, were expected to cue for an artifact psychology. Therefore, I expected participants to judge
that complex foods are more similar to substances and artifacts than they are to living kinds. For these types of foods, respondents were expected to privilege similar functional properties or designed attributes of foods over similar biological content when making comparative judgments. These results would indicate that living kind status is weighted less heavily when thinking categorically about complex foods than when thinking categorically about basic foods. Compared to a minimally processed food, respondents indicated that fully *processed foods* whose biological source and designed function were made apparent are more comparable to other similarly *designed* food substances than they are to their biological sources in the living world (Table 4-16). For instance, respondents tended to agree that high fructose corn syrup is more like Sweet n’ Low (an artificial sweetener) than it is like a cob of corn. This finding was consistent with the prediction that similarity judgments involving complex (highly processed) foods would be based on shared function (design). The prediction was also confirmed where respondents showed significantly more agreement that peppermint tea is more like chamomile tea than it is like a living mint plant (Table 4-16). These results indicate that people take information about the design and intended uses of these food items into account when making comparative judgments rather than basing their responses on information provided about similarities in biological content. The findings are interpreted as evidence of an artifact mode of construal in which processed food items are categorized according to design, function, and intended uses.
In the most extreme cases, study participants were expected to agree that modified and unmodified variants of the same kind of basic food (i.e., genetically modified chicken and free-range chicken) are more similar to one another than either is to an artifact (i.e., rubber chicken) that replicates the appearance of that living kind. Thus, even the most extreme types of modifications to basic foods, such as genetic engineering, were not expected to affect perceptions so strongly as to cue for representations of inanimate and inedible objects. However, a surprisingly large number of respondents disagreed that a genetically modified variant of a basic food/living thing is more like an unmodified variant of the same kind (i.e., chicken) than it is like an inanimate and inedible replication of its kind (i.e., rubber chicken) (Table 4-17). These respondents appear to have overlooked or discounted shared biological content and living kind status in drawing such a strong distinction between genetically modified and non-genetically modified variants.

Table 4-16.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Disagree or Strongly Disagree</th>
<th>Neither fully Agree nor fully Disagree</th>
<th>Agree or Strongly Agree</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>High fructose corn syrup is more like “Sweet’N Low” (an artificial sweetener) than it is like a cob of corn</td>
<td>85</td>
<td>83</td>
<td>153</td>
<td>321</td>
</tr>
<tr>
<td></td>
<td>26.5%</td>
<td>25.9%</td>
<td>47.6%</td>
<td></td>
</tr>
<tr>
<td>Peppermint tea is more like chamomile tea than it is like a living mint plant</td>
<td>70</td>
<td>130</td>
<td>118</td>
<td>318</td>
</tr>
<tr>
<td></td>
<td>22.0%</td>
<td>40.9%</td>
<td>37.1%</td>
<td></td>
</tr>
</tbody>
</table>
of chicken. Genetic modification of a living thing has the effect of cueing for representations of an inanimate, inedible object. In a similar case, respondents also disagreed that a highly processed food (i.e., twinkie) is more similar to a common plant-based food source (i.e., wheat) than it is to an inedible artifact (i.e., plastic bag) (Table 4-17). Compared to the responses to the other nine statements used in the study instrument, the distribution of responses to this statement was the most skewed with approximately one-half of the respondents disagreeing or strongly disagreeing and only one-fifth agreeing or strongly agreeing. Complex highly processed foods appear to have the effect of cueing for representations of completely unrelated artifacts, and as a result, respondents discounted the relationship between one highly processed food item and one unprocessed, yet potential, food item. Genetic modification of a basic food appears to have such a strong effect on how people conceptually handle the resulting product that it gets categorically treated in a similar fashion as a highly complex processed food, which is to say, like an artifact.

In contrast, respondents showed a greater tendency to agree that a chemically-treated variant of a basic food/living thing is more similar to the unmodified living version of that basic food (i.e., strawberry) than it is to an artifact resembling its kind (i.e., plastic strawberry) (Table 4-18).
Table 4-17.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Disagree or Strongly Disagree</th>
<th>Neither fully Agree nor fully Disagree</th>
<th>Agree or Strongly Agree</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genetically modified chickens are more like free-range chickens than they are like rubber chickens.</td>
<td>111</td>
<td>109</td>
<td>100</td>
<td>320</td>
</tr>
<tr>
<td>A twinkie is more like a stalk of wheat than it is like a plastic bag.</td>
<td>160</td>
<td>93</td>
<td>68</td>
<td>321</td>
</tr>
</tbody>
</table>

Table 4-18.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Disagree or Strongly Disagree</th>
<th>Neither fully Agree nor fully Disagree</th>
<th>Agree or Strongly Agree</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strawberries grown with chemicals are more like organically grown strawberries than they are like plastic strawberries.</td>
<td>118</td>
<td>76</td>
<td>127</td>
<td>321</td>
</tr>
</tbody>
</table>
Overall, the results show some support for the prediction that similarity judgments involving basic unprocessed foods or foods with minimal processing are based on shared biological content, and in contrast, perceived similarities among more complex processed foods reflect shared processing history, design attributes, or intended uses. Foods with different amounts of processing are perceived differently. This distinction between perceptions of basic foods and perceptions of more complex processed foods supports the view that human cognitive architecture is comprised of specific domains for living things and artifacts. These domain specific modes of construal are well described in the literature on cognitive psychology and evolutionary psychology. However, the results showed some exceptions indicating that basic foods are not all treated the same. A genetically modified basic food is treated in a categorically similar fashion as complex processed foods that cue for an artifact mode of construal.
Chapter 5

DISCUSSION

Perceptions of food in terms of naturalness provide an opportunity to test hypotheses about innate, evolutionarily designed categories of the human mind. People have distinct intuitions about entities in the world that originate from either biological reproduction or from intentional human actions. Researchers who approach the study of the brain from the perspective of evolutionary psychology interpret these intuitions as evidence of innate categorical distinctions between living things and artifacts whose properties are unique. Furthermore, people have distinct intuitions about different kinds of living things according to their membership within folkbiological categories. The results of this study support the idea that content-dependent preferences and perceptions of basic foods in terms of naturalness are representative of innate categories of the mind within the domain of folkbiology. The results also suggest that different naturalness judgments of foods are representative of broader distinctions that are made when food contents or processes cue for a categorical shift from the domain of living things to that of artifacts. A discussion of these results has been framed from an evolutionary psychology perspective to consider how the seven predictions of this study relate to our understanding of these two domains.

DO PEOPLE HAVE A PREFERENCE FOR NATURAL FOOD?

The positive influence of natural content on consumer’s food preferences and perceptions of food quality is well established in the literature, yet the suggestion has
repeatedly been made to extend this analysis to non-Western-developed cultures (Rozin, 2005, 2006; Rozin et al., 2004; Steptoe et al., 1995). The results of the principal study for this thesis demonstrate that there is a substantial preference for natural over commercial foods among university students in Mexico City. The natural preference in Mexico City is at least as strong as it is among students and adults in the United States and in European countries where prior studies have tested this phenomenon (Rozin, 2005; Rozin et al., 2004; Rozin et al., 2009; Spranca, 1992).

In the current study, compared to their counterparts in Sacramento, the respondents in Mexico City demonstrated an even stronger preference for natural foods when (1) independently rating the favorability and naturalness of six variants of either a meat or a vegetable, and when (2) making categorical choices among a natural option, commercial option, or indifference for natural and commercial alternatives of basic foods under varying conditions with definitions of “natural” and “commercial” provided. University students in Mexico City used labeled category scales to demonstrate a positive relationship ($r^2=0.671$) between perceived naturalness and favorability of six corn variants and a linear positive relationship ($r^2=0.936$) between perceived naturalness and favorability of six chicken variants. The results of the categorical choice task from Mexico City are similar to those from Spranca (1992) and Rozin et al. (2004), and they are similar to results gathered from Sacramento during the pilot study. Subjects in each of these studies maintained a preference for natural food despite the stipulation that natural and commercial alternatives were chemically identical.
The current results from Mexico City offer support from a non-U.S./non-European sample for the idea that the reasons underlying natural food preferences are moral, aesthetic, or ideational when health and sensory properties are equalized (Rozin et al., 2004). The ideational bases for the natural preference include the belief that the normative order of things is best, where natural represents a certain state prior to human intervention, or the belief that natural is inherently better, whether or not it is prior.

Significant gender differences were observed in Sacramento with a higher percentage of females preferring the natural form of basic foods over commercial alternatives. These findings were consistent with results from a similar study in Switzerland testing for gender differences in preferences for natural food, attitudes towards chemicals, and perceived risks from environmental hazards (Dickson-Spillman et al., 2011). In a study among undergraduate students, Beaudreault (2009) found that females self-reported more often than males that labels on organic food products influence their perceptions. Rozin and colleagues (2004) found that females showed a stronger preference than males for natural food, but these differences were not significant. Preferences of males and females in Mexico City when choosing among natural and commercial forms of basic foods and indifference do not show any statistically significant gender differences.

The gender difference in natural preferences among respondents from Sacramento may reflect psychological factors described by Davidson and Freudenburg (1996) in support of their ‘Safety Concerns Hypothesis’, which holds that health and safety are more salient to females than to males. A plausible explanation for these psychological
differences is that women display increased health and safety concerns because of their roles as mothers/caretakers, which Davidson and Freudenburg (1996) refer to more specifically as the ‘Parental Roles Hypothesis’. Similarly, Curtis et al. (2004) consider higher disgust sensitivities among females compared to males as an evolved response as a result of their increased responsibilities in protecting both self and offspring from disease. Thus, in the current study, the observed gender differences in preferences for natural food were expected. However, even under the condition stipulating equal health of natural and commercial alternatives of potatoes, the percentage of females in Sacramento who demonstrated the natural preference remained significantly higher than the percentage of males. This was not the case when the alternatives of beef were stipulated as being equally healthy. Dickson-Spillman and colleagues (2011) reported that gender differences in risk perceptions of additives and contaminants could not explain gender differences in preferences for natural food. They conclude that gender differences in “universal” values (e.g., social justice) or differences between males and females with regards to the importance attributed to food in one’s life may be determinants that lead to gender differences in the preference for natural food. If greater concerns about health, and stronger associations between health and naturalness among females partially explain the observed gender differences, such factors may be shaped by cultural influences. In a study of environmental risk perceptions among people of different races and ethnicities in the United States, Flynn et al. (1994) found that non-Hispanic Caucasian males consistently differed from all other sub-groups in expressing lower risk concerns. The authors suggest that gender gaps in environmental risk concerns may actually be unique
to majority Caucasian groups living in the United States as a result of high thresholds for risk among males in this population. The results of the principal study for this thesis also suggest that any effects that health and safety concerns have on differences between male and female preferences for natural food are not independent of a food’s biological contents.

Along with differences between men and women in Sacramento, there were some pointed differences between the natural preferences of respondents from each of the countries. Respondents in Sacramento were significantly more likely than their counterparts in Mexico City to shift their preference for natural foods to indifference given the stipulation that the chemical identities of natural and commercial alternatives of a plant-based food are the same. On the other hand, respondents in both samples tended to maintain natural preference for an animal-based food despite stipulating that natural and commercial alternatives have the same chemical identities. Significantly larger percentages of Mexico City respondents prefer natural beef and natural potatoes compared to the percentages in Sacramento given the stipulation that natural and commercial alternatives of each food type are chemically identical. It is possible that the older mean age of the sample from Mexico City was a factor, since older people are more likely to show a natural preference and would be more likely to uphold this natural preference despite information that conflicts with this attitude (Steptoe et al., 1995). However, Rozin et al. (2004) point out that age was not the critical factor responsible for natural preference differences between adults from a jury group and university students – two samples with virtually no overlap in age.
An unanticipated finding from the principal study was that less than half of the respondents in Sacramento preferred natural potatoes in the condition stipulating chemical identity, and the majority indicated indifference for natural or commercial. Although the question is designed such that the indifferent choice is a logically-correct category, this finding is different from the results of the pilot study. Nevertheless, the majority of respondents from the principal study in Sacramento who started out preferring natural potatoes did not abandon their preference even when chemical identity was stipulated, which is consistent with findings from the pilot study and from Rozin et al. (2004).

Unlike their counterparts in Mexico City, respondents in Sacramento perceived that the variant of chicken that forages in manure would be unfavorable to eat although this same variant received the highest mean naturalness rating. The effect that this portrayal of a chicken has on perceived naturalness is approximately the same in Sacramento and Mexico City, yet the prediction that a relatively high naturalness rating would correspond with a relatively high favorability rating was satisfied in Mexico City and not in Sacramento. Dietary restrictions did not have a significant effect on naturalness and favorability ratings in Sacramento and, therefore, cannot account for this cultural difference. An important implication of this finding is that naturalness is not always equated with ‘good to eat’, at least not among university students in Sacramento when it comes to judging the qualities of an animal-based food. This apparent cultural difference in food attitudes could be an indicator that university students in Sacramento and Mexico City, despite living within or in close proximity to urban environments, have
a different range of experiences or information to draw from when thinking about environmental contexts and biological origins associated with food. Studies in naïve biology that identify significant effects of interactions with the natural world on developmental shifts in children’s living kind concepts suggest that similar experiential factors could influence adult judgments of related cues (Inagaki, 1990). Different experiential databases across cultures would depend on rural-urban socioeconomic networks, historical developments of cuisine, and everyday stimuli attached to market and household experiences of purchasing and consuming foods that all influence perceived norms and expectations regarding the nature and acceptability of animals and animal-based foods. These factors were not tested in the current study, but would be worthwhile to consider in future cross-cultural research.

Although it is not the case that preferences for natural food are stronger among females compared to males in both Sacramento and Mexico City, there is evidence from both samples that females perceive greater violations of naturalness in modified foods than do males. The naturalness ratings provided by females tended to be lower than those of males in Sacramento and also among the representative subsample of respondents from Mexico City less than 25 years old. In both countries, it is more apparent that males and females have different perceptions of natural food when considering animal-based foods rather than plant-based foods. Modifications appear to have a stronger effect on females than on males in terms of reducing the perceived naturalness of foods, particularly animal-based foods. This may explain why females are more likely than males in Sacramento to prefer natural foods. On the other hand, in Mexico City, the
perceptions of natural were different between male and female students of similar ages despite the fact that they shared similar preferences for natural food. Preferences for natural food were very high among both males and females in Mexico City, despite there being differences in perception between the genders. If gendered preferences for natural food reflect evolutionarily based psychological differences between males and females, then such differences should have been observed cross-culturally. Curtis and colleagues (2004) demonstrate and describe evolved gender differences in the disgust response. Rather than being demonstrated in preferences for natural food, it may be that perceptions of natural in the domain of food parallel findings from other studies suggesting that men and women evolved different psychological responses and other adaptations that were designed to prevent the acquisition of infectious disease and exposure to potentially noxious materials in the environment as a result of different biologically based roles in raising and protecting offspring.

In both Mexico City and Sacramento there were significantly stronger preferences for natural foods over commercial alternatives. The different influences that plant- and animal-based cues have on food preferences and naturalness perceptions were evident where pronounced cultural differences existed between the samples and where pronounced gender differences were observed. This brings us to the question of whether biological content and folkbiological assumptions have effects on perceived naturalness of basic foods, and whether perceived naturalness corresponds with the inferred folkbiological properties of living things and inferred instrumental (i.e., health, safety) properties of basic foods.
DO PREFERENCES AND PERCEPTIONS OF NATURAL FOOD SHOW EVIDENCE OF CATEGORIES THAT ARE “NATURAL” TO THE HUMAN MIND?

Natural Food Judgments and the Domain of Folkbiology

Differences Between Animals and Plants

Effects of a basic food’s biological content on preferences for natural were observed in both cultures. Preferences for natural food over a commercial alternative, and the amount of correspondence between perceived naturalness and favorability depended on whether respondents were judging a plant- or animal-based food. In both Sacramento and Mexico City, respondents were significantly more likely to maintain their preference for natural beef than they were to maintain their natural preference for potatoes when the conditions changed from stipulating equal cost of natural and commercial alternatives to stipulating chemical identity. This biased natural preference for animal-based foods was pronounced in Sacramento where respondents were also more likely to maintain their preference for natural beef compared to potatoes when the condition changed from stipulating equal health to stipulating chemical identity.

The results from Mexico City demonstrate that perceived naturalness is a more reliable predictor of perceived favorability for an animal-based food than for a plant-based food. This cannot be said for the results from Sacramento where a chicken variant received high naturalness and low favorability ratings, thus making it an outlier when representing the relationship between these qualities in a linear model. However, a
comparison of these ratings across food types from Sacramento indicate that similar modifications are perceived as having significantly more negative effects on the animal-based food compared to the plant in terms of reducing both naturalness and favorability. In Sacramento, chicken received significantly lower favorability ratings than its plant-based counterpart in three pairs of variants. These significantly lower favorability ratings for chicken corresponded with significantly lower naturalness ratings. The results were similar in Mexico City where comparisons across food types demonstrate that chicken variants received lower favorability and naturalness ratings than corn variants in all instances where significant differences occurred. Together, the results show consistency between category-based perceptions and preferences in the domain of folkbiology. Similar modifications cause greater reductions in perceived naturalness of animal-based foods compared to plant-based foods, and animal-based foods elicit a stronger natural preference.

The results do not indicate that dietary restrictions (i.e., vegetarian, vegan, red meat restricted), which are much more common in Sacramento than in Mexico City, were factors to explain different preferences for, and perceptions of, animal- and plant-based foods. There is evidence from Sacramento and Mexico City that females tend to give lower naturalness ratings than do males. No significant gender differences were observed in Sacramento or Mexico City among variants of corn, but females did rate variants of chicken significantly less natural than did males in both countries. Therefore, the larger proportion of females than males in the samples may account for some of the differences between perceived naturalness of animal- and plant-based foods. Future research could
look at correlations that potentially exist among gender differences in the perceived naturalness of foods, dietary restrictions, and the differences in perceived naturalness between foods of animal and non-animal origins. The results of future studies on perceptions of natural food are likely to parallel findings from other studies demonstrating that women greatly outnumber men among vegetarians in Western-developed countries, disgust reactions among these vegetarians are reportedly caused by moral beliefs, and non-vegetarian women in these countries eat considerably less meat than men (Fessler et al., 2003).

Results of the principal study for this thesis support arguments made elsewhere that animal-based foods are more likely than plant-based foods to produce food aversions, disgust, and other ambiguous responses (Rozin and Fallon, 1980; 1987). For instance, Pliner and Pelchat (1991) report that people were less willing to taste novel foods of animal origins compared to plant-based foods, and that there were no differences between their willingness to taste foods from different categories when subjects were familiar with the names and descriptions of the foods. Fessler and Navarrete (2003) explain that numerous selection pressures related to food consumption in the past could have resulted in heightened sensitivity to the risk of pathogen transmission, and that emotional responses to the category of animals in the food domain would have been targeted specifically. Evidence of a stronger natural preference for animal products compared to plant products is consistent with related studies that document lower levels of acceptance of genetic engineering for animals compared to plants, particularly when genetic modification targets food production (Beckwith et al., 2003; Gaskell et al., 2007;
Hursti and Magnusson, 203). Different attitudes toward animal and plant food products of biotechnology are suggestive of the role of folkbiological thought in naturalness judgments. Acceptance of genetic engineering in different types of organisms varies along a graded scale that reflects hierarchical thinking about living things at the level of the biological kingdom (Beckwith et al., 2003; Gaskell et al., 2007). The sequence from highest to lowest levels of acceptance includes microorganisms, plants, lower animals, and higher animals (including humans).

A widely documented difference in the acceptance of genetic modification in food products lies between plants and animals (Frewer et al., 1998; Hamstra, 1995; Hursti and Magnusson, 2003). These prior studies document attitudes from the U.S. and throughout Europe. From a study in Sweden, Hursti and Magnusson (2003) found that ratings of various attributes of organic potatoes and organic meat were about the same, while opinions on genetic modification of foods differed between animal and vegetable applications. Bredahl (2001), however, expresses doubt as to the level of significance between different attitudes with regard to food products where plants or animals have been genetically modified, and therefore considers this to be an obvious subject for future research. Among the various applications of biotechnology that exist, food production and agriculture are considered to be the least acceptable and medical uses are most favored. Consumers appear to be most concerned about the application of genetic modification when it comes to the meat industry. Strong opposition to the process of cloning animals for the supply of meat is an indication that perceived violations of naturalness in the domain of animals are not only elicited by the notion of mixing species,
but more generally, are sensitive to the notion of unnatural parentage (Gaskell et al., 2007). Gaskell and colleagues (2007) suspect that people will refer to internal natural and unnatural categories of food to infer certain attributes of meat from cloned animals, and they suspect that knowledge and intuitions about more familiar instances of unnatural parentage (i.e., human inbreeding) may guide attitudes and decision-making with regard to the products of this new technology.

Results of this study show that food attitudes, perceived naturalness of food, and the desire for natural qualities in food, depend on whether it is derived from either an animal or plant. This content-dependent dynamic of natural food preferences and perceptions is interpreted as evidence of a role for higher-order folkbiological categories. This intuitive division of living things has predictable and similar consequences on food judgments in two different cultures that do not necessarily share similar views and information regarding specific types of food modifications. The findings suggest a role for universal category-based cognitive mechanisms that are presumed to have an evolutionary basis. The division of living things into animal and plant categories at the “folk-kingdom” rank supports the partitioning of organisms into lower-order groups of generic species. This hierarchy of inclusive groups has been described as an evolved trait of our cognitive architecture that provided an adaptive advantage for human ancestors by supporting systematic reasoning about the properties of living kinds, particularly when organisms were newly encountered or unidentifiable (Atran, 1998).
Essentialism and Genetic Modification

Respondents’ ratings of genetically modified variants reveal the extent to which universal cognitive representations of living things influence perceived naturalness and preferences for natural in the domain of food. The defining features of living things - what causes them to be what they are and what underlies their membership in a certain category – are internally based. This perception of the nature of living things is different from how other types of things (i.e., artifacts) are perceived, and it appears to be a universally shared feature of the human mind. Prior studies demonstrate that university students perceive that molecular features (i.e., genetic code) are more important than physical and functional features of a living thing when: (1) determining what category it belongs to and (2) determining what causes it to possess its unique attributes (Ahn, 1998). These findings appear to be directly related in that molecular features have the strongest influence on categorical judgments of living things as a result of the belief that molecular features are responsible for causing each living thing to take on its unique identity. Hence, genetic makeup may be said to represent the essence of living things, at least among the sample of students used in Ahn’s (1998) study and in other related studies.

For the principal study of this thesis, food variants modified at the level of the gene were expected to receive lower mean naturalness ratings than variants modified under other conditions. The prediction that genetically modified foods are perceived to be the least natural among the variants tested was confirmed in Sacramento for chicken and in Mexico City for corn. Within each food type, respondents in Sacramento and Mexico City gave the three genetically modified variants significantly lower naturalness ratings
than the variants grown or raised indoors and the variants grown or raised in manure. However, a variant of corn in Sacramento and a variant of chicken in Mexico City modified by chemical additives each received lower naturalness ratings than a genetically modified variant in its respective food group. Respondents in Sacramento and Mexico City, therefore, did not perceive that all three variants modified at the level of the gene were significantly less natural than the other three variants for both food types. It is possible that design problems in the study instrument account for the finding that, in each country, a variant modified by chemical additives received a lower naturalness rating than the genetically modified variants. The precise descriptions of these chemically modified variants could be adjusted in future research to test for this possible design problem.

Rozin and colleagues (2009) suggest that different types of human contact and interventions in food production are likely to be critical factors shaping the perceived risks and perceived naturalness of food, and they specifically suggest that going “inside” to produce changes will lead to judgments of unnaturalness. Genetic modification of an animal-based food had a very strong effect on perceived naturalness among respondents in Sacramento. The strong effect that the notion of “chickens injected with hormones” has on perceived naturalness among respondents in Mexico City probably reflects the increasing negative attention that similar real-life food production technologies are receiving in the media and by consumer groups throughout Mexico today (Vallejo, personal communication). The results could also be confounded by the use of the term “injected”, which denotes an effect to internal biological contents. For instance, Heuvel
(2008) found that consumers have very different perceptions of plant genetic modification as a result of transferring genetic material from one specimen into another versus the use of genetic information to determine which plants to cross-pollinate in breeding experiments (otherwise known as genomics). Genetic modification is perceived to be less natural than genomics-enhanced plant breeding, which in turn, is perceived to be less natural than conventional plant breeding. In looking at the ratings of genetically modified variants relative to the other variants, the results from the current study suggest that perceptions and categorizations of food in terms of naturalness conform with principles of psychological essentialism to some degree, but not to such an extent that they are a complete mirror image of essentialist representations of living things.

The negative effect of genetic modification on perceived naturalness of food is not entirely unique given the observed effects of applying outside chemical agents. However, the relative differences among ratings of genetically modified variants offer further evidence that biological content and living kind categories do play a significant role. Consistent with results from the pilot study, but unlike Rozin’s (2005) findings, the principal study demonstrates that perceived naturalness of genetically modified corn and chicken variants depend on the biological source of genes being inserted. Genetically modified variants comprised of genes from vastly different taxa cue for different naturalness ratings than variants inserted with genes from more closely related taxa.

The genetically modified corn variant receiving the highest naturalness rating in Sacramento and Mexico City was inserted with a gene from wheat, the species most closely related to corn among the genes tested. Among students of similar ages in both
countries the genetically modified corn variant inserted with a gene from a cow received a significantly lower mean naturalness rating than the corn variant inserted with a gene from wheat. Significant differences among ratings of genetically modified corn variants in Sacramento met the predicted pattern whereby violations of naturalness corresponded with taxonomic relatedness: corn inserted with a gene from a cow (different kingdom) received significantly lower naturalness ratings than the variant inserted with a gene from an orange (same kingdom, distant taxa), which in turn, was rated significantly less natural than the corn variant inserted with a gene from wheat (more closely related taxa). Respondents in the Mexico City Subsample gave corn inserted with a gene from a cow (different kingdom) a relatively lower naturalness ratings than the variant inserted with a gene from an orange (same kingdom, distant taxa), which in turn, was rated relatively less natural than the corn variant inserted with a gene from wheat (more closely related taxa). Thus, similar to the Sacramento samples from both the pilot study and the principal study, this representative sample from Mexico City perceived that a genetically modified plant-based food inserted with the gene from a different plant is similar in terms of naturalness to a variant that lacks genetic modification, but which was exposed to a chemical additive. And meanwhile, both of these variants received significantly higher mean naturalness ratings than the plant-based food variant inserted with a gene from an animal.

This pattern was also observed when genes were transferred from one animal to another. In Mexico City, chicken genetically modified with a gene from a cow received a relatively lower naturalness rating than the chicken variant inserted with a gene from a
duck, and the naturalness ratings of these variants were significantly different in Sacramento. In both samples, an animal genetically modified with a gene from a plant (chicken inserted with a gene from corn) was perceived to be significantly more natural than the product of genetic modification involving the transfer of a gene between two animals (chicken inserted with a gene from a cow). The relatively high mean naturalness ratings from both samples for an animal inserted with a gene from a plant provide reason to reconsider the specific prediction that perceived naturalness of genetically modified variants decreases with increasing taxonomic distance between the living target and genetic source. Nevertheless, differences in biological content were the main variables that can account for these differences in perceived naturalness. The results are again suggestive of different perceptions of plants and animals since their perceived qualities of naturalness are affected differently depending on which is the target of genetic modification and which is the modifying agent.

The relative differences among naturalness ratings of genetically modified variants in Mexico City tended to follow the predicted pattern and were similar to the results in Sacramento. Significant differences among naturalness ratings of genetically modified variants of corn were observed in the Mexico City Subsample of respondents less than 25 years old. On the other hand, when analyzing the entire Mexico City sample, there were no significant differences among naturalness ratings of genetically modified variants within each food type. This demonstrates that perceptions of natural in Mexico City differ between younger and older age groups. The lack of significant differences among naturalness ratings of different genetically modified variants in the entire Mexico
City sample may reflect general ambiguity that exists among older adults regarding the process of genetic modification. During administration of the study instrument, respondents in Mexico City raised many questions, doubts, and concerns regarding the possibility that genetically modified variants such as the ones presented in the study actually exist in the food supply and markets (Gonzalez, personal communication). Very little research has explored the amount of information, knowledge, and unique cultural values that people have in developing and newly industrialized countries with respect to perceptions of genetically modified food (Finucane and Holup, 2005). It is possible that with time and changing historical circumstances, as people become more familiar with the idea of genetic modification, these cues elicit more specific responses that reflect underlying folkbiological concepts rather than general risk-related aversions associated with limited data about the process or technology. Age differences may explain why younger respondents in Mexico City, but not older respondents, gave different naturalness ratings to genetically modified variants based on their biological contents. Age being a factor could undermine the argument proposed in this thesis that different naturalness judgments of certain foods are influenced by evolved cognitive mechanisms specific to the domain of folkbiology. Cultural influences, rather than innate species-like categories of the human mind, may be responsible for perceived differences in naturalness among genetically modified foods comprised of different biological contents.

The results of this study show that people assign different naturalness ratings to variants of the same basic food that have undergone the same genetic modification process. The only differences among these variants are the types of genes being mixed.
This finding is interpreted as evidence that the living kind contents of these cues activate innate folkbiological structures and concepts to produce nuanced naturalness ratings in the domain of food. Relative differences between these naturalness judgments appear to be a function of the perceived taxonomic distance between the biological source and targets of genetic modification, and are therefore, content-dependent. Further research will be necessary to confirm these findings demonstrating that biological content of genetically modified foods is more important than the modification process in shaping naturalness judgments by students of comparable age in two different cultural contexts. The differences between these results and Rozin’s (2005) findings lead to different conclusions about the relative importance of contents and processes on the perceived naturalness of food.

The results from Sacramento, and to a lesser extent Mexico City, are interpreted as evidence that natural species-like categories, as outlined in folkbiological studies, play a role in shaping perceptions of natural food, particularly when genetic modification occurs. Plant and animal groupings into generic species are based on the smallest fundamental biological discontinuities that are easily recognizable in a given habitat. Distinctions made between biological taxa or generic species tend to be based on the folkbiological notion that members of separate species have different essences. The mixing of genes violates a deeply embedded folkbiological assumption that the identity of each kind of living thing is the result of a fixed causal source. This is a common perception that Kniazeva (2005) heard from people in focus groups who expressed negative attitudes toward genetic modification. Genetic modification involving
unrelated taxa violates ideal notions of the natural world by blurring the boundaries between species and by preventing things like corn, chicken, and oranges from taking their own separate places.

Different entities belong to the “natural” category to different degrees. Natural food may be considered a category in which membership is graded, and yet essentialist representations of living things are meaningful and influential. The extent to which different things belong to the category “natural” has the potential to reflect valid biological information. In this study, different variants of each basic kind of thing (corn and chicken) were categorized somewhere between “not natural at all” and “completely natural”. If asked specifically about biological identity, respondents would be expected to say that corn and wheat are mutually exclusive kinds of living things, as are corn and oranges, and as are corn and cows. People presumably do not believe that essences of different living kinds at the same taxonomic rank could naturally exist within a single entity. For instance, people from different cultures share the folkiological assumption that members of a taxon in a species-like group have the ability to interbreed with one another, but not with members of any other taxon at that rank. However, the mixing of genes between these mutually exclusive categories for this study resulted in kinds of things that achieve different levels of membership within a category of naturalness. None of the genetically modified variants received a mean rating equivalent to “not natural at all”. This suggests that for the purposes of a natural category of food (or substance), people’s conceptual systems allow for essences of otherwise mutually exclusive living kinds to be mixed, albeit with different consequences depending on their relatedness
within a taxonomic system comprised of different hierarchical ranks. Different genetically modified variants received significantly different naturalness ratings in both countries, but this occurred more in Sacramento than it did in Mexico City. For instance, genetically modified corn with a gene from wheat and corn with a gene from oranges received significantly different naturalness ratings in Sacramento, but nearly equivalent naturalness ratings in Mexico City. Cultural differences in terms of there being more or less rigid natural category boundaries between variants could reflect differences as to how each culture represents the essences of basic foods, or other biological substances. A similar essentializing conceptual system to represent living kinds in Mexico City and Sacramento may nevertheless result in different representations of essences in the domains of substances or foods, with greater potential in Mexico City than in Sacramento to accommodate representations of essences as blendable or dilutable (Barrett, 2001).

Inferences, Causal Reasoning, and Modes of Construal

Special design features of the mind evolved to exploit enduring sets of relationships in the world that had consequences on human survival and reproduction in our ancestral past (Barkow et al., 1992; Cosmides and Tooby, 1994). Cognitive architecture designed to store and organize information about living things evolved by natural selection as a result of the reproductive advantage gained from referring to taxonomic status and category membership to make inferences about the properties and attributes of living things. Atran (1998) argued that the ability to conceptualize and predict the properties that link together generic species and distinguish them from others
would have been necessary for the survival of our ancestors. In this study, innate ways of construing living things were found to influence perceived membership of foods within the category “natural”, based on differences in biological contents. Since membership within the category “natural” was found to vary based on folkbiological categories, judgments regarding the naturalness of food were also expected to correspond to some extent with people’s predictions about folkbiological properties. Prior studies suggest that identification of a basic food as being natural is a cue that the food is healthy and/or safe to eat. Rozin and colleagues (2004) classify health and safety reasons for preferring natural foods as instrumental, or functional, motivations that reflect the anticipated consequences of consumption. This instrumental basis for preferring natural foods is contrasted against ideational motivations, including the belief in some type of inherent superiority of nature, or certain knowledge about where an item comes from (origins) (Rozin and Fallon, 1980). In this study respondents were asked to consider the effects that different modifications have on the health and safety properties of foods and also to consider the effects that these modification have on the properties of living things. In performing these tasks, respondents were expected to shift between essentialist modes of construal that are presumably different, or domain-specific, for food (biological substances) and for living things (Barrett, 2001). Evidence from this study that naturalness judgments correspond with people’s inferences about the attributes of living things from which foods are derived contributes to our understanding of what it means for something to be perceived as natural.
In this study, naturalness ratings corresponded with inferences about living kind behavioral attributes. However, the extent to which this was the case was somewhat surprising. The perceived naturalness of a corn variant turns out to correspond closely with people’s predictions about the behavioral attributes of that variant as a living thing, even more so than perceived naturalness corresponds with people’s predictions about the health and safety properties of that variant as a food item. In other words, the perceived naturalness of each corn variant reflects respondents’ expectations about a living kind behavioral property of corn more so than it reflects their expectations about how healthy or safe it would be to eat these variations of corn. This was the case in both Sacramento and Mexico City. The study instrument was designed so that respondents were primed to think about these variants as foods rather than as living things. For instance, a series of introductory questions asked respondents about their dietary habits. Respondents were then asked to rate how favorable it would be to eat each of the different variants, followed by a prompt to rate their naturalness. In the next series of questions respondents rated their expectations about the properties of corn, beginning with the health property and continuing on to the behavioral property and the safety property. Therefore, the findings of this study are interpreted to mean that perceptions of a plant-based food item in terms of naturalness reflect people’s notions about where that food comes from in the living world as much as, or even more so, than they reflect human-centered instrumental or functional concerns about the food. The main difficulty with this interpretation, however, was the challenge of describing variants of basic foods on the study instrument so that they could realistically be perceived in one instance as a living thing, and in
another instance as a food substance or potential food. This is the main drawback of the study design.

Naturalness ratings of chicken in Mexico City also corresponded very closely with people’s predictions about the behavioral attributes of that variant as a living thing. In addition, perceived naturalness and perceived health and safety properties of chicken corresponded closely with one another in Mexico City. The set of responses from Sacramento dealing with the chicken variants are different from those dealing with corn, and they are also different from the Mexico City responses dealing with chicken. What makes these responses different is that students in Sacramento perceive all six variants of chicken as being ‘likely’ or more than ‘likely’ to maintain the behavioral property. This perception is upheld regardless of the fact that five out of the six chicken variants were perceived to be less than ‘moderately natural’. In contrast, all of the five chicken variants that were perceived to be relatively non-natural were relatively unlikely to maintain the health and safety properties. The likelihood that chicken maintains the behavioral property increases directly with perceived naturalness as predicted. However, these responses from Sacramento stand apart from the other results, and they suggest that the living kind behavioral property in an animal is perceived to be more resistant to modifications that, otherwise, reduce perceived naturalness, health, and safety. Specifically, modifications of an animal at the genetic level reduced perceived naturalness without causing a substantial effect to perceived behavior in Sacramento.

Apparently, while a behavioral property of chickens is not affected by genetic modifications, there is a greater likelihood of there being effects to human consumers
who consume the modified chicken. The finding that respondents in Sacramento gave relatively invariable ratings for the behavioral properties of the different chicken variants may reflect a greater inclination to think about this food type in terms of health, safety, or other instrumental properties as opposed to generating intuitions about its origins in the living world. Again, this may reflect a cultural difference between Sacramento and Mexico City that is specific to perceptions of animal-based foods, as outlined above in the discussion about food preferences. Different cultural experiences may account for the finding that respondents in Mexico City consider non-natural chicken variants unlikely to maintain a “natural” behavioral property, whereas respondents in Sacramento are less inclined to think about such consequences, but instead focus on the health and safety risks associated with the biological basis of the food substance.

Regardless of the precise explanation for these differences, it is apparent that for respondents in Mexico City the thought process underlying the determination that certain chicken variants are not natural parallels their thinking about the presence or absence of a living kind behavioral trait. Respondents in Sacramento believe that the most natural variants of chicken are more likely than their less natural counterparts to maintain a behavioral property. Thus, the results from Sacramento demonstrate that higher naturalness ratings correspond with higher expectations about the presence of behavioral properties in plants and animals from which foods originate. Many packaged foods use images of nature to conjure specific ideas about the lives and behaviors of the plants and animals, or the related ingredients, from which the foods are derived as a way to promote
their quality of naturalness. The results of this study could explain the prominence of such imagery and indicates that it probably works as a marketing strategy.

Barrett (2001) explains that substances, such as water, gold, meat and wood, fail to meet the same sets of conditions that make living kinds such a likely target group for an essentialized mode of construal. The inductive potential of substances is much poorer because the causal pathways stemming from an executive causal agent to other inducible properties in a substance are small and limited. For instance, there is not much inductive advantage in construing an essentialist account of water once one has learned the few necessary functional properties of water that are relevant to everyday decision-making and use. Whereas water from one source shares only a small number of relevant properties with every other exemplar (wet, odorless, drinkable), a lion shares an immense number of inducible properties with every other lion (ferocity, teeth, running).

The difference between the homogeneous nature of substances and the whole-body properties of living things is another reason for the existence of kind-specific modes of essentialism. The inducible properties that are specific to gold hold for any quantity of this substance, and in any shape or configuration. The homogeneity assumption applies to nonbiological (i.e., water) and biological (i.e., wood) substances. When applied to an animal, such as tigers, the homogeneity assumption is likely referring to a biological substance, such as blood or meat, which is the property of a portion of an animal that holds for any other portion of that animal. Barrett (2001, 2004) argues that the most important inducible properties of an animal, such as a tiger, are whole-body properties, including their psychology, behavior, and aspects of morphology that are relevant to
behavior. Barrett proposes that behavioral dispositions would have been among the most important properties to generalize across members of a living kind for human decision-makers in ancestral environments. He gathers support from Gelman and Wellman (1991) who found that children essentialize behavioral traits more than morphological ones in living kinds.

Barrett (2001) raises the possibility that plants are more often thought of under a substance mode of construal, since there would have been relatively few uses for thinking about whole-organism properties of plants, particularly their behaviors, in ancestral environments. This idea is consistent with Opfer and Siegler’s (1994) finding that children are not inclined to attribute plants with the ability to engage in goal-directed behaviors, in strong contrast to children’s living kind concept of animals. Barrett (2001:15) suggests that a substance mode of construal of plants is more relevant “for making inferences about them as building materials, food, sources of medicinal compounds, and so on”. And, while Barrett (2001:16) predicts that “a single mode of construal for substances could handle both biological and nonbiological substance kinds”, he notes a possible exception in cases where “taxonomic relatedness of the sources of biological substances may support induction in ways that are not true for nonbiological substances”.

In his discussion, Barrett (2001) proceeds to say that the line between essentialist modes of thought that are fit for substances and for whole organisms does not separate biological and nonbiological entities, but rather the animate and inanimate. Accordingly, death is what causes an entity to transition from one mode of construal to another, as in
the case where an animal is killed and processed to become food. There is the expectation that the shift of an entity from one ontological class to another causes a shift in people’s mode of construal of that same entity in order to accommodate the switch from making inferences about one set of properties to another.

It was surprising that the results of this study do not demonstrate a stronger correspondence between naturalness ratings and inferred health and safety properties of the different variants. According to Siegrist and colleagues (2006), people who express a stronger preference for natural food are more concerned about unobservable risks in foods. Findings by Dickson-Smith and colleagues (2011) suggest that people hold the belief that choosing to eat natural foods is a way to reduce exposure to chemical risks. Multiple studies suggest that concerns about health are the main reason for preferring, purchasing, and consuming foods with natural ingredients, including organic foods (Magnusson et al., 2003). The finding that perceived naturalness corresponds closely with perceived health and safety of chicken in Mexico City and Sacramento suggests that there is greater consistency among these perceptions across cultures for an animal-based food than for a plant-based food. This finding may provide further support for the idea that cognitive adaptations were designed to heighten sensitivity to the potential risks of consuming animal products, more so than for plant-based foods.

The results offer some evidence that essentialist modes of construal specific to biological substances influence people’s perceptions of the different variants used in this study. The perception that properties are transmitted from one entity to another may represent an essentialist mode of construal that is commonly applied when thinking about
substances, diseases, and other transmissible entities of biological origin (Barrett, 2001). Notably, in Sacramento, the chicken variant that “forages in manure for worms and insects to eat” received correspondingly high ratings for naturalness and behavior, only moderate ratings for health and safety, and a low rating for favorability. Whereas the conceptual image of a chicken foraging in manure cues for naturalness in Sacramento, the same notion apparently conjures some kind of a disgust response or aversion when framed within an eating context, and thus cues for low favorability. The perception that this chicken variant is not favorable to eat and also less healthy and less safe to eat compared to a “chicken raised indoors” may illustrate beliefs about contagion among respondents in Sacramento. The law of contagion applies to the belief that “when two things make contact their properties are exchanged and they may be permanently affected” (Rozin, 1990:560). Curis and Biran (2001) assert that disgust is an adaptation crafted by natural selection to distance people from contagion. This argument is supported by evidence that almost all disgusting items are animal or animal products, and that bodily secretions are among the items that universally elicit the disgust response, particularly feces (Angyal, 1941; Rozin and Fallon, 1987). Interestingly, respondents in Sacramento had different perceptions of “corn harvested from a field with fresh manure”, which received high naturalness and favorability ratings, as well as correspondingly high ratings for health, safety, and behavior.

Each group of respondents in Sacramento and Mexico City also gave some surprisingly high ratings for the health properties of genetically modified variants of corn. In Sacramento, the genetically modified variant with the insertion of a gene from an
orange and the variant inserted with a gene from wheat were perceived to be likely to maintain health properties. In Mexico City, genetically modified corn with the insertion of a gene from a cow was perceived to be likely to maintain a health property. First of all, these results indicate that food that is perceived to be relatively unnatural may nevertheless be perceived as healthy. And second, these outliers possibly represent local beliefs about the health properties associated with the sources of these genes. If this is true, then respondents in both groups subsequently share beliefs about the transmission of attributes to foods, and the transmission of these attributes to human consumers. Lacking additional data one may only assume for the purposes of this discussion that the group of respondents in Sacramento considers oranges and wheat to be particularly healthy, and that respondents in Mexico City consider food products from cows (i.e., meat or milk) to be particularly healthy. If these assumptions are correct, pending additional research, then respondents in each sample may share the belief that health properties are transmitted from a genetic source to the targeted corn variant.

Rozin (1990) suggests that this type of conception of invisible entities is a requirement for articulating beliefs about contagion. Perceived effects that certain food additives and processes have on food and on a consumer’s body appear to be motivated, in part, by folkbiological expectations of the interactions and exchanges between things. During a study with focus groups to solicit concrete examples of genetically modified food products, Kniazeva (2005:30) found that the names of these foods “reflect the perceived essence of them, which is seen as a result of combining and mixing of things in nature in order to create a novel foodstuff which is not characteristic to nature”. Other
authors have noted that the effect of contagion beliefs on perceptions of foods appears to extend into a folkbiological notion of essence transfer between food and the human body, as in the belief that “you are what you eat” (Nemeroff and Rozin, 1989). While there is a biochemical reality to it, such a belief, as it is most commonly expressed, does not tend to conform to the laws of science. Though considered more prominent in traditional societies, the belief is widely documented in Western-developed societies, such as the U.S. In addition, Toyama (2000) has demonstrated that by the age of 4 or 5, children in Tokyo accept the concept that food turns into our bodies. This concept develops despite the fact that preschoolers there tend to learn about eating in functional terms (i.e., growth) rather than in terms of material transformations.

The results of this study support the assertion made by Rozin et al. (2004) that preferences for natural food are not simply representative of instrumental concerns, and instead may be more indicative of a role for ideational motivations. The first part of the study demonstrated that perceived naturalness corresponded with favorability of different variants of a basic animal-based food and plant-based food. Perceived naturalness also tended to correspond with folkbiological expectations regarding the behavioral traits of living things from which these foods are derived. This was the case for perceptions of a plant in Sacramento and in Mexico City, and also for perceptions of an animal in Mexico City. Thus, there is evidence that naturalness judgments of food reflect certain intuitions or expectations that are specific to the domain of folkbiology, and thus perceived naturalness could have the potential to reflect valid biological information. There is less support for the prediction that naturalness ratings correspond with instrumental
expectations regarding the health and safety properties of these basic food variants. Perceived naturalness corresponded with expectations about health and safety more so for an animal-based food than for a plant-based food in both Sacramento and Mexico City. Respondents in Sacramento did not perceive genetic modification of chicken to have a strong effect on a behavioral trait of the living organisms. And yet these respondents perceived there to be strong negative effects of genetic modification of chicken on health and safety to human consumers.

**Perceptions of Food and the Domain of Artifacts**

*Process versus Content*

Both the pilot study and the principal study for this thesis found that different genetically modified variants of basic foods received significantly different naturalness ratings. These results suggest that a food’s contents are at least as important as a modifying process in people’s determinations of naturalness. However, these results contradict Rozin’s (2005) finding that naturalness ratings among genetically modified variants of basic foods were essentially equivalent. Rozin’s (2005) results supported his hypothesis that process has greater importance than contents in influencing naturalness judgments. Rozin (2006) conducted a follow-up study in which he found that different naturalness ratings of food items could only be accounted for based on the history of processing. This interpretation was based on the fact that the processed item was chemically identical to that of the unprocessed item, yet the processed item received a lower naturalness rating.
More recently, Evans and colleagues (2010) tested similar hypotheses by comparing the naturalness of foods with different added ingredients. In one test, the same basic food variants had different added ingredients, but these added ingredients had undergone similar processes (i.e., dried and rehydrated fruit powder and vegetable powder). These basic food variants with different added ingredients received significantly different naturalness ratings. The authors interpreted this finding to mean that content is just as important, or more important, than process in naturalness judgments. Evans and colleagues (2010) tested a related hypothesis, which proposed that there are minimal effects of mixing like entities on perceived naturalness. The results demonstrate that two different types of food (e.g., carrot soup and tomato sauce) that have the same ingredient added (e.g., black carrot concentrate) receive different naturalness ratings. They found that the addition of carrot concentrate to tomato sauce causes a greater reduction in perceived naturalness than the addition of carrot concentrate to carrot soup. Food products are perceived to be more natural when they contain like entities. This finding resembles data collected during studies for this thesis research although Evans and colleagues (2010) tested their proposals using physical additive processes and this thesis research analyzed the importance of biological contents in relation to more complex processes, including genetic modification. The findings from the study by Evans and colleagues (2010) and from studies conducted for this thesis research, which suggest that content dominates process in judgments of naturalness conflict with Rozin’s (2005, 2006) proposal that naturalness depends more heavily on the process-history of an entity.
Humans have innate ways of thinking about living things that are based largely on knowledge of origins in reproduction, whereas cross-cultural findings indicate that people are inclined to identify and use artifacts in ways that are consistent with their origins in the intentions of their creators (Keil, 1994). The final section of this study sought evidence that would illustrate to what extent, and under what circumstances, each of the domain-specific conceptual systems for representing living things and artifacts influence perceptions of food. Since these conceptual systems were each expected to play a different role depending on the nature of the food item in question, students in Sacramento were asked to make numerous similarity judgments involving basic foods, processed foods and food substances, living things, and inanimate-inedible objects. In testing Prediction 7 for the principal study of this thesis research, the goal was to distinguish between, on one hand, perceptions of food in terms of where it comes from in the living world and, on the other hand, perceptions of food in terms of its history of contact with humans, including the processes underlying its creation and its intended uses.

The results of studies conducted for this thesis research demonstrated that the biological content of basic foods plays a role in shaping perceptions of natural food and preferences for natural food. Therefore, when judging similarity among variants of basic plant-based foods that have been grown in different environments, respondents were expected to privilege similar biological content over similar growing environments. This prediction was confirmed in Sacramento. Similarly, respondents in Sacramento tended to judge that a basic food item that has undergone only minimal processing (i.e., potato
diced into cubes) is more similar to its counterpart in the living world (i.e., potato growing in a field outdoors) in comparison with a slightly more processed food item of the same kind (i.e., dried potato starch).

When judging similarity among variants of basic animal-based foods that have been genetically modified or chemically treated (i.e., injected with hormones), respondents were expected to privilege similar biological content and living kind status over similar types of modifications. Contrary to this prediction, the findings from Sacramento suggest that shared history or type of intervention is more important than shared biological content or living kind status in shaping similarity judgments involving basic foods that have undergone these types modifications. These responses contradict the prediction that similarity judgments involving basic foods are based on shared biological content. The results indicate that process could have a stronger role than biological content in shaping general comparative judgments of basic foods that are modified by genetic engineering or by chemical additives. Thus, the same set of students in Sacramento showed a greater tendency to focus on differences in content among variants of genetically modified basic foods when focusing specifically on naturalness, whereas more general similarity judgments appear to overlook shared biological content.

*Naturalness Judgments of Basic and Processed Foods*

For the purposes of this study, a basic food is distinguished from a complex processed food. In contrast to a basic food, a complex processed food is an item that has been transformed and/or packaged to such an extent that it barely resembles the actual
living kind from which it was derived. Naturalness judgments and natural preferences have been shown to vary across different product or consumer categories (Rozin et al., 2004; Tenbult et al., 2005). Assessing the characteristics of these broader categories may help to address the question of whether human contact, history, agency, and intended uses of a food entity, which predict an artifact construal, are consistent with certain types of judgments and preferences with respect to the entity’s naturalness.

The first phase of the study by Rozin and colleagues (2004) demonstrated that among college undergraduates natural preference is greatest for raw foods (e.g., peaches, lettuce), and decreases steadily through the categories of processed foods (e.g., ice cream, peanut butter), food/medicine (e.g., dietary supplements, vitamins), and medicines (e.g., antacid, antibiotic). The same sequence is found for ratings of healthiness/effectiveness, yet the difference between health ratings of raw foods and processed foods in their natural forms was not significant. These results indicate that processed foods are much more similar to functional food and medicinal products with respect to natural preference. The results are suggestive of a categorical distinction between raw (basic) foods and those that have undergone any type of human-induced modification. Presumably, raw foods have more of “something” to lose when transformed into an unnatural entity than do processed foods, but that “something” is not specifically health-related. The lack of a functional/instrumental explanation (i.e., health) to account for the distinction between the natural preference for raw (basic) foods and processed foods is interpreted as evidence of ideational motivations. Framed within a discussion about the distinctions between concepts of living things and artifacts, an ideational account for the natural
preference of basic foods appears to have similarities with essentialist accounts in the domain of folkbiology. It appears that basic foods possess something internal and vital to their identity, which is causally related to its other properties, and which is at greater risk of being affected compared to an entity that has already been altered.

Rozin and colleagues (2004:153) also state that, compared to medicines, “foods are perceived to be normally closer to nature”. Both phases of the study by Rozin and colleagues (2004) demonstrate stronger natural preferences for the food items (raw and processed) than for the food/medicines and medicines. College undergraduates in phase one indicated a belief that natural medicines are less effective than commercial equivalents. There is, however, a strong natural preference for medicines when they are stipulated as being chemically identical to a commercial variant. The belief that natural foods are inherently superior to commercial counterparts appears to be stronger than the same belief with respect to medicines. Rozin and colleagues (2004) argue that an ideational/moral belief still accounts for natural preferences for medicines. Nevertheless, they account for the distinction between food and medicine by proposing the idea that food consumption helps to ally the human body with nature in a constructive manner whereas medicines are applied to the body in cases where humans are fighting against nature to ward off illness and disease. From this perspective, medicine may be considered a domain of thought and behavior that aligns with features of an artifact construal that include the manipulation of objects with specific intentions. As Rozin (2006) suggested, a similar scenario may also take place in which people’s representations of processed foods cue for an artifact construal.
Tenbult and colleagues (2005:50) conclude that “the more a product loses its perceived naturalness when it is genetically modified, the less it will be accepted”. Their results are similar to those of Rozin and colleagues (2004) in finding that certain consumer categories of foods are perceived to have more at stake than others in terms of losing naturalness. The findings are consistent with prior studies demonstrating that the way tomatoes are produced is more important than its quality, taste, and price, whereas this pattern is reversed with a processed item, such as a chocolate biscuit (Gamble et al., 2000). Tenbult and colleagues (2005:49) found that products that are seen as being more natural from the start are found to be less acceptable in a genetically modified form.

The Essence of Artifacts and Perceptions of Processed Foods

The perceived naturalness and natural preference for a food that remains in its basic unprocessed state appear to be different from perceptions and preferences for a food after it has been changed from its original condition, incorporated into a more complex product, or imbued with intentions of being used for a specific purpose. As a result of these differences, respondents were expected to privilege similar types of modifications and similar functional, or designed, attributes over similar biological content when making general comparative judgments involving complex processed foods. In other words, while basic foods were expected to cue for representational systems specific to the cognitive domain of folkbiology, more complex processed foods were expected to cue for an artifact psychology. Many of Rozin’s proposals to account for naturalness judgments and preferences for natural in the domain of food hint at the role of essentialist thinking
and a domain-specific, content-dependent conceptual system that is known to cue for representations of things as artifacts. For instance, in explaining the role of contagion beliefs Rozin and colleagues (2004:148) state that “when human made machines or chemicals contact a food, the human negative essence is transmitted to the food via the machine/chemical vehicle” since “human contact with what is natural contaminates it more powerfully than the human is purified by contact with nature”. The principal study for this thesis builds upon this notion that natural categories of food and other food judgments show evidence that the human mind shifts from a folkbiological mode of thought to one that reflects artifact concepts and essentialist thinking specific to this domain.

Rozin (2006:96) notes that “[t]he importance of the history of an object in its valence and characterization assigned by humans is generally under-rated… the 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”. He expands on this point by relating his findings regarding the salience of process in naturalness judgments to Bloom’s (1996) argument that human conceptions of artifacts are deeply connected to past history, including the intention of the creator of an object. He is suggesting that food with a history of contact with humans, particularly contact motivated by a person’s intentions to transform the food substance, cues for an artifact psychology and, thus, the loss of naturalness. The loss of naturalness may represent an ontological boundary that is crossed whereby essentialist assumptions about the entity, or at least the bases for categorizing the entity,
become more attuned to the goals and intentions of the external modifying agent rather than an internal causal agent that “naturally” made the entity what it originally was.

As predicted for this study, respondents indicated that processed foods whose biological source and designed function were made apparent are more comparable to other similarly designed food substances than they are to their biological sources in the living world. This prediction was confirmed based on similarity judgments involving the triad of high fructose corn syrup, Sweet n’ Low (an artificial sweetener), and a cob of corn, and again in the triad involving peppermint tea, chamomile tea, and a living mint plant. This pattern of responses indicate that biological content was discounted when thinking categorically about complex processed foods and also foods that are not as complex, but which are designed for specific uses. The responses to the statement involving high fructose corn syrup (Table 4-16) may also be contrasted against responses to the statement involving potatoes (Table 4-15). The differences between the responses to these statements may also reflect different perceptions of chemical and physical transformations of foods. Rozin and colleagues (2004) found that chemical manipulations, such as boiling or irradiating foods, result in greater reductions in perceived naturalness compared to physical transformation, such as grinding and freezing. The results of these similarity judgments may, therefore, demonstrate that perceived similarities between a processed food and its living counterpart are sensitive to perceived differences between physical and chemical transformations. Other results from the principal study for this thesis were similar in demonstrating that chemical additives produce major reductions in favorability and perceived naturalness of basic foods.
compared to the effects of different physical environmental contexts (i.e., indoors, manure) in which basic foods are grown or raised.

Rozin and colleagues (2009:475) state that, “[p]erhaps there is something about going ‘inside’ to produce changes that lead to judgments of unnaturalness”. Whereas the essence of an artifact has been described as being external to the object and as being synonymous with the intentions of its creator, essences of living things and the causal relations among biological properties have been described as converging inside a biological entity. This comment by Rozin and colleagues (2009) refers to the process of genetic engineering, which according to Rozin (2005) causes an unexpectedly larger reduction in naturalness than the process of domestication. The difference between genetic engineering and other types of chemical transformations lies not only in the level at which humans intervene, but also in the degree to which the type of transformation is capable of achieving a precise intended consequence. Results of the principal study for this thesis indicate that modifications at the level of the gene can have strong effects on perceived behavior and other properties of the targeted entity.

As described earlier, the results of this study demonstrated that respondents in Sacramento tended to distinguish genetically modified and non-genetically modified versions of living things and basic foods from one another according to their types of modification or their lack of modification rather than according to their biological content and status as living things (i.e., chicken, fish, apples). This is interpreted to mean that respondents conceptually treated basic animal-based foods that have been genetically modified more like complex processed foods. Students in Sacramento offered an even
more extreme view of genetically modified foods in judging that a basic food/living thing that has undergone *genetic modification* is less similar to an unmodified variant of the same kind than it is to an *inanimate* and *inedible* replication of its kind. Even the most extreme types of modifications to basic foods, such as genetic engineering, were not expected to affect perceptions so strongly as to cue for representations of inanimate and inedible objects. This surprising set of responses suggests that a genetically modified basic food is treated in a categorically similar fashion as a highly complex processed food, such as a twinkie. Both are perceived to be more similar to an artifact than to a corresponding living thing or potential food item. In contrast, respondents showed a greater tendency to agree that a *chemically-treated* variant of a basic food/living thing is more similar to the unmodified *living version* of that basic food than it is to an artifact resembling its kind. Modification of a basic food as a result of chemical additives doesn’t appear to have as strong of an effect that genetic modification of a basic food has on categorical thinking, at least in terms of cueing for the domain of artifacts.

Responses in Sacramento to the comparative statements involving basic foods that have been either genetically modified or chemically treated (i.e., injected with hormones, grown with chemicals) are suggestive of extreme attitudes about the applications of these technologies. Beliefs about how healthy or how safe it is to consume these types of modified foods may explain such extreme responses. The results for Prediction 6 in this study demonstrate the belief that basic plant- and animal-based foods that are treated with chemical additives fail to remain as healthy or safe as their unmodified counterparts. Both types of basic foods with chemical additives are also perceived to be less than “slightly
207
natural”. The results demonstrate similar beliefs about the health and safety of basic
animal-based foods that are genetically modified. These are also considered to be close
to “not natural at all”. Thus, perceptions of health, safety, and naturalness may explain
why certain types of modifications of basic foods, rather than their contents, are the focus
of these comparative judgments. The descriptors ‘genetically modified’ or ‘injected with
hormones’ may serve a similar heuristic role as other types of labels, for instance
generating the opposite effect that occurs with labeling something as ‘natural’.
Occhipinti and Seigal (1994), for instance, demonstrate that people are willing to
consume a food item whose label otherwise raises caution if, and only if, the intent of the
labeler is unambiguously portrayed as harmless. Otherwise, people resort to cautious
label-based strategies to infer whether it is safe to make food-based judgments when the
possibility of contamination is either unclear or likely. By employing the Wason selection
task, Occhipinti and Seigal (1994) provide evidence in support of the argument that
reasoning tasks that involve food and safety elicit more formal logic responses than tasks
that are relevant to food or safety, but not both. The authors suggest that the adaptive
constraint facilitating reasoning in the domain of food and contamination reflects a
readiness to suspect ambiguous information about food safety, and that a relaxation of
cautious behavioral strategies is difficult to achieve without unambiguously ruling out the
possibility of harm or deceit.
In providing a possible explanation for “additivity dominance”, Rozin and
colleagues (2009) state that “[i]t is conceivable that addition is seen as more ‘agentic’
than subtraction”, and they suggest that naturalness judgments of food reflect enhanced


risk perceptions as a result of human contact and agency in certain contexts, particularly where human malevolence is suspected. If this interpretation is correct regarding foods whose naturalness has been violated by certain additive processes then perceptions and assumptions in such cases would appear to be framed within the human-social-artifactual, rather than biological, domain.

The results of this thesis are interpreted as evidence that biological ‘content’ has as much (or more) of an influence as ‘process’ on people’s perceptions of natural, preferences for natural, and causal reasoning about certain properties of basic foods and the living things they originate from. General comparative and categorical judgments, on the other hand, demonstrate the importance of processing history, design, and intended use in shaping perceptions of more complex processed foods, and also perceptions of certain types of modified basic foods. Rozin’s explanations as to why process may play a more important role than content in naturalness judgments are consistent with the literature on the evolutionary basis of artifact cognition and domain-specific essentialist modes of thought. Rozin’s proposals, therefore, help to explain why this thesis research observed differences between judgments of basic foods and processed foods, which partially confirm Prediction 7.

Some improvements in the design of the final section of the study instrument would avoid the translation problems that occurred in Mexico City, and would also support stronger interpretations of the findings. Rather than providing written statements in the form of ‘Item A is more similar to Item B than it is to Item C’, it would be better to replicate the format of the similarity judgment task used in Rozin (2006). He presented
study participants with the names of three items and then asked them to circle the two items that are most similar. Barrett (personal communication, 2010) suggests that future studies include specific questions rather than asking for general similarity judgments. For instance, study respondents could repeatedly be asked to circle which two items in the same triad are most similar, and each time judge similarity based on a different property (i.e., health, taste, safety, behavior, naturalness).

CONCLUSION

The primary goal of this thesis was to investigate the influence of evolved human cognitive mechanisms on contemporary preferences for natural food and the perceived naturalness of food in two different countries, the United States and Mexico. The principal study found that the favorability of foods, perceived naturalness of foods, and similarities and distinctions that people draw among foods are sensitive to certain types of information. Preferences and perceptions differ depending on the biological contents of food and the types of human contact with food. Interpersonal differences among study participants, such as gender and age, also affected the responses, and some significant cultural differences were observed. Overall, the findings of this thesis suggest that prior research into the evolutionary basis of domain-specific conceptual systems for living things and artifacts can guide predictions and interpretations in cross-cultural studies of food judgments, including the meaning of natural in this domain.

Prior research in folkbiology and cognitive science provide theoretical frameworks for understanding the evolutionary basis for differences in the ways people
think about entities that come directly from the biological world and other entities that are products of human actions and intentions. Evidence that humans categorically restrict our use of different concepts to these different types of entities is consistent with the principle of domain-specificity (Keil, 1989). This thesis argued that the existence of innate cognitive domains in the mind for living things and human-made artifacts explain different preferences and perceptions of natural in the domain of food.

The first research question of this thesis asked whether people in two different cultural contexts show a preference for natural foods. The principal study provides evidence that people in a non-Western developed country (i.e., outside of the United States, Europe, and Australia) demonstrate a preference for natural in the domain of food. By employing the same task as the one used by Rozin et al. (2004), the findings of the principal study support the argument that there is an ideational basis for preferring natural foods in Mexico City. These ideational factors are distinct from instrumental concerns about the potential consequences of consuming foods (i.e., health, safety). A remarkable distinction between the findings from Sacramento and Mexico City that warrants further research are the different ways people rated the favorability of “chicken that forages in manure for insects and worms to eat”. Respondents in both samples provided relatively high naturalness ratings for this variant, yet students in Sacramento did not consider it to be relatively favorable as was predicted and as was observed in Mexico City.

Whereas females demonstrated a stronger preference for natural food than males in Sacramento, this gender difference was not observed in Mexico City. Though evolutionary models and prior research addressing related topics, such as the disgust
response, predict cross-cultural gender differences in risk perceptions of foods, preferences for natural in Mexico City did not conform to these expectations (Curtis et al., 2004). This could indicate a strong ideational basis for the natural preference among males and females there. Females of similar age (less than 25 years old) in Sacramento and Mexico City perceive foods as being less natural than their male counterparts. This cross-cultural gender difference was more pronounced among foods of animal origin than among plant-based foods.

Atran (1998) argues that folk systematizing of plants and animals into similar categories in different cultures is evidence of natural selection for a common human ecological cognition. The second research question this thesis pursued was whether preferences and perceptions of natural food show evidence of innate categories of the human mind. Categories under consideration were plants and animals, different species, living things and artifacts, and basic foods versus processed foods.

The principal study results from Sacramento and Mexico City demonstrate that perceived naturalness of food and the desire for natural qualities in food depend on whether it is derived from either an animal or plant. As predicted, respondents were more likely to maintain their preferences for the natural form of an animal-based food than they were to maintain the natural preference for a plant-based food under varying conditions. Also, as predicted, similar modifications to animal- and plant-based foods are perceived as causing significantly more negative effects to the food of animal origins in terms of reducing naturalness and favorability. Additional evidence from Mexico City indicates that perceived naturalness is a more reliable predictor of perceived favorability
for an animal-based food than for a plant-based food. Together, these results are interpreted as evidence of a role for higher-order folkbiological categories in natural food preferences and perceptions.

The results suggest that perceived naturalness has slightly different meanings for plants and plant-based foods compared to animals and animal-based foods. In both Sacramento and Mexico City the perceived naturalness of a plant-based food corresponded with people’s expectations about a behavioral attribute of that plant living in the natural world. In both countries, naturalness ratings corresponded more closely with expectations about this living kind behavioral property than with expectations about health and safety properties of the plant-based food. Inferences about a living plant and plant-based food were different from inferences about a living animal and animal-based food. In Sacramento and Mexico City, naturalness ratings of different chicken variants were strongly correlated with people’s expectations about the health and safety properties of these variants. Evolutionary theory predicts that there are innate differences in the ways people perceive foods of animal origins and plant-based foods as a result of increased sensitivity to the risks of infectious diseases that are more likely to be acquired by consuming meat (Fessler and Navarrete, 2003). An alternative explanation is that people have learned that meat is less safe and less healthy, or they have simply come to associate meat with these qualities, and therefore the current study results simply reflect cultural influences. However, in both countries respondents tended to maintain their preferences for natural animal-based foods even when the conditions for natural and commercial variants changed from stipulating equal cost to stipulating equal chemical
identity (i.e., equal taste and equal health value). The differences between the categorical treatment of plant- and animal-based foods in terms of naturalness and corresponding differences in inferential reasoning appear to derive from folkbiological structures and concepts in the mind.

Rozin (2005) found that people assign essentially the same naturalness ratings to different variants of food that have undergone the same genetic modification process. Since these variants underwent the same type of process and were different only insofar as the kinds of genes that were mixed, Rozin (2005) proposed that process is more important than content in perceived naturalness of food. The results of this thesis contradict Rozin’s (2005) findings. After demonstrating in the pilot study that university students in Sacramento perceived significant differences between the naturalness of different variants of genetically modified foods, the principal study demonstrated similar results for university students of similar age in Sacramento and Mexico City. A basic food inserted with a gene from a vastly different kind of living thing receives a significantly different naturalness rating than a variant inserted with a gene from a taxonomically similar living kind. Perceived violations of naturalness occurred to different degrees in different genetically modified variants and tended to reflect taxonomic distance between living things and the corresponding folkbiological assumption of species boundaries.

The differences between these results and Rozin’s (2005) findings lead to different conclusions about the relative importance of process and content in shaping the perceived naturalness of basic foods. The findings in this thesis are interpreted as
evidence that natural species-like categories, as outlined in folkbiological studies, play a role in shaping perceptions of natural food. The findings suggest a strong role for living kind considerations and shared biological content, and a weaker role for shared processing history.

Older students in Mexico City gave similar ratings to different variants of genetically modified foods despite differences among these variants with respect to their biological contents. Students in Mexico City under 25 years old, however, gave significantly different naturalness ratings to genetically modified variants inserted with genes from different living kinds. Age appears to have been a factor shaping perceived naturalness in Mexico, and further research will be necessary to examine ways in which such cultural influences interact with the influences of evolved cognitive mechanisms to shape contemporary perceptions and categorizations of food.

The principal study found evidence that content is more important than process when students of similar ages in Sacramento and Mexico City rated the naturalness of different genetically modified foods. However, a follow-up test in Sacramento demonstrated that people privileged the genetic modification process over similar contents when making more general similarity judgments among food variants. Contrary to the prediction that similarity judgments involving basic foods are based on shared biological content, the findings from Sacramento offer evidence to support the notion that shared history or type of intervention is more important than shared biological content or living kind status in shaping perceptions of basic foods that have been genetically modified or treated with chemical additives.
The results of the similarity judgment task show that students in Sacramento do not always categorize or judge basic foods according to their biological content, and that students in Sacramento do not privilege processing history over biological content for all types and levels of food processing. Genetic modification of a living thing or basic food was perceived to be so extreme that it even had the effect of cueing for representations of an inanimate, inedible object. Based on these findings, whether or not people think about a food in terms of its biological origins or in terms of its history of human contact appears to depend on the type and amount of processing the food has undergone, and whether the processing affects its physical or chemical properties.

Whereas biological things reproduce and possess something intrinsic that gives rise to stable phenomenal properties, the production of an artifact and its properties generally depends on human intentional forces or external natural forces (Keil, 1994). Similarly, the perceived essence of an artifact has been described as being external to the object and as being synonymous with the intentions of its creator, and alternatively the perceived essences of living things and the causal relations among biological properties have been described as converging inside a biological entity (Barrett, 2001). These domain specific modes of construal are well described in the literature in cognitive psychology and evolutionary psychology.

In Sacramento, similarity judgments involving basic unprocessed foods or foods with minimal (physical) processing were based on shared biological content and supported predictions derived from prior studies in folkbiology dealing with perceptions of living kinds. On the other hand, perceived similarities among more complex
processed foods reflected shared processing history, design attributes, or intended uses of the foods. These results support Rozin’s (2006) notion that food with a history of contact with humans, particularly contact motivated by a person’s intentions, cues for an artifact psychology. Rozin and colleagues (2004) found that chemical manipulations, such as boiling or irradiating foods, result in greater reductions in perceived naturalness compared to physical transformation, such as grinding and freezing. The human mind appears to shift from a folkbiological mode of thought to one that reflects artifact concepts when thinking comparatively or categorically about different types of foods or different types of processes.

Biological ‘content’ appears to have as much (or more) of an influence as ‘process’ on people’s perceptions of natural, their preferences for natural, and their inferences about certain properties of basic foods and the living things they originate from. General comparative and categorical judgments, on the other hand, demonstrate the importance of processing history, design, and intended use in shaping perceptions of more complex processed foods, and also perceptions of certain types of modified basic foods. Future cross-cultural research should be conducted to build upon this thesis’ efforts to assess how innate ways of representing living things and artifacts influence perceptions of food and the meaning of the desirable attribute “natural”. Evolutionary considerations about the prehistory of different food processing techniques, the social and environmental contexts of these technological changes, and the possible cognitive adaptations that corresponded with these changes can continue to guide predictions and the design of future cross-cultural studies.
APPENDICES
APPENDIX A
Request for Review by the CSU Sacramento Committee for the Protection of Human Subjects

Project Title: Perceptions of Natural in the Domains of Food and Medicine

Name(s) and affiliation(s) of Researchers: Jordan Serin, CSUS graduate student
Dr. Roger Sullivan, CSUS Assistant Professor

Mailing address (or Department and campus mail code): Anthropology
(916) 448-2435, jordanserin@gmail.com
04/01/2008
Telephone and e-mail address for researcher Anticipated starting date
Dr. Roger Sullivan sullivar@csus.edu
Name of faculty sponsor (for student research) E-mail address of sponsor

1. Who will participate in this research as subjects (e.g., how many people, from what source, using what criteria for inclusion or exclusion)? How will their participation be recruited (e.g., what inducements, if any, will be offered)?

Undergraduate and graduate students at CSUS will be recruited from classes where a professor has agreed to allot time for a written questionnaire to be completed. The goal is to recruit approximately 300 students. An equal number of students will be recruited from university classes in Mexico City with the help of colleagues there.

2. How will informed consent be obtained from the subjects? Attach a copy of the consent form you will use. If a signed written consent will not be obtained, explain what you will do instead and why. (See Appendix B for examples of consent forms, an example of an assent form for children, and a list of consent form requirements. Also see Informed Consent earlier in this manual.)

Signed written consent will be obtained from all participating subjects. Please see attached consent form.

3. How will the subjects’ rights to privacy and safety be protected? (See Level of Risk earlier in this manual.)

The subjects will remain anonymous, and any documentation of a subject’s participation will be kept confidential and will be destroyed following the analysis of the results.

4. Summarize the study’s purpose, design, and procedures. (Do not attach lengthy grant proposals, etc.)

This quantitative study intends to address the growth of the natural product industry in the United States, and includes a cross-cultural comparison between students in the United States and students in Mexico. There are three related objectives of this study. First, we will investigate the
extent of people’s preferences for natural in the domains of food and medicine. Second, we will investigate people’s perceptions of the healthiness/effectiveness of different forms of food and medicine. And third, we will investigate the production techniques and properties of food and medicine that best account for people’s judgements of naturalness. Three questionnaires will be administered in this study, which intends to replicate and expand upon previous research conducted by Rozin et al. (2004) and Rozin (2005). Each student in the United States and in Mexico will complete one two versions of the questionnaire. The results of this study will be compared to those of Rozin et al. (2004) and Rozin (2005), and possible cultural differences between students in the U.S. and Mexico will be assessed.

5. Describe the content of any tests, questionnaires, interviews, etc. in the research. Attach copies of the questions. What risk of discomfort or harm, if any, is involved in their use?

Please see attachments of the questionnaires. No risk of discomfort or harm is foreseen in administering them. All subjects will be made aware of our interest in how people perceive naturalness and what people think naturalness is. Approximately 150 students enrolled in courses at CSUS and 150 students at a university in Mexico City will complete the written questionnaires (in English and Spanish, respectively). Definitions of ‘natural foods’ and ‘commercial’ food items will be provided to participants before asking them to indicate for each of the items whether they prefer it in its natural form, its processed form, or are indifferent. Participants will also be asked if they thought that either a natural or processed form of each item was healthier or more effective. The questionnaire will also ask subjects to rank a large range of items using a scale that runs from “not natural at all” to “completely natural”. Various items on this questionnaire will be similar in kind (i.e., oranges), but they will vary in the degree to which they’ve been exposed to certain production or manufacturing techniques (i.e., grown with pesticides, genetically engineered). All questionnaires will contain standard demographic questions. They will also contain additional questions about Body Mass Index (BMI), frequency of food control behaviours and reactions (dieting, feeling guilty, concern about weight), dissatisfaction with body image and religiosity.

6. Describe any physical procedures in the research. What risk of discomfort or harm, if any, is involved in their use?

There are no physical procedures in the research.

7. Describe any equipment or instruments and any drugs or pharmaceuticals that will be used in the research. What risk of discomfort or harm, if any, is involved in their use?

No equipment, instruments or drugs will be used in the research.
8. Taking all aspects of this research into consideration, do you consider the study to be “exempt,” “no risk,” “minimal risk,” or “at risk?” Explain why. (See Level of Risk earlier in this manual.)

This study presents “no risk” to subjects. None of the procedures or content of the questionnaires would cause discomfort or harm to subjects. The purpose and procedures of the study will be explained to subjects prior to administering the questionnaires, and confidentiality will be maintained.

_____________________________  ____________________
Signature of Researcher     Date

_____________________________  ____________________
Signature of Faculty Sponsor     Date
APPENDIX B
Consent to Participate in Research

You are being asked to participate in research that will be conducted by Jordan Serin and Dr. Roger Sullivan in the Anthropology Department at California State University, Sacramento. The purpose of the study is to gather information about people’s perceptions of natural foods and medicines. The study will investigate the extent to which individuals prefer natural foods and medicines and some of the reasons why these preferences may exist. This information is important because of its implications for health and diet-related choices and behaviours.

You will be asked to complete a questionnaire about your perceptions of different foods and medicines. Some definitions about foods and medicines may be provided. Any questions you may have about the contents of the questionnaire will be answered as best as possible by the facilitator. The questionnaire will be completed individually and your responses will remain entirely confidential. You will be asked to provide some personal and demographic information to assist with our analysis of the results.

There are no health risks associated with this study.

Participation in this research offers you an opportunity to reflect upon your perceptions and choices of foods and medicines. The study may provide new information about people’s motivations for choosing certain foods and medicines. Understanding the influences of perceptions and attitudes on consumption behaviours is relevant for promoting healthy eating and appropriate food production techniques.

Any documentation of your participation in this study will be destroyed following the analysis of the results. Though your responses to the questionnaire may be shared with the public, this information will not be presented in a way that would indicate your personal involvement or contributions.

You will not receive any compensation for your participation.

Please address any questions about this research to Dr. Roger Sullivan at (916) 278-4083 or by e-mail at sullivar@csus.edu.

You will not face any consequences for declining to participate in this study. By signing below, you are indicating that you have read this page and agree to participate in the research.

_________________________________ __________________________
Signature of Participant              Date
APPENDIX C
Pilot Study Questionnaire

1. Age: ______
2. Height: _________
3. Weight: ________
4. Sex (please circle): M F

5. Using the scale provided, please indicate how religious you are:
   (please circle)
   
   0 1 2 3 4
   Not religious at all Extremely religious

6. Please indicate the highest educational level you have completed:
   (circle one)

   9\textsuperscript{th} grade or below 10\textsuperscript{th} grade 11\textsuperscript{th} grade H.S. Diploma
   College 1 year College 2 years College 3 years College 4+ years
   Bachelor’s Degree Master’s Degree Doctoral Degree

7. Using the scale provided, indicate how closely your current body figure approximates your ideal body figure:

   Please Circle
   
   0 1 2 3 4 5 6 7 8 9
   (Not At All) (Exactly)
8. Using the scale provided, please indicate how often you experience
the attitudes or behaviors listed in the chart below:

(0=never, 1=rarely, 2=occasionally, 3=often, 4=nearly all the time)

Please Circle

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am on a diet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel guilty about what I eat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am concerned about my weight</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I hold back from eating at meals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9. a) Do you think NATURAL is generally a good thing? (please circle)

YES   NO

b) WHY?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
When completing questions 10-11, please refer to the following naturalness scale, which runs from 0 to 4. The numbers correspond to naturalness in the following ways:

0= not natural at all
1= slightly natural
2= moderately natural
3= very natural
4= completely natural

There is no right answer to any question, so please respond in a way that best represents your personal outlook and beliefs.

10. Place the appropriate number, from 0 to 4, in the space next to each item to indicate your naturalness rating.

| Steak harvested from a buffalo living and feeding on a prairie |   |
| Steak harvested from a free-range cow fed organic grass and grains |   |
| Steak harvested from a free-range cow fed chemically treated grass and grains |   |
| Steak harvested from a cow housed in a small stall and fed organic grass and grains |   |
| Steak harvested from a genetically modified cow with a gene inserted from a pig so that it will grow faster; the cow ranges freely and is fed organic grass and grains |   |
| Steak harvested from a genetically modified cow with a gene inserted from corn so that it will grow faster; the cow ranges freely and is fed organic grass and grains. |   |
11. Place the appropriate number, from 0 to 4, in the space next to each item to indicate your naturalness rating.

<table>
<thead>
<tr>
<th>Item</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>An orange grown organically (without added fertilizer or pesticide)</td>
<td></td>
</tr>
<tr>
<td>An orange grown without added fertilizer or pesticide, but genetically modified with a gene from another plant inserted so it will be more resistant to insects</td>
<td></td>
</tr>
<tr>
<td>An orange grown without added fertilizer or pesticide, but genetically modified with a gene from a cow inserted so it will be more resistant to insects</td>
<td></td>
</tr>
<tr>
<td>An orange without genetic modification, but grown with chemical fertilizer and pesticide</td>
<td></td>
</tr>
<tr>
<td>Fresh squeezed juice made from organically grown oranges</td>
<td></td>
</tr>
<tr>
<td>Fresh squeezed juice made from oranges without genetic modification, but grown with chemical fertilizers and pesticides</td>
<td></td>
</tr>
<tr>
<td>Fresh squeezed juice made from oranges grown without added fertilizer or pesticides, but genetically modified with a gene from another plant inserted so it will be more resistant to insects</td>
<td></td>
</tr>
<tr>
<td>Fresh squeezed juice made from oranges grown without added fertilizer or pesticides, but genetically modified with a gene from a cow inserted so it will be more resistant to insects</td>
<td></td>
</tr>
<tr>
<td>Fresh squeezed juice made from organically grown oranges with an added natural calcium supplement</td>
<td></td>
</tr>
<tr>
<td>Fresh squeezed juice made from organically grown oranges with an added 20 mg per serving of natural Vitamin C</td>
<td></td>
</tr>
<tr>
<td>Fresh squeezed juice made from organically grown oranges with an added 300 mg per serving of natural Vitamin C</td>
<td></td>
</tr>
<tr>
<td>Fresh squeezed juice made from organically grown oranges with the pulp removed</td>
<td></td>
</tr>
<tr>
<td>Tea made from dried organically grown oranges</td>
<td></td>
</tr>
</tbody>
</table>
When completing questions 12-17, please refer to the following definitions to make your selections:

A **natural food** is one that has not been changed in any significant way by contact with humans. It could have been picked or transported, but it is chemically identical to the same item in its natural place.

A **commercial food** is one that has been grown or produced with fertilizers or pesticides and might contain additives or preservatives to enhance its taste.

A **natural medicinal item** is one that has been extracted from plants or animals.

A **commercial medicinal item** is one that has been synthesized in a chemical/pharmaceutical laboratory.

**When completing questions 12-14, please assume that the natural and processed products cost the same.**

12. Please indicate whether you prefer each of the following products in its natural form (N), its commercial form (C) or are indifferent (I).

<table>
<thead>
<tr>
<th>Product</th>
<th>N</th>
<th>C</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meat</td>
<td>N</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>Mouthwash</td>
<td>N</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>Antibiotic</td>
<td>N</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>Vitamins</td>
<td>N</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>Peaches</td>
<td>N</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>Dietary Supplements</td>
<td>N</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>Analgesic</td>
<td>N</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>Energy Drink</td>
<td>N</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>Doedorant</td>
<td>N</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>Bread</td>
<td>N</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>Thyroid Hormone</td>
<td>N</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>Lettuce</td>
<td>N</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>Yogurt</td>
<td>N</td>
<td>C</td>
<td>I</td>
</tr>
</tbody>
</table>
13. Using the same N (natural), C (commercial), and I (indifferent) alternatives, please indicate which form you think is healthier or more effective.

<table>
<thead>
<tr>
<th>Item</th>
<th>N</th>
<th>C</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meat</td>
<td>N</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>Mouthwash</td>
<td>N</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>Antibiotic</td>
<td>N</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>Vitamins</td>
<td>N</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>Peaches</td>
<td>N</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>Dietary Supplements</td>
<td>N</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>Analgesic</td>
<td>N</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>Energy Drink</td>
<td>N</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>Deodorant</td>
<td>N</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>Bread</td>
<td>N</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>Thyroid Hormone</td>
<td>N</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>Lettuce</td>
<td>N</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>Yogurt</td>
<td>N</td>
<td>C</td>
<td>I</td>
</tr>
</tbody>
</table>

14. Suppose there are two chemically identical pure drugs. The first one is natural (N) because it has been extracted from a plant leaf. The second one is commercial (C) because it has been synthesized in a chemical laboratory.

(Please circle)

a) Which of the drugs would you prefer? N C I

b) Which do you think is more effective? N C I
15. Please respond to the following questions by circling your choice between NATURAL (N), COMMERCIAL (C), or INDIFFERENT (I).

a) Think of a natural potato and a commercially grown potato that cost the same. Which would you prefer to eat?
   
   N   C   I

b) Now assume that both the natural and commercial potatoes taste exactly the same. Now, which would you prefer to eat?
   
   N   C   I

c) Now assume that both the natural and commercial potatoes are equally healthy, containing exactly the same nutrients, whether or not they have the same taste. Now, which would you prefer to eat?
   
   N   C   I

d) Now assume that both the natural and commercial potatoes are chemically identical, and thus taste the same and have the same health value. Now, which would you prefer to eat?
   
   N   C   I
16. Please respond to the following questions by circling your choice between NATURAL (N), COMMERCIAL (C), or INDIFFERENT (I).

a) Think of a natural ice cream and a commercially made ice cream that cost the same. Which would you prefer to eat?
   
   N  C  I

b) Now assume that both the natural and commercial ice creams taste exactly the same. Now, which would you prefer to eat?
   
   N  C  I

c) Now assume that both the natural and commercial ice creams are equally healthy, containing exactly the same nutrients, whether or not they have the same taste. Now, which would you prefer to eat?
   
   N  C  I

d) Now assume that both the natural and commercial ice creams are chemically identical, and thus taste the same and have the same health value. Now, which would you prefer to eat?
   
   N  C  I
17. Please respond to the following questions by circling your choice between NATURAL (N), COMMERCIAL (C), or INDIFFERENT (I).

a) Think of a natural antibiotic and a commercially made antibiotic that cost the same. Which would you prefer to use?

   N     C     I

b) Now assume that both the natural and commercial antibiotics have the same side effects. Now, which would you prefer to use?

   N     C     I

c) Now assume that both the natural and commercial antibiotics are equally effective, demonstrating the same ability to accomplish its primary goal, whether or not they have the same side effects. Now, which would you prefer to use?

   N     C     I

d) Now assume that both the natural and commercial antibiotics are chemically identical, and thus have the same side effects and are equally effective. Now, which would you prefer to use?

   N     C     I
APPENDIX D
Consentimiento a Participar en Investigación

Sr. Jordan Serin y Doctor Roger Sullivan del departamento de antropología de la Universidad del Estado de California en Sacramento están haciendo una investigación y le a usted piden el favor de participar. El propósito de este estudio es coleccionar información sobre las percepciones de comida. El estudio investigará hasta que punto cada persona prefiere que la comida sean natural y las razones porque estas preferencias existen. La información es importante por sus implicaciones para la salud, y comportamientos y elecciones relacionados a la salud.

Pregúntele al entrevistador si necesita clarificación en algunas cosas. Cada individuo va a cumplir su propio cuestionario y las respuestas quedarán completamente confidenciales. Le pedirá a usted que de información personal para asistirnos analizar los resultados. Tardará quince minutos, aproximadamente, para cumplirlo.

Hay riesgos mínimos asociados con este estudio porque las preguntas sobre sus comportamientos y actitudes relacionados a comida y medicina pueden dirigirse a temas sensitivos para usted.

Toda la documentación de su participación será destruida en cuanto los resultados estén analizados. La posibilidad existe que sus respuestas sean compartidas con el público. No obstante la información no va a ser presentado en una manera que indica su identidad.

Usted no va a recibir ninguna pagamiento para su participación.

Si tiene algunas preguntas sobre esta investigación por favor dirígalas al Doctor Roger Sullivan por correo electrónico sullivar@csus.edu.

No hay consecuencias para rechazar de participar en este estudio. También puede elegir de no responder a cualquier pregunta presentada en el cuestionario. Su firma en este papel indica que ha leído esta página y esta de acuerdo con participar en la investigación.

Firma de participante               Fecha
APPENDIX E
Principal Study Questionnaire: Version A

1. Age: ______

2. Height: __________

3. Weight: ________

4. Sex: __________

5. Religion:
   ___ Catholic  ___ Protestant  ___ Hindu  ___ Jewish  ___ Mormon
   ___ Muslim  ___ Jehovah’s Witness  ___ Buddhist  ___ Not religious
   ___ Other (please specify): ____________________________

6. Please indicate the highest educational level you have completed:

   High school or below _____
   College or University: One year _____
                          Two years _____
                          Three years _____
                          Four or more years _____
   Master’s or Doctorate _____

7. Using the scale provided, indicate how closely your current body figure approximates your ideal body figure:

   Please Circle

   0 1 2 3 4 5 6 7 8 9
   (Not At All) (Exactly)

8. If you follow a special diet, please specify below:
   ___ Vegetarian  ___ Vegan  ___ Kosher
   ___ Raw Foods  ___ Macrobiotic  ___ Red meat restricted
   ___ Other (please specify): ____________________________
9. Using the scale provided, please indicate how often you experience the attitudes or behaviors listed in the chart below:

\[
\begin{array}{l}
\text{Please Circle} \\
\text{I am on a diet} & 0 & 1 & 2 & 3 & 4 \\
\text{I feel guilty about what I eat} & 0 & 1 & 2 & 3 & 4 \\
\text{I am concerned about my weight} & 0 & 1 & 2 & 3 & 4 \\
\text{I hold back from eating at meals} & 0 & 1 & 2 & 3 & 4 \\
\end{array}
\]

(0=never, 1=rarely, 2=occasionally, 3=often, 4=nearly all the time)

10. Refer to the following scale, which runs from 1 to 5. The numbers correspond to your attitudes about eating a particular food in the following ways:

1= strongly unfavorable
2= unfavorable
3= neutral
4= favorable
5= strongly favorable

Place the appropriate number, from 1 to 5, in the space next to each item to indicate how favorable it would be to consume each one.

_____ Corn that has been genetically modified with the insertion of a gene from wheat
_____ Corn that has been grown with chemical fertilizers and pesticides
_____ Corn that has been genetically modified with the insertion of a gene from oranges
_____ Corn that has been harvested from a field with fresh manure
_____ Corn that has been genetically modified with the insertion of a gene from a cow
_____ Corn that has been grown indoors
11. Refer to the following naturalness scale, which runs from 1 to 5. The numbers correspond to naturalness in the following ways:

   1= not natural at all
   2= slightly natural
   3= moderately natural
   4= very natural
   5= completely natural

Place the appropriate number, from 1 to 5, in the space next to each item to indicate your naturalness rating.

There is no right answer, so please respond in a way that best represents your personal outlook and beliefs.

_____ Corn that has been genetically modified with the insertion of a gene from wheat
_____ Corn that has been grown with chemical fertilizers and pesticides
_____ Corn that has been genetically modified with the insertion of a gene from oranges
_____ Corn that has been harvested from a field with fresh manure
_____ Corn that has been genetically modified with the insertion of a gene from a cow
_____ Corn that has been grown indoors
In the following section, you will be given a premise statement about one item and then asked how likely it is that the same statement is true for different items. Please refer to the following scale to choose your answers:

1= not likely at all
2= unlikely
3= likely
4= very likely
5= certainly

For example:
Premise: Brown sugar dissolves when you put it in water.
Question: How likely is it that the following item also dissolves in water?

_____ White sugar cubes

Write the number (1 to 5) that corresponds to your answer on the line next to each item.

12. Premise: Corn contains many minerals and vitamins that provide health benefits to human consumers.
Question: How likely is it that each of the following items also contains many minerals and vitamins that provide health benefits to human consumers?

_____ Corn that has been genetically modified with the insertion of a gene from wheat
_____ Corn that has been grown with chemical fertilizers and pesticides
_____ Corn that has been genetically modified with the insertion of a gene from oranges
_____ Corn that has been harvested from a field with fresh manure
_____ Corn that has been genetically modified with the insertion of a gene from a cow
_____ Corn that has been grown indoors
13. **Premise:** Corn contains naturally-occurring chemicals that defend the plant against predators.

**Question:** How likely is it that each of the following also contains naturally-occurring chemicals that defend the plant against predators?

- _____ Corn that has been genetically modified with the insertion of a gene from wheat
- _____ Corn that has been grown with chemical fertilizers and pesticides
- _____ Corn that has been genetically modified with the insertion of a gene from oranges
- _____ Corn that has been harvested from a field with fresh manure
- _____ Corn that has been genetically modified with the insertion of a gene from a cow
- _____ Corn that has been grown indoors
14. **Premise:** Corn is safe to eat in its raw form before it has fully matured.

**Question:** How likely is it that each of the following is also safe to eat in its raw form before it has fully matured?

_____ Corn that has been genetically modified with the insertion of a gene from wheat

_____ Corn that has been grown with chemical fertilizers and pesticides

_____ Corn that has been genetically modified with the insertion of a gene from oranges

_____ Corn that has been harvested from a field with fresh manure

_____ Corn that has been genetically modified with the insertion of a gene from a cow

_____ Corn that has been grown indoors
In the following section, please refer to the following definitions to make your selections:

A **natural food** is one that has not been changed in any significant way by contact with humans. It could have been picked or transported, but it is chemically identical to the same item in its natural place.

A **commercial food** is one that has been grown or produced with fertilizers or pesticides and might contain additives or preservatives to enhance its taste.

15. Please respond to the following questions by circling your choice between **NATURAL (N)**, **COMMERCIAL (C)**, or **INDIFFERENT (I)**.

a) Think of a natural potato and a commercially grown potato that **cost** the same. Which would you prefer to eat?

   N  C  I

b) Now assume that both the natural and commercial potatoes **taste** exactly the same. Now, which would you prefer to eat?

   N  C  I

c) Now assume that both the natural and commercial potatoes are equally **healthy**, containing exactly the same nutrients, whether or not they have the same taste. Now, which would you prefer to eat?

   N  C  I

d) Now assume that both the natural and commercial potatoes are **chemically identical**, and thus taste the same and have the same health value. Now, which would you prefer to eat?

   N  C  I
16. Please respond to the following questions by circling your choice between NATURAL (N), COMMERCIAL (C), or INDIFFERENT (I).

a) Think of natural beef and commercially raised beef that cost the same. Which would you prefer to eat?

   N  C  I

b) Now assume that both the natural and commercial meats taste exactly the same. Now, which would you prefer to eat?

   N  C  I

c) Now assume that both the natural and commercial meats are equally healthy, containing exactly the same nutrients, whether or not they have the same taste. Now, which would you prefer to eat?

   N  C  I

d) Now assume that both the natural and commercial meats are chemically identical, and thus taste the same and have the same health value. Now, which would you prefer to eat?

   N  C  I
17. Please use the scale provided to indicate the extent to which you agree or disagree with the following statements.

1= Strongly disagree
2= Disagree
3= Neither fully agree nor fully disagree
4= Agree
5= Strongly agree

<table>
<thead>
<tr>
<th>Statements</th>
<th>1</th>
<th>2</th>
<th>3</th>
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<tr>
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<td>Strawberries grown with chemical fertilizers and pesticides are more like organically grown strawberries than they are like plastic strawberries</td>
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<td>Peppermint tea is more like chamomile tea than it is like a living mint plant</td>
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<tr>
<td>A twinkie is more like a stalk of wheat than it is like a plastic bag</td>
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</table>
APPENDIX F
Principal Study Questionnaire: Version B

1. Age: ______

2. Height: __________

3. Weight: ________

4. Sex: _____________

5. Religion:
   ___ Catholic   ___ Protestant   ___Hindu     ___Jewish     ___Mormon
   ___ Muslim     ___ Jehovah’s Witness   ___ Buddhist     ___ Not religious
   ___ Other (please specify):___________________________________________

6. Please indicate the highest educational level you have completed:
   High school or below _____
   College or University: One year _____
                           Two years _____
                           Three years _____
                           Four or more years _____
   Master’s or Doctorate _____

7. Using the scale provided, indicate how closely your current body figure approximates your ideal body figure:

   Please Circle
            0  1  2  3  4  5  6  7  8  9
   (Not At All)                (Exactly)

8. If you follow a special diet, please specify below:
   ___ Vegetarian    ___Vegan    ___Kosher
   ___ Raw Foods     ___ Macrobiotic ___ Red meat restricted
   ___Other (please specify):___________________________________________
9. Using the scale provided, please indicate how often you experience the attitudes or behaviors listed in the chart below:

(0=never, 1=rarely, 2=occasionally, 3=often, 4=nearly all the time)

<table>
<thead>
<tr>
<th>Attitude or Behavior</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<tbody>
<tr>
<td>I am on a diet</td>
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<tr>
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<td>I hold back from eating at meals</td>
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</tbody>
</table>

10. Refer to the following scale, which runs from 1 to 5. The numbers correspond to your attitudes about eating a particular food in the following ways:

1= strongly unfavorable  
2= unfavorable  
3= neutral  
4= favorable  
5= strongly favorable

Place the appropriate number, from 1 to 5, in the space next to each item to indicate how favorable it would be to consume each one.

_____ Chicken that has been genetically modified with the insertion of a gene from a duck
_____ Chicken that has been injected with hormones
_____ Chicken that has been genetically modified with the insertion of a gene from a cow
_____ Chicken that forages in manure for insects and worms to eat
_____ Chicken that has been genetically modified with the insertion of a gene from corn
_____ Chicken that has been raised indoors
11. Refer to the following naturalness scale, which runs from 1 to 5. The numbers correspond to naturalness in the following ways:

1= not natural at all  
2= slightly natural  
3= moderately natural  
4= very natural  
5= completely natural

Place the appropriate number, from 1 to 5, in the space next to each item to indicate your naturalness rating.

There is no right answer, so please respond in a way that best represents your personal outlook and beliefs.

_____ Chicken that has been genetically modified with the insertion of a gene from a duck
_____ Chicken that has been injected with hormones
_____ Chicken that has been genetically modified with the insertion of a gene from a cow
_____ Chicken that forages in manure for insects and worms to eat
_____ Chicken that has been genetically modified with the insertion of a gene from corn
_____ Chicken that has been raised indoors
In the following section, you will be given a premise statement about one item and then asked how likely it is that the same statement is true for different items. Please refer to the following scale to choose your answers:

1= not likely at all  
2= unlikely  
3= likely  
4= very likely  
5= certainly

For example:
**Premise:** Brown sugar dissolves when you put it in water.  
**Question:** How likely is it that the following item also dissolves in water?

_____ White sugar cubes

Write the number (1 to 5) that corresponds to your answer on the line next to each item.

12. **Premise:** Chicken is a healthy source of lean protein for human consumers.

   **Question:** How likely is it that each of the following items is also a healthy source of lean protein for human consumers?

   _____ Chicken that has been genetically modified with the insertion of a gene from a duck
   _____ Chicken that has been injected with hormones
   _____ Chicken that has been genetically modified with the insertion of a gene from a cow
   _____ Chicken that forages in manure for insects and worms to eat
   _____ Chicken that has been genetically modified with the insertion of a gene from corn
   _____ Chicken that has been raised indoors
1= not likely at all
2= unlikely
3= likely
4= very likely
5= certainly

13. **Premise:** Chickens have a strong maternal instinct to care for offspring.

**Question:** How likely is it that each of the following also has a strong maternal instinct to care for offspring?

______ Chicken that has been genetically modified with the insertion of a gene from a duck

______ Chicken that has been injected with hormones

______ Chicken that has been genetically modified with the insertion of a gene from a cow

______ Chicken that forages in manure for insects and worms to eat

______ Chicken that has been genetically modified with the insertion of a gene from corn

______ Chicken that has been raised indoors
14. **Premise:** Nearly every part of a chicken is safe for human consumption.

**Question:** How likely is it that nearly every part of each of the following items is also safe for human consumption?

_____ Chicken that has been genetically modified with the insertion of a gene from a duck

_____ Chicken that has been injected with hormones

_____ Chicken that has been genetically modified with the insertion of a gene from a cow

_____ Chicken that forages in manure for insects and worms to eat

_____ Chicken that has been genetically modified with the insertion of a gene from corn

_____ Chicken that has been raised indoors
In the following section, please refer to the following definitions to make your selections:

A natural food is one that has not been changed in any significant way by contact with humans. It could have been picked or transported, but it is chemically identical to the same item in its natural place.

A commercial food is one that has been grown or produced with fertilizers or pesticides and might contain additives or preservatives to enhance its taste.

15. Please respond to the following questions by circling your choice between NATURAL (N), COMMERCIAL (C), or INDIFFERENT (I).

a) Think of a natural potato and a commercially grown potato that cost the same. Which would you prefer to eat?
   N  C  I

b) Now assume that both the natural and commercial potatoes taste exactly the same. Now, which would you prefer to eat?
   N  C  I

c) Now assume that both the natural and commercial potatoes are equally healthy, containing exactly the same nutrients, whether or not they have the same taste. Now, which would you prefer to eat?
   N  C  I

d) Now assume that both the natural and commercial potatoes are chemically identical, and thus taste the same and have the same health value. Now, which would you prefer to eat?
   N  C  I
16. Please respond to the following questions by circling your choice between NATURAL (N), COMMERCIAL (C), or INDIFFERENT (I).

a) Think of natural beef and commercially raised beef that cost the same. Which would you prefer to eat?
   N   C   I

b) Now assume that both the natural and commercial meats taste exactly the same. Now, which would you prefer to eat?
   N   C   I

c) Now assume that both the natural and commercial meats are equally healthy, containing exactly the same nutrients, whether or not they have the same taste. Now, which would you prefer to eat?
   N   C   I

d) Now assume that both the natural and commercial meats are chemically identical, and thus taste the same and have the same health value. Now, which would you prefer to eat?
   N   C   I
17. Please use the scale provided to indicate the extent to which you agree or disagree with the following statements.

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<td>strawberries</td>
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<td>mint plant</td>
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APPENDIX G
Principal Study Questionnaire: Version A (Spanish Translation)

1. Edad: _______

2. Altura: _______

3. Peso: _______

4. Sexo: _______

5. Por favor, indique con una (X) su nivel escolar completo:

   Primaria_______
   Secundaria_____  
   Universidad:     Un año _____
                   Dos años _____
                   Tres años _____
                   Cuatro o más años _____
   Posgrado:      Maestría_______
                   Doctorado ____

6. Por favor, usando la escala de 0 a 9, indique con una (X) sobre el número, si su figura corporal se aproxima a una figura de un cuerpo al que los medios de comunicación llaman cuerpo ideal

   0 1 2 3 4 5 6 7 8 9
   (nada) (exacto)

7. Por favor, indique si Ud. es vegetariano:

   Si____    No _____

   No, pero yo sigo otro régimen dietético, ¿cuál?
8. Usando la escala de 0 a 4, por favor, marque con qué frecuencia tiene las actitudes o comportamientos que a continuación se muestran:

\[(0=\text{nunca}, \ 1=\text{casi nunca}, \ 2=\text{a veces}, \ 3=\text{con frecuencia}, \ 4=\text{casi siempre})\]

- Estoy a dieta
- Me da vergüenza lo que como
- Me preocupa mi peso
- No como toda la comida de mi plato

9. En la escala que se muestra a continuación, señale en el espacio del 1 (muy desfavorable) al 5 (muy favorable), sus preferencias de consumo:

\[1=\text{muy desfavorable}\]
\[2=\text{desfavorable}\]
\[3=\text{neutral}\]
\[4=\text{favorable}\]
\[5=\text{muy favorable}\]

- Maíz transgénico con un gen de trigo.
- Maíz cultivado con fertilizantes y pesticidas.
- Maíz transgénico con un gen de naranjas.
- Maíz cosechado de un campo con estiércol fresco.
- Maíz transgénico con un gen de vaca.
- Maíz cultivado en un invernadero.
10. Refiera a la escala de 1 a 5. Los números que corresponden a NATURAL en los modos siguientes:

1= para nada natural
2= un poquito natural
3= casi natural
4= muy natural
5= completamente natural

Indique su opinión de la naturalidad de cada producto citado, usando los números, del 1 al 5 según sea conveniente, en el espacio al lado de cada descripción.

No hay una respuesta correcta. Por favor, responda en la forma que represente sus creencias y puntos de vista.

_____ Maíz transgénico con un gen de trigo.
_____ Maíz cultivado con fertilizantes y pesticidas.
_____ Maíz transgénico con un gen de naranjas.
_____ Maíz cosechado de un campo con estiércol fresco.
_____ Maíz transgénico con un gen de vaca.
_____ Maíz cultivado en un invernadero.
En la sección siguiente, se muestra un hecho de un producto comestible. Después se le preguntará con qué probabilidad el mismo hecho sería cierto en referencia a otros productos similares o diferentes. Por favor, haga referencia según la escala del 1 al 5 que a continuación se presenta.

1= completamente improbable  
2= improbable  
3= probable  
4= muy probable  
5= seguramente

Por ejemplo:

**Proposición:** El azúcar moreno se disuelve cuando se pone en agua.  
**Pregunta:** Con qué probabilidad se disolvería el siguiente producto en el agua?

5 Un terrón de azúcar blanco

Use los números de 1 a 5 para indicar su opinión de la probabilidad en el espacio al lado de cada oración.

11) **Proposición:** El maíz contiene muchas vitaminas y minerales.  
**Pregunta:** Con qué probabilidad se contendrían las vitaminas y minerales en los productos siguientes?

_____ Maíz transgénico con un gen de trigo.
_____ Maíz cultivado con fertilizantes y pesticidas.
_____ Maíz transgénico con un gen de naranjas.
_____ Maíz cosechado de un campo con estiércol fresco.
_____ Maíz transgénico con un gen de vaca.
_____ Maíz cultivado en un invernadero.
12) **Proposición:** El maíz contiene un antibiótico que sirve a la planta como defensa en contra de una plaga.

**Pregunta:** ¿Con qué probabilidad contendría cada uno de los siguientes productos un antibiótico que le sirve a la planta como defensa en contra de plagas?

_____ Maíz transgénico con un gen de trigo.

_____ Maíz cultivado con fertilizantes y pesticidas.

_____ Maíz transgénico con un gen de naranjas.

_____ Maíz cosechado de un campo con estiércol fresco.

_____ Maíz transgénico con un gen de vaca.

_____ Maíz cultivado en un invernadero.

13) **Proposición:** Es sano comer maíz cocido y/o asado.

**Pregunta:** ¿Con qué probabilidad es sano comer también cada uno de los siguientes productos cocidos y/o asados?

_____ Maíz transgénico con un gen de trigo.

_____ Maíz cultivado con fertilizantes y pesticidas.

_____ Maíz transgénico con un gen de naranjas.

_____ Maíz cosechado de un campo con estiércol fresco.

_____ Maíz transgénico con un gen de vaca.

_____ Maíz cultivado en un invernadero.
En la sección siguiente, refiera a las definiciones siguientes para hacer sus elecciones:

Una comida natural es algo que no se ha cambiado en su forma por el resultado del contacto humano. Puede ser cosechado o transportado, pero es químicamente igual a lo que se encuentra en su lugar natural.

Una comida industrial es la que ha crecido o producido con fertilizantes o pesticidas químicos, y quizás contiene aditivos o conservadores para aumentar su sabor.

14. Por favor, responda a las siguientes preguntas eligiendo entre:

   NATURAL (N), INDUSTRIAL (I), o NO IMPORTA (NI).

a) Imagínese una papa natural y una papa cultivada industrialmente que costaron lo mismo. ¿Cuál papa preferiría comer?
   
   N      I      NI

b) Ahora, suponga que los dos tipos de papas tengan el mismo sabor. ¿Cuál papa preferiría comer?
   
   N      I      NI

c) Ahora, suponga que la papa natural y la papa industrial son igualmente sanas, contienen la misma cantidad de nutrientes. ¿Cuál papa preferiría comer?
   
   N      I      NI

d) Ahora, suponga que la papa natural y la papa industrial son químicamente iguales, y por eso tienen el mismo sabor y son igualmente sanas. ¿Cuál papa preferiría comer?
   
   N      I      NI
15. Por favor, responda a las preguntas siguientes eligiendo una vez más entre NATURAL (N), INDUSTRIAL (I), o NO IMPORTA (NI).

a) Imagínese que la carne de res natural y la carne de res industrial **costaron lo mismo**. ¿Cuál carne preferiría comer?
   N      I      NI

b) Ahora, suponga que los dos tipos de carne tienen **el mismo sabor**. ¿Cuál carne preferiría comer?
   N      I      NI

c) Ahora, suponga que la carne natural y la carne industrial son **igualmente sanas**, y que contienen la misma cantidad de nutrientes. ¿Cuál carne preferiría comer? 
   N      I      NI

d) Ahora, suponga que la carne natural y la carne industrial son **químicamente iguales**, y por eso tienen el mismo sabor y son igualmente sanas. ¿Cuál carne preferiría comer?
   N      I      NI
16. Por favor, indique en la escala de 1 a 5, según este de acuerdo con las siguientes oraciones:

1 = Completamente en desacuerdo  
2 = No estoy de acuerdo  
3 = No estoy de acuerdo ni en desacuerdo  
4 = Estoy de acuerdo  
5 = Estoy totalmente de acuerdo  

Marque el número, del 1 al 5 según sea conveniente, en el espacio al lado de cada descripción.

<table>
<thead>
<tr>
<th>Argumento</th>
<th>Escalas</th>
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<tbody>
<tr>
<td>Los pollos modificados genéticamente son más parecidos a los pollos de rancho que los pollos de goma.</td>
<td>1 2 3 4 5</td>
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<td></td>
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<tr>
<td>Los pollos de rancho son más parecidos a los pollos modificados genéticamente que las manzanas orgánicas.</td>
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<td>La carne de pollo manipulada con hormonas se parece más la carne de pollo de rancho que la carne de res manipulada con hormonas.</td>
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<td>El jarabe de maíz rico en fructosa es más parecido al azúcar artificial que el maíz de natural de la mazorca.</td>
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<td>El té de yerba santa empaquetado es más como el té de manzanilla que la planta de yerba santa al natural.</td>
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<td>Un pastelito “marinela” o similar es más parecido al tallo de trigo que la bolsa de plástico.</td>
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¡GRACIAS!
APPENDIX H
Principal Study Questionnaire: Version B (Spanish Translation)

1. Edad: _______
2. Altura: _______
3. Peso: _______
4. Sexo: _______
5. Por favor, indique con una (X) su nivel escolar completo:
   Primaria_____
   Secundaría_____
   Universidad: Un año _____
   Dos años _____
   Tres años _____
   Cuatro o más años _____
   Posgrado: Maestría_____
             Doctorado _____

6. Por favor, usando la escala de 0 a 9, indique con una (X) sobre el número, si su figura corporal se aproxima a una figura de un cuerpo al que los medios de comunicación llaman cuerpo ideal
   0    1    2    3    4    5    6    7    8    9
   (nada) (exacto)

7. Por favor, indique si Ud. es vegetariano:
   Si____   No _____
   No, pero yo sigo otro régimen dietético, ¿cuál?
8. Usando la escala de 0 a 4, por favor, marque con qué frecuencia tiene las actitudes o comportamientos que a continuación se muestran:

\[(0=\text{nunca}, \ 1=\text{casi nunca}, \ 2=\text{a veces}, \ 3=\text{con frecuencia}, \ 4=\text{casi siempre})\]

<table>
<thead>
<tr>
<th>Actitud</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<tbody>
<tr>
<td>Estoy a dieta</td>
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<td>Me da vergüenza lo que como</td>
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<td>Me preocupa mi peso</td>
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<tr>
<td>No como toda la comida de mi plato</td>
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9. En la escala que se muestra a continuación, señale en el espacio del 1 (muy desfavorable) al 5 (muy favorable), sus preferencias de consumo:

1= muy desfavorable
2= desfavorable
3= neutral
4= favorable
5= muy favorable

_____ Pollo transgénico con un gen de pato.
_____ Pollo manipulado con hormonas.
_____ Pollo transgénico con un gen de vaca.
_____ Pollo que busca para comer, insectos y gusanos en el estiércol.
_____ Pollo transgénico con un gen de maíz.
_____ Pollo que vivió encerrado en una casillita.
10. Refiera a la escala de 1 a 5. Los números que corresponden a *NATURAL* en los modos siguientes:

1=para nada natural  
2= un poquito natural  
3= casi natural  
4= muy natural  
5= completamente natural

Indique su opinión de la naturalidad de cada producto citado, usando los números, del 1 al 5 según sea conveniente, en el espacio al lado de cada descripción.

*No hay una respuesta correcta.* Por favor, responda en la forma que represente sus creencias y puntos de vista.

_____ Pollo transgénico con un gen de pato.  
_____ Pollo manipulado con hormonas.  
_____ Pollo transgénico con un gen de vaca.  
_____ Pollo que busca para comer, insectos y gusanos en el estiércol.  
_____ Pollo transgénico con un gen de maíz.  
_____ Pollo que vivió encerrado en una casillita.
En la sección siguiente, se muestra un hecho de un producto comestible. Después se le preguntará con qué probabilidad el mismo hecho sería cierto en referencia a otros productos similares o diferentes. Por favor, haga referencia según la escala del 1 al 5 que a continuación se presenta.

1= completamente improbable
2= improbable
3= probable
4= muy probable
5= seguramente

Por ejemplo:

**Proposición:** El azúcar moreno se disuelve cuando se pone en agua.

**Pregunta:** ¿Con qué probabilidad se disolvería el siguiente producto en el agua?

5. Un terrón de azúcar blanco

Use los números de 1 a 5 para indicar su opinión de la probabilidad en el espacio al lado de cada oración.

11) **Proposición:** El pollo de rancho contiene cantidades de proteínas más sanas que las carnes rojas.

**Pregunta:** ¿Con qué probabilidad contendría también cada uno de estos productos una sana cantidad de proteínas?

____ Pollo transgénico con un gen de pato.
____ Pollo manipulado con hormonas.
____ Pollo transgénico con un gen de vaca.
____ Pollo que busca insectos y gusanos en estiércol para comer.
____ Pollo transgénico con un gen de maíz.
____ Pollo que vivió encerrado en una casillita.
1= completamente improbable
2= improbable
3= probable
4= muy probable
5= seguramente

12) Proposición: El pollo de rancho tiene un instinto maternal fuerte.
Pregunta: ¿Con qué probabilidad tuvieran cada uno de los productos que a continuación se presentan, también un instinto maternal fuerte?

_____ Pollo transgénico con un gen de pato.
_____ Pollo manipulado con hormonas.
_____ Pollo transgénico con un gen de vaca.
_____ Pollo que busca insectos y gusanos en estiércol para comer.
_____ Pollo transgénico con un gen de maíz.
_____ Pollo que vivió encerrado en una casillita.

13) Proposición: Casi todas las partes del pollo de rancho son seguros para comer.
Pregunta: ¿Con qué probabilidad fueran seguras también todas las partes de los productos siguientes?

_____ Pollo transgénico con un gen de pato.
_____ Pollo manipulado con hormonas.
_____ Pollo transgénico con un gen de vaca.
_____ Pollo que busca insectos y gusanos en estiércol para comer.
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_____ Pollo que vivió encerrado en una casillita.
En la sección siguiente, refiera a las definiciones siguientes para hacer sus elecciones:

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14. Por favor, responda a las siguientes preguntas eligiendo entre: NATURAL (N), INDUSTRIAL (I), o NO IMPORTA (NI).

a) Imagínese una papa natural y una papa cultivada industrialmente que costaron lo mismo. ¿Cuál papa preferiría comer?
   N  I  NI

b) Ahora, suponga que los dos tipos de papas tengan el mismo sabor. ¿Cuál papa preferiría comer?
   N  I  NI

c) Ahora, suponga que la papa natural y la papa industrial son igualmente sanas, contienen la misma cantidad de nutrientes. ¿Cuál papa preferiría comer?
   N  I  NI

d) Ahora, suponga que la papa natural y la papa industrial son químicamente iguales, y por eso tienen el mismo sabor y son igualmente sanas. ¿Cuál papa preferiría comer?
   N  I  NI
15. Por favor, responda a las preguntas siguientes eligiendo una vez más entre NATURAL (N), INDUSTRIAL (I), o NO IMPORTA (NI).

a) Imagínese que la carne de res natural y la carne de res industrial costaron lo mismo. ¿Cuál carne preferiría comer?
   N  I  NI

b) Ahora, suponga que los dos tipos de carne tienen el mismo sabor. ¿Cuál carne preferiría comer?
   N  I  NI

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   N  I  NI

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¡GRACIAS!
LITERATURE CITED


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