

Fishing for Sustainability: How two persuasive styles differently affect changes in attitudes versus actions

Turadg Aleahmad, Aruna Balakrishnan, Jeffrey Wong
Human Computer Interaction Institute
Carnegie Mellon University
5000 Forbes Avenue
Pittsburgh PA 15232 USA

ABSTRACT

In this paper, we investigate the effectiveness of indirect methods of persuasion that might induce sustainable attitudes or actions. We built a recipe search web site that offers information on sustainability and health of its recipes. In a between-subjects study we compared two variants of this web site. One site, EcoEats, used direct methods of persuasion, such as explicit instructions to make more environmentally sustainable food purchases. The other site, Tastee, presented the same information with less explicit instructions. We measured the effects of each site on users' attitudes and actions towards the environment. Results indicate that direct style was more effective in changing consumer actions while the indirect style was more effective at changing attitudes. We discuss the implications of this dissociation for research and applications.

Author Keywords

Persuasive technology, Consumer attitudes, Consumer action, Sustainability, Information design.

ACM Classification Keywords

H5.2. User Interfaces. User-Centered Design.

INTRODUCTION

Despite the fact that 75% of US adults believe that the environment is important, there remains a low correlation between attitudes and personal actions [25]. This mismatch between attitudes and actions provides an open research target for HCI to understand how people come to act upon these alternatives, how more people can be persuaded to act, and how those who do change can be persuaded to change more. While these questions have been addressed before [e.g. 1, 2, 3], little is known about supporting sustainable agriculture.

Global food retail sales exceed \$2 trillion annually[19]. Unfortunately, food production and distribution is increasingly unsustainable. The US food system in 1940 expended 6 calories for every one calorie produced, and as of 1975 this had reach 10 to 15 calories for every one calorie of energy produced [13]. The average farm would show a \$29 per acre loss if the costs of soil loss, water

contamination, and environmental harm from conventional farming were included. Transitioning to more sustainable practices can yield a positive impact to global climate, fresh water availability, diversity of organisms, and even political and economic stability.

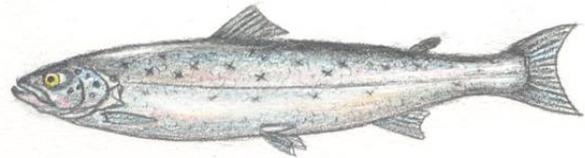


Figure 1. Fish, it's what's for dinner.

Sustainable agriculture has been promoted via local, grassroots efforts such as supporting local, community farms [e.g. www.foodroutes.org] and fair trade coffee practices. Many efforts seek to inform people of the environmental situation and focus on changing people's attitudes toward environmental issues [15]. However, little research has been done on the point at which consumers make decisions that can support sustainability.

Our research aims to examine this gap. We built a persuasive technology to evaluate design factors that influence attitudes and actions of consumers. Linking to sustainable agriculture, the technology is a recipe search site that offers information on sustainability and health of its recipes. We sought a culinary domain for which a coherent set of health and environmental data was available. Consequently we constrained our study to sustainable seafood consumption (see Figure 1).

In the subsequent sections, we will discuss relevant theory, related work, the design of the site and experiment, results, and a discussion of future directions for research and applications.

PERSUASION

Psychology literature offers multiple definitions of persuasion. All agree that persuasion includes some notion of inducing another person to do something. Most definitions exclude coercion, such as BJ Fogg's notion of persuasive technology [11]. Bogost [5] is even more selective than Fogg, who he claims relies primarily on

operant conditioning and social pressure rather than changing a person's beliefs, values, or attitudes. Simons [30] includes operant conditioning but excludes social pressure, conformity, and coercion.

For the purposes of this paper, we borrow a definition of persuasion and related terms from Simons: "persuasion is *human communication designed to influence the autonomous judgments and actions of others*." Simons, however excludes group pressure and "external" incentives such as money. *Attitudes* are judgments about the goodness of a thing, whether it is desirable or undesirable. *Beliefs* are judgments about what is true or probably true in the world. *Values* "are judgments about relative worth," such as happiness vs. fairness. From these terms, we assert that what we are interested in is changes in attitudes and manifest actions towards a sustainable environment.

There are several theoretical characterizations why resistance to persuasion occurs. A meta-review [27] of persuasion and forewarning concluded that forewarnings about persuasion intentions of messages induce resistance because they threaten recipients' existing attitudes and identities. Jacks & O'Brien [16] hypothesized that an important motivation for persuasion resistance is the need to protect the self-concept from threat and change. Burgoon *et al.* [6] proposed a similar theory of *reactance* that explains that persuasion sometimes doesn't work because persuasion threatens a person's sense of autonomy and freedom of action. Some groups may have stronger reactance to others and that a "boomerang effect" may occur where people engage in the direct opposite behavior of the persuasion as a means of asserting one's sense of freedom.

Consumer Identity

Individuals have a consumer identity. This is defined as attitudes, values and psychological needs, including affiliation, social interaction, security, and comfort [22]. Individuals are strongly motivated by affiliation and injunctive norms (behaviors which are perceived as being approved of by other people) [24].

Unfortunately, an individual's sense of environmental self-identity is not well-developed [34]. This complicates factors because behavior is closely aligned with how similar to one's self-identity the activity is perceived to be [18]. In one study, those who perceived their self-identity to be more similar to typical recyclers and who planned on recycling actually recycled more [18]. However, another study showed that even people who did not perceive themselves to be recyclers had the habit of recycling, (i.e. were unaware of their self-identity as recyclers) [15]. Those who do not perceive themselves to be pro-environmental will not seek out information or actions that are pro-environmental.

Further, this situation can bring on resistance to persuasion. If they do not view themselves as environmental or view

"environmental" as something unappealing (i.e. "I don't want to be a tree hugger."), overt language directed at emphasizing these environmental qualities will alienate those who do not feel affiliated with such a group.

Environmental persuasion through technology (such as websites) may be strongly affected by this phenomenon as users must voluntarily use the technology in order to be influenced by it. People who may be hostile or ambivalent to the importance of the environment may resist persuasion about the environment, which undermines its effectiveness.

We define persuasive systems that use *direct persuasion* as those systems that have a clear and apparent intention to persuade. In contrast, *indirect persuasion* aims to persuade without clearly exposing its own position, confronting or condemning users existing attitudes, or constructing an identity that is typical of the user that already shares the same attitudes as the system designers. Because indirect persuasion does not make its attitudes clear or give indications that its purpose is to change users' attitudes, it will incur less resistance from users. This leads to our first hypothesis:

Hypothesis 1: Indirect persuasion will improve attitudes towards sustainability more than direct persuasion.

However, when indirect persuasion does not openly seek to persuade, it cannot openly command the user to do specific actions. One of the principles of persuasive technology is that simplifying a process and giving clear instructions on what to do increases the likelihood that people are going to do something [11]. Therefore, when direct persuasion is used it can provide clear directions on what a person should do, regardless of whether or not they believe in it.

Hypothesis 2: The actions taken by people who receive direct persuasion will be more sustainable than those taken by people who receive indirect persuasion.

RELATED WORK: PERSUASIVE TECHNOLOGY

Persuasive technology is a set of design approaches and heuristics that were developed with the view that computing technology is a powerful method to shape individuals' behavior [11]. Persuasive technology attempts to close the gap between intention and action for activities such as exercise [e.g., 10, 12], smoking cessation [e.g., 11], dieting [e.g., 8], and medication schedules [e.g., 31]. Sustainable consumption technology is a subset of persuasive technology, specifically aimed at reducing an individual's or group's ecological footprint. Previous research on sustainable consumption focuses on water conservation [e.g., 2] and energy consumption [e.g., 1, 3, and 14].

Sustainable eating practices (and specifically seafood consumption) have been supported with technology, although not carefully studied by persuasive technology researchers. Websites such as SustainableTable.org and OrganicConsumers.org provide information to website visitors on how to make "green" diet choices. The

Monterey Bay Aquarium
[www.mbayaq.org/cr/seafoodwatch.asp] and the Blue Ocean Institute [www.blueocean.org/seafood/] have websites that direct consumers specifically on how to make sustainable seafood choices. These organizations also make available mobile applications of their information interventions. For example, the Blue Ocean Institute offers Fish Phone by which users can text the organization the name of a particular seafood and receive back information about that seafood's environmental safety. The Monterey Bay Aquarium Seafood Watch initiative has made a wallet card that contains lists of seafood that have been categorized by the organization as environmentally safe, acceptable, and not acceptable. A mobile web version of this wallet card is also available for web-enabled phones.

Several other systems have been developed on behalf of large supermarket chains and cash register companies. One PDA-based system attempted to make shopping easier by integrating pre-planning of shopping lists at home with in-store diagrams of where items from that list could be found [21]. Another system sponsored by several large supermarket chains used RFID tags and smart carts to eliminate the checkout process and provide more detailed product information to shoppers [28]. Recently, a concept shopping cart was described in a marketing study [35] by EDS Corporation that enabled users to retrieve health and environmental information on various foods by scanning bar codes.

These applications and efforts are steps in the right direction however fall short of making effective change due to several limitations. We discuss these limitations in turn and provide design goals directed at addressing these limitations.

Decision Point Interventions

When an individual makes a food purchase, more often than not, that individual does not realize that a choice has been made with respect to consumption and, with respect to sustainability. Indeed, studies have shown that individuals are aware of only a fraction of the food decisions they make in a day and are even further unaware of how their environment influences their eating habits [e.g., 33]. Mobile systems, such as the Blue Ocean Institute's Fish Phone, Monterey Bay Aquarium's mobile Seafood Watch listings, and RFID smart carts are technologies designed to make consumers more aware of these food decisions.

Although these technologies are steps in the right direction, the intervention must match existing routines and behaviors of consumers. Consulting a PDA while grocery shopping may violate existing social norms within shopping environments and using a smart cart may increase the time it takes to grocery shop, thereby becoming an inconvenience. Ideally, a technology would bring low infrastructure and usage impediments.

Additionally, these technologies address decision-making

late in the shopping process. It is true that shopping list creation and actual shopping are points of decision where the consumer may be influenced. However, selection of the recipe to be cook has a strong influence on what is put into the shopping list. A proper intervention should persuade when the user is making or planning a shopping list and, by extension, deciding on a recipe. A tool must also support improvisation in the store when an ingredient is suddenly unavailable. This is crucial for fish as the selection in a store varies by season and supply. This leads us to our first design goal.

Design Goal 1: We seek to build a persuasive technology that supports current practices and routines of consumers while also targeting a crucial point in decision making.

Decision Plane Complexity

Although these websites, mobile systems, and RFID augmented shopping carts contain extensive information relating to all possible seafood options available to a consumer, none of these technologies recognize the complexity of the consumer decision plane. Consumers must balance (1) needs, which include nutrition, health, convenience, and variety; (2) opportunities, which include food prices, available food products and services, advertising, and information; and (3) abilities, which include per capita disposable income, education (nutrition, exposure to food and food preparation skills, environmental awareness) [23]. The current technologies do not integrate in a practical manner the myriad of concerns that a consumer confronts. For example, the sustainable eating web sites and the affiliated mobile systems do not address health concerns, convenience of cooking or preparation methodologies, or cost. While RFID augmented shopping carts do report environmental, health and cost information, they do not integrate these in a practical fashion. Shoppers have to place individual items in their cart or scan them to find out this information and then sequentially scan items they wish to compare information. This is a cumbersome process that might frustrate the user.

Design Goal 2: We seek to build a persuasive technology that integrates several decision factors that consumers must address when making food purchases.

Additionally, due to these individual level factors, information presented to consumers to help inform purchasing behavior must be tailored to suit the individual's needs and preferences [23]. Previous research has shown that personalized and explicit information and instructions increase adherence with respect to persuasive technology [9]. However, there is a balance between dictating actions and allowing for autonomy. Individuals are more likely to take suggested actions when left feeling as if they do still have autonomy over their choices [21]. This leads us to our third design goal.

Design Goal 3: We seek to build a persuasive technology that allows consumers to maintain control over their

options while also providing personalized information such that it relates specifically to the choices they make.

We built a persuasive website to meet these three design goals. Specifically, it:

- Reaches consumer when they are choosing what food to purchase.
- Fits into a popular routine among consumers: searching online for recipes.
- Integrates two important factors for consumers: health and environment.
- It maintains consumer's autonomy by offering all known recipe options and personalizing the information they receive to the choices they make.

DESIGN METHOD

To design an effective recipe search web site catered to promoting sustainable eating practices, we conducted contextual inquiries to inform us on end-user practices with respect to fish purchasing and recipe searching, developed a set of design parameters, evaluated local grocery stores to explore the viability of design parameters, and used an iterative design process to develop two different persuasive websites in order to test differences in persuasive styles.

Preliminary Design Guideline Development

Prior to developing our web site design, we conducted several preliminary steps to gain a better understanding of the decision processes and contexts that govern seafood purchases.

Seafood Purchase Contextual Inquiry

To understand how fish consumption decisions are made, we conducted contextual inquiries [4] of people shopping for fish at a popular local seafood market, Wholey's. In particular, we were interested in understanding what factors come into play when making a seafood purchase decision, what sources of information are used for these decisions (e.g. store staff, recipe books, websites), when plans for seafood purchases are formed, and how plans are altered.

The main findings and design implications from our first contextual inquiry were multi-fold. First, we found that the majority of buyers enter the store already knowing exactly what type of seafood they want to buy and how they will prepare it. This is an important piece of information because it emphasizes that the initial point of intervention must precede the shopping trip.

Second, factors that influenced their decisions at the time of purchase include the price of the seafood, the quality of the seafood (i.e., how fresh it looks), personal taste preferences, and sometimes health benefits related to that particular seafood. This finding is important because it demonstrates how factors relating to seafood purchases are focused on

individual level factors. In order to effectively persuade individuals to change their behavior, alternative actions must be proposed at this level.

Recipe Search Contextual Inquiry

Next we conducted a recipe search contextual inquiry to uncover when and why individuals use recipes to cook and what motivates them to search online.

First, we found that the main sources for recipes are cookbooks, recommendations from friends, and online recipe web sites. This confirmed that online recipe sites are a viable method to engage certain users at the appropriate time for intervention.

Second, individuals often use online recipes to compare various ways of cooking the same dish. This suggested that a recipe search website should include a method to compare recipes with each other.

Third, there were three main reasons that motivated people to search for online recipes: (1) for a special occasion, (2) to use a special or specific ingredient, (3) to try something new. This finding revealed an opportunity for flexibility when showing recipe search results to the user.

Store Evaluations

Finally, to test for utility, we conducted an evaluation of the seafood options at three local commercial grocery stores. We found that the seafood counters at these stores contain fish that are both environmentally friendly and environmentally harmful, based on ratings of Seafood Watch. This variety provides an opportunity for intervention. If these counters only stocked environmentally friendly fish, then consumers would not have a choice to make an environmentally poor decision.

User Interface Design

The first step in the user interface design for the web site was an overview and analysis of online recipe search sites. 9 sites were examined for overall layout, search options, specialized functions, and target clientele population. From these observations, functionality and design patterns important for the web sites were determined.

Our contextual inquiry indicated that people often look for recipes online when they want to be adventurous and try something new. To reach this audience, our design presents environmentally friendly options as alternatives to what the recipe calls for. When presenting a recipe with a seafood ingredient, the website shows multiple options for that ingredient along with health and environmental ratings for the seafood options. For example, for a recipe with shrimp, the user will see that "spot prawn" is an "Eco Best" option because the harvesting method and fishery management is sound while the "Chinese white shrimp" harvest harms sea turtles or come from farms that damage mangrove forests.

The contextual inquiries also led to a health information feature. When asked if they had any environmental

concerns about their fish choices, fish shoppers often talked about health issues such as mercury contamination and cancer risks. Because users' health concerns may conceptually lumped in with thoughts of the environment, we made this clearly distinct in our interface and also always put health concerns ahead of environmental concerns. Other sustainable fish websites do have health information but it is not often given equal prominence to sustainability. In our design, we hope that users who are not interested in sustainability will at least find the website useful for protecting their health and perhaps later decide to consider environmental criteria.

The experimental design required two variations of the user interface, one for each persuasion style condition. The direct style site was named EcoEats and the indirect style was named Tastee. The designs of the sites were differentiated on four aspects: overall skin, verbal persuasion, presentation of ratings, and presentation of recipe alternatives. In the next sections, these will be discussed with respect to both sites. Following these will be a description of the instrumentation for analysis.

Overall Skin

The overall skin comprises the site name, logo, and tagline. The skin of EcoEats has an direct message promoting environmental sustainability. First, the name denotes ecological eating. Second, the logo image is the Earth, an icon of environmentalism. Third, the tagline for the website is "Saving the world with every bite," indicating that one of the main goals for this site is to promote environmentally sustainable eating. Tastee, by contrast, presents itself as just a recipe site (Figure 3). The name does not draw any associations beyond the culinary. The logo image is of a plate of appetizing food, while the tagline is "Satisfying your palette with every bite."



Figure 2. EcoEats initial start page. Comments in the left of the page tell the user to avoid action that are harmful to the environment.



Figure 3. Tastee initial start page. Comments in the left sidebar give information but do not suggest any specific actions.

Verbal Persuasion

Next, verbiage of the two sites conveys different messages. These messages appear in the left side bar as randomly selected "Did you know?" snips and on the recipe page as the suggestion to use an alternative fish to that called for in the recipe. The EcoEats site explicitly details actions that should be taken and that the motivation for these actions should be to be more environmentally friendly. The Tastee site offers the same information but as friendly suggestions.

The "Did you know?" left side bar presents facts to the user on environmental food issues, such as food miles and biodiversity. In the EcoEats site this is done in a manner that endorses action to be taken to be more sustainable. e.g., "Avoid contributing to global warming due to food transportation and buy locally grown produce and farmed food." On the Tastee site, the left bar also presents information on food issues but does not include actions that could be taken to ameliorate the situation.

On the recipe page there is a display of alternative fish options. Here EcoEats site urges users: "It looks like the fish in your recipe has a few alternatives that can be substituted in to make your dish more environmentally friendly! Take action and help save the environment!" In contrast, Tastee users are told, "In case your grocery store does not carry the fish called for in this recipe or if you'd like to try some alternatives, click for some other options."

Presentation of Ratings

The directness of the persuasion was also manipulated in the presentation of health and environmental ratings in the search results. In both conditions, for each recipe the site determined the alternatives to the fish in the recipe and then presented summary information next to the recipe in the search results showing each alternative as a red, yellow or green dot by the Health Options and Environmental Options. (The data rating each alternative is described in the Data Design section below.) On the Tastee site these dots were aggregated within the Health and Environmental columns (Figure 4). On EcoEats the alternatives dots were further sorted columns with more explicit judgments for each color: AVOID, Caution, and Safe (Figure 5).

and the run-time environment can be examined. Unfortunately, code can not be fixed live and execution can not be resumed.

The data model in the MealMaster format is not uniform or clean, which makes it difficult to create a mashup. For example, a recipe is composed of ingredients. Each ingredient can be expressed as a quantity, a unit, and a text description of the item. For example, one ingredient may be “1 cup sugar” while another recipe may call for “1 cup sweetener, such as sugar or Splenda.” These two recipes have ingredients that are somewhat equivalent but not equal. Similarly, a recipe may call for “1 fillet halibut” where the unit is “fillet”. Another recipe may call for “1 halibut, tilapia, or other white fish fillet.” This is a consequence of the data being intended for human use, interpretation, and improvisation for a particular context, which is related to the pervasive problem of representation in HCI.

We chose MealMaster recipes as the recipe data for our website instead of scraping information off of more well-known recipe sites such as Epicurious due to copyright concerns as well as the fact that scraping information from websites is slow because getting each recipe takes about as much time as visiting a web page.

OceansAlive.org

To incorporate the sustainability measures of the fish in each fish recipe, we extracted information from a website about ocean sustainability run by the Environmental Defense Fund. The website has a semi-structured section of information for a variety of fish and shellfish species that likely to be eaten by the public. The datasheet for each species contains information on:

1. commercial sources for the species,
2. ecological information, such as,
 - a. if the fish are caught in the wild, how well-managed are the fisheries where the fish come from (i.e. are they overfished or not)
 - b. for wild-caught fish, do the common fishing methods harm the ocean environment at large (for example, by catching other fish that are endangered or which cannot be sold or does the fishing damage the ocean floor)
 - c. if the fish are farmed, does farming of the fish have harmful impacts for the environment, which may depend on the country of origin
3. health information, such as,
 - a. whether the fish often contaminated with chemicals such as PCBs, mercury, or pesticide runoff
 - b. the maximum number of safe servings per month for men, women, and children given known

pollution information. This ranges from 0 servings (always unsafe eat) to 4 or more servings per month (i.e. safe to eat often)

- c. if there is enough data to classify the fish as safe to eat. For these fish, Environmental Defense recommends that the public avoid eating too much of fish with unquantified contaminant data to minimize risk of chronic disease. Fish that are deemed safe to eat can be eaten “at least once a week,” which is another way of saying “more than once per week”
4. explicit iconic labels for the health ratings of the species: Health Alert, Health Concern, Health Safe. (corresponding to the red, orange, and green dots on the search results page)
5. explicit iconic labels for the environment ratings: Eco Worst, Eco Concern, and Eco Best (the red, orange and green dots on the search results page)

OceansAlive labels fish with two different dimensions: ecological impact and health risks. We wanted to use the iconic labeling as summary information for all of the fish and display some notion of good, mediocre, and bad options for each fish in both dimensions. We needed to create labeling for some notion of “good” and “mediocre” on the health scale as well as a mediocre option for the environmental scale.

Examining the text of the warnings more closely, some fish were somewhat contaminated and had maximum serving numbers for children but not adults. Species with these and unknown contaminant levels were labelled as “mediocre” on the health scale. We created an orange icon labeled “Health Concern” and changed the original red “Health Concern” icon to “Health Alert”. Fish that were described as having “low contaminant levels” and being “safe to eat more than once a week” were labelled “Health Safe.” The text of some of the health advisories was also edited for brevity.

The environment scale was supplemented with an orange “Eco Concern” label if the species had some kind of environmental comments. These comments often discussed the how environment impacts of choosing that species might depend on the source or method of catch. Some species were given no environmental remarks. These do not appear in the search result summaries.

Species in OceansAlive were grouped in major fish categories. For example, Atlantic Salmon and Pacific Salmon were both grouped under “Salmon”. Blue Crab, Dungeness Crab, and other species of Crab are grouped in the “Crab” group.

When the OceansAlive data is placed in the website database, we search all ingredients of all recipes for names of the groups. If a group name matches one of the ingredients in the recipe, all species are listed as possible

alternatives for the recipe. Many recipes in the MealMaster data set list multiple kinds of fish that can be used for any one ingredient. For example, a recipe may call for “fish fillets, either trout or tilapia.”

SeafoodWatch.org fish data

Data from SeafoodWatch.org was not included because it uses data from OceansAlive for health warnings and the groupings are not as coherent. For example, there are several groupings of tuna: yellowfin, bluefin, and albacore. Each of these groups is separated into sub-groups by origin or method of fishing. We chose not to integrate this data as it was hard to match up with data from OceansAlive and much of the data was redundant.

STUDY DESIGN

To test the difference between directed persuasion and indirect persuasion, we conducted a pilot study using the two different recipe search web sites, EcoEats and Tastee. The study called for a between subjects design.

Participants

Twelve individuals, recruited via an online recruitment flyer, participated in the study. One participant dropped out of the study due to time constraints. Of the remaining, seven were male and four were female, and the average age was 27.6 years old with an age range of 18 to 54. Participants were compensated \$20 to offset the costs and time for participating in the study.

In order to participate, individuals had to meet two requirements. First, individuals had to at least cook, on average, one meal per week. Second, individuals had to enjoy seafood. All participants voluntarily consented to participate in the study.

Task

Participants were told that they were evaluating a new web site for finding recipes online. In the first part of the study, the participants took a quick survey to ensure they matched the minimum participation requirements, were familiarized with the web site search features, were asked to find for two recipes that they would like to cook that used at least one seafood ingredient, and finally took a survey regarding their experience using the web site.

In the second part of the study, participants were asked to cook at least one of the recipes that they found from the first part of the study. They were given \$10 to help with the costs for ingredients needed to cook the recipe. Participants were asked to return with the food label of the seafood they purchased. Upon return, participants filled out a final survey regarding their shopping and cooking experience. They were compensated an additional \$10 for completing this second stage.

Independent Variable

Participants were randomly assigned to one of two experimental conditions. Users in the directed persuasion

condition performed the recipe search task using the EcoEats web site (EcoEats condition) while users in the indirect persuasion condition performed the same task using the Tastee web site (Tastee condition).

Dependent Measures

Both self-reported and monitored measures were collected during the task in order to assess differences in attention allocation, affect, and changes in attitudes. These measures were distributed between three surveys: Pre, Post, and Final. The Pre-Survey was conducted prior to the web site recipe search task, the Post Survey was conducted after the web site search task, and the Final Survey was conducted after the participant had cooked the recipe..

Demographic and Personal Information

Basic demographic information was collected from the participants, including age, gender, cooking frequency, seafood predilection, the type of stores they shop for groceries, and online recipe search frequency and sources.

Manipulation Check

We assessed whether or not the manipulation of direct persuasion and indirect persuasion was noticed by users in the different conditions. In the Post Survey, participants were asked to assess how bossy they found the web site and to characterize the site (i.e. political, environmental, health related, etc.).

Site Experience

In the Post Survey, participants were asked to assess their experience using the web site, including measures on affect. Specifically, participants rated how easy the site was to use, if they would use the site again, and how much they enjoyed using the site. To identify whether the participants liked using the alternative options provided with the recipes, they were asked to rate how much they enjoyed various features of the website, including the shopping cart, recipe bookmarks, and the given alternatives.

Site Usage

In addition to the self-reported measures above, we collected usage logs of each participant. These measures include how many searches were performed, how many individual recipes were considered prior to making a final decision, and whether they actively clicked for more information on health and environmental ratings.

Attitudes

One of the main interests of our study is to determine if different persuasive methods are more effective at eliciting a change in action. In particular, we are interested in understanding whether the direct or indirect persuasion will be more effective at promoting thoughts of sustainable eating. To assess this, all three surveys ask the participant to check off what factors they consider when making a seafood purchase decision. The factors included are: cost, taste, heartiness, health benefits, environmental

friendliness, ease of preparation, convenience, quality/freshness, and novelty.

Actions

To see if there were differences in how participants chose recipes and narrowed them down to a few choices, we collected information on which specific recipes participants reviewed, which recipes participants bookmarked, and finally which participants actually prepared. To quantitatively describe the recipes, we counted the number of alternates given for that recipe by each of the 6 alternative types: Health Alert, Health Caution, Health Safe, Eco Worst, Eco Caution, and Eco Best. (See Data Design for the origin of the ratings.) For analysis by participant, these 6 counts were averaged across all recipes in each analysis group. E.g. all recipes viewed by participant; all recipes bookmarked by participant.

Cooking Experience

Participants were asked whether or not they chose the fish that the recipe called for or a supplied alternative fish, whether they enjoyed the dish prepared, and if that dish met their expectations.

RESULTS

Hypothesis 1: Attitudes

Our first hypothesis stated that indirect persuasion (Tastee condition) would affect changes in attitudes toward sustainability. Initial evaluations by participants on how environmental factors important to seafood purchases revealed no group bias ($t(9) = 1.48, n.s.$). Next, we ran a repeated measures ANOVA to test for differences in environmental attitudes across the different surveys (Pre, Post, and Final). As shown in Figure 8, there was no significant difference in attitudes by condition, $F(1, 1) = 1.26, n.s.$, but the environmental attitudes of Tastee participants significantly changed from Post to Final, $t(5) = 2.91, p = .033$ (for Post $M = 2.75, SD = 0.55$; Final $M = 3.33, SD = .97$).

Additionally, we calculated the change in environmental attitudes between the Post and Final surveys. We ran an ANOVA controlling for individual environmental ratings from the Pre-Survey to see if the change in attitudes differed significantly between conditions. The Tastee condition increased the importance of environmental attitudes ($M = .59, SD = .24$) significantly more than the EcoEats condition ($M = -.20, SD = .25$), $F(1, 8) = 4.8, p = .05$. These results confirm Hypothesis 1.

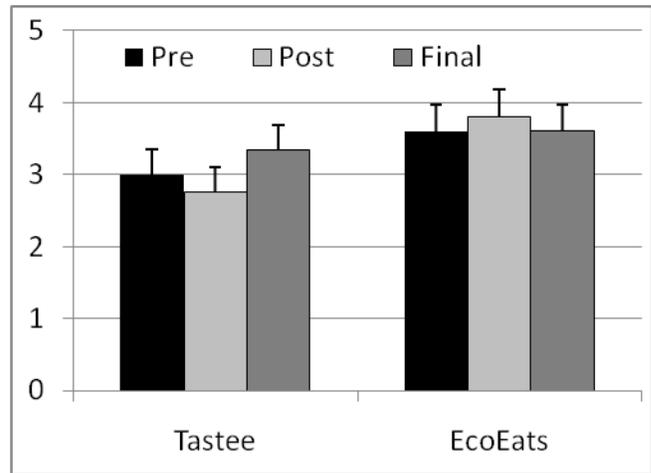


Figure 8: Environmental Value Ratings by Condition across different surveys

Hypothesis 2: Actions

To analyze our second hypothesis that direct persuasion (EcoEats condition) would lead to environmental actions more than indirect persuasion (Tastee condition), we compared average environmental and health ratings of viewed, bookmarked, cooked recipes. We obtained an average rating for each rating category (e.g. Eco Best and Eco Worst) by taking the mean number of dots for each ratings category. There were no significant differences in the health and environmental ratings by condition for viewed recipes (repeated measures ANOVA $F(1, 9) = 2.78, n.s.$) nor for bookmarked recipes ($F(1, 7) = .10, n.s.$). However, there were differences in the health and environmental ratings for cooked recipes. As shown in Figure 9, EcoEats users tended to pick recipes that had a high number of Eco Best and Health Safe ratings and were low in all four less ratings. Tastee participants did not have a preference for recipes with higher ratings in one category or other. Participants in the EcoEats condition cooked recipes that had significantly lower Eco Worst ($M = .95, SD = 1.15$), Eco Concern ($M = .19, SD = 1.15$) (Table 1), than Eco Best ratings ($M = 4.70, SD = 1.15$), providing support for Hypothesis 2.

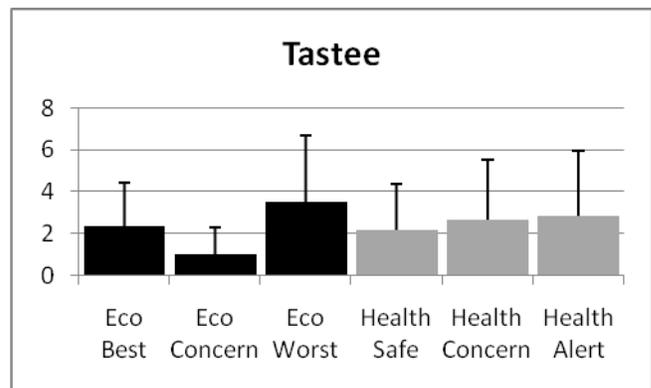


Figure 9a. Average Environmental and Health Ratings of

Cooked Recipe by Condition

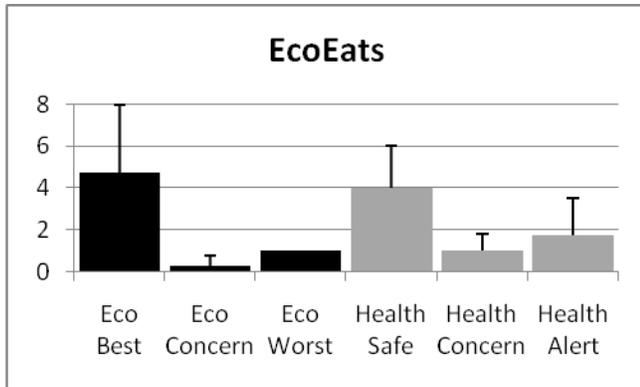


Figure 9b. Average Environmental and Health Ratings of Cooked Recipe by Condition

Condition	Rating Type	Rating Name	Value	Std Dev	Group*
EcoEats	Eco	Best	4.70	1.15	A
		Concern	0.20	1.15	D
		Worst	0.95	1.15	BCD
	Health	Safe	3.95	1.15	AB
		Concern	0.95	1.15	BCD
		Alert	1.70	1.15	BCD
Tastee	Eco	Best	2.27	0.93	ABCD
		Concern	0.93	0.93	CD
		Worst	3.43	0.93	BCD
	Health	Safe	2.10	0.93	ABCD
		Concern	2.60	0.93	ABCD
		Alert	2.77	0.93	ABCD

* Values not connected by the same letter are significantly different, $p < .05$.

Table 1. Average Rating Attitudes and Standard Deviations by Condition

Controlling factors

We wanted to ensure that the participant populations and the two websites did not differ in other manners that could affect our measures of attitudes and actions.

Demographic and Personal Information

To ensure that group differences did not influence our analysis, we first analyzed basic demographic characteristics of our participant pool. There were no significant differences between groups in cooking frequency, seafood preference, types of places individuals shopped for food, or frequency of online recipe searching.

Manipulation Check

To assess how the different persuasive styles affecting

people's opinion of the sites, we asked participants to assess various characteristics of the web site. We found that these factors, combined to a single *Site Character* variable for a MANOVA which revealed that although there was no significant main effect or interaction effect with condition, site character had a significant effect $F(7, 3) = 26.9, p = .04$. Additionally, although there were no significant main effects for condition, qualitatively, we can see in Figure 10 that the EcoEats site was viewed as more heavily environmental, health conscience, experimental, instructional and informational. Neither group viewed the site as political. Finally, Tastee participants viewed the site as bossier. It is interesting to point out that there is a significant difference between the scores assigned by EcoEats participants to environmental, health conscience, and informational versus bossy, $p < .05$.

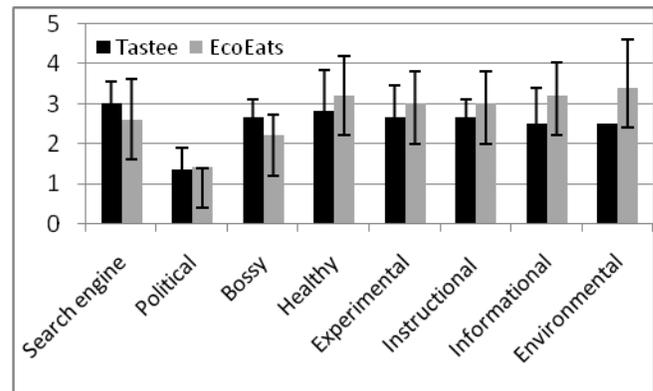


Figure 10. Site Character Ratings by Condition

Site Experience

We did not want users of one site to find it more difficult to use than users of the other site. There were no differences in website usability between the EcoEats condition ($M = 3.4, SD = 1.34$) and the Tastee condition ($M = 3.6, SD = .82$) ($t(9) = 0.39, n.s.$), how much participants enjoyed the site between the EcoEats condition ($M = 3.4, SD = .89$) and the Tastee condition ($M = 3.6, SD = .52$) ($t(9) = 0.59, n.s.$), nor the likelihood of returning to the site between the EcoEats condition ($M = 3.8, SD = .45$) and the Tastee condition ($M = 3.3, SD = .82$) ($t(9) = -1.20, n.s.$).

Site Usage

Similarly, we did not want our design variants to effect how active participants were on either site. There were no differences in how active participants in each condition were during their time using the web site. In a particular, t-tests comparing web site usage between participants in the EcoEats condition and Tastee condition showed no difference in how many total hits to the server a user had ($t(9) = 1.29, n.s.$), how many pages requested ($t(9) = 1.29, n.s.$), how many searches for recipes performed ($t(9) = 1.06, n.s.$), how many individual recipe pages viewed ($t(9) = .41, n.s.$), and how many times information on environmental

and health ratings were clicked on to receive more detailed information ($t(9) = -.92$, n.s.).

Cooking Experience

Finally, we did not want the cooked dishes to affect final evaluations. Participants in the Tastee condition did not significantly enjoy their cooked dish ($M = 4$, $SD = 0$) more than participants in the EcoEats condition ($M = 3.6$, SD) nor did Tastee participants report or that the cooked dish met their expectations ($M = 3.5$, $SD = .55$) more than participants in the EcoEats condition ($M = 3.4$, $SD = .55$). Controlling for enjoyment in the model built to assess differences in attitudes by condition did not diminish the statistical significance.

DISCUSSION

The analysis of participants' attitudes supports Hypothesis 1. Participant attitudes towards the environment improved more in the indirect persuasion condition (Tastee) than in the direct persuasion condition (EcoEats). The effect of the Tastee site on subjects' attitudes towards the environment was 0.6 on the scale, shifting from between "Somewhat not important" and "Neither" to between "Neither" and "Somewhat important". While this may not be a large effect, it is worth noting that the shift is across the critical point of indifference. Perhaps the point of indifference or neutrality is a tipping point, in that after crossing it people become increasingly aware and concerned for the environment. Conversely, perhaps this is the easy threshold to cross, as compared to reaching or exceeding the "Somewhat important" rating. This is another possible explanation for why the EcoEats participants did not show gains in environmental attitudes. They began with more positive attitudes already, which may be more difficult to improve.

The analysis of recipes cooked supports Hypothesis 2. Participants cook more sustainable recipes in the direct persuasion condition (EcoEats) than in the indirect persuasion condition (Tastee). While Tastee participants chose recipes with similar numbers of dots in each rating color, EcoEats participants both chose recipes with more green Eco Best dots and avoided recipes with orange Eco Concern or red Eco Worst dots. This suggests that direct persuasion is more effective at changing specific personal activities. This may be because the actions to take are more evident to the user. This effect may have no duration and exist only in the presence of the directly persuasive stimulus. An implication for future research is that the measure of actions directly following an experiment may not be informative unless coupled with delayed repeated samples to measure the endurance of any effect.

Taken together, the findings suggest that research in consumer's environmental behavior should include both measures. While intuitively attitudes and actions would seem to be correlated, our findings show them to be completely independent. Any experiment that influences

one should be careful to see the effects on the other. The effect on the other could in fact be deleterious. A design that improves actions may impair attitudes. The decline in EcoEats participant attitudes towards the environment from Post to Final survey point to this possibility, although the effect is not statistically significant. If, in fact, gains in actions come at the expense of attitudes and/or vice-versa, this trade-off would have significant implications in the design of both research and products.

Another result that may implicate product design is the effect of each persuasive style on the user's perception of bossiness. Users characterized the Tastee site (indirect) as more "Bossy" than the EcoEats site (direct). This may be because the EcoEats site was blatant in its persuasive agenda. Because the site branding primes users to expect persuasion, they are less impacted by it. On the Tastee site, while the suggestions were less heavy handed, they were unexpected for such a generic site, thus making a stronger impression. (Perception of bossiness was tested as a main effect on attitudes and actions, and found not to be.)

Limitations

There are several limitations of this research. First, because this was a pilot study aimed at testing feasibility and methodology, the number of participants is quite small. Despite the small sample size, the results are statistically significant but it is difficult to assess the generalizability of our findings.

We did not include a control group in our conditions. In a full study, we would include two control groups. One control group would use a regular recipe search website, such as Epicurious.com. This would allow us to make sure changes in environmental attitude ratings are not spurious (i.e. due to natural variability in attitudes) and are related to use of our web sites. A second control group would use a regular recipe search website and also be given the Seafood Watch wallet card. This would help to assess the importance of information integration that is performed by the web site rather than the consumer. Additionally, by giving the user information at the point of purchase rather than at the planning point, it would illuminate which decision point is more effective for intervention.

We were limited by the nature of the data on sustainable aquaculture. The manner in which various types of seafood are categorized as environmentally acceptable or not is not codified and regulated. For our dataset, we relied on only one set of environmental data ratings, but this reduces the reliability of our ratings. We did this to reduce the variance within our dataset but it also impacted the accuracy of the data. For example, certain seafood have plenty of alternate options data of all categories (i.e. good and bad for the environment). This means that the ratings do not necessarily reflect actual environmental safety but rather penalize options that have more data accompanying them. One way to get around this is to normalize the ratings of the recipes in the database, rather than use total number of

alternate counts for each category. Although we did not transform the data for this study, we would want to implement this normalization in subsequent work.

We had initially wanted to measure the environmental rating of the actual cooked seafood, not just the ratings of the cooked recipe. Participants brought back fish labels from the fish they purchased to cook. Our plan was then to code these fish for environmental friendliness and use this as our final measure of action. However, when trying to find ratings for the fish used, it was impossible to reliably identify exactly which fish in the database it was. The unreliable measure introduced too much variance in our ratings and we chose to eliminate this measure. We restrict our analysis to the intentions of the purchase, rather than the effect since this issue of food labeling is outside the scope of this research. While accurate food sourcing information is not available in most purchasing transactions, we believe this situation is improving and will improve more rapidly as more consumers want this information.

Lessons Learned

Use test-driven programming

Experimental design requires rapid development, especially during a semester long project. Changes are made to the system constantly to satisfy the evolving needs of the experiment. E.g. new measures or new facets to the manipulation. While we used agile technologies, we failed to make use of an import practice of agile programming: test-driven development. This practice is particularly well suited to experimental technology since the requirements for the experiment are so specific. These can be written into unit tests to begin with and the code can be developed to satisfy these tests. Tests such as: search button loads search page; search page contains correct results; or, search page appears within one second. In particular, since we were a three-person interdisciplinary team, we could have benefited from task separation: one person specifies the behaviors in functional detail, another person writes tests to validate these behaviors, and a third implements them. Had we done this, we would not have had the last-hour discovery of bugs and which led to changes in the functionality in the experiment.

Piloting is essential in subtle technology-dependent experiments

Since our experiment depended on so many factors operating correctly and such a subtle manipulation, this full-feature but small scale pilot has been an essential in creating a full scale and fully valid experiment that can convincingly affirm these findings.

Future Work

This project was motivated by long term research goals. The website built for this research project is a platform to conduct extensive behavioral research on persuasive design, specifically targeting populations that are not inclined to be

persuaded and are not looking to be persuaded.

Several ideas on future work have been uncovered from this initial pilot study. For example, different participant populations will have distinct reactions to the different websites. An individual with pro-environmental attitudes may be equally persuaded and motivated to take action by either indirect or direct methods of persuasion. An individual with anti-environmental values may feel alienated by a direct design, such as EcoEats. Understanding the effects of indirect and direct styles of persuasion on different populations is crucial to informing design practices that are aimed at a very large population. In order to have a positive impact on the environment, sustainable living practices must be adopted by all, not just those who already are motivated to change.

In addition to understanding different populations, understanding how specific variations of information display and types of persuasion affect experience and behavior will guide design principles. While building the current designs for Tastee and EcoEats we came across a myriad of options for information presentation. For example, in Tastee, participants had to click on text in order to display information on environmental and health ratings which was readily available to view in the EcoEats version. This additional barrier to immediate information meant that Tastee users had to be motivated or curious enough to take action in order to get relevant information. In a follow-up study, it would be important to test how giving Tastee users all the information on environmental factors up front affects website use. Similarly, EcoEats users may be motivated by the direct persuasion and would have clicked on text to display information on environmental factors. Switching the current information display set up on the conditions would test how motivating direct persuasion is and also if indirect persuasion must be accompanied by relevant information without barriers in order to be most persuasive. Another technique is to offer an option to permanently show or hide some level of information and measure use of this feature.

Previous persuasive technologies relating to shopping have not been properly evaluated to measure effectiveness. Although a field study of the RFID smart shopping cart system was conducted and did reveal that providing additional information made the shopping experience more enjoyable, this study did not evaluate if the information provided by the shopping cart actually changed actions [22]. We attempt to measure both changes in attitudes and actions but more rigorous measures need to be developed. For example, our ratings scale used to assess participants' views on the importance of environmental factors when making a seafood purchase may not be precise enough to measure actual levels of attitude. Refining these measures is necessary to ensure proper evaluation of exactly how persuasive these technologies are.

The current study focused on immediate and short-term

changes in attitudes and actions. It is unclear whether these effects would endure over a few weeks or if repeated use of the web site is needed in order to maintain the change in attitudes or actions. Longitudinal studies are needed to explore the duration of these effects and the necessary actions to maintain levels of change.

So far our findings on the effect of indirect and direct persuasion only test the attitudes versus actions in fish purchases. We would like to test these for other food purchases and other aspects of sustainability. We believe these interesting relationships are pertinent to other domains as well.

Several participants in the study expressed the desire to visit the site again. We have thought about making the site publicly available for use and are encouraged by such positive feedback. However, current server and resource limitations serve as a barrier to implementing a fully operational website. We are evaluating turning the software we have developed into a more robust platform to conduct externally valid, online-only experiments. Such widespread use of the system could offer the amount of data necessary to refine the effects of the design parameters we have identified. Further, the design space could be expanded and the impact of individual and clusters of parameter states compared.

The current research platform offers the opportunity to test such research questions in an effective manner. Searching for recipes online is a prevalent activity that is an easy task for users to perform. Additionally, recipe searching does not involve participants to engage in behavior outside of what is already incorporated into their lifestyle. By learning about sustainability when looking for recipes, this knowledge will eventually permeate into other food decisions they make, whether it be choosing items at the grocery store or a meal at a restaurant.

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