Projecting Instant Information *In Situ*: Can It Help Us Make More Informed Decisions?

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ABSTRACT

How can a supermarket shopper choose a yogurt that is affordable, nutritional and has minimal environmental impact? How might they weigh these criteria in making a choice? Increasingly we are told about the risks, the costs and benefits of food choices. However, the information currently available – online, on food labels, or in information leaflets – can be either patchy and difficult to find, or too prevalent and overwhelming. How can it be consolidated and presented to supermarket shoppers in an easy to understand and meaningful form? Our research is concerned with how we can best support decision-making in this domain. In particular we are investigating how augmented reality can deliver relevant 'instant information', that can be interpreted and acted upon *in situ*, enabling people to make more informed choices. We discuss our research program, to explore whether or not such technology interventions can encourage and empower people. We also examine the issues surrounding personal versus public projection and suggest two kinds of tool that can be used to explore these.

1. INTRODUCTION

You're standing in a supermarket aisle looking at two similar products, trying to decide which to choose. You want to make a healthier and greener choice and select the one that has low calories and a low carbon footprint. You glance at the labeling icons on the packaging but they are confusing; one shows a higher amount of fats and saturates than the other but a lower amount of CO2 grams per pack. One says percentage per adult's daily amount and the other per serving. You then look at the prices: one costs £1.59 and the other £1.39. You are in a hurry and decide to select the cheapest product.

The proliferation of labels on food packaging can be more confusing than informative. How might we help people make more informed choices about values they care about when confronted with multi-dimensional information? Technology pundits and researchers are beginning to promote 'augmented reality' that uses Smartphones and other ubiquitous technologies as the latest solution to this problem. For example, Pattie Maes (Media Lab, MIT), demonstrated her team's "6th Sense" wearable device for this purpose in her much-discussed 2009 TED presentation. The device, comprising a wearable camera, a mirror and a tiny battery-powered Pico projector, could superimpose relevant digital information, such as level of 'greenness', onto the packaging of a product picked up by a shopper. Commercial companies will soon be offering new opportunities for people to augment their everyday activities. Apple, Nokia and Samsung Electronics are all planning to launch handsets with built-in micro projectors while Pepsi has just started displaying QR Codes (unique black and white chequered boards) on its drinks that, when photographed using an enabled cell phone, will instantly bring up a game, video or informative website.

It is not surprising, therefore, to see journalists asking whether these new augmented reality technologies can finally make it easy for people to do the right thing. Kuang [7], for example, marvels at the possibility: "what if all the food in your grocery store was marked with a QR code — you could compare the carbon footprints of two batches of produce… without having to spend any time or effort looking it up…" He continues by claiming it is "the best chance we have to speed crucial information about our world to the people living in it". This vision, however, begs the research questions: *Will people be able to read and act upon such 'instant information'? Will new forms of augmented reality have the desired galvanizing effect encouraging and empowering people to act upon various social causes (e.g., reducing carbon emissions) or improve their well-being (e.g., changing their diet)?*

Having instant information at one's fingertips is certainly a promising technological approach but for it to succeed in changing people's behavior we need to understand how new forms of augmented reality are interpreted and used, especially when *in situ*. While the capabilities of the emerging technologies are impressive in how they can project contextualised information, there is a paucity of research into whether people can process and exploit that extra information profitably. While it is easy to imagine Pepsi Max drinkers in a café enjoying the surprise of being presented with a new game or a funny website on their mobile phone it is less clear whether people will make greener and healthier choices whilst managing their weekly budget when presented with projected information of one form or another in the middle of their busy shopping trip.

We are interested in whether instant information can enable people to make better-informed choices when shopping or overwhelm them with new things to consider. In particular, we are looking at how ubiquitous technology intervention can help people pay attention to and act upon information while engaged in a demanding consumer task. This requires understanding when and where to display information so that people can make more informed decisions. A further design challenge is determining how to develop effective representations of multi-dimensional data using appropriate computational support.

To address these wide-reaching concerns we propose that an interdisciplinary methodological approach is needed, one which uses cognitive science models of decision-making and evolutionary theories of human behavior together with design principles for information visualization from interaction design.

2. BACKGROUND

Rational theories of decision-making [e.g., 15] posit that making a choice involves weighing up the costs and benefits of different courses of action. When alternatives are ordered on more than one relative dimension, this involves compensatory strategies where information is processed exhaustively and trade-offs made between features. Such strategies are very costly in computational and informational terms – not least because they require the decision-maker to find a way to compare apples and oranges. Non-compensatory strategies may be used instead as a form of bounded rationality where not all of the available information is used and trade-offs can be ignored [10]. Furthermore, recent research in cognitive psychology has shown people tend to use simple heuristics of this sort when making decisions [6]. A theoretical explanation is that human minds have evolved to act quickly, making 'just good enough' decisions by using fast and frugal heuristics. We typically ignore most of the available information and rely only on a few important cues. In the supermarket, shoppers make snap judgments based on a paucity of information, such as buying brands they recognize, are low-priced, or have attractive packaging [12] – seldom reading other package information.

At the same time, recent consumer surveys are revealing that shoppers are demanding more information about the products they buy and are becoming increasingly aware of the global consequences of the decisions they make [4]. This raises the question of whether it is possible to make people pay attention to *more* information, such as nutritional, ethical, *and* environmental features, when making their food purchases and subsequently deciding how to use what they have bought to make healthy meals that have a low carbon footprint.

3. WHICH VISUALIZATIONS?

We propose that rather than providing ever more information to enable consumers to compare products in minute detail when making a choice, a better strategy is to design technological interventions that provide just *enough* information and in the *right* form to facilitate good choices. One solution is to exploit new forms of augmented reality technology that enable 'information-frugal' decision-making, in the context of an intensive activity replete with distractions (i.e., shopping in a supermarket or deciding at the kitchen table what to have for dinner). To this end, we suggest using 'glanceable' displays that can represent multiple dimensions of information in an easy-to-digest form.

However, we must first work to redress the scarcity of research on how people use multi-dimensional information under time pressure and the extent to which it has differential effects on rapid decision-making [5]. What kinds of visualization might be effective for use by the general public when wanting to make a choice? Answers so far are only tentative, or address a situation with limited applicability to the kind of challenging daily task we tackle here. Within the field of Information Visualization there have been a number of tools that have been developed specifically to represent multidimensional data that allow for comparisons [cf. 1]. The majority of these are designed for experts to interrogate complex data sets and use a variety of rich 2D and 3D graphical representations. A key aspect of such visualisations is that they are interactive, so that users may themselves choose which dimensions are more salient in the display. Other simpler canonical forms, such as tables and trend graphs have been developed for web-based decision-making activities, such as online shopping, making investments, choosing insurance policies or buying a house. An innovative approach has been to develop interactive visualizations that compute the performance of alternative options for a range of different parameter values. An early example of this was the Influence Explorer [14] that allowed a user to compare how products (e.g., a light bulb) perform on core values (e.g., brightness and working life) when varying multiple parameters (e.g., diameter, length, material and number of coils). More recently, Bargrams have been developed for e-commerce applications. For example, EZChooser helps consumers choose one item from many (e.g., cars) through selecting attributes that are visualized as parallel horizontal interactive histograms along a number of dimensions [16]. Even though these kinds of visualizations are targeted at non-expert users, they are essentially visual query languages that require considerable cognitive effort to generate and interpret.

An important consideration when representing multiple dimensions that can be glanced at and perceived rapidly is to enable comparisons to be made and cumulative information inferred *in situ*. For example, simple contrasting icons (e.g., thermometer icons, percentage bars, balls that change in color) can be presented which increase or decrease in amount in relation to the values being represented. Another approach is to fuse relative measures on different dimensions (e.g., greenness, price, fat level) into singular displays where shape carries the salient information, such as a rectangle that gets taller to convey a nutritional dimension that is general (healthiness) or specific (e.g., salt content) and wider to convey price. A third dimension, such as 'greenness', could be added by filling in the rectangle with a shade from red to green to show the amount of carbon emissions for that product. Similar to the idea behind Chernoff faces, the visualizations will be placed side by side to enable quick comparisons.

Another important question is whether to use 'emotive' visualizations that can persuade people to select food items they might not otherwise choose. Various persuasive technologies have recently been developed to encourage people to take more exercise. Examples include Fish'n'Steps [8]; Chick Clique ([13] and UbiFit [2] where various types of graphic representations (e.g., butterflies, flowers, bar charts) are used to represent amount of exercise type performed, e.g., cardio, strength training, and walking. Findings from a three-month field trial of UbiFit showed that these display systems can be motivating, encouraging participants to maintain fitness levels that were significantly higher than for a control group without the visualizations [3].

More dramatically, Shultz et al. [11] have shown how emoticons can have a powerful effect on changing behavior for energy consumption. In their study, a number of householders were told exactly how much energy they had used and the average consumption of energy by others in their neighborhood. The above-average energy users then significantly decreased their energy use while the below-average energy users significantly increased theirs (presumably because they felt they had more room to increase their consumption). But then the researchers tested the effect of instead giving householders who consumed more than average an unhappy smiley icon – suggesting it was socially disapproved – and those who consumed less than the norm a happy smiley icon – suggesting their energy consumption was socially approved. The impact of providing these two visualizations was dramatic: The big energy users showed an even *larger* decrease in their energy use while the below-average users did not change their energy consumption upward (presumably because the addition of the happy emoticon suggested they were doing just fine).

4. WHAT AND WHERE TO PROJECT?

So far we have discussed the kinds of information to present to people in order to aid their decision-making when faced with a choice in a supermarket. But what is the best way to project this information so that it is readily glanceable? One possibility is to design an augmented reality app on a smartphone or shopping cart display, that depicts in real time the proposed visualizations superimposed on an image of the items appearing in front of the shopper. Another possibility is to display the visualizations directly onto a surface in the environment, such as the palm of a shopper's hand or the packaging of a box that has been picked up, using a pico projector attached to a smartphone or smart cart.

A benefit of presenting information onto a phone, hand or cart display is that it is personal to the shopper. However, this can make it difficult for others to view, which could impede families or other groups shopping together from sharing information when deciding what to purchase. Moreover, information projected directly onto food packaging may be subjected to the 'noise' of the labeling on the packaging itself, making the new information hard to discern, especially in certain lighting conditions.

The extent to which the projection of information is made personal or public could also influence a person's decision-making. Cumulative values of multi-dimensional data could be totted up to give an overall score and projected onto the handle of the shopping cart (for example a green handle could signify that the shopper has obtained a 'carbon footprint' or 'fat content' score below the average for a particular target). Here, the idea is to investigate whether people will be more or less likely to change their behavior when information about the contents of their shopping cart is publicly visible for all to see versus being privately displayed. For example, would shoppers try to fill their cart with healthy and green foods and on finding they were under the average then treat themselves to luxury goods high in fat and food miles? Would having their shopping cart glow green at the check-out, indicating the contents were well below the average, make them feel good in front of other shoppers such as participants in the Shultz et al study [11]? Would the prospect of others seeing just how much butter and cheese they are buying make shoppers think about buying less, or just thinking about shopping elsewhere?

To address the efficacy of using public versus private information projection in a food shopping context we propose two classes of tools:

(1) A Comparative Tool that is a 'private' mobile application running on a smartphone that can be displayed (i) on the device, (ii) on the person's hand or clothing or (iii) on some aspect of the environment, such as the packaging. The underlying design is intended to show simple visualizations, representing various dimensions, such as price, environmental impact, and nutritional information (goodness) that can aid *in situ* decision making. The nutritional value could be broken down into categories used by existing food labeling (e.g., level of sugar, fat, salt, saturates per serving). After taking a photo of a product, such as a yogurt, the tool will show the values on each dimension selected.

(2) A Cumulative Tool that is projected as part of an ambient display onto a shopping cart (e.g., its handle) and changes in response to the summed properties of the items placed in the cart as they tot up for a dimension selected by the shopper. A 'total' color will appear on completion of their shop relative to a social norm. For example, this could be their approximate carbon footprint for a weekly shop for a family of four.

Whether these novel kinds of personalized projection can help people make better decisions remains to be seen. Emerging research suggests that simple visualizations can be designed to be information-frugal and emotive – encouraging people to change their behavior at the point of decision-making. It will be interesting to see how people react and respond to their choices being made public in this manner or whether they will prefer to keep such information in the palms of their hands. Such motivational differences could make all the difference in how, and how much, information shoppers are willing to incorporate into their food purchase decisions.

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