

# Persuasion not Required

## Improving our Understanding of the Sociotechnical Context of Dietary Behavioural Change

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**Abstract**— In view of the well-acknowledged inequalities in health between the rich and the poor, populations of low socioeconomic status stand to benefit most from advances in technology designed to promote health-related behavioural change. In this paper we investigate attitudes towards diet and the perceived barriers to making positive changes from the perspective of the primary caregivers of seventeen families with low socioeconomic status. Participants were aware of the weaknesses their family's dietary habits and were motivated to make changes, but lacked financial, strategic, and social resources needed to do so. Based on our analysis, the current trend of raising awareness and motivation to change does not appear to address the needs of this population. We call for research to investigate systems that address existing gaps in health-related communication and empower people to take practical steps towards achieving realistic goals; matching any attempt to motivate change with an attempt to facilitate change.

**Keywords:** *underserved, low-income caregivers, health behaviours, diet, nutrition, barriers, assistive technology, family*

### I. INTRODUCTION

Persuasive technologies are those that are designed with the intention of promoting behavioural change [1]. Over recent years many novel persuasive technologies have emerged aiming to encourage health-related behavioural change. Given the prevalence of self-monitoring in systems focusing on promoting change in dietary habits, the presumption seems to be that a greater awareness of existing dietary habits is needed to prompt a change in dietary behaviour. While this may be true to some extent, we suggest that this is a somewhat naïve view of how people come to make lifestyle choices.

The work in this paper investigates the broader socioeconomic context of dietary behavioural change for low-income families, and considers if and how technology can assist them in overcoming barriers to change. We were motivated to study the issues faced by this particular population by Barton et al's [2] recent study into the prevalence of cardiovascular disease (CVD) risk factors amongst preschoolers in low-income families. The study reported that 87% of children in low-income families were already exposed to *at least* one modifiable risk factor by preschool age; poor diet being the most prevalent. CVD remains the biggest killer in the US [3], and more importantly for this work, remains most prevalent in communities of low socioeconomic status.

We are investigating the 'messiness' [4] of the sociotechnical landscape where technology may have a positive impact. The contribution of this work is a more nuanced representation of behavioural change within low-income communities than is currently afforded by models of behavioural change and accounted for in current technological approaches. Through a focus group and in-depth interviews with low-income parents of young children we found that health was a concern for most of the participants. They were already aware of the weaknesses of their family's dietary habits and were motivated to make changes, but lacked the financial, strategic, and social resources needed to do so; issues that most current technological approaches fail to address.

Essentially, we call for technologies to be *designed for action, not persuasion*. We suggest that any attempt to motivate to change should be paired with an equal attempt to facilitate change. Rather than conclude with design implications, this paper ends with a discussion of technology's role in promoting dietary change in this population. We understand there are many barriers to health that technology alone cannot solve, however, the target population's outstanding need prompts us to argue that there is scope for low-cost, accessible and appropriate technological innovations in this area. By appropriate we mean technologies that do not focus solely on raising the self-awareness and motivation of the individual, but address existing gaps in health-related communication and empower people to take practical steps towards achieving realistic goals.

### II. RELATED WORK

While poverty, or socioeconomic status in general, is something seldom considered in HCI, in terms of health it is a dominant determining variable. Simply put, income and social class are the major factor on life expectancy after gender and ethnicity [5].

#### A. eHealth Promotion and Pervasive Health Technology

The range of technological interventions developed specifically for low-income populations have so far ranged from low-cost healthy eating information web-portals to interactive multimedia teaching modules e.g., *La Cocina Saludable* [6] and the cartoon-based Baylor GEMS Internet Intervention [7]. Each of these interventions illustrate how different aspects of the socioeconomic context of their target

population can be integrated into the design of a health-related behaviour management system. Apart from the work done by Grimes et al. [8], and Khaled et al [9] needs of underserved communities and populations have so far mostly been ignored in the wave of health-related persuasive technologies emerging from the HCI communities.

As mentioned earlier, generic approaches to health related behavioural change have tended to include some form of self-monitoring; a well-recognised behavioural change technique [10]. Though various approaches to automated physical activity monitoring have been established, the automated monitoring of nutritional intake is more problematic. RFID has been offered as a potential technological solution [11], but this depends on the adequate categorising and labelling of foods. Here we give an overview of some systems that have gone beyond prototyping in the promotion of nutritional behavioural change by employing some form of self-monitoring.

Researchers are seeking to develop the basic format of self-logging, nutritional reference, and user feedback employed by commercial desktop applications such as DietMatePro (dietmatepro.com) and BalanceLog (healthetech.com). In these desktop applications, a user enters his/her dietary intake textually and then the system refers to a nutritional database to provide the user with feedback about his/her nutritional intake. Tsai et al. [12] also employ text-based data entry on their mobile-phone application that provides caloric balance feedback. Text-entry systems require a degree of technical aptitude and literacy that can become a barrier to adoption.

Alternative methods of data input include PDA-based scanning of receipts [13] and barcodes [14]. Camera phones are also used as an alternative data-capture tool in myFoodPhone (myfoodphone.com), but the ease of data capture is traded off against automated nutritional analysis; instead of a database, a nutritionist provides nutritional values to the system. This labour-intensive task can be avoided by using the photograph itself as a reflective prompt [15]. Imagery may be preferable when considering raising dietary awareness within a population with varying literacy rates. Systems have also been proposed to go beyond simply raising awareness of dietary intake to helping those already persuaded or motivated to make a change to their nutritional behaviours. These commonly take the form of recipe repositories and price/nutritional value comparisons and recommendations [6,13].

### B. Community Initiatives

Parents are the primary target of the few initiatives aiming to improve the health of preschoolers. In spite of intensive face-to-face approaches results have been relatively modest: most programmes showed 'some' improvement in 'some' of the target behaviours [17]. Two such outreach programmes that currently serve the study population are Headstart (nhsa.org) and Women, Infants, and Children (fns.usda.gov/WIC/). Headstart is a national school readiness programme, providing education, nutrition and health services to low-income children and their families in the US. WIC is a nutritional program that provides food supplements and education to nutritionally at-risk pregnant women and preschool children. The majority of these programmes occurred in community settings, benefiting

from the ability to reinforce the health promotion message through repeated exposure over multiple mediums. Lee et al. [18] highlight the complexities of tackling health promotion within low-income populations:

*We can continue to advise individuals about their CVD risk factors, but we also have to acknowledge that deprived and less affluent neighbourhoods have a negative effect... the benefits of advising patients to participate in exercise and to improve their diet needs to be balanced by the availability of local resources.*

## III. THE STUDY

We conducted our studies in the same low-income communities in which Barton et al. found children had at least one modifiable CVD risk factor [2]. We collaborated with a trusted resource within those communities, The Bridge Project, to conduct this research.

### A. The Bridge Project

The Bridge Project is a community outreach project with four centres situated within public housing neighbourhoods in which families often fall on or below the poverty line. The project provides after-school and summer-school programmes for children within these neighbourhoods, and college and trade school scholarships. In the after-school programmes, children aged 3 to 18 attend their local centre between 3pm and 8pm each weeknight. They are given the opportunity to participate in various activities including a literacy program, art classes, and technology education.

Due to limited resources health education is not a core component of the project's curriculum, but physical activity is encouraged through participation in team sports and an outdoors leadership course. The children are given healthy eating education intermittently. During homework hour the children are given a snack with a drink of fruit juice or milk. Somewhat anecdotally, a project employee commented that when the project first opened some of the children would not drink the milk that was provided because they thought it was poison.

Our future aim is to complement this exposure to positive health behaviours with health promotion technologies that extend the scope of exposure beyond the confines of the project centres into the homes and families of the project's children. The results presented here will inform the design of future community-based systems and give insight into current system challenges for underserved populations.

### B. Participants

We worked with administrators from the Bridge Project to recruit primary caregivers of children under eight years old who lived in the public housing community and spoke English. A total of 17 participants were recruited for the study. The participant group was primarily Latino (n=12), but included African American (n=3) and White (n=2) individuals. Although not exactly proportional, this sample does compliment the most common ethnic orientations of the Bridge Project families (52%, 20%, 10% respectively).

All of the participants were women between the ages of 20 and 56 years old (average age = 32.3; s.d. = 10.1). The women were the primary caregivers for between two and five children (average  $n = 3$ ; s.d. = 0.94) that ranged from one week to 16 years old. Three were married, one was engaged, and 13 were single. Eight women were not working outside of their homes at the time of the interviews (one participant was on bed rest, prior to which she was employed), seven women worked full time, and two women worked part-time. Their out-of-home jobs included everything from sales associate to personal banker to janitor. The number of people in the participant's social network who helped them care for their children ranged from zero to four (average  $n = 1.35$ ; s.d. = 1.16).

From a technological standpoint, nine participants owned a computer, however 16 participants had access to a computer either in their home or at a community centre. Sixteen of the participants had at least one year of experience with computers—they felt the most competent with using the Internet and moderately comfortable with using word processing, email and chat programs. Thirteen of the participants owned mobile phones and used their phones daily. Those who owned mobile phones had at least two years of experience using their phone, and felt comfortable using their phones for making and receiving calls, sending and receiving text messages, and taking pictures with their phones.

### C. Method

After the Bridge Project management team agreed to collaborate on the study, one of the authors spent time at the centres answering questions that the staff had about the study and familiarising herself with the centres, their activities, and the children—and allowing them to familiarise themselves with her. She spent time helping clean dishes, putting deliveries away, helping the preschoolers in their IT sessions, and helping the middle-schoolers during their homework-hour. Formal collaboration with a trusted party eased recruitment of participants, while informal familiarity helped to establish a rapport with the family caregivers once they were recruited.

The primary caregivers of children up to the age of eight were invited to take part in either a focus group or one-to-one interview. The focus group and interviews took place in the Bridge Project building. Spatial constraints limited the maximum number of focus group participants to five. We originally recruited five mothers to participate in the focus group, but due to family and work demands two of the mothers had to cancel at short notice. We therefore carried out the focus group with three mothers. Twelve mothers and two grandmothers participated in the one-to-one interviews. Although the number of participants may appear low, we were recruiting from a pool of twenty-one potential participants: English speaking caregivers of children less than eight years old who attend the Bridge Project. We acknowledge the limitations of working with small numbers, but do not feel that the findings of this paper are any less important.

Initial topics of health, diet, and technology were raised in the focus group to generate insight into the main issues and concerns as perceived by the primary caregivers in low-income families. In-depth interviews then allowed us to elaborate on

the emergent themes of lack of time, financial pressures, and the need for developmental knowledge to support the desire to change. Individual commonalities and differences in the participants' attitudes and approaches towards health-related behavioural change were also explored.

The focus group and interviews were transcribed and coded during data analysis sessions, then analysed for emergent themes. To interpret our findings within the context of the participants' current attempts to make dietary changes, we used the Transtheoretical Model of Behaviour Change (TTM) [19].

Change within TTM is viewed as a process. The five stages of change are precontemplation, contemplation, preparation, action and maintenance. TTM was chosen because of its widespread adoption and acceptance throughout the multiple disciplines concerned with health-related behavioural change. However, it is not without its critics. Adams et al. [20] suggest that by focusing solely on the individual, contributing factors such as gender and income are consequently ignored by the TTM. Additionally, when considering the complexity of dietary behaviours, Ni Murchu et al. [21] suggest that an individual may potentially be categorised into multiple stages. Despite its limitations, the model remains a useful tool to identify where in the process of change an individual is at any one time. Rather than assess stage of change using stage-based questioning or questionnaire responses, we chose to categorise participants based on evidence of their behaviour and behavioural intent that arose during the interviews. We chose this approach, which has previously been employed by Lin et al [22] because: (1) the majority of validated questionnaires focus on one particular dietary behaviour e.g., fat-intake and (2) direct questioning about their intention to change could be perceived as more judgmental than if the same information was elicited during the flow of conversation.

When analysing the interview transcripts to categorise participants' stages of change, as shown in Table 1, it became apparent that Adams et al.'s criticism was relevant here. Many of our participants, although in precontemplation with respect to TTM, were only precontemplatives through lack of resources rather than motivation. For this reason we added an additional category: *Forced Precontemplation*, with a definition of currently being unable to change, despite intent or desire to do so.

## IV. FINDINGS

We categorised participants' stages of change based on the information we received from participants during interviews. As can be seen from Table 1, only four of our participants were precontemplatives. Four were in forced precontemplation. Although financial constraints were often expressed during interviews, the more frequent reason for forced contemplation was not knowing where to start, or not knowing how to make the changes they knew were necessary.

P3 (contemplation) was intending to make changes to her family's eating routine when she and her family moved to a larger house. P10 (preparation) was in the process of gathering healthy recipes and planning family activities after being told by her doctor at a routine medical that she was overweight. P9 (action) had recently started to cut out snacks from her

children’s diet after being told that her daughter was 50 pounds overweight.

Four of the participants had successfully made dietary changes following bereavement, exposure to ill health, or formal intervention through outreach programmes. The remaining participant who is not represented in this table, P4, grew up eating healthily, and therefore did not consider herself to have ever made a behavioural change.

*A. Living the Statistics*

Echoing the health statistics that surround low-income populations, the majority of our participants lived with an awareness of ill health and bereavement caused by conditions associated with health-related behaviours such as poor dietary intake. P13 had recently been registered disabled due to multiple medical conditions. Two other participants were the main caregivers for their infirm mothers. In both cases the mothers were disabled through diabetes-related illnesses. For P2, the younger of the two, the experience of looking after her mother through the last stages of her illness served as a direct motivator to look after herself.

P12 lost her 35 year old mother to breast cancer. Although she rarely thought about health until she had children herself, she was now highly motivated to keep herself and her children well. P8’s family has a strong history of cardiovascular disease, none of her mother’s side living past 55. Her aunt’s recent death served as a catalyst for change for P8 and her mother:

*I said we have to get serious... and she was like ‘alright’ and it kind of woke her up... my aunt was the healthiest one in the bunch and she still passed away, so it kind of scared my mom... And I told them I am not going to wait till I am 45, 50 to be healthy, I am going to do it now. P8*

Despite the relatively young age of our participants (32.3 years old, on average) many of them expressed concern about their weight, and reported related complications such as joint pains, general aches, lethargy, and breathlessness on minimal exertion. In two cases weight-related discomfort had prompted successful behavioural change, P8 losing 50 lbs. and maintaining that new weight and P10 similarly losing 25 lbs. and maintaining her new weight, neither participant now suffering from their original complaint. The majority of the remaining participants expressed a desire to change, but were limited financially or overwhelmed by the size of the task; they simply did not know where to start. Some were actively preparing or beginning to make changes, but two were honest in saying that they just did not want to change.

Of the five participants not to report any concerns about their own health, P1 and P2 were both in maintenance; spurred on by experiences with ill relatives, both had made behavioural changes under the guidance of the Headstart and WIC programmes during their pregnancies. P4 had never needed to make dietary changes as such, and the remaining two participants were not affected by any of the aforementioned issues. They were both happy with their health and the health of their children, and had no experience of serious illness in their families; both were precontemplatives.

*B. Beyond the Food Pyramid*

Given the observed level of awareness with respect to the risks and consequences of poor dietary intake, and the overarching concern about the need to make changes, it would not be unreasonable to presume that an area of informational need is the nutritional components of a healthy diet. However, all of our participants were aware of the strengths and shortcomings of their diet. All of the caregivers had an awareness of ‘good’ and ‘bad’ foods, many referring to the

Stage of Change	Generic Definition	Example Evidence	Participants
Precontemplation	No intention of changing within the next 6 months	I don’t think I do [want to make dietary changes]. I’m not totally sure if I want to do it so that’s why I really – I think that’s why I keep putting it off maybe.	5, 11, 14, FG3
<i>Forced Precontemplation</i>	<i>Unable to change within next 6 months despite desire or intent to do so</i>	Well there is a lot of things I would like to change but you can’t afford it.... They raised my food stamps to I think 262 I think a month that is supposed to feed a family of four. There is nothing left, you know, so we skimp on the meats one month, just so we can buy the fruits for the kids.	6, 7, 13, FGI,FG2
Contemplation	Seriously thinking of changing within the next 6 months	I am thinking about when I move to a bigger place that I want to make a menu, a weekly menu of what I want to make very week and paste it on the refrigerator, so the kids know what they are going to eat and they are prepared for it. That is what I am going to do.	3
Preparation	Intending to change in the next month	I’m going to try it. I’m telling you, I’m just going to get ready with all the research I started doing and print out everything that I want to start to know how to do and then from there on I’m going to try to see if I could achieve it. Hopefully I could.	10
Action	0-6 months after changing	I started [not buying snacks] the first of the year. I told myself that’s my New Year’s resolution, we going to lose some weight.	9
Maintenance	>6 months after changing	I don’t feed my kids that anymore like I used to, like when they were young. When I was a teenager, like, “Oh, McDonald’s. Here you go, here’s dinner.”	1, 2, 8, 12

**Table 1: Participants' Stages of Change**

food pyramid (a graphical guide to the recommended daily intake of the major food groups, developed by the US Department of Agriculture) when asked about what constitutes a healthy diet.

It is one thing to be aware of the food pyramid, and quite another to be able to translate that into everyday dietary practices. Despite a desire to change, many of our participants were simply overwhelmed by the task of changing their families' dietary behaviour. In some cases they did not know where or how to start making changes, while P5 reported having made many enthusiastic attempts to change all aspects of her dietary habits; these enthusiastic efforts generally lasted for two weeks. While the food pyramid tells us what should be in our diet, it does not address the practicalities of buying, preparing or even eating the food.

While the family doctor was the most frequently cited and trusted source of information, they provided information that was of limited utility:

*When someone hands you a sheet and tells you just to follow this and count calories and things like that and sodium, you are looking at them like "okay... do you want to hand me something I don't know how to read or even understand?" P6*

In some cases the anticipation of being recited meaningless guidelines was enough to deter our participants from seeking guidance from the doctor. Medical terminology was not the only factor affecting the delivery of health promotion education and its response:

*For some people living healthy is totally different than other people and what I don't like about it is they are trying to put everyone in the same category to live healthy... so if you can take getting healthy and kind of interpret it into their culture or lifestyle, I think it might be little easier. P12*

The cultural disparity between the message and the recipient was also compounded by the additional cultural disparity between the recipient and the conveyor. When discussing why some local families do not use the resources provided by the Bridge Project, one Project employee commented, "they do not want more white women telling them how to raise their children."

Some participants used the Internet to answer questions they had about healthy eating. Four participants reported using the Internet to search for recipes, three of them specifically searching for healthy recipes while the fourth searched for recipes that used what she had left in the house. Reasons given by other participants as to why they did not use the Internet to search for recipes or general health information reflected their perception of the complexity of searching for such information and the notion that the Internet was for things other than seeking help/advice.

### C. Waste Not, Want Not

One of the most common barriers that prevented most participants from purchasing health foods was the fear of waste. Waste was defined in many ways—from family members not eating to food spoilage to risking money on new food items. Participants were highly sensitive to waste because,

with their limited resources, they had to consume each food item they purchase or risk the possibility of not having enough food for the rest of the month. Picky eaters were the most cited source of wasted healthy food. Children in ten of the participants' households refused to eat healthy foods purchased, thus the foods would rot. In extreme cases, participants had given up on purchasing healthy foods. Predictably, three of the four participants in this case were categorised as precontemplative.

Those participants who had not given up on purchasing fruits and vegetables, had the added challenge of finding a place to purchase unspoiled fresh food items. Participants discussed how the cheaper markets in close proximity to their homes had lower quality fresh produce. Eight participants went to multiple supermarkets to get inexpensive staple foods at the cheaper shops and higher quality produce and meat from more expensive shops. Unfortunately, going to the more expensive shops decreased the amount of food they could purchase because of food prices and travel costs. Occasionally, participants would have to supplement their food supplies by going to food banks, where they risk receiving spoiled food and have limited choices on the foods they select. Thus, people may have to get new foods that their families are not familiar with. In addition, when making a lifestyle change to eat more healthily, new foods most likely will be introduced. Three of the participants voiced concerns about cooking new, healthier foods because their families may not eat the food. Thus, they would waste both resources to obtain the food and the food itself, as shown in the following quote by P12:

*But I try not to cook too much that they ain't going to eat, because that is wasting food on my end and that is money, so I try to cook stuff I know they are going to eat.*

The participants in the active and maintenance stages of change were more likely to discuss fears of waste in terms of spoiled food and trying new food items. Based on their categorisation, we can surmise that they had more experience with purchasing and preparing healthy foods and thus had more of these experiences with wastage. Participants in earlier stages of change had more problems with picky eaters and were deterred from trying new foods because of waste fears.

### D. Making Something Out of Nothing

Meal planning is a great way to create a variety of healthier, well-balanced meals for less money. Overall, we found a fairly even mix of those who planned and those who did not plan their meals. Three of the participants who planned their meals did so because they were generally well-organised people, and understood the benefits of budgeting and time efficiency by laying out exactly what their families were going to eat for a specific period of time. The amount of time participants planned for ranged from two days to two weeks in advance. P1 displayed the plan on a calendar on her refrigerator.

Participants who planned meals with their children openly discussed healthy and unhealthy foods. These discussions provided the children with opportunities to learn about health and budgeting. For example, a participant described how her entire family changed their eating habits when her live-in mother was diagnosed with diabetes. Another caregiver, P10,

discussed how her children went from helping her plan meals to helping her cook the meals. However, in addition to the skills that are needed to plan, there are other barriers incurred by the socioeconomic constraints of this population.

#### a) Barriers to Planning

Participants who did not plan meals commonly cited time constraints, lack of space, and financial uncertainty. Participants described hectic schedules:

*I work two jobs... I walk all day from 6:30 in the morning till about 10:30 at night...The only thing I sit down for is my breaks, when I eat lunch, when I eat and that is it. FG3*

Two participants also discussed lack of physical space as a barrier to meal planning. When too many people are in one space, they do not have room to prepare meals at the same time, eat together, or have group discussions together. These stressful environments make it difficult for the primary caregiver to keep track of what is being consumed and what needs to be replenished.

Although only one participant discussed financial uncertainty as a barrier for planning meals, based on the financial concerns voiced by other participants, we believe this may play into the lack of meal planning by other participants. We found that participants relied on many forms of resources to purchase food, such as income, food vouchers, alimony, and child support. The latter two are not always received on time, thus budgets must be flexible. Even the change in receiving food stamps made one participant rethink meal planning:

*I did for a while, but lately when we stopped getting our food stamps, it is like day to day now. It is just day to day, I will just look in the cupboard, this looks good, I will pull out the meat first, whatever looks good with the meat, I will pull out with it, the starch, the vegetables. But I don't plan anymore. P14*

We highlighted lack of space and financial uncertainty as barriers to meal planning because they are specific to our target population and must be considered when developing applications to assist with meal planning. Participants who did not plan their meals were in different stages of change, thus addressing these barriers can help a large set of the target population. Even if participants do not plan their meals, everyone must obtain food using their own strategies. Participants who planned their meals were more likely to search for bargains and buy bulk items than those who cooked day-to-day. These results bolster findings that people who plan their meals have more control over the foods their families consume.

#### E. A Problem Shared: Isolation

Overall, health and healthy living were not topics that were openly discussed between friends or within families, despite being a concern for the majority of our participants. With the exception of those who were brought up with an awareness of healthy eating, and those who had been bereaved or affected by serious illness, it was something of a conversational taboo. Within P2's group of friends she is known as 'the healthy one.' When she was in the early stages of changing her eating habits

her friends would make jokes about it or try and persuade her not to bother. Now she has established healthy eating practices it is not something that they comment on. Neither does she try and persuade her friends to change, speculating that "if they wanted to know they would ask." When asked what could have made the transition easier she replied "having more people around me that wanted to make the change." Although she felt isolated within her group of friends with respect to her attitude towards health, she received support from formal outreach programmes. The remaining participants categorised in maintenance reported sharing an interest in health with at least one other trusted person.

For others it was not a case of the topic not coming up in conversation, rather there was nobody to have that conversation with. Many of our participants were new to the area when they were interviewed, not yet having had the chance to get to know other families. Once settled in the area, issues of trust limited the possibility of establishing a social network:

*I've been in bad situations with neighbours, that's why I say it's a safety issue with me now because I made bad choices in friends where I used to stay, and it was just – it was h-e-l-l. So, when I moved here, I said, "I'm going to change the friendliness, I'm going to change the talking to everybody in the neighbourhood, I'm just going to stick to myself and get my stuff done." P9*

Isolation was not necessarily perceived as a bad thing. Pride and independence, borne out of a history of self-reliance and self-sufficiency, meant that many of our participants were reluctant to ask for help from others. During P3's interview it was clear that she was extremely concerned about her youngest's picky eating, having run out of strategies to try persuade him to eat. When asked if she had approached anyone for advice she replied that she would take care of it herself, like she always does. All participants reported some degree of isolation, be it due to external factors such as lack of social network, internal factors such as lack of trust, pride or self-efficacy. There seemed to be some degree of correlation between the extent of isolation and stage of change. All of the precontemplatives reported both internal and external isolating factors, while, as mentioned earlier, external isolation was only reported by one of the participants in maintenance.

## V. DISCUSSION: A PLACE FOR TECHNOLOGY?

We set out to investigate the issues and factors relating to dietary intake and behavioural change within low-income families, with a view to better understand the dynamics of behavioural change and scope for potential technological involvement. Essentially, what we have found is:

- a breakdown in communication within traditional health promotion media
- messages being conveyed by health professionals do not address the financial and strategic resources required to make behavioural change
- social resources, such as the benefit of common interests and experience, are not being shared within the community

- a more complex representation of behavioural change than is currently accounted for in technological approaches to promoting health-related behavioural change
- self-awareness and desire to change does not mean an individual is equipped to make changes

Our findings suggest that there is scope for low-cost, accessible, and appropriate technological interventions in this area that address the existing gaps in communication and empower people to take practical steps towards achieving goals that are within their means. We are not saying that one application will solve this population's problems. What we are saying is that if it is done well, it may play a role in lowering some of the existing barriers to behavioural change. It need not do the job on its own, but can and should be considered as part of a wider community-based approach.

There are some major obstacles that must be overcome before technology can play an integral role in the behavioural change of low-income families. For example, although mobile phone ownership was relatively high, any additional applications and services deployed outside the constraints of a user trial will incur costs to the families themselves: sending/receiving texts and GPRS data download/upload costs. Overlooking problems of scalability and cross-platform compatibility, if the system is not subsidised it is unlikely that these families will be able to afford them. However, one important argument in favour of pursuing health promotion technologies for this population is that current approaches are simply not working. If they were, the findings of Barton et al.'s study [2] would have been very different.

The messages being conveyed by traditional means either do not resonate with the population, or are missing the crux of the problem. When looking for information about healthy eating, our participants were given generic advice from their healthcare providers and often found the same irrelevant or inappropriate advice online. Translating the content of the food pyramid into a meaningful resource for change is one area of need. In addition to converting the pyramid components into balanced meals, the practicalities of buying, preparing, and introducing new foods should be considered within the tight socioeconomic constraints illustrated by our findings. As we call for a realistic view of technology's potential for intervention, we also call for a similar view of behavioural change goals. Considering that our population currently have to prioritise between staple (e.g., meat, bread) and luxury (e.g., fruit) items, rather than pursuing a complete change of dietary intake, systems should help users set realistic and incremental goals (recall P5's unsurprisingly short lived efforts to make complete change). For example the most basic goal could be to buy healthier equivalents of existing prepackaged meals, before substituting prepackaged ingredients with fresh ingredients. Incremental goals will allow the users to step back when they feel that they have made all of the changes that they want to. Although this may go against traditional concepts of the success and failure of a system by not promoting complete behavioural change, we suggest that it is not our job to force new behaviours on people, but to assist them in making the changes they want to. Once goals have been negotiated, the

system should also assist them in taking practical steps towards achieving their goals. Our results showed that participants wanted to change their diets, but most did not know how to start. We need health promotion technology to be more than just digital leaflets, to go beyond raw information provision and support individuals in making changes to their lifestyles. What follows is a brief discussion of ways this need could be addressed, and suggests future avenues of research.

In addition to being a more dynamic and adaptable medium, *health messages can also be given a local face and a local voice through technology*; something that is not often done through leaflets. Cultural disparities between recipients and those delivering health messages compounded the disparities between the message and the socioeconomic context of the participants' lifestyles. The stories and experiences of those who had succeeded in making changes could serve not only as inspiration but as practical guides for those currently overwhelmed by the size and complexity of the task. For example, consider the subtle differences between:

- a generic webpage that suggests planning meals in advance saves money (freeing up money for luxuries such as fruit) and one that has a first hand account of how planning saves money
- a webpage listing strategies to introduce foods to your child and a forum where caregivers exchange experiences and ideas

Ideally, the benefit of experience would be passed between family and community members, but we have found that the transient nature of the housing projects and lack of trust in neighbours means that the benefits of experience do not disseminate through the community. The *EatWell* System [8] provides a good example of how computer mediated social capital can contribute to this problem space.

The sharing or provision of information is just one form of social support that is widely acknowledged to be a resource for behavioural change and an indicator for health [23]. It follows therefore, that those with low levels of support or who attempt behavioural change alone are at a disadvantage in relation to those who have the support of others. Indeed, all of the participants who had successfully implemented dietary changes reported having formal or informal sources of support. Given the reported lack of interaction between community members, technology could prove to be instrumental in the establishment of lines of communication. *Anonymous and asynchronous communication appear to be promising technical strategies to overcoming the current socially obstructive issues of trust and lack of time.* Traditionally acceptable topics of conversation (e.g., recipes) could form basic foundations upon which to build. Once established, users could manage their own level of disclosure and introduce topics of concern, thus slowly breaking isolation barriers. It is conceivable of course, as we found with a few of our participants, that not everybody wants to seek help from others. In such cases it is possible that they would avoid using sociocentric health applications. Alternatively, their sense of pride and independence may prevent them from seeking technology for help. Either way, at least the resources (social and technological) would be there for them to use if and when they wanted to.

To reiterate, when developing technologies, we call for them to be *designed for action, not persuasion*. We found that the majority of the participants were already aware of the unhealthy aspects of their current dietary habits, and already wanted to make a change. Persuasive technologies might offer some purchase on the target populations' problems, but in general are not needed here. Similarly, systems such as the diet-aware dining table [11] would not help the majority of our participants, who already know what they eat and what they should be eating. What restricted their attempts to change were the barriers of lacking financial, strategic and social resources. Instead, we argue that systems that use context and community to empower the development and application of such resources are better suited to this population.

## VI. CONCLUSION

This paper presented an exploration of the broader socioeconomic context of health-related behavioural change for a population not traditionally considered in the design of pervasive health technology. Based on our findings with regard to the needs of this population, we discussed the opportunities and barriers for technological interventions and strengths and weaknesses of current approaches. The contribution of this work is a reframing of behavioural change as more than a simple matter of motivation, and the identification of alternative avenues of research for technology aiming to promote positive changes to dietary behaviour.

Despite our call to design for action, there is a need for traditional persuasive technologies for the participants categorised as precontemplatives. We acknowledge the self-selectivity of the study participants and cannot rule out the possible disproportionate representation of motivated caregivers. For family-based technologies, we suggest that a fruitful focus could be the children, and envisage a system that collaborates with caregivers in their attempts to integrate new food into their children's diets. What is pertinent to remember is to *match any attempt to motivate change with an equal attempt to facilitate change*.

Finally, as much as there is a limitation to what technology can achieve, so too is there a limit to what the individual can do. The degree of focus that current approaches take towards the individual misrepresents the distribution of power with regard to the well-documented societal and environmental influences on health-related behaviour. Perhaps this is the true challenge for persuasive technology: in highlighting social inequalities and persuading change of policy.

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