Exploring A New Paradigm for E-Groceries

R.K.E. Bellamy, W.A. Kellogg, J.T. Richards and C.B. Swart
IBM T. J. Watson Research Center
PO Box 704, Yorktown Heights, NY 10598
{rachel, wkellogg, ajtr, cals}@us.ibm.com

ABSTRACT
As e-commerce and pervasive computing take shape, they will come together to create innovative opportunities in new application domains. This paper reports the iterative design and development of a handheld application for such a domain, that of grocery shopping. The PDA solution we describe, for home ordering of groceries, moves e-shopping beyond the desktop and the browsing experiences typical of web e-shopping applications. Our focus is on the evolution of the application design and understanding this domain through alternating design activities and formative evaluations in the field. The Easi-Order™ application that resulted from this process is currently being used by 200 shoppers in the UK, and is starting to be rolled out for full-scale production use.

Keywords
e-commerce, personal digital assistants, PDAs, field studies, grocery shopping, e-shopping, handheld devices, applications, design.

INTRODUCTION
Grocery shopping is an ubiquitous activity in the modern world, something that almost everyone does on a frequent and regular basis. It’s also a realm, with the exception of the growing volume of e-shopping sites on the web, where technology has had little to offer to shoppers. Creating a successful e-grocery business is a challenge, and most e-grocers rising to meet this challenge are adopting web-based on-line ordering coupled with home delivery. Given the growing number of households with Internet access, this solution seems logical and primed for success: a recent report projects that the number of households using online services to buy groceries and other household goods will rise to 15-20 million by 2007 (Andersen Consulting, 1998).

But is it really what users want? There are many potential pitfalls with the web plus home delivery model: Web-based applications are notoriously slow, often involving booting up a PC, starting a web browser, accessing the site, and downloading multiple graphics laden pages as the site is browsed and the order constructed. More telling, browsing simply may be an inappropriate model for grocery shopping which after all involves many repeat purchases. Finally, shoppers may feel that having to wait for a scheduled home delivery, or paying an extra charge is not worth the benefit.

Safeway UK and IBM have developed a new paradigm for e-grocery shopping, building on an innovative pilot program initiated by Safeway UK called Collect & Go™. Rather than home-delivery, Collect & Go™ is a home-ordering service where customers place orders remotely via phone or fax and pick up their bagged groceries at the store the following day. Collect & Go™ is a personalized service that presents customers with a shopping list containing all of the items they have bought over the past three months. When using this service, the store staff develop a relationship with the customer as they prepare customer orders and become familiar with their shopping needs and preferences. In addition, customers can order items on special offer and write in new requests.

Building on the Collect & Go™ backend processes, Easi-Order™ provides a new shopping experience using a personal digital assistant (PDA). Customers use Easi-Order™ to create and place orders from home using a modem connection. The Collect & Go™ backend saves customers considerable time because store staff pick and pack their orders. The program also allows customers to browse the store or collect items they want to pick themselves when they go in to collect their shopping. Thus, Easi-Order™ might be viewed as giving the customer the best of both worlds: the convenience and time-savings of ordering from home and the advantages of picking any items they want to choose for themselves.

Easi-Order™ is one of the first e-commerce applications of pervasive technology. Deployed as a pilot at a Safeway UK store beginning in February 1999; by May 1999 it had been deployed to 200 loyalty cardholders. To date over 1930 orders have been placed by these customers. Safeway UK is in the process of expanding the pilot project to other stores, as well as to their headquarters staff.

This paper offers an exploration of a new paradigm for pervasive e-commerce applications, focusing on an, “everyday” activity domain and on the details of Easi-Order™’s design. We develop the story chronologically, from our initial conceptualizations and understandings of the domain of grocery shopping through field work with Safeway UK and its customers. We then describe the first fully functional version of Easi-Order™ that was again studied in the field prior to the pilot deployment. Finally we describe the changes driven by our field evaluation and the design rationale behind the deployed version of the Easi-Order™ application. We finish with a discussion of the results from the deployment of Easi-Order™.
RELATED WORK
There are two areas of related work, that focusing on designs for e-commerce and particularly e-shopping, and that focusing on interface techniques for handheld devices. HCI research in the domain of e-commerce tends to take the web as its platform [e.g. 9,10]. We know of no work to date that has used a handheld device working with a mainframe transactional system to create an e-commerce application.

New interface techniques for handheld devices have to address issues raised by limited display size [4, 7, 8], and the design of Easi-OrderTM was no exception. We discuss below a technique for rendering the familiar tab metaphor in a “space-saving” guise.

GROCERY SHOPPING AS A DOMAIN
The coming ubiquity of handheld and wearable computing devices and e-commerce will offer many new design and application opportunities for human-computer interaction, many of them in “everyday” activity domains. Grocery shopping is clearly such a domain, one where some of our own intuitions as shoppers might be useful (as opposed to unrepresentative), if still dangerous to rely on. Our initial efforts focused on conceptualizing the application to be built and understanding users’ views of grocery shopping and Safeway UK’s existing Collect & GoTM program. We discuss these activities in turn.

Initial Conceptualizations of the Application
In May, 1998 the design team started from scratch to create a handheld shopping application. Based on discussions of grocery shopping, an analysis of artifacts used in Collect & GoTM and information gleaned from the project manager about Safeway UK, we made several early prototypes. Different kinds of prototypes help explore different aspects of the design space [5]. We used a variety of external representations: scenarios, pen and paper interface sketches, quick prototypes of interface elements. We found different kinds of prototypes particularly useful for communicating ideas amongst the members of our interdisciplinary design team, to our customers and to our end-users. For example, a scenario and accompanying visualizations developed very early in the design process were used to communicate to Safeway UK possibilities for using the Palm Pilot which, given it’s market penetration, we were considering as the delivery platform.

As we probed for the essence of the application, we settled on providing an electronic catalog of store products as a central concept. Thus several of our early prototypes focused on exploring representations for an electronic catalog that could be browsed by a shopper. One of these, a cardboard mock up of a Palm Pilot and scrollable screen, explored the possibility of portraying a graphical image of grocery product categories (bakery, produce, etc.) to enable direct access to the store’s catalog of items. The rationale behind this was that the existing Collect & GoTM program relied on a very limited (paper) catalog. Indeed, we knew that it was expensive for Safeway UK to produce this catalog and keep it up to date. We wanted to expand it to more fully reflect the store’s offerings, and to minimize the need for shoppers to write in requests for items not already on their list, which on the Palm would be cumbersome. We were interested in making the e-shopping experience much like the experience of shopping in a real store. Our rationale was that physical store layouts and walking the aisles were memory aids that reminded people of what they needed. Thus our early explorations centered on pushing the display capabilities of the Palm to enable richer interactive graphical representations and rapid access to the contents of a very large database.

We considered how people normally conduct their grocery shopping. Is a shopping list used? Is it prepared all at once, or built incrementally between shops? How often did people shop? How did people view shopping – was it an occasion for a social experience within the family or with friends or just a chore? How many members of the household were involved? Did family members make a list together? Did people plan for specific meals, or just get what they thought they needed? Did people use recipes to decide what to buy? Somewhat to our surprise, we became fascinated by grocery shopping.

Field Study I: Interviews with Grocery Shoppers
Personal understandings of an application and domain are important, but not sufficient. Designers’ individual characteristics may fall at the edges, or even outside of the typical behavioral characteristics of the users. For this reason, we made two visits to Safeway UK during the design and implementation phases to talk face-to-face with and observe both current Collect & GoTM customers as well as customers who had not tried Collect & GoTM or who had used it a few times and then stopped. In our first field trip, we spoke with a dozen customers who spanned a number of demographic characteristics (age, gender, work in/out of the home, etc.). We used structured interviews that lasted about an hour, loosely following the contextual inquiry method [3]. For current Collect & GoTM customers, we asked them to show us how they put their orders together, tell us what they liked and what they didn’t like about the program, and discuss any problems they had had. The goal of this first study was to understand how these customers thought about grocery shopping, to discover how the current program was perceived and being used, and to test some of the assumptions we were building into the initial design concepts as described above. During these conversations with users we did more than just get their reactions – we allowed them to become our partners in design, bringing their unique perspective and thoughts.

What we discovered over the course of three days of talking with our users (of course) profoundly influenced our thinking and changed many of our assumptions about the domain of grocery shopping and the design of the application. We found, for example, that although many people did find ways to socialize over grocery shopping with partners and friends, they still thought of it primarily as a ‘chore.’ Shopping was something that had to get done, but that people would just as soon skip, particularly since they were usually buying much the same stuff every week.
Customers using Collect & Go™ clearly stated that the value to them was saving time. Several had begun using the service when some event had occurred in their lives to make trips to the grocery store less manageable. They also highly valued the personal relationship and service that developed with the store staff who picked their groceries. Instead of an anonymous experience with a checkout clerk, they knew the staff and were known by name. We probed for improvements to the program: would a home delivery service be even more valuable for saving time? To our surprise, the customers said no. They did not like the idea of having to wait on delivery “at the store’s convenience,” and several said they liked to pick certain products like meat, produce, and fresh vegetables themselves. Coming in to the store to pick up their groceries afforded them the opportunity to do this and to pick up anything forgotten in the week’s order.

In general customers were highly satisfied with the program and had few criticisms. The only criticism we heard from several people was that preparing their order was difficult when the staff was unable for some reason to provide them with their weekly personalized shopping list. Another concern that surfaced for customers who typically did not walk through the store when picking up their orders was wondering whether they were missing out on new products stocked by the store or special offers that were not on the list provided by the store.

Finally, for those using Collect & Go™, we learned that they did not use the product catalog nearly as much as we had anticipated. Instead, it was their personalized shopping list that was the center of their process for creating an order and one of the main sources of saving time. If a customer’s personalized shopping list was unavailable for a week’s shopping, it was cause for major disappointment and frustration. One woman had created her order from till receipts; another man kept his own database to ensure he always had access to his personalized shopping list. The store staff confirmed this impression of the centrality of the personal shopping list.

Given these findings it was clear that to be successful, an e-grocery application would have to meet a high standard of convenience. It would need to be effortless and take very little time. It would have to be better than doing the shopping in the store yourself, and it would have to be better than the existing Collect & Go™ method of phoning or faxing in the order. Given the high familiarity of these technologies, we knew that delivering a successful application to these users on the unfamiliar Palm Pilot platform would be a challenge, to say the least. Would real grocery shoppers want anything to do with a strange handheld device for shopping?

**DESIGNING THE CLIENT**

One of the objectives of the project from the start was to capitalize on Safeway UK’s unique ability to generate personal shopping lists directly from logs of till transactions for loyalty card customers. Since these data were stored on a mainframe computer, the solution we developed had to encompass everything from the palmtop in the end-user’s hand to the store’s mainframe technology that tracked inventory and individual customer transactions.

**System Architecture**

An additional objective was to explore the potential for intelligent collaborative filtering based on data mining algorithms of customer transaction data [11]. This objective, coupled with the desire to insulate and protect the integrity of the mainframe transaction system, led to an architecture with servers interposed between the pervasive clients and the mainframe. One of these servers maintained the information extracted and generated for each customer in the program, and was responsible for synchronizing content on the palmtop device whenever the customer connected to submit an order.

**Device**

The particular device we were designing for was the Palm Pilot III. This has a 160x160 pixel display, black & white screen. The small screen size makes it hard to present much information on the display (about 30 characters per line) and interaction controls have to be minimal. The single bit of color depth means those graphical techniques such as depth cues and shading used to help people parse the screen are hard to render. Parsimonious use of screen real-estate is key to a successful design. The Palm operating system also has a somewhat limited set of UI components consisting of icons, forms, scrollable lists, dialog boxes and buttons. It was likely that these would have to be augmented to produce a satisfactory user experience in this domain.

**Solution and Design Rationale**

'Keep it simple' was the design mantra for this project, since our end-users clearly saw this task as a chore, and since some would be technologically naive. The goal was to produce an application that would reduce the time for creating and placing an order and that people could 'pick up and use' virtually without.

Figure 1 shows the design of the Easi-Order™ client application arrived at after much iteration and a field evaluation. The application uses a tab metaphor to organize shopping lists from which a customer can choose items to add to their order. There are five lists: a personalized shopping list, a list of items on special offer, a list of recommendations based on the customers past shopping habits, a list of items that customers can buy with Safeway loyalty points, and the customers current order. To help navigate through a potentially long list, an 'Index' is provided, as well as a 'Find' function. Customers can
also request items not on any of these lists by using a custom request form and keyboard. Once an order has been created, the customer attaches their PDA modem and phone line, and sends the order to the store. A customized dialog allows specification of the day and time the order will be picked up.

**Expanding tab control (Figure 1a):** Traditional Palm applications have a hierarchical structure. Users select a category from a dropdown list, causing a list of items to appear. But forcing users to traverse such a hierarchical structure merely to switch lists is overly cumbersome and tends to hide the overall structure of the application. We sought a metaphor that would allow rapid switching between lists. A tab metaphor is often used for such an interaction, each tab containing a text label to indicate its content. The Palm’s limited screen size makes the possible number of tabs with labels very small. Our solution was to create the expanding tab control [2]. In this control, tabs have both an icon and a label. When selected, a tab displays both. However when not selected, the tab appears in a collapsed form showing only its icon. Tabs expand in place and always appear in the same order. This allows users to readily learn tab placement in much the same way they learn menu placement [6]. Thus experienced users can readily navigate among tabs without having to pay attention to the icons.

**Primacy of personal list:** The first field study found that the personal shopping list attracted people to Collect & Go™, and was a key driver of their continued use of the service. Our design shifted away from its initial focus on an electronic catalog to a distinct emphasis on the personal list. Thus, the personal list is the first tab, and is shown when the application opens. The personal list became a central motif of the design, a conceptualization that both users and the design team used as a conceptual anchor [1].

**Multiple lists.** Although we could have combined lists for various types of items (personal list items, items on offer, recommendations, items that could be purchased with loyalty points) into one and used visual cues to distinguish different items, the categories of ‘Offers’ and ‘Points’ were already salient to our users. We chose to keep different lists separate. This allows people to look at just those lists that they are interested in. Someone who does not care about what’s available for ‘Points’ this week does not have to have their shopping list cluttered with that information. This decision was bolstered by the high-level design decision to make the personal list primary: by keeping the lists...
separate, the personal list remained “unpolluted” by other sorts of items.

**Familiar basket metaphor:** Our initial prototypes did not include an order screen. We worried that having two different places where ordered items appeared would be confusing to users. However, this was not a problem when we conducted informal tests. On the contrary, people felt uncomfortable not being able to see their order as a distinct entity before they committed to ‘Send’ it. Thus, we incorporated an ‘Order’ screen using the familiar basket metaphor used by many e-shopping web sites.

**No graffiti required.** From the outset we realized that requiring people to learn graffiti would be inappropriate. Our initial requirements gathering confirmed our intuitions that this application needed to be as simple as possible and be immediately usable with no training. Thus, the application requires no graffiti. Where users need to write, we provide a keyboard.

**FIELD STUDY 2: TESTING A RUNNING PROTOTYPE**

In December 1998, we went back to Safeway UK with a running prototype. We interviewed 12 of Safeway’s loyalty card customers. Each interview lasted from 45-95 minutes, and centered on informants creating and placing an order. To ensure that the experience we observed was as realistic as possible, we preloaded the application with each customer’s personal shopping list as would eventually be true of the deployed application. We also had them attach the modem and complete the sending of the order (to our server in New York, so that no groceries were actually ordered during the evaluation).

**Methodology**

Our method was to tell participants that we wanted them to create and place an order without assistance from the observers if possible. Thus, we did not give our informants any specific information about how to use the application before they started. We did provide them with a short explanatory card and let them know that if they were really stuck or frustrated that they could ask for assistance. We adopted this method in order to provide a stringent test of how well these users and the application could fend for themselves, and in order to maximize relevant feedback on ease of use. After all, most users would interact with the application in their own homes without technical support.

After our initial questions and instructions, we handed the informant a Palm Pilot and directed them to tap on the Easi-Order™ application icon. Then we sat back and watched as our informants attempted to create and place an order, encouraging them to talk out loud as they did so.

When they had finished placing an order, we probed any parts of the application they had not explored spontaneously by asking them to act out specific scenarios. For example, if their order had not included a write-in request, we would ask them to make one.

**Results**

The data and insights generated by the three days of field testing were enormously rich. Here we highlight a few of the findings that were critical for subsequent redesign.

**Parsing the screen.** Although we expected technologically naive users, we were still surprised by the difficulties many people had in basic interactions with the Palm: navigating lists, pressing buttons, etc. As we pondered the cause, we realized that the problems we were seeing were a result of users being unable to ‘parse’ the contents of the Palm screen. To these users, button and dialog box borders were essentially meaningless. They treated the screen as a flat sheet of paper. On seeing a modal dialog box, they did not perceive it as “on top” of an underlying screen or as something that to be dismissed, but instead would try to tap on objects outside of the box when they were done. This led to confusion when the device just beeped at them. Other users didn’t perceive the structure at the top of the screen as tabs. And yet others, even when they spent minutes searching the limited Palm display for a way to write a comment, did not tap the “Keyboard” button until we asked “do you see anything on the screen that might help you?”

The selective processing of screen content underscored for us how unfamiliar this technology really was for these users, and suggested a relatively high cognitive burden.

By the 8th or 9th participant, we had seen many behavioral patterns repeat, and our understanding of the major problem areas was becoming relatively stable. For the last 3 or 4 informants, then, we changed our procedure to test how a brief two-minute orientation to the application and hints on how to interpret the screen (e.g. “This is a button”) would affect the results. We were relieved to find that with this amount of ‘training’ people were much better able to proceed. Of course, people already familiar with technology fared quite well, and in one case a 4-year-old child who couldn’t read created an order while we wrapped up with his Mum!

**Perceiving boundaries.** Another problem that we observed frequently with users given no instruction was tangled errors that arose from a failure to appreciate the boundaries of the shopping application. Users frequently would use the silk-screened or hard buttons of the Palm to invoke application functionality or seek help and end up in the Palm OS without realizing they were “out” of the application we were asking them to use. Once this had occurred repeatedly, we put users back on the path by guiding them back into the shopping application.

**Order uncertainty.** Users had no difficulty figuring out how to add an item to the order. However, when we asked them directly after taking an ‘add item’ action whether or not the item had been added to their order, and if so, how did they know that to be true, most were at a loss. Some did try to confirm that the item had been added by navigating to the ‘Order’ list and showing us that the item was there. Others were satisfied to note that since there was a number next to the item, it had been ordered.
Using the keyboard. In writing in order requests, once we helped users to find the Palm keyboard, we found that it was too difficult to use. In particular the modal separation of numeric and alpha characters and the concomitant switching between them proved too difficult to use. We also found that people did not need all the characters available on the full Palm keyboard.

Tapping errors. Since personal shopping lists were long enough to cover many screens, our running prototype had several ways to navigate lists. One of these was on-screen ‘up’ and ‘down’ arrows that occurred within the list itself. We noticed that even when the Palm had been calibrated to the user, people had trouble hitting these arrows. They would often miss, bringing up the details for the item on the line that was adjacent to the scroll arrow.

Connecting the modem. We were prepared to see the worst when it came to understanding the need for and actually carrying out the connection of the modem to send the order. However, to our surprise, every single user was able to attach the modem to the Palm within seconds.

Unlike the software, the affordances of the industrial design were such that even the least experienced user just picked up the modem and snapped it onto the Palm.

REFINING THE CLIENT DESIGN FOR DEPLOYMENT

The field study results helped us to focus on the most crucial aspects of the application needing redesign. A particularly troublesome issue was how to address the inability of people to parse the screen. We did not believe the results called for a total redesign because we were impressed by how well people were able to use the application once they had had a brief explanation. We responded in two ways. First, we redesigned the wallet card from a list of task instruction steps to an annotated picture of the application that emphasized the structure of the screen. This card would eventually be placed inside the case of every device given to a customer. Second, we carefully recrafted the screen appearance to make it easier to parse. We made the tabs more visually distinct by making the selected tab outline thicker and changing the tab spacing. We changed all dialog boxes so that they either filled the whole screen, or at least obscured all screen content (except for the tabs, which provided context) so that users knew where they were and were less likely to get out of the application by mistake.

To further aid navigation and a sense of place, we increased the visual distinctiveness of each list by tagging items with an icon indicating their type (the same icon that is used in the tab area). For example, all items in the ‘Offers’ list have one icon next to them, items in ‘Points’ have a different icon, and so on. Items in the personal list have no icon next to them unless they are also on one of the other lists, a suggestion from our users, described later.

Considering the difficulty people had with write-in requests and the standard alpha-numeric split keyboard, we designed custom keyboards that combine alpha and numeric characters on the same screen. We eliminated the keyboard button on the request screen, and created a request screen with an integrated keyboard (Figure 1).

To provide better cues to confirm that an item had been added to the order, we carefully crafted coordinated audio/visual feedback. In the redesign, when an item is added to the order, the icon in the ‘Order’ tab flashes and an audio is played. This has the dual effect of providing immediate perceptual feedback that an item has been successfully added to the order, and of attracting the user’s attention to the ‘Order’ tab, thus enticing them to view the Order screen. We developed several versions of this coordinated design, softening the audio and playing with the timing of the audio and visual cues to ensure effective but non-intrusive feedback.

We addressed the difficulty people had in tapping on-screen targets such as the scroll arrows by increasing the tap-sensitive region around the arrows. Again, we had to iterate our design because of the tradeoff between a larger sensitive region around an icon and the sensitive region around neighboring tappable objects.

We also incorporated several suggestions from users garnered during the field study. The idea of marking items on the personal list that were also on Offer came from the users. This reinforces the importance of Offers to shoppers that we found in the initial field study. It also highlights the primacy of the personal list for users. We tagged items from other lists that were also in the personal list with an icon indicating which list they were from. This icon was the same as that shown in the tab region and on all items for that list.

FIELD STUDY 3: EVALUATING THE DEPLOYED APPLICATION

Easi-Order™ deployment began in February 1999. To date it has been deployed to 200 people who have placed over 1930 orders. Store staff briefed new customers on the application and ordering procedure when giving them their Palm Pilot preloaded with their personal shopping list.

People differ in how often they shop, 40% shop weekly, 30% bi-weekly and 30% monthly. Throughout the deployment we have been collecting data about the orders, the number of items ordered, time of order, etc. Three questionnaires have also been conducted: one collecting background information before a customer starts to use Easi-Order™, one after the first order is placed, and the third after several orders have been placed. In May, 1999 we went back to the UK and interviewed 13 of the customers who had been using Easi-Order™ for several months, and one of the Collect & Go™ staff. The methodology was similar to that of Field Study 2, revolving around asking people to bring their Palm Pilot and create an order while talking out loud and responding to questions and probes.

Results

In general we found an extremely high acceptance rate; only three out of the 200 people who started using Easi-Order™ had stopped at the time of our visit. We only know the reason for one of these dropouts. That person placed an
order, but when they turned up at the store to pick it up, it was not there. The staff had not been able to access the order due to a network service failure, and the customer dropped out of the program.

We also looked at the volume of calls to the support center. According to Safeway UK’s Chief Technology Officer, there have been very few calls to the support desk since program launch, and most of these have come from husbands who wanted to try Easi-Order™ themselves but hadn’t received the initial training. 14 out of 84 people who answered questionnaires after placing their first order said they had made a call to the Call Center. Examination of the Call Center logs show that only two of these calls concerned the operation of the client application.

To our surprise, people reported no problems using Easi-Order™ when placing their first order. Of the 84 people answering a questionnaire just after placing their first order, 92.9% said that they found it easier to use Easi-Order™ to place a Collect & Go™ order than the phone-based Collect & Go™. 66.7% said that it had changed the way they shop, the majority citing time savings and not having to make a shopping list as the major incentives to use Collect & Go™. We were told by the Safeway UK staff that the average phone call to place a Collect & Go™ order was 30 minutes, compared to a few minutes for Easi-Order™.

In general, the application has increased customer loyalty. One woman who said that previously she and her husband would decide which of the four major grocery stores in their area they would shop at said that now she “would never dream of going anywhere else.” Overall, there are a number of key elements that people seem to really like:

**Ease and speed of order placement.** Given that people thought of shopping as a chore, one of our design goals was to provide an application that allowed them to do their shopping in less time. Everyone we spoke to reported that it saved them considerable time, up to two hours per week. It took them less time to create and place an order than using the phone/fax based Collect & Go™. They also found it considerably easier than the phone/fax based Collect & Go™. In our user’s words: “It’s just obvious how to use it.”, “It’s so simple.”.

Several of the customers we spoke with reported that the application had had a significant beneficial effect on their life. One woman spoke about how she found herself eating much healthier food, and was now much more adventurous about food she prepared. She said that she and her husband had begun to cook together, consulting recipe books in order to generate their order for the week, and that this had transformed their eating habits. A man whose wife is housebound in a wheelchair told us the application was a “Goddess” for him.

**Focus on the personal shopping list.** The personal shopping list has remained a powerful idea. It was the unavailability of this list that had upset customers so greatly when using the phone/fax-based Collect & Go™, and the improved reliability of access to their personal shopping list is key Easi-Order™’s success. People base their shopping on this list; it’s generally where they start their shopping and they like the fact that this is the primary list in Easi-Order™. Our informants placed great value on the fact that it was their list and had not been ‘messed’ with by including other kinds of items.

**Access to offers:** In our early interviews of phone/fax based Collect & Go™ customers, there was some concern that they might be missing out on special offers. Users felt that they grew increasingly out of touch with the store (with respect to both promotions and new products) as they used Collect & Go™. This problem was directly addressed in Easi-Order™ by the inclusion of a list of items on special offer. Several of our informants told us that they planned their shopping around what was on ‘Offer’, and all took a look at the contents of the ‘Offers’ tab.

**Incremental order creation.** Easi-Order™ supports incremental order creation in that it always saves the state of the application, and content of the order even if the device gets turned off, or the user switches to another application. As soon as the device is turned back the user can resume ordering from where they left off. When asked in our second field trial if they anticipated creating their orders throughout the week people said they wouldn’t. However, when they actually used the device, people did create orders incrementally. In fact, most of the people we talked used Easi-Order™ in this way. One of the people we talked to said

“Well, J. being in a wheelchair, if she drops off to sleep, I can start compiling my shopping list for Thursday. If she’s having a bad day and she’s so sedated that she doesn’t want to do anything other than sit in the chair, I can go and do my compiling the shopping list. Late in the evenings, for instance, if I’m having a bad night with her, I can do my shopping list. That is at my convenience, not Safeway’s convenience... the paper system [phone-based Collect & Go™], like all paper it tends to be put in a place where you can do it, and at the last minute you’re trying to find it and you’re doing it, whereas with this, you know, I can carry it around with me basically. It’s always at hand.”

This way of using Easi-Order™ is confirmed by data from the questionnaire. Of the 84 people, 59.6% said that they added to their list throughout the week.

As with any design, we discovered many improvements that we could make; however, these were minor. People wanted to have their personal list reflect seasonality. They didn’t want to see seasonal items still on their list once the season was past, and when a season started, they wanted to see the items they bought last year at this season. People had a different expectation about what ‘Ideas’ should be. In particular they wanted to know about new products and to get ideas about meals. Basically the attitude we perceived was that people tend to buy the same items and brands unless they are incented to change.

**7.0 Conclusions**

This paper has explored a new paradigm for pervasive e-commerce applications. In particular, it has focused on the
design of Easi-Order™, a Palm application for home-ordering of grocery shopping. This is the first instance of an already expanding class of e-commerce applications that combine properties of pervasive devices, transaction software and personalization. Evaluation of Easi-Order™ following deployment to 200 customers showed that a carefully designed pervasive application, combined with an insightful service model can be highly successful. Easi-Order™ offers an alternative e-commerce paradigm to the more usual web-based approach. In developing this application, we have realized that a PDA application has several advantages over a web-based home ordering service. Firstly, PDAs are instant-on, unlike a PC, which takes considerable time to start-up. Secondly, a PDA is extremely mobile, so that users can do their shopping when and where it is most convenient. Thirdly, the limited graphics capabilities of a PDA application are not a problem for the grocery shopping domain, driven by repeat purchases. People know what they want to buy, so the role of browsing is curtailed. Fourthly, the continual save feature of PDA applications readily supports incremental order creation which users find convenient.

Our process in designing Easi-Order™ exemplifies the importance of a tight coupling between field work and design work. At the start of the project the importance of this tight coupling was not obvious to everyone involved. For example, we were asked ‘What (exactly) will you learn by talking to end users?’, and ‘How will talking to users change what you design?’. We knew that talking to users would be invaluable for informing our design work; for us it was a necessity rather than a luxury. But giving specific answers to these questions at the outset was impossible. The work presented here answers these questions. It shows how interleaving field work and iterative prototyping was critical, how it changed the entire focus of the application, and guided the creation of a simple, easily used application. Incorporating the rich perspective of real users and their contexts of use into our design process allowed us to understand and preserve the aspects of the service that made it most valuable.

8.0 ACKNOWLEDGEMENTS
We would like to thank Jeremy Wyman and Sue Stephens of Safeway, UK for all their help. We would also like to thank Marisa Viveros, project manager, for her comments and support.

9.0 REFERENCES