A Design Thinking Approach to Sustainable Inclusive Shopping Environments for Grocery Shoppers with Low Vision

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Donna Alcamo Saccutelli

Abstract

The seemingly simple daily life activity of grocery shopping could be an exhausting ordeal for people who are blind or have low vision. The objectives of this inclusive design research study were to ethnographically identify the barriers experienced by shoppers with low vision and to carry out participatory design of an inclusive solution to mitigate the situation. This report documents the four phases of the study – Discover; Define; Develop; and Disseminate. A demo prototype 'Shopping Buddy,' with the innovative idea of Universal Product Inclusive Code (UPiC) at its core, was designed to aid shoppers with low vision. The UPiC system will provide necessary product information to the shopper by leveraging existing data from the manufacturers' databases. Thus, the proposed solution is not just an assistive tool; it also includes ingredients for effecting systemic changes in the retail grocery ecosystem comprising the industry's Manufacturers, Distributors, Retailers and Consumers (MDRC). To make the benefits, and resulting inclusion, sustainable, recommendations regarding the UPiC are made to the MDRC, also addressing the needs of commercial viability. Such sustainable inclusive design will ultimately result in *curb cut* advantages for all shoppers, thereby enhancing sales and benefitting the Canadian economy.

Keywords: Low vision, Grocery shopping, Accessibility, Design Thinking, Inclusive Design, Ethnography, Participatory design, Inclusion, Sustainability, UPiC.

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1. Introduction

Shopping for groceries is a fundament activity of daily living that should be possible for everyone to do in a just society. Wheelchair ramps and accessible doorways are found at many shopping centers. Nevertheless, the way-showing planogram[1] design and shelf talkers[2] that are placed inside to help shoppers typically have signs too high overhead, which prevent individuals in wheelchairs from recognizing and accessing many products. Shoppers with visual impairments also struggle with seeing product labels, store signs and prices as well as obstacles in aisles. These common practices reduce the personal independence and the self-respect of people with disabilities[3] who must exert considerable energy and cognitive resources if they are to access desired items themselves. (Balabanis, Mitchell, Bruce, & Riefler, 2012, p. 485).

These barriers reveal a chasm in the retail sector and packaging world that are but one manifestation of a range of social problems thriving in a culture led by mass-market economic values. Envisioning technical solutions that will make shopping accessible and enjoyable for blind and partially sighted customers is not hard but implementation will require retailers to consider accessibility issues in their planning, to ask blind and partially sighted customers what works for them.

[1] Planograms are visual representations of a store's products or services. They are considered a tool for visual merchandising. It is a model that indicates the placement of retail products on shelves in order to maximize sales.
[2] A shelf talker is a small strip of horizontal paper, usually located below the product on the shelf that has the barcode / UPC, price of the item, name of the item, and weights and shipping and skew codes. Simple shelf talkers advertise sales, product improvements or new items. Despite their size these small displays are remarkable effective selling tools. Displays take many forms.
[3] Disability, here, is seen as a result of mismatch between individuals and their social and physical environment.

1.1 Personal motivation

During a class/group ethnography project in 2013, my team observed and documented the aging world around us noting changes in business, technology, society, culture, and policy. There was synergy between our observations and my professional background in graphic/package design, which led to the choice of accessible grocery shopping as a topic for my individual Major Research Project (MRP) in Inclusive Design.

Our group reviewed shopping environments and shopping competitors. We gathered current happenings, cutting-edge developments and latest accessibility news. We identified many non-inclusive retail practices and studied trends that could contribute to a more inclusive shopping arena. It was noteworthy that complementary shopping companies had virtually no standard convention that would make grocery shopping in multiple locations more predictable and, therefore, less confusing for all shoppers but especially for shoppers with low vision. Gathering knowledge about the complex areas involved in developing a solution and interactions among them, therefore, became the primary focus of this qualitative research study.

1.2 Design Challenge

The need to improve access to products and the information about them for shoppers with low vision in retail store environments is an inclusive design

challenge. This study addresses the above challenge and also the need for systemic changes in grocery industry ecosystems to eliminate many of the barriers faced by shoppers with low vision. It is based on the belief that information design can be a catalyst for inclusion. The Registered Graphic Designers Association of Ontario recognizes this and is partnering with the Government of Ontario Through the EnAbling Change Partnership Program[4], to raise awareness in the professional graphic design community and to help graphic designers and their clients meet the requirements of the Accessibility for Ontarians with Disabilities Act, (AODA), which aims to make Ontario accessible to people with disabilities in key areas of daily living by 2025.

An assumption underlying this study is that individuals with low vision deserve to enjoy full access to the shopping world around them; and, developing practical accessibility solutions for shoppers with low vision was the initial intent of this inclusive design research. However, while working with participants with low vision to develop a thorough understanding of the challenges they face, the systemic nature of the barriers in retail grocery environments became evident. Therefore, community collaboration and sustainability became the study's overarching goal, leading to the development and proposal of systemic solutions to the Manufacturers, Distributors, Retailers and Consumers (MDRC).

[4] http://designedgecanada.com/news/rgd-teams-up-with-ontario-government-on-enabling-partnership-program/

In terms of intended users, there are two categories: i) implementers - the MDRC - who must also benefit economically; and ii) all grocery shoppers who choose to use the system, who will benefit after the implementers act on the recommendations of this study.

1.3 Study Objectives

The objectives of this study are to expand an understanding of barriers facing the low vision shopper, which historically include challenges for cognition, and communication in retail settings. The study will:

1. Investigate barriers that currently exist within traditional retail grocery shopping environments.
2. Explore the cognitive, aesthetic and communication abilities of shoppers with low vision so that systems can be designed to assist them in receiving and decoding product/package information.
3. Create aids for shoppers with low vision, including seniors with diminishing vision, to help them navigate unfamiliar visual cues in grocery store aisles and find needed items on shelves with ease.
4. Explore pre-store/in-store options that use online services to help shoppers locate products within store aisles and also allow checkout to be inclusive and accessible.

5. Create a prototype of a variant of a UPC code for shelf talkers and packaging that could access product data via grocery stores LAN networks that currently exist and share selected data with consumers.
6. Demonstrate to grocers that accessibility solutions for low vision shoppers will also be a cost effective curb cut[5] assisting all shoppers.

1.4 Approach and methods

The research underlying this study was conducted following the interpretive epistemological tradition of "narrative inquiry" in qualitative research, where trustworthiness stems from *validation* of the reported observations, interpretations and generalizations by ongoing discourse among researchers rather than from *validity* of static properties of instruments and scores (Angen, 2000, p.387; Mishler, 1990, p.419.) This study accepts that trustworthiness in inclusive design research can be generated and validated by such ongoing discourse, as argued by by Mishler below:

> Rather than relying for their assessments on an investigator's adherence to formal rules or standardized procedures, skilled researchers depend on their tacit understanding of actual, situated practices in the field of inquiry. Validity claims are tested through the ongoing discourse among researchers, and, in this sense, scientific knowledge is socially constructed.
>
> (Mishler, 1990, p. 415)

[5] Curb cut metaphorically refers to how changes created to assist individuals with a disability turn out useful for all, similar to how the curb cut from the sidewalk to the street built for accommodating persons on wheelchair is used by skateboarders, rollerbladers, mothers with strollers, and so on.

For the emerging field of inclusive design, this has resonance, whereby in the process of discourse, observations, interpretations and generalizations, scientific knowledge can be socially constructed.

The design approach was based on the Design Thinking concepts of Empathy, Creativity and Rationality (Brown, 2008, 2014.) User requirements for the design were elicited from shoppers with low vision using *empathic* processes; several possible *creative* solutions were conceived; and a *rational* choice was made among them that took into consideration not only accessibility for the low vision shoppers but also sustainability of the solution for the corporate players in the system.

With regard to methodology, *applied ethnography*[6] was used in the initial stage of user requirements gathering to observe and interview shoppers with low vision while they were shopping, and *participatory design*[7] was used throughout the design exercise by involving the end users in all phases. As can be seen from the design research methods landscape (Sanders & Steppers, 2012) portrayed in Figure 1, applied ethnography and participatory design occur to the bottom and to the right of the grid, positioning this study as a *research-led design* exercise carried out with a *participatory mindset*.

[6] A methodology involving observation and interviewing of people in their natural situations to elicit their stated and unstated needs to mitigate a problem.
[7] A design methodology in which end users influence the outcome, by being involved in all stages of the design cycle.

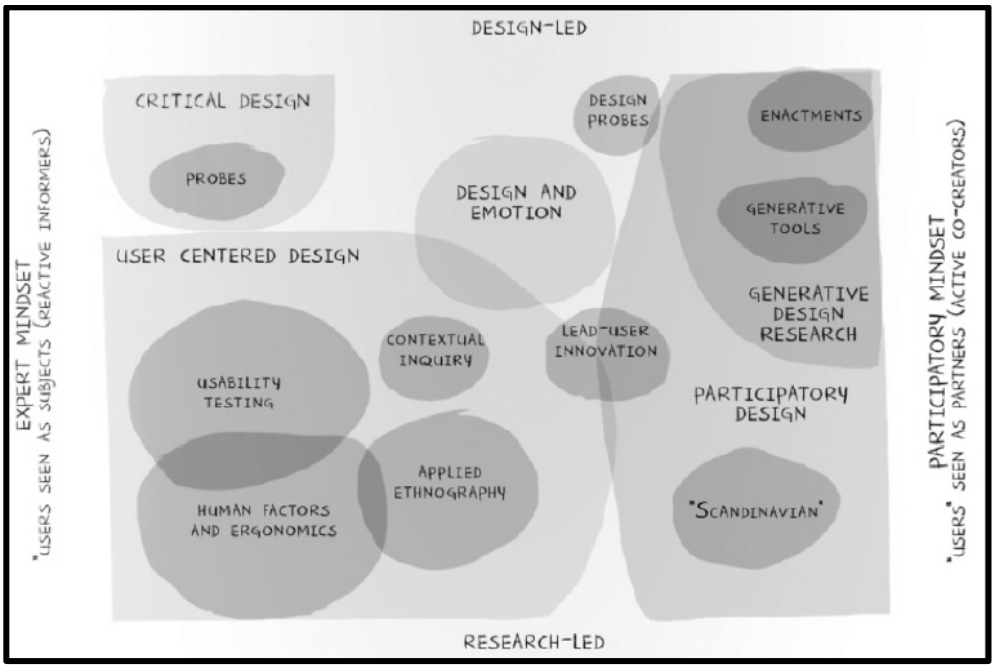

Figure 1: Design Research Methodologies Quadrangle

The study involved the following four phases:

1. Discover user needs,
2. Define user requirements,
3. Develop prototype solution,
4. Disseminate information to companies.

During the design process, community collaboration was identified as the essential driving force for ensuring sustainability of the inclusive design efforts.

1.5 Outcomes

A demo prototype of an assistive technology (AT) solution 'Shopping Buddy' that has at its core a Universal Product Inclusive Code (UPiC) was developed and evaluated. Recognizing the importance of sustainability to ensure continued benefits, the proposed solution transcends accessibility and proposes recommendations for meeting the needs of commercial viability in the MDRC chain to achieve sustainable inclusion in the retail grocery ecosystem.

1.6 Report Outline

Following this introductory section is a description of the conceptual framework upon which this research is grounded (Section 2). The design thinking methodologies and processes adopted are described thereafter in Section 3, followed by a discussion in Section 4 of the importance of sustainability in creating inclusive environments and the need for a holistic approach in design problem solving. Finally, in Section 5, the contributions made by this study are outlined, along with limitations experienced and future steps proposed.

2. Conceptual Grounding

This section presents key literature and related facts in four areas:

1. Living with low vision,
2. Grocery shopping environment,
3. Assistive shopping tools, and
4. Systemic aspects of inclusive design.

These discussions converge into a conceptual framework that guides the study.

2.1 Living with Low Vision

Over a billion people, about 15% of the world's population, have some form of disability.[8] The World Health Organization (WHO) defines disability as follows:

> Disability is an umbrella term covering impairments, activity limitations, and participation restrictions. Impairment is a problem in body function or structure; activity limitation is difficulty encountered by individuals in executing tasks or actions; participation restriction is a problem experienced by an individual in involvement in life situations. Disability is thus not just a health problem. It is a complex phenomenon reflecting an interaction between features of a person's body and features of the society in which he or she lives. Overcoming the difficulties faced by people with disabilities requires interventions to remove environmental and social barriers.

[8] http://www.who.int/topics/disabilities/en/

The 'World Population Ageing: 1950-2050[9]' report published by the United Nations in 2002 describes the increase in the aging of the world's population as *unprecedented, pervasive, and enduring.* As the population ages, one of the effects is that the number of people who have a disability, or require a degree of specialized access in some aspect of daily living, is consistently rising. Based on the current demographic data, the Ontario government forecasts that the number of seniors will "double from almost 2.1 million, or 15.2 per cent of population, in 2013 to over 4.5 million, or 25.5 per cent, by 2041. It is estimated that in 2017, for the first time, seniors will account for a larger share of the population than children aged 0 to 14." Today, more than 15% of Ontario residents have some form of disability; and as the population ages, the percentage will increase.

According to the World Health Organization (2010), there were 285 million blind and visually impaired people worldwide, 39 million of whom were considered legally blind and 246 million of whom had sufficiently low vision to be considered visually impaired. Of these, among individuals 50 years and older, 82% were blind. Although 90% of the visually impaired live in developing countries, visual impairment is common in developed countries as well (Pascolini & Mariotti, 2011.) The CNIB (formerly known as the Canadian National Institute for the Blind) states that every 12 minutes, someone in Canada begins to lose their eyesight[10].

[9] http://www.un.org/esa/population/publications/worldageing19502050
[10] http://www.cnib.ca/en/your-eyes/Pages/default.aspx

Lighthouse International, an organization dedicated to fighting vision loss through prevention, treatment and empowerment, estimates that around 3.9 million working age Americans have "difficulty seeing words and letters in ordinary newsprint even when wearing glasses or contact lenses[11]." Thus, the ubiquity of vision loss makes it very likely we all will know someone experiencing vision loss due to either a specific eye condition or one of the following common age-related conditions: glaucoma (tunnel vision in which side vision is lost and only central vision remains,) diabetic retinopathy (blurred or patchy vision,) cataracts (clouding of the lens inside the eye which leads to a decrease in vision,) and macular degeneration (loss of central vision whilst side vision remains.)

A diagnosis of low vision refers to a vision loss that affects the ability to perform every day activities such as recognizing faces, writing or reading a newspaper with corrective glasses on at a normal reading distance of 40 cm[12]. And since, reading is considered critical to full participation in modern society, the inability to read constitutes disability in industrialized societies (Chung, Mansfield & Legge, 1998.) Many older people have difficulty reading standard text, including medical information, hospital forms, and medication labels. People with low vision may only see people, shapes and objects if they are very close to them, and can read words and signs only if they are very large. Sometimes vision loss progresses

[11] http://www.lighthouse.org/research/statistics-on-vision-impairment/prevalence-of-vision-impairment/

[12] http://www.cnib.ca/en/your-eyes/eye-conditions/eye-doctor-1107/Documents/ResearchBook%20ENG%20(web).pdf

rapidly and a person suddenly has to give up driving and reading as they had before. Thus vision loss can be a trigger for depression as well[13].

The following is a list of key barriers that vision loss creates to accessibility. It is based on findings from a survey of the shopping experience of 150 blind and partially sighted people conducted by the Royal National Institute of Blind People, UK (RNIB, 2011):

- 79% said difficulty in navigating shops prevent shopping there again.
- 96% mentioned difficulty in reading signs.
- 95% had difficulty in reading labels.
- 73% found objects in aisles difficult to avoid.
- 89% asked if shop assistants would help by reading out bills.

2.2 Grocery Shopping Environment

Despite the foregoing description of the effects of vision loss, persons with comparable vision loss levels do not experience daily life activities such as shopping in similar ways. Research by Baker (2006) has shown that experiences are also determined by how shopping environments are designed. Baker conducted in-depth interviews with consumers with visual impairments regarding their retail experiences. Not all her participants expressed the same marketplace needs and

[13] http://www.cnib.ca/en/services/resources/Clearprint/Pages/default.aspx

concerns; thereby revealing differences within consumers with visual impairments. She concluded that:

> The retail servicescape can enhance a consumer's identity or help a consumer create or recreate their identity, it can also devalue it and contribute to consumer vulnerability. When symbolic elements of the servicescape signal certain customer types should not be there, who they are is not okay, they are incompetent, and/or they are not part of the in-group of shoppers, the servicescape communicates certain customer types are not normal…The outcome of this segmentation, intentional or not, is a repression of and a devaluing of the identities of certain groups of people.

Thus to improve how society works, thinks and relates is to become mindful and respectful of others' needs. A similar message is echoed on the website of the Canadian Optometrists Association (COP) that an ever-growing aging population (with increasing vision loss) is generating greater need for both understanding of vision loss and for adaptive technologies.[14]

With the intention of investigating the range and severity of barriers impeding shoppers who are blind or have low vision, Andreen (2005) completed a comparative observational study merging qualitative and quantitative approaches. He sought to record and quantify steps shoppers with low vision usually take when they approach obstacles to shopping. His core research question was, "What can a person who is blind do and what does she/he need help with?[15] Though he anticipated that navigation would be problematic, the blind used "not only sight but

[14] http://visionhealth.ca/

[15] http://www.anopic.com/jonas/jonasandreen/filer/groceryshopping.pdf

audition, haptics, smell, and awareness of flow and motion" to navigate the stores. Andreen concluded that if remediation must put weight on only one issue it should be to enrich sensations that involve sight alone. "Reading text on packages is impossible for the blind and no other sense can exchange that ability, they need to be labelled tactically or even with smell in order for the visually impaired to discriminate between them." Andreen interpreted his overall results to mean that tasks that involve "more senses than sight posed few obstacles and tasks that could only be accomplished with sight, such as reading expiration dates, posed major access barriers."

Andreen also interviewed his participants about the possibility of adapting a technology called, the glove, proposed for libraries by Lindberg (2002) to grocery shopping. The glove is a hand held camera linked to audio feedback that a user points "in the direction one wants information about and the system gives feedback through a pair of headphones about what lies in that direction." This process is repeated until the desired shelf is found, and the user can point at specific books to have information about them is played through the headphones thereby increasing a user's independence in a library. The participants gave mixed feedback about the glove. Three participants saw potential yet commented that since grocery stores have more new items than libraries, it would mean a lot of work for stores. A concern that many of the participants expressed was that "if only the price strip

below the products was marked one would never know for sure that you got the right product because sometimes items are in the wrong places and one participant noted "it would be hard to hold the cane in one hand, a basket in another and also have this glove on one of your hands – it would have to be very inconspicuous in order to work."

Other work on accessible grocery shopping includes guides for both retailers and consumers published in Britain by the RNIB. They describe current best practices for making shopping accessible to blind and low vision shoppers, most of which involve the assistance of a sighted person. For retailers there is an emphasis on staff training that is sensitive to the position of users who are experiencing vision loss and for consumers they stress alternatives to in store shopping such as internet, telephone and personal shopping assistance in stores who train their staff to be sensitive to low vision users needs.[16] Such compensatory strategies are perhaps a current reality, but a need to broadly raise the awareness of the difficulties inherent for shoppers with low vision and remediate them remains critical.

Rune Pettersson (2007) wrote extensively about how human sensory systems should be studied by designers. He advised them to become more cognizant of interactions among viewers sensory perception systems. Andreen's observation that his participants' senses intuitively compensated for one another is consistent

[16] https://www.rnib.org.uk/information-everyday-living/shopping and http://www.rnib-business.org.uk/our-courses

with Pettersson monograph, which states that it is through experience and knowledge that we acquire our perception of ourselves, the world around us, and our relationship to it. These experiences are assimilated through our senses: sight, hearing, taste, smell, and touch. Millions of simultaneous chemical reactions throughout the body allow us the ability to experience and interpret these sensations. What happens when we are void of one or more of these senses manifests the human drive for survival, our body's interactions encourage each remaining sense to become stronger.

One possible way to mitigate this situation is to provide a technological tool to assist shoppers with low vision make better use of the multi-sensory perception described above. Two such tools are described below.

2.3 Assistive Shopping Tools

Assistive Technology (AT) is specialized hardware or software that provides users with an alternative format for communication and information access. AT can be specialized software and/or hardware that is designed to be used by people with and without disabilities to adapt how specific tasks can be performed and are useful tools to support learning.[17] AT takes into account diverse ways of exchanging information and is relied upon to fill the gap between the user interface alternatives

[17] http://www.un.org/esa/socdev/enable/documents/execsumnomensa.doc

provided by the standard software and hardware and the alternative access needs of individuals with disabilities. [18]

Two studies that describe the development of in-store assistive tools in the form of grocery apps for low vision users are: Toward *Real-Time Grocery Detection for the Visually Impaired* by Winlock, Christiansen & Belongie (2010) and *Trinetra: Assistive Technologies for Grocery Shopping for the Blind* by Lanigan, Paulos, Williams et al (2007).

The Winlock et al study results from the continuation of the GrOCR project at the University of California SanDiego School of Computer Science and Engineering (UCSD_CSE) that developed a device, named GroZi, to assist visually impaired individuals to shop at their own convenience using computer vision technology including object recognition, sign reading and text to speech software. To use GroZi, a shopping list must be preloaded. In the store, the computer vision system read aisle signs and gives the user auditory feedback. The GroZi's object detection system constantly pans shelves to locate each item from the shopper's preloaded list. When it is located approximately, an audio or tactile alert is conveyed to the user. For example, using spatialized audio instructions, the device provides cues such as 'above,' 'below,' or 'top left.' Then it guides the user's hand to the product's precise location using object tracking. Once the blind user has his/her hand on the correct product, object detection software allows the GroZi to play another audio alert. The

[18] http://www.snow.idrc.ocad.ca/content/inclusive-technology

final stage is product confirmation, where either bar code scanning or detailed object recognition is used to check if the item chosen is correct or wrong. The accuracy is conveyed to the blind user using audio or speech synthesis. The intention, ingenuity and technical sophistication of this system is admirable but the authors acknowledge that running it in real time created processing speed issues and that it would only function if the training data (package images) was kept up-to-date. Based on current publications listed on the UCSD_CSE website, it appears that the researchers have moved away from development of the hand held visual recognition solution and are now focusing on text recognition apps. In addition to the technical barriers Winlock et al mention, the GroZi would require a shopper with low vision to carry a device that makes him or her stand out. Carrying a GroZi would not allow users to blend in with the other shoppers in a grocery store and thereby experience the positive self-esteem benefits of feeling included.

Trinetra, a solution by Lanigan et al (2006,) on the other hand, is a barcode-based solution using the Internet and an off the shelf Bluetooth-enabled cell phone with text-to-speech software as well as a commercial, portable barcode reader. One member of its development team, who was blind, wrote, “Products targeted specifically at blind people tend to be significantly more expensive than those for the sighted, and keeping costs down in assistive technologies is important to their adoption.” Trinetra is a three-tier distributed system using a BaracodaPencil or IDBlue pen, the Trinetra App on a cell phone and the Trinetra remote server as a

third tier. It is described as functioning well in a small cooperative grocery store in the vicinity of the Carnegie Mellon campus. However, its technology must communicate in real time with its proprietary server and the data in the server must be kept up to date in terms of the store inventory. Further development would require techniques for labeling and navigating RFID enriched stores and it appears the researchers have shifted their focus for the time being as they conclude "we intend to address other targets for assistive technologies for the blind – one of our immediate targets is to address and explore transportation needs for the blind by targeting the CMU campus shuttle."

As society's understanding of the impact of the low vision on daily activities is increasing, a plethora of technological advancements and audio adaptations have become the important developmental links for users with low vision. While assistive technologies have improved, there is still more room to grow.

2.4 Systemic aspects of inclusive design

More than 500 years ago, inclusive communication design began when Gutenberg published pages that opened access to knowledge that had been previously available to only a few of society's elite. That tradition continues. Today package/communication designers, move inside a medium that crosses cultures, education levels and geo-political boundaries. However, a chasm in communication/packaging design is revealed in the current marginalization of

shoppers with low vision, including seniors with diminishing vision, typically in grocery stores. Renewing designers' commitment to inclusiveness is necessary in this situation. A mission of inclusive design is to bring comprehensiveness and clarity in a cohesive manner to all content, contexts, environments and materials, no matter the substrate or delivery system.

Ideally, a package's design contributes to a positive interaction between a product and its consumer. To facilitate this interaction, the successful package designer will understand the audience's personality, values, attitudes, interests, and psychographics[19]. The inclusive design thinker considers psychographics to visualize and empathize with the consumers for whom they are designing, such as shoppers with low vision. The study of human perception, thinking, and learning provides inclusive package designers crucial insights into the needs of users. How individuals interpret and acquire new knowledge needs to be explored by investigating learning styles and cognitive processes. Design thinkers also need insight into the aging segment of the population. They need to gain understanding of human sensory systems and how this knowledge is essential to the advancement of accessible package design.

Demographic[20] information is also important as it guides inclusive designers' decisions on packaging size, cost and functionality. Potential solutions must not only

[19] Psychographics is the study of personality, values, opinions, attitudes, interests, and lifestyles of shoppers for increasing sales by improving their shopping experience.
[20] Demographic information related to details such as age, income, and education about a population.

meet the needs of all shoppers (those with and without special needs) but also meet the needs of the businesses that will bear the costs of implementing them. Thus the goal is for demographics together with psychographics to contribute to the development of inclusive one-size fits all creative retail shopping solutions that will benefit shoppers with low vision, including seniors with diminishing vision.

In the words of Evastina Bjork, a champion of Universal Design, "… there is the lack of sustainable thinking in planning and production, which has socio-economic consequences, as well as environmental implications" (2009, p.117). Similarly, in their study on accessibility of Self Service Terminals (SSTs), Petrie, Darzentas, and Power (2014) argue rightly that, "there needs to be cooperation between all stakeholders in the value chain of SSTs if accessibility problems are to be solved."

From the foregoing exploration of previous research and design reports in this area, the following points guided this study.

1. People with low vision face the following challenges:

- Keeping up with daily life activities.
- Reading standard text on signs and labels.
- Recognizing faces and objects unless they are very close.
- Price strip information should be on the product.

- Other senses tend to compensate for vision loss.

2. Assistive tools should be designed so as to

- Maintain the users' positive self esteem:
- Not be a hindrance to use along with canes.
- Not make users stand out.

3. Solutions must be sustainable, in that:

- They should not be abandoned once project funding is over.
- They should keep in mind the overall ecosystem.
- Benefits must reach beyond the immediate targeted user group.

2.5 Conceptual Framework

Based on the four areas of focus discussed above – people living with vision loss, grocery shipping environment, systemic aspects of inclusive design, and assistive shopping tools, – a framework, as depicted in Figure 2, was derived to signify a virtuous spiral of grocery shopping experience for all.

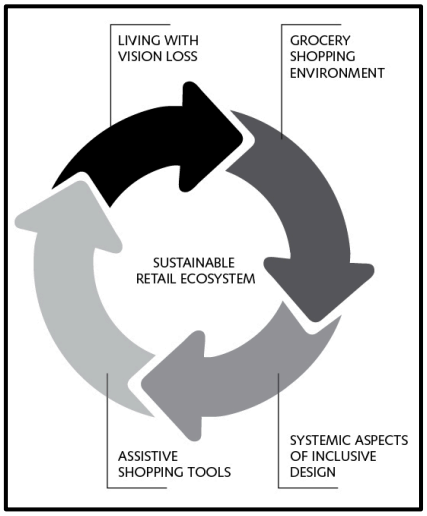

Figure 2: Conceptual Framework for a sustainable inclusive shopping system

The framework implies that by combining the experiences of *people living with vision loss* in *grocery shopping environments* with *systemic aspects of inclusive design*, effective *assistive shopping tools* could be designed for enhancing their shopping experience. Iterative evaluation and redesign of these tools could launch the shopping experience of people with low vision on a virtuous spiral. This framework guides the study design and implementation as described in the next section on Design Thinking Journey.

3. Design Thinking Journey

This research-led design exercise was based on two questions:

1. What gaps exist in information design for the low vision shopper to identify the products / packages in retail grocery stores?
2. How could shelf talkers assist in creating an autonomous shopping experience for low vision individuals?

The research protocol was formulated in an ethical manner and the approval of the OCAD University Research Ethics Board was obtained. Using a Design Thinking approach, the study was designed in five phases – Discover, Define, Develop, Deliver and Disseminate. These are enumerated in brief below and described subsequently.

Phase 1: Discover Needs

- Empathic exploration of the accessibility barriers for shoppers with low vision, including seniors with diminishing vision;
- Observations made during ethnographic shopping journeys of two participants and documentation of the inherent design challenges.

Phase 2: Define Requirements

- Systematic coding of the two ethnographic journeys;

- Clarification of accessibility barriers and identification of design variables to remove them;
- Generation of creative suggestions for the design of accessibility artifacts that would mitigate barriers;
- Rational choice of the UPiC idea, an App that will take data already exiting in the manufacturers' databases and make it available to shoppers, as the way to proceed;

Phase 3: Develop Solution

- Prototype design and development of the 'Shopping Buddy' artifact;
- Field testing with 'Shopping Buddy' through ethnographic shopping journeys with more participants;
- Refinement of the proposed UPiC as a sustainable inclusive solution;

Phase 4: Disseminate Information

- Sensitization of shopping executives through a presentation of the effectiveness of the prototype 'Shopping Buddy' app.

These phases are described in detail below.

3.1 Phase 1: Discover needs

An ethnographic approach to ascertaining user needs was adopted because it helps in eliciting their stated and unstated needs. Vijay Kumar, in his book *Design Methods*, reminds designers approaching new problems about the need to "extend our thinking to not only look for problems, but also to sense unstated needs" (Kumar, 2013, p. 90.) And, he emphasizes his point by recalling that Henry Ford is supposed to have said, "If I had asked people what they wanted, they would have said, faster horses." The lead users of this study were people who challenge today's retail system in ways beyond average mainstream users. Conducting ethnographic research with them helped in going beyond functional problem solving. The participant shoppers with low vision inspired creative design thinking and a drive for innovation within the grocery sector.

This phase represents the preliminary research that was done to establish parameters for this MRP. It was an inductive phase where the shopping experience of two low vision participants was observed using applied ethnographic method. Their shopping activities and interactions with produce, packaging objects, planograms, shelf talkers, way finding/assistive devices and paying options were documented using video taping, photography and note taking.

The results illustrated what was not working well in current shopping situations, how people with visual impairments interact with challenges to their daily shopping, and how those who don't give up work around the limitations. It

reports conversations with them about possible new products or services and includes a description of the developing relationships between the researcher and both the individual participants and retail participants. Reflections on the ethnographic journeys with the two participants are given below:

Participant 1:

Participant 1 is a male in his fifties. His loss of vision relates to Retinitis Pigmentosa, an inherited, degenerative eye disease that causes severe vision impairment. He is in good health.

Non-visual sensory inputs caused Participant 1 to notice the banging of carts upon entering the store, and then this input was stored and moved to his short-term memory. The brain had sufficiently rehearsed this action and there was an obvious mental processing in action called the feedback-loop. It entered his long-term memory where he stored this cart information and consequently retrieved it each time he enter this familiar turf. The theory of Miller's Magic Number[21] helped in identifying the limits of the capacity of each low vision shopper's short-term memory for processing information while shopping (Miller, 1956.)

Participant 1 chunked out his shopping route as he travelled the perimeter in his selection of products from a print and way-showing perspective. However, we observed that if a package grouped or chunked the name of the brand product, there

[21] The theory of Miller's Magic Number states that the number of objects an average human can hold in working memory is 7 ± 2.

was a greater level of retention made possible due to aesthetic and communication decisions that targeted various stages of the memory process of Participant 1.

The use of contrasts in type weight and size and color to attract immediate notice and separate the key hierarchal elements of the primary display panel, helped create associations with familiar objects to help the participant store the information and most likely repeat the purchase at an alternate time. This chunking of the graphic elements were very pronounced in weight and often solid in colour.

This is one way of providing the shopper with parsed, accessible chunks of product content for easy messaging. If we start to make the packages and shelf talkers easy to read and use, Miller's Magic Number can take complex information groups on the product display and store way-showing surfaces, and then all users will experience cross-barrier access, to locate, perform the selection and understand, and recall the product easily.

The process of breaking lengthy content into smaller chunks, utilizes information design to create continuity to link those product sections into a broader inclusive planogram message unit. Within the cognitive realm, the principles of proximity, similarity and prägnanz[22] seemed relevant while observing Participant 1's selection of products. He mentioned that the grid system of repetitive aisles is a barrier. The display stands are often placed in the middle of the aisles or obstructing

[22] 'Prägnanz' is the German word for 'pithiness', which means 'concise and meaningful'. It is an overall principle in Gestalt theory (a theory of the mind) that shows how we tend to complete shapes.

the right-of-way. He can use his short-term memory and recall his experiences with sight to understand that in-store overhead way-finding signs navigate you to the products and then the shelf talker's strips within the planograms give detailed information on the products slotted on the shelves.

Due to this cognitive process, he stored, retrieved and applied his in-store knowledge to navigate through the environment, thereby exercising in his long-term memory a sort of storage and retrieval of the store contents. This long-term memory was observed to work in both participants like a permanent product depository in which the information and items are stored and from where the participants behaviorally retrieve them when needed, based on the memory of their shopping routes.

Participant 2:

Participant 2 is a male in his fifties. His loss of vision relates to macular degeneration that led to a loss of central vision whilst peripheral vision remains. He is in good health.

The vision loss of Participant 2 was not advanced, and he was able to find the different zones easily because of the map that he had built in his memory due to being familiar with the store. He did not bump his cart while shopping and he found his way around faster; however, there were some barriers that may have prevented him from finding the right product once he reached the necessary zone. Some of the main barriers were due to print accessibility and good customer service practice.

The chunking of the graphic elements in weight and colour assisted Participant 2 to understand the package's Primary Display Panel (PDP.) This provided the shopper with parsed, accessible chunks of product content for easy messaging. In both Participants, it is clear we need to design packages and shelf talkers easy to read and again use Miller's Magic Number to take complex information groups on the PDP and store way- showing surfaces then all users will experience cross barrier access, to locate, perform the selection and understand, and recall the product easily. Participant 2 also felt intimidated by the aisles in the centre of the store. The grid system of repetitive aisles was a barrier to both participants.

The display stands were often placed in the middle of the aisles or obstructing the right-of-way. However within the one of the stores, the way-showing signs and shelf talkers were in black & white. The shelf talkers had a black chalkboard appearance. This made the print easy to read, as the pricing figures were large and reversed on black. In addition, the overhead way-finding signs were all similar in style, which made Participant 2 enjoy the navigation to some of the produce items.

Participant 2 reacted positively to aural cues within the shopping experience. This produced a type of way-finding so that navigation within the store's environment was more effective. Shiny packaging, various font types, sizes and colours, were difficult for Participant 2 to understand. Confusion existed and so the product was left behind on the shelf. However, packaging with high contrast colours

and tall, plain font types provided ease of identification, as did the weight and texture of the items.

What was evident is that not only location of the items is crucial to making the store accessible to the low vision user, but also the packaging employed by the manufacturers. This experience made it very clear that accessibility needs to permeate the entire grocery retail market. This Participant consistently used his magnifier.

3.2 Phase 2: Define requirements

The insights derived from the preliminary research and observations of first two participants' ethnographic journeys were mapped and related to design variables in a way that produced an Accessible Design Toolkit. Major repetitive barriers were observed in packaging, planograms, shelf talkers, wayfinding (obstacles in aisle), and in customer service variables. Some of the characteristics of packaging that improve accessibility for these shoppers with low vision were:

- Matte rather than gloss finishes,
- Bold photos,
- Clearly identifiable type hierarchies,
- Flush left text,
- Fonts with tall X height, and
- A 70% difference in colour value between type and background tones.

Themes developed from the coding of the observations were categorized under the following headings:

- Speculation,
- Verification,
- Concentration,
- Bumping,
- Apologies,
- Sensory Clues,
- Assistance, and
- Trust.

In terms of print accessibility, the priorities were identified as: Packaging, Shelf talkers, and Wayfinding

To enable effective customer curb cut, the design of a prototype with following criteria was decided upon: App, Ubiquitous device, and Wayshowing.

Current assistive technological assumptions were questioned partly because of the technological lag between them and mainstream artifacts such as smart phones. Design steps such as persona creation, scenario building, cognitive walkthrough, storyboarding, SAP foresight scenario building and consideration of affordances were undertaken. A preliminary design idea was selected from several brainstormed versions. It was a prototype “Shopping Buddy” that provided audible

readout of the information on a package. The prototype effectively communicated the talking package concept to both low vision and sighted shoppers as described in the next section.

3.3 Phase 3: Develop solution

This phase focused on integrating the concepts and artifacts of the enhanced Universal Product Code (UPC) into the synergic solution - a UPiC Code. The benefits of this UPiC Code, which is one of the main contributions of this study, are described in context in this section and the next.

A Universal Product Code (UPC) – see Figure 3 - is the black and white bar code on the side of a product, which is also often found in the price strip below the product in shopping aisles. In the retail grocery world, the printed strip is often referred to as a shelf talker although it appears silent to the customers. UPC codes have been used since the late 1970's for encoding standardized information for manufacturers and retailers throughout the world. Embedded in a UPC or EAN barcode are the numbers beneath it which can be read by the cash register scanner and linked to the product/price databases. Current UPC codes do not contain a reference to, for example, things like ingredients or allergens although that information will be elsewhere on the package. On the other hand a QR code, if on the package, will take the consumer to a website that allows access to detailed information about the product. A QR code gives, for example, a history of when pasta was made and shipped or when coffee was roasted, packaged and shipped.

This data already exits in the manufacturers' databases, and when it is added to the UPC barcode that merger will create a UPiC code proposed as a result of this research study – see Figure 4. The merger is created by tagging the information driven to the price strip that houses the UPC as we currently know it. The App will allow product descriptions to be read out to the shopper.

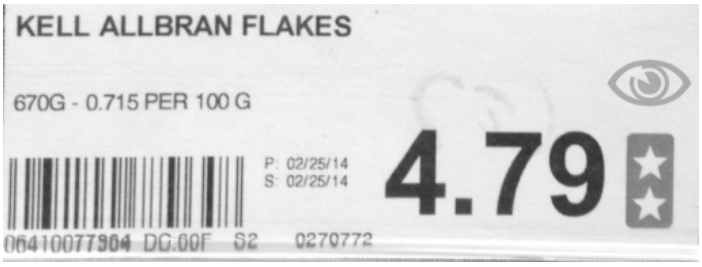

Figure 3 Universal Product Code (UPC)

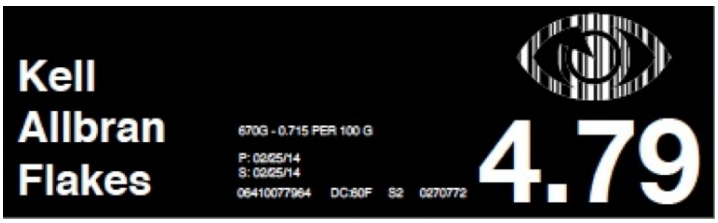

Figure 4: Universal Product inclusive Code (UPiC)

An inexpensive prototype was quickly created by recoding the Universal Product Code (UPC) packing information on an All Bran cereal box (see Figure 5) in a more inclusive manner as Universal Product inclusive Code (UPiC) and recording the information into the voice memo App on an iPod (see Figure 6.)

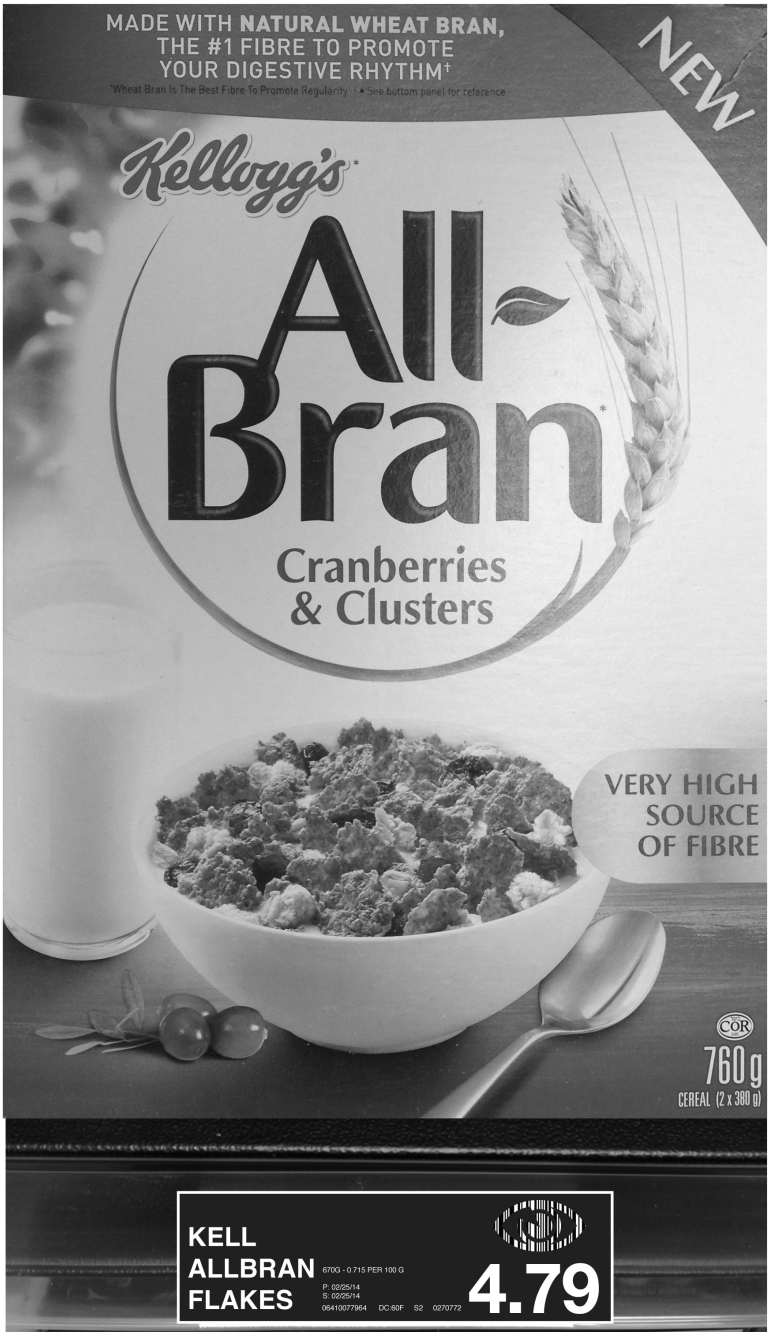

Figure 5: Cereal box with UPiC code

Figure 6: Shopping buddy.

The Shopping Buddy read out aloud the following information from the UPiC prototype cereal box:

- New Kelloggs All Bran Cereal (to make us know its not POST)
- Cranberries & Clusters
- Very high source of fibre
- Made with Natural Wheat Bran, The #1 Fibre to Promote Your Digestive Rhythm, Wheat Bran is the Best Fibre to Promote Regularity
- Symbol of the Council of Orthodox Rabbi's Kosher Approved
- Net weight – 760 grams of cereal and 2 bags of 380 grams each
- Image of a glass of milk
- Image of bowl of all bran cereal
- Image of branch of cranberries
- Image of tablespoon

Ten additional participants were brought in - a mix of shoppers with low vision and sighted shoppers who consented to wear glasses that mimicked visual impairments. Visual impairments experienced by the low vision shoppers were Bardet-Biedl syndrome (childhood-onset visual loss preceded by night blindness,) Leber congenital amaurosis (retina disorder causing difficulty with light perception,) and Retinopathy of Prematurity (abnormal blood vessel development in the retina of the eye in infants that are born too early.)

Eye conditions mimicked by the glasses were Glaucoma (tunnel vision in which side vision is lost and only central vision remains – see Figure 7,) Diabetic Retinopathy (blurred or patchy vision - see Figure 8,) and Macular Degeneration (loss of central vision whilst side vision remains – se Figure 9.)

Figure 7: Glaucoma simulator.

Figure 8: Diabetic retinopathy simulator.

Figure 9: Macular degeneration simulator.

The glasses assisted in building understanding of the consequences of low vision and empathy among the sighted participants. Wearing them challenged

lingering prior assumptions that grocery shopping is currently accessible for all that the sighted participants may have had.

When the participants arrived at the stores, the UPiC "Shopping Buddy" prototype was in place. Items they were to locate were not placed in difficult locations and participants were given ample preparatory instruction and coaching on how to use the system. A cognitive walkthrough was done to learn to what extent the order of audible and visual cues/prompts in the prototype was consistent with the way-showing navigation cues that people with low vision innately use to process way-showing cues from an environment, i.e. did it anticipated their "next steps" and lead toward an accessible retail system for shoppers with low vision? The participants found the test items within the grocery store and reported that they were at ease with the use of the UPiC prototype. It was a particularly insightful exercise for the sighted participants who had been unfamiliar with the need for improved accessibility within the retail sector and/or user-centric innovation. Thus, the cognitive walkthrough was successful.

The pathways used to observe the low vision and sighted shoppers involved making a list of the activities that would occur throughout the experience; interviewing the participants using talk out loud protocols to call out problems and pain points and extending journey mapping observations with additional layers of photos and audio clips. The sighted participants expressed surprise, disbelief and frustration regarding the barriers faced by shoppers with low vision in the retail

environments. Each respondent's commentaries are presented in turn. Empathy interviews with both the sighted and low vision shoppers brought forth the stories that were synthesized into a list of unanticipated needs.

The additional participant data led to some additions and clarifications of the of list themes developed in Phase 2. Sensory Clues category was subdivided into smell, hearing and visual, Four new categories were added: Joking, Gratitude, Conversation with the Researcher, and Explaining to the Researcher. Subsequently, all the records were checked for recurring themes to develop insights that would lead to increasingly comprehensive solutions.

3.4 Phase 4: Disseminate information

Sharing the potential benefits of the UPiC with grocery retailers was the next step toward having it become an artifact that would contribute to improved grocery store accessibility for low vision shoppers, including seniors with diminishing vision. During July 2014, a presentation was made to Loblaws® executives. Starting with a mapping of low vision shoppers' hypothetical journey, the narrative described not just the assistive solution proposed but how various UPiC concepts are going to add value during the low vision shopping journey. The shopping narrative translated this abstract UPiC system into a real human shopping experience that requires collaboration with the grocery industry to be implemented. The iPod prototype gave the executives the opportunity to hear the package surface while wearing simulator glasses. Suddenly there was an empathetic connect for the

Loblaws® executives with the shopper with low vision on emotional and experiential level in a way that all the metrics and diagrams or charts could not deliver.

Many grocery retailers today have customer service staff available as guides for shoppers. This practice has a cost to the retailer and simultaneously diminishes customers' independence and self respect. UPiC will encourage individuals with low vision, those who are hard of hearing and those with special dietary needs to shop more independently, more pleasantly and more often. Thus, early adopting retailers are likely to increase their market share.

Implementing UPiC requires collaboration between the manufacturers, distributers and retailers for their own benefit and the benefit of consumers. Through the UPiC system, shoppers will be able to find the information they require about products as well as the location of the products on shelves without staff assistance. The price strip will become able to talk about products to shoppers. UPiC coding will let manufacturers push much more valuable information about their products to consumers with minimal added cost as the UPiC code will source information from existing websites and databases. After the demonstration, Loblaws® executives appeared to recognize both the extent of current barriers in their stores and the UPiC value to them. It has the potential to become a curb cut in the retail grocery industry.

4. Towards sustainable inclusive environments

4.1 Moving beyond assistive tools

The empathic ethnographic journey with low vision participants revealed some of the physical, cognitive, social, cultural and emotional elements that drove the overall user experience. For the participants, a shopping trip was a constant cycle of speculation and verification. Constantly speculating where something might be, in which direction to turn, what words were on a sign or exactly what was inside a package. It was noteworthy that the participants depended significantly on clues from senses, other than sight, to assist with the verification process. The senses of touch, smell and hearing often assisted them. Constant speculation and verification requires great concentration. It is exhausting. While pushing a grocery cart, sighted users would not need to constantly speculate about their location, verify it and fear hitting unseen obstacles in aisles. Yet physical bumping of their carts was a common experience for shoppers with low vision.

More inclusive retail store designs would reduce the need for constant speculation and verification and increase the opportunities for shoppers to receive wayfinding clues from senses other vision. For example, the sound of water being sprayed on produce could confirm the location of that section and the smell of bread baking could identify the bakery (even if the yeast scent is piped in the way fast food outlets draw in passersby with the smell of burgers and fries). However, attitudes at

the corporate head offices of grocers need to be brought on board with inclusive design if even small adaptations are to be actualized.

During their shopping trips, participants engaged socially in a cycle of asking for assistance and trusting helpers. Participants who carried white canes said they had them not so much as a guide for walking, but rather, in their circumstances, to show when asking for assistance that their requests were socially appropriate. As a result, others shoppers and/or store staff were usually willing to help.

There is cultural norm that expects us to stay with our carts while grocery shopping, not leaving them in aisles where they could be an impediment to other shoppers. However, participants with low vision often left their buggies unattended when they went to ask for help. An accessible design would enable shoppers with low-vision to ask for assistance, without having to leave their buggies. Shopping carts could come equipped with a communication/locating device that would allow a shopper to talk to customer service staff from any location in the store. Culturally, those participants with low vision who seemed most comfortable in the digital world, i.e. who made fluent use of their iPhones and other devices, would probably opt for a communication device on their shopping cart while some others participants would likely have chosen an assistant if one was offered. Such solutions are reasonable easy to imagine once the barriers to inclusion have been observed and spoken about.

A retailer could also provide staff or volunteers to shop with people needing assistance throughout their journey during regularly scheduled hours. If high school students were allowed to complete their community service hours this way, the latter solution may initially be less costly for grocers to implement. It would also have the advantage of providing companionship for the shoppers with special needs. However, it does less than an AT solution in terms of supporting independence and self-respect.

As little as fifty years ago, many consumers were able to go to their closest grocery, drug or department store and find a known sales associate who would call them by name, perhaps inquire about their family and use other courtesies typical of personalized assistance. It was even customary for grocers to send personal holiday greeting cards. In such circumstances, many individuals with special needs could be accommodated. Today, only the most high-end apparel shopping services offer anything close to a personalized experience, and even then if pre-shopping occurs online it's rarely carried through to the retail environment. 23 In the intervening years, the escalating financial bottom line values has transformed typical grocery environments to varying flavors of mass market mechandising. Row upon row of similarly packaged items that are restocked by night shift workers or manufacturers reps who know only the products their company provides the supermarket. Few staff are present and fewer know exactly what the store sells and/or where to find

[23] Microsoft (2013). *The consumer decision journey: retail, Understanding consumer decision-making along the retail path to purchase*. (Microsoft Advertising Research Report). Retrieved March 15, 2013 from: http://advertising.microsoft.com/en-us/cl/4198/consumer-decision-journey-retail

it. Virtually nowhere today are customers greeted audibly by name in a way that would welcome shoppers with low vision.

Balabanis et al (2012) suggest that physical adaptations are not the primary barrier to the implementation of accessible design concepts in retail environments. There is a lack of understanding regarding the goals of accessible design and a misperception that accessible design is overly time consuming and cost prohibitive. Retailers' reluctance to spend is supported by both social values that stress the short term financial bottom line and ambiguity in the research literature concerning the definition of accessible environments. The confusion contributes to some companies' hesitation to invest the necessary resources to create accessibility. [24]

4.2 UPiC: Universal Product Inclusive Code

Designing barriers out of a system should be done with purpose. Inclusive Design has been called "design with a purpose" specifically toward greater inclusion and equity. It does not advocate specialized, segregated design to accommodate disability, but rather champions the design of products and systems that consider the needs of extreme users. The goal everywhere should be to "design for human diversity, social inclusion, and equality" (Design for All Europe[25], 2008.)

The UPiC shopping buddy system, described in sections 3.3 and 3.4 uses inclusive design features coupled with databases that are in existence to increase

[24] http://www.ittatc.org/technical/litreview/section1.php
[25] http://www.designforalleurope.org

the profitability of early adopters. This system can be layered into any store. Because UPiC codes will also be tagged to the stores planogram database, they will allow shoppers to locate an item, to understand the item and to select the item of their choice, thereby facilitating an autonomous shopping experience for most shoppers not only those with visual limitations. UPiC codes are able to augment and eventually replace UPC codes. UPiC is a method of information accessing and wayfinding that will decrease shopping frustrations at the same time that it increases customer independence, product knowledge and freedom of choice in a manner accessible to shoppers with low vision.

The current market is in an extreme push market. Producers and suppliers often spend up to 90% of their capital in marketing and commercialization, leaving very little for production and innovation. This makes it very difficult for new ideas to break into the market without a similar investment in commercialization and marketing. Most producers and suppliers are also competing for larger market shares, causing a winnowing of diversity of products. This means that products for the outliers, those with special needs, become more and more expensive at the same time that their group's spending power is decreasing due to barriers in employment.

That having been said, there are still persuasive, corporate profit motives for inclusive design. More than a billion people globally report having a disability. At least 2 billion additional people are friends and family of people with disabilities. Even though a disproportionate number of individuals with disabilities are living in

poverty, they still control a large amount of spending power. In the US, people with disabilities are estimated to control an aggregate annual income of $1 trillion. Add what is known about the aging demographic and its effects on increasing the incidence of disability and the resulting market share becomes powerful argument for the MDRC to seriously consider adding this curb-cut to their budget forecasts.

Because a capitalist economy is truly based upon competition and survival of the fittest, each competing company is not likely to be persuaded that they should, in isolation, adopt a policy that might put them at any disadvantage within their industry even if the policy would benefit society as a whole. Even companies that appear to be ethically motivated by adopting policies that align with the greater good, are frequently taking an ethical stance to improve their corporate image and thereby indirectly benefit their bottom line. In a competitive environment, a persuasive argument must articulate why adopting the plan will benefit the company in question and put them at a competitive advantage. One of the UPiC goals is to allow companies to better meet the needs of existing customers as well to help them to expand into a previously untapped market of shoppers with limited sight or hearing. Early adopters will leave the non-inclusive competition behind. Another advantage to adopting UPiC is that it will elevate a company's corporate social responsibility profile.

In a society that tends to equate good with normal and measures success in terms of a balance sheet calculation, empathy building demonstrations like the one

the Loblaws® executives participated in during Phase 4 are uncommon. However, data from this ethnographic study indicates that they can be effective tools for recommending to other inclusive designers to promote inclusive design initiatives. Treviranus (2014) states that simply raising awareness about accessible design will go a long way toward promoting the design of accessible products. The presentation at Loblaws® provided a platform for an inclusive designer to assist successful retailers in becoming more mindful of the barriers low vision shoppers face; it enhanced their understanding of human sensory systems at the same time that it presented a cost-effective technical solution to grocery industry situation that requires an accessible solution.

4.3 Sustainable and Inclusive

The Global Alliance on Accessible Technologies and Environments[26] (GAATES) state their Vision of Sustainable and Inclusive Universal Design on their website as: "a society of environments and products, that are designed for and usable by everyone, without need for adaption or accommodation; and of attitudes and policies that encourage the full integration of persons of all abilities."

The retail challenge concerns itself with the interpretation of human plurality. The UPiC product system signifies that diversity in abilities in the human condition is to be accommodated1. The UPiC App for low vision shoppers is a universal design that is linked to plurality, inclusion and self-respect at a societal

[26] http://gaates.org/about-gaates/gaates-vision-of-ud/

level as it employs inclusive design features coupled with databases that are in existence, to increase the profitability of early adopters2. It is a strategic system to promote respect for human dignity and acknowledges diversity in abilities amongst the retail citizens. "Plurality is the condition of human action because we are all the same, that is human, in such a way that nobody is ever the same as anyone else who ever lived, lives, or will live." Hannah Arendt (1998: 9) Due to this condition of plurality, there is a need to plan for diversity physically, socially and spatially. 5

The design of retail spaces should show respect for all the shoppers as equal citizens. This study recognizes that one of the tasks within the UPiC environment is to create and build habitable retail worlds for all shoppers. The UPiC system is an innovative concept not because the idea is new but because it is perceived to be new by the majority of stakeholders.6 The UPiC design is not to be perceived as "design for disability." The broader public has limited knowledge in the low vision shoppers' barriers and their interest in UPiC may be marginal because they do not see the relevance it has for them. Therefore, adopting the UPiC requires communicating the concept in a way that is relevant to everyone beyond the early adopter group so we are not just "preaching to the choir."

From an ethical perspective, the MDRC will promote and foster inclusion for low vision shoppers. The main challenge for the UPiC environment would be to take into account the whole range of human functioning. We often see the universal solutions for access to people with mobility impairments. The MDRC ecosystem’s

main challenge is mainstreaming the implementation of driving the data that already exists in the manufacturers' databases, and when added to the UPC barcode that merger will create a UPiC code. This retail implementation makes information accessible by creating a sustainable inclusive retail environment.

The strategic UPiC retail start up community needs to be created for effectively building an entrepreneurial retail ecosystem. For the benefactors of the start up UPiC shopping community to be effective they need to be inclusive partners and thinkers. These benefactors (MDRC) have a special role to play. They are literally the gatekeepers for this sustainable retail ecosystem. They must concur the gates are open and will remain so for information to truly be the catalyst for inclusion. These benefactors need to be inclusive of all the shopping members within this start up community who have chosen to become inclusive leaders. The successful retail startup communities must have porous boundaries (Feld, 2012). The information or data will be pushed and pulled from the MDRC community to the retailer and, ultimately, the end users. It is to be expected that there will be factions, but over time the short term benefit of the factions are often outweighed by the porous boundaries.

A continual shift is required from closed subsets of retail stakeholders to an inclusive set, in the form of an inclusive sustainable retail community. The MDRC participants will need to share a 'long range view' and embrace this inclusive sustainable retail community so the boundaries are stretched and accessible

information at capacity and each entrepreneurial member of these startup retail communities will be sustained as the boundaries embrace diversity within the shopping environments.

The UPiC Shopping Buddy relies on spoken interaction and, with a low vision shopper this remains the most effective means of human communication. The goal of UPiC is to frame the tagged package information that has the encoded manufacturers' / brand information. In its capacity as a medium for transforming meaning, speech will reveal the characteristics of the package and its content within the shopping culture. The UPiC thus becomes a type of flexible speech synthesis system that is completely reliant on an environment dependent ecosystem, which is the MDRC. The testing of the UPiC prototype was done in noisy store conditions, and the lead users listened intently as they concluded that the speech recognizers must be robust enough to handle these adverse conditions.

The UPiC appears to be a good candidate for "ambient intelligence (AMI,)" which is a vision for human centric environments and inclusive applications (Aghajan, Augusto & Delgado, 2009, p. 256.) The use of the UPiC Shopping Buddy displays clear potential for machine learning, whereas the development of practical methods of ambient intelligence and smart environments still remain a significant challenge. The Speech Synthesis System can produce pleasant sounds while maintaining the tagged information. This is a challenging but a necessary task for

the “ambient intelligent environment” that will store the MDRC data within the individual inclusive retail communities.

In an ambient intelligent environment that affords a fluid form of interactions between humans and a machine or ubiquitous device, information on where someone is looking for how long might play a prominent part. While gaze is important in social interactions, the UPiC system is driving the packaging data to the low vision user in an audible fashion. The methodology within this report looked at the interpretation of tagged information by observing the shopping activities of low vision and sighted shoppers with low vision simulator glasses.

The use of language that precisely describes the primary display panel of the package and its surrounding surfaces, symbols and icons uses its own phonemes. The content contains its own morphemes and maintains its own unique syntax. By developing this “sensory motor language” ((Aghajan, Augusto & Delgado, 2009, p. 96) we create an information bridge with an integrated hierarchal structure that will lead to a sustainable inclusive retail ecosystem that can lead to a successful MDRC business community over time.

5. Conclusion

5.1 Contributions

This study makes a twofold contribution to the field of inclusive design. To the first group of intended users – grocery shoppers with low vision and any one else who choose to use the system – it provides a way to access essential packaging information without having to carry any special adaptive device. To the second group of intended users – the MDRC – it provides an accessibility solution that will be cost effective for them to implement and, at the same time, increase their market share and benefit them economically.

One of the unique contributions of this design research study is the concept of Universal Product Inclusive Code (UPiC) underlying the Shopping Buddy tool designed to meet the functional and emotional needs of shoppers with low vision. UPiC foreshadows a labeling/packaging/wayfinding retail system that will improve the shopping experience of most shoppers. UPiC is not about the aesthetics of packaging. This inclusive design strategy will promote accessibility and foster social inclusion for low vision shoppers, ensure sustainability of the solutions based on it and will assist retail companies in increasing their market share in a socially responsible manner.

From an accessibility point of view, package designers' jobs have become increasingly complex in Ontario. They must provide Federally mandated information about products and meet the Ontario AODA requirements as well as adapt their designs to the trend being set by environmentally conscious consumers who want to see less packaging. These are among the reasons why a new larger print or a Braille system is not a practical solution to the low vision shoppers needs. Such modifications would be costly to implement and would not meet the needs of other shoppers, for example, hearing impaired shoppers. The UPiC solution provides a cross over where the information can also be audible. The UPiC will encouraged reduced packaging and be environmentally sustainable. It provides a response to an emerging trend as people age and is also a mindful consideration of people with special dietary requirements and many disabling conditions.

By enabling shoppers to retrieve information about products that may not be on the actual product package, the UPiC code will encourage manufacturers and retailers to create an enhanced shopping experience for all shoppers. As this technology unfolds, more applications will become evident and they will work for everyone who can use a cell phone. UPiC will create a retail business ecosystem that will bring the main stakeholders manufacturers, distributors, retailers and consumers_ the (MDRC) together. It will take information in the existing database(s) of the MDRC and drive it to the consumer - including the low vision shopper and others with special needs.

The UPiC would possibly fulfil a shopper's dream by helping them access from the packaging detailed information that they might need for making informed shopping choices. It will add value to the existing MDRC ecosystem that drives all its product information as well as special features of sales, product points and incentives, etc. The UPiC ecosystem requires collective agreement among the MDRC stakeholders to develop it as a strategy for inclusively designed shopping. The UPiC concept is an all round shopping buddy that will assist shoppers with allergies, dietary restrictions, and cultural preferences as well as those with low-vision. It could be layered into any store's App. It suggests a way in which a curb cut could be economically introduced into grocery shopping ecosystems to enhance the shopping experience of not just shoppers with low vision, but all shoppers who desire more information from the packaging; just as a curb cut on the sidewalk benefits not just users of wheelchair for whom it was designed but also other pedestrians such as parents with baby carriages, children on skateboards, and such.

5.2 Limitations and further steps

A primary premise of inclusive design is that we require the participation of the range of human diversity to enable the necessary creativity and innovation that will lead to designs that are inclusive of the full range of human diversity; and that this will benefit everyone. An important premise is that social inclusion will lead to operational, technical or design inclusion and vice versa. Another premise is that social and operational inclusion will lead to a virtuous cycle of innovation and

creativity, which feeds into greater inclusion. However, just as other inclusive design artifacts have met initial resistance, the most salient current obstacle to UPiC implementation is the failure of those with the power to make systemic change in the grocery industry see that it will benefit their industry to make system wide change. Therefore, next steps toward achieving more inclusive grocery shopping environments are: to reach out to the Canadian Packaging and Grocers associations; to ask to make presentations at their annual conferences; to plan demonstrations for larger numbers of powerful executives, similar to the successful presentation to Loblaws® in Phase 4. A key message in the presentations will be that when a design is made to work for both the main stream and those who are "differently-abled", innovation and creativity in design is enhanced. Cultural diversity results in faster growing and more productive cities and countries (Treviranus, 2013). The next big step now would be to make a critical mass of industry executives aware of both the need for the UPiC ecosystem and its cost-effective feasibility.

The organic linkage between sustainability and accessibility has been emphasized in previous research studies. Giraudy (2013, p.59) states that,

> Sustainability and Accessibility might be considered two sides of the same goal – socially aware and value-driven principles for human dignity and survival. However, they may need further understanding and study by designers, developers, builders, and owners, to ensure both are achieved concurrently.

Hopefully, this study was a step in that direction, with several more to come to solidify the path of sustainable inclusive design.

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