RETHINKING THE GROCERY STORE: INCLUSIVE WAYFINDING SYSTEM FOR VISUALLY IMPAIRED SHOPPERS IN GROCERY STORES

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Abstract: Many people with disabilities face considerable barriers while shopping in grocery stores. One such barrier is that they cannot find their way around easily, especially when they visit the grocery store for the first time and have not yet built a cognitive map in their memory. They may also experience delays in finding the right product or waiting for assistance from store employees, thus leading them to rely on family, friends, relatives, or volunteers to help them with their shopping. Problems start when these people are not available, in which case the individual is forced to cancel their visit to the grocery store and reschedule the trip.

Grocery stores include many different zones and services, the aisles area being one of the main barriers to access for people with different disabilities. This area features many different sections such as canned goods, dry packaged goods, spices, drinks and snacks, baking supplies, baby items, cereals, cleaning products, pet supplies, and health and beauty items. For visually impaired individuals, however, it can be hard to reach these various sections and find the relevant products. The objective of this research is to design an inclusive and innovative wayfinding system in grocery stores for visually impaired shoppers in order to help them find the center zone, orient between different aisles, decide where to go, move easily between different sections, and select products with ease. The research approach will be based on the literature review and the application of the Delphi method.

Abbreviation:

AODA: Accessibility for Ontarians with Disabilities Act, HCD: Human-Centered Design

LV: Low Vision, PL: Grocery Store Planner, VI: Visually Impaired, CNIB: Canadian National Institute for the Blind

Keywords: Grocery store, Wayfinding, visually impaired shoppers, vision impairment, accessibility, inclusive design, sensory environment.

Introduction

The use of self-serve grocery stores is very popular today, providing the consumer a range of product and cost choices, and ability to gauge quality to individual standards. The first self-serve grocery stores began to emerge in North America and Western Europe during the middle of the 20th century, and large self-serve supermarkets became common since the late 1960s (Humphrey, 1998; Shove & Southerton, 2000). In-store grocery shopping has emerged as a common personal task indicative of our ability to lead an independent, capable, and engaged life. Shopping in grocery stores however commonly requires the use of visual and physical abilities.

People who are visually impaired (VI) face considerable barriers while shopping in grocery stores. They cannot find their way around easily especially when they visit the grocery store for the first time and have not yet built a cognitive map of the grocery store environment. They may also experience difficulty in finding desired products or delays while waiting for assistance from store employees. This often leads to the reliance on family, friends, relatives, or volunteers to help them with their shopping. When such help is not available, they are forced to cancel their visit to the grocery store or reschedule the visit.

Some alternative shopping services, such as home delivery and online shopping are available for VI people. These services, however, are not

available everywhere and they require the shopper to place their order with the store and wait for delivery. Furthermore, anecdotal evidence shows that VI people would prefer to shop in person and enjoy the shopping experience of exploring the store.

Grocery stores are divided into different zones: a decompression zone, a front zone, a center zone, and a checkout zone. The most challenging zone for VI shoppers is the center zone with aisles as they are often challenged to shop independently in that zone even if they are familiar with the store. The aisle area consists of different types of aisles such as food aisles, cleaning aisles, and health and beauty aisles that have minimal visual or physical differentiation. In each aisle, there are many sections, and in each section, there are different types of products. The built environment in the center zone is not specifically designed to be accessible to shoppers with different abilities, and for this reason, VI shoppers often have difficulties orienting, navigating between the different aisles and sections.

The questions that naturally arise are the following: What then of VI people who want to do their shopping independently? How can we design an inclusive system to help them find their way around the grocery store independently? And what is the role of interior design in the solution of this problem?

Purpose of the Study

Although human beings are differently sized and abled, people with vision impairments are usually not considered when formulating designs for private commercial spaces that attract the public. Built environments are designed according to the size of the average person. A well-designed model is one that can enable all users to function easily and successfully within the environment and can be adopted by any business. Architects, designers, and other professionals should be encouraged to create inclusively designed environments that fit the needs of a diverse range of people, including people with disabilities (Advisory Committee on Accessibility, 2010).

The objective behind the research is to design an inclusive and innovative wayfinding system in grocery stores for VI shoppers in order to help them find the center zone, orient between the different aisles, decide where to go, move easily between the different sections, and select products with ease. The design proposes the following:

- Creating at least two sensory environments
- Applying Wayfinding cues for VI shoppers
- Adjusting current shelving systems and the physical environments that surround them

What is Wayfinding?

Wayfinding is a basic task in daily human activity where individuals navigate from one place to another in a built environment to reach the desired destination and to locate different zones and objects within a space. Wayfinding is the planning stage that precedes dynamic motion, where the navigation process is a combination of wayfinding (cognitive elements) and motion.

Spatial cognition relates to how people behave, navigate, and find their way in the space, while simple cognition is the mechanism of processing information in the brain; it varies from one person to another depending on mental function and intelligence. One element of cognition skills is spatial orientation, which is the ability to orient within a space in relation to other objects (Hajibabai, Delvar, Malek, & Frank, 2006).

Wayfinding is a process where the person behaves and orients within a built environment. It is the user's dynamic relation with space. Wayfinding is dynamic while spatial orientation is static. According to Passini and Aurthur (1992), wayfinding has three different processes:

1. Developing a plan and deciding where to go
2. Executing the plan moving to the right place
3. Processing information by understanding the perception of the environment

In order to accomplish that, the wayfinder should be able to,

1. Orient

2. Know their destination

3. Know which route to select for the new destination

4. Follow the route

5. Know when to reach the new destination

A good wayfinding system assists the wayfinder's decision-making process. Tools of good wayfinding are components designed to assist spatial orientation and cognitive mapping. These tools can help people with different cognitive skills, including:

- Cognitive-focused users who rely on maps and written directions

- Visually based learners who respond to landmarks, art, graphics, and colours

- People who respond to verbal communication when someone explains direction to another

All of these include diverse people with different abilities (Huelat, AAHID, ASID, & IIDA, 2007).

Wayfinding design principle

Wayfinding is a model that helps solve spatial problems in a built environment. The mental map is developed by the information gained by the built environment's cues. Wayfinding in a built environment can be developed by using a combination of the following:

1. Develop a simple layout that is easy for no-/low-vision users to memorize

2. Add acoustic characteristics to the space

3. Use colour and bright contrasts

4. Provide tactile information

5. Use of signage

6. Use audible signs to provide information by hearing

7. Use lighting to differentiate between areas

8. Use texture and tactile to help shoppers' find direction

The design shall include identifications and marked spaces; the spaces should be linked and grouped, and this experience should be communicated to the user. Signage, audible signage, colours, contrasts, light, acoustic characters, texture, and materials should follow the AODA standards in order to be accessible by VI shoppers. (limited, 2014)

Research Methods

This study employs two different approaches to answer the main research questions. The research approach will be based on the literature review and the application of the Delphi method. The literature review will focus on two central contexts. The first context consists of grocery store planning strategies for the aisle zone, accessibility, and wayfinding requirements within the building environment for VI people. The second context will focus on the science of LV and on how people who are affected by LV cope with their vision impairment, while the Delphi survey will be employed in the study to collect reliable information and enhance the effectiveness of the store planners and LV experts' decisions regarding the proposed design.

The aim of the Delphi survey is to determine which different themes should be included in the design to create an inclusive wayfinding system that will enhance VI shoppers' independent shopping experience. A successful wayfinding system should allow VI shoppers to (1) recognize the start points and end points of the shopping journey, (2) identify their location within the space, (3) recognize whether they are travelling in the right direction, (4) orient themselves within the building environment, (5) identify the destination upon arrival, and (6) escape safely in emergency situations (Innovation, 2007). Wayfinding criteria should include the following: (1) architectural clues, (2) graphic communication, (3) audible communication, and (4) tactile communication. Wayfinding cues, together with wayfinding design, give rise to a successful and inclusive grocery store wayfinding system (Innovation, 2007).

With the application of the principles of universal design, inclusive design can accommodate people with different disabilities. These principles include

(1) simple and intuitive use (comfort/appeal theme), (2) size and space for approach and use (accessibility), (3) low physical and vision efforts (convenience theme), (4) perceptible information and flexibility in use (legibility theme), and (5) tolerance for error (safety theme) (Innovation, 2007). Guidelines or accessibility building codes for people with vision impairment are unavailable for the grocery store building environment. Hence, the Delphi method will be suitable for gathering experts' opinions on the design process and testing the design for its capacity to meet the five different themes and to create an inclusive wayfinding system.

Moreover, the Delphi method will collect information from the PLs about the design limitations and will test whether the design features are applicable by grocery store organization or not.

Delphi Survey

This study will use a Delphi survey to gather experts' opinions on the design process (Gunaydin, n.d.). A Delphi survey is a technique for collecting reliable information from subject matter experts and promoting effective decisions. This technique presents groups of experts with a series of questions. These data are then compared and analyzed in order to develop a design.

This study will survey two groups of experts: (1) store planners and (2) LV specialists. Two surveys were developed, one for each of the expert areas, that would collect data from the experts about what physical features derived from the socio-ecological framework would address the five concepts for independent use of grocery stores by LV individuals relative to the other set of factors associated with their expertise. As such, LV experts addressed issues that linked individual factors of LV with physical environmental factors of shopping and store planners addressed issues that linked organizational factors of grocery stores with physical environmental factors of shopping. The survey, was provided in written format to the experts with follow-up interviews by phone or in person and utilized check-box, Likert scale answers along with open-ended answers.

A Delphi survey can include repeated iterations to achieve the required result. This study will include two rounds with two surveys, one for each group.

Round 1

In the first round of Delphi survey, LV experts have been asked very specific questions about grocery shopping for LV shoppers, the science of shopping and the science of vision, and recommendations about wayfinding cues for LV users. The PLs were asked to answer structured questions about what are the standards to design a grocery store, the science of shopping and shopping behaviour, and wayfinding cues and techniques that can be adopted in grocery stores building environment.

The answers to these questions will help to understand the needs of LV shoppers to shop independently in relation to the five main concepts that relate to the physical environmental factors; also, it will address the limitation in the design that relates to the organizational factors of the grocery store.

Round 2

The second round of Delphi survey will gather experts' comments and feedback about the preliminary design. Each participant will receive a copy of the design model, along with a second questionnaire intended to gather more detailed information. In this round, experts will make detailed clarifications and adjustments in order to come out with final recommendations (Chien Hsu, 2007).

Design Approach: Human-Centred Design (HCD)

The research considered HCD for the interior design model that will be used to create the wayfinding experience. HCD is about empathy and understanding people's tasks, goals, and ways to approach challenges. HCD can be used in the design of products, spaces, services, and systems. Physical environments give people cues on how to behave and feel; by

rethinking the design of any space, we can create an experience and provide cues for the user when interacting with his or her physical building environment. HCD is one of the methods for creating barrier-free spaces (Greenhouse & Semsie, n.d.).

Figure 1. Human-centered design.
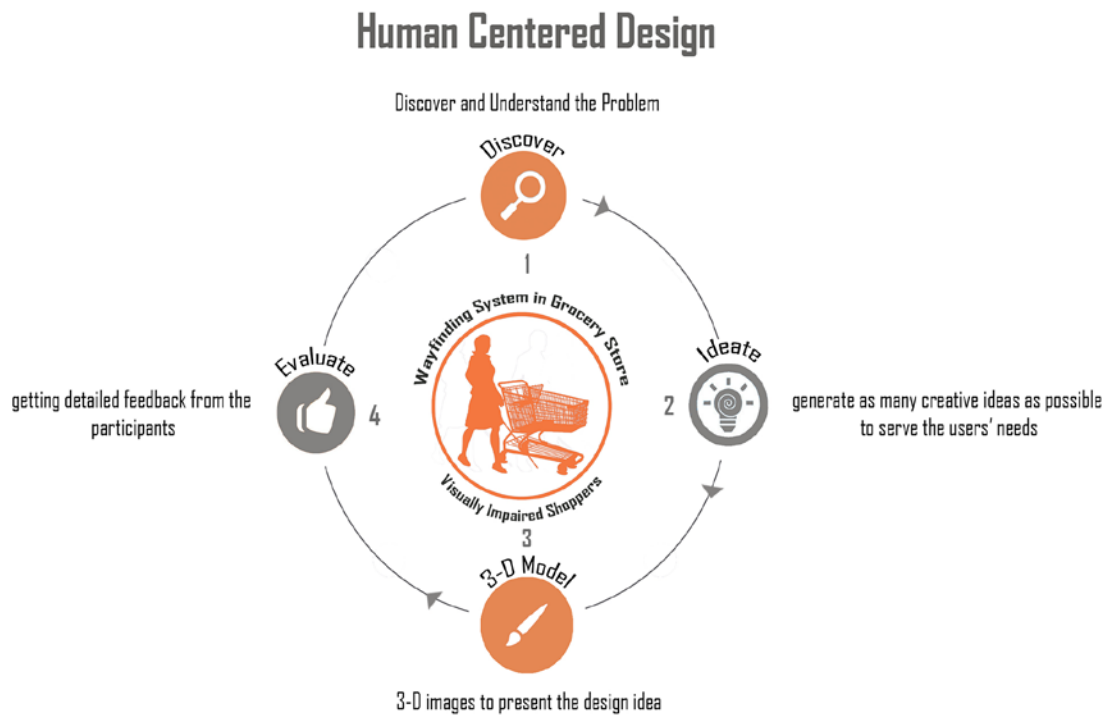
Design Process

HCD has different stages. For the research, the design process consists of four main stages: discovery, ideation, 3-D modeling, and evaluation.

Discovery. Different methods can be used to discover and understand problems, and these methods also have differing strengths and weaknesses. The ethnography has been developed from previous research (Khattab, 2015), literature reviews, Delphi surveys, and conversational interviews. These methods were used to understand users, their needs, the barriers they face, and the contexts and purposes they use the system for. These methods resulted in qualitative and quantitative data (Lindstrom & Malmsten, 2008).

Ideation. Ideation identifies the end users' needs and generates as many creative ideas as possible to serve these needs. The goal of the ideation phase of this research was to provide solutions to the problem presented in the first Delphi survey and to check whether or not the participants agree on the suggested ideas. After getting the participants' feedback, a 3-D model was presented to create better communication and to help in the final evaluation (Dorta, 2008).

3-D Modeling. Using 3-D images is a fast and efficient way to present a design idea; this approach will help participants make firm decisions about the design, give detailed feedback, and add different options.

Evaluation. The design model will be evaluated by getting detailed feedback from participants, LV experts, and PLs. The 3-D model will be submitted to both groups in the second Delphi survey to get their opinion about the design to decide whether the eight elements of design are applicable by grocery stores and whether this design will enhance VI shoppers' independent shopping experiences.

The essential elements of HCD are the consideration of appeal/comfort, accessibility, convenience, legibility, and safety for the users in the design model.

Appeal/comfort. "Appeal/comfort" will be used in this study to describe the physical and digital elements in building environments that provide visual and sensory appeal as well as comfort.

Accessibility. "Accessibility" for the physical environment is defined as the presence of zones that can be easily entered and exited (width, height, and spatial orientation), have reachable shelving (height, size, and locating the needed shelf), and have easily available wayfinding cues (location and usability). For the digital environment, "accessibility" refers to the customers' ease of identifying aisles, sections, and shelves by using digital factors including sound or light.

Convenience. "Convenience" relates to three factors: (1) the simplicity of the layout to navigate the center zone, (2) the minimal physical effort and

time required to locate the desired aisle, section, and product, and (3) the information can be accessed by LV individuals.

Legibility. Legibility in a space provides an understanding through helping create cognitive maps and wayfinding. Legibility relates to (1) perception (zone, aisles, and pathways), (2) usability of wayfinding cues in relation to users, and (3) intelligence of wayfinding cues.

Safety. The objective of the safety factor is to provide a secure environment for VI shoppers in grocery stores in the aisles area, and that will be achieved by removing all physical factors that may cause injuries while shopping due to unseen elements.

3D Wayfinding Model

The design proposes creating a dual-sensory environment that incorporates visual and haptic elements. For this dual-sensory environment, eight elements related to individual and organizational physical environmental factors for shoppers with VI will be presented. The wayfinding model consists of eight design features:

1. Aisle signage
2. Product signage
3. Metal transition stripes at the two ends of each aisle
4. Light-projected floor numbers
5. Coloured flags
6. Raised texts and numbers
7. Red clip to code products on sale
8. Clear pathways

Figure 2 presents the 3-D wayfinding model with these eight components. The image presents five aisles. The shelving system is gray, and the product signage and the shelves' skirting is white. In addition, it uses vertical metal dividers to create different sections in each aisle. The floor for this design is light gray colour in which it will create a colour contrast with the white skirt and the dark grey shelves, with stainless steel floor stripes at both ends of

the aisles. The lighting system consists of two types of lighting fixtures: general lighting fixtures and projected light (which will project the aisle's number on the floor when the grocery store identifies VI shoppers in the store). Also, an image for an existing grocery store will be presented to compare the design model to an existing grocery store model.

Figure 2. Center zone (aisles) with eight design features.

Figure 3. Center zone (aisles) for an existing grocery store.

Aisle Signage

The image presents aisles number 4 & 5 in white colour and green back ground. The products for aisle 4 displayed on the right side as it represents the international products (European, Caribbean, Asian, and soya products). While the products on aisle 5 are shampoo, hair colouring, and hairstyling products. Products` text are in white colour and black background.

Figure 4. Aisle signage.(Design feature 1)

Figure 5. Aisle signage for an existing store.

The image below presents the aisle signage for an existing grocery store. The signage is 300 cm above ground which is not accessible by VI shoppers.

The design proposes changes to the aisle signage by providing two numbers for each aisle; each number will identify the side of the aisle so it will be more convenient for the shoppers and VI shoppers to orient themselves and to know the products in relation to the aisle number. For example, if the VI shopper is passing in aisle 4, the aisle signage to the right side will show the aisle number (which is the number 4), and the types of products will be displayed on the right side of the aisle. The left side of the aisle's signage will not only show the aisle number (which is also the number 4) but also display the types of products on the left side of the aisle.

In addition, the design proposes changing the location of the signage to be over the end cap and within the eye level (180 cm [70 inch] to 220 cm [86 inch]). The aisle numbers will be displayed in white on a green background. The aisle text (types of products contained within each aisle) will be displayed in white on a black background.

Product Signage

Figure 6. Product's signage. (Design feature 2)

The image below presents the product signage in which it will be located over each section in the aisles area (black text with white back ground) with 30 degree angle towards the shopper`s sight line.

Figure 7. Products with no signage for an existing store.

The image below presents sections in the aisles area in an existing store. The sections have no signage in which it will be difficult for VI shoppers to recognize the sections and products.

The design proposes adding product signage over each section in each aisle, and this signage has an angle (30 degrees); the signage will be located at the top end of each aisle. The text will be in black, and the background will be in white. The product signage design and colour contrast will be effective for VI shoppers to find the needed section within the aisles area; also, the proposed angel will reduce the vision effort needed for VI shoppers.

Metal Transition Stripes

Figure 8. Metal transition stripes. (Design feature 3)

Figure 9. Center aisle floor in an existing store.

It is very important for VI shoppers to know when the aisle starts and ends. To aid VI shoppers, the design proposes using a metal transition stripes on the floor before entering and exiting from the aisles area, as per the 3-D image. The floor's metal transition will function as a haptic wayfinding cue and a haptic landmark. VI shoppers will feel the floor's metal transition by either stepping on it or moving their carts over it. This will serve as an indicator that they are entering or exiting the aisles' section.

Light-Projected Floor Numbers

Figure 10. Light-projected floor numbers. (Design feature 4)

The image presents a light projected floor number # 6 in white colour over grey flooring

The design proposes using ceiling light to project aisle numbers on the floor (digital element) as it will help VI shoppers identify which aisle they are in; also, it will provide accuracy in navigation. When a grocery store identifies that a VI shopper is in the store, a light from the ceiling will project numbers on the floor for each aisle so the shopper will get to know which aisle they

are in, and by that time, they will get to know what products are available in each aisle.

Using Flags to Colour-Code Sections and Products

Figure 11. Coloured flags. (Design feature 5)

The image below presents vertical flags (blue, yellow, green, and red colours) on the vertical dividers for the different sections in the aisles area.

Figure 12. Center aisles.

The image below present the beverage section in the aisles area in an existing grocery store. Different kind of beverages on a grey shelving system.

The design proposes using flags to colour-code the aisles and some sections. These flags will be on the vertical dividers of the shelving system and 2″ wide. Their purpose is to colour-code the products and aisles. For instance, baby blue flags are used in some sections to mark baby products in aisle number 6. International food will have different colours in the same aisle so when the shopper passes by different colours in the same section, he or she will get to know that the aisle presents international food.

Raised Text and Numbers

Figure 13. Raised text & numbers. (Design feature 6)

The image presents the shelf within the different sections in the aisles area with the blue flag and raised text (shampoo) .
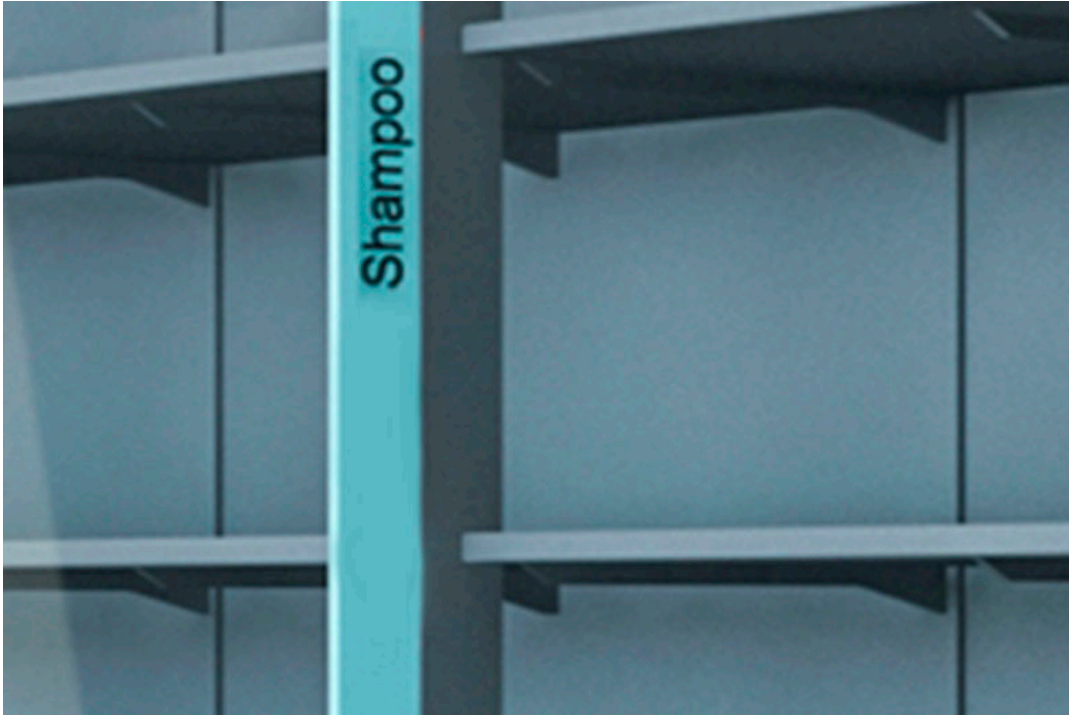

The design suggested adding the product's name and aisle number on the coloured flags beside each shelf; the print will also be raised to be convenient and legible for VI shoppers and will be depicted in the 3-D model. Also, it will work as a haptic wayfinding technique.

Coding products on sale

Figure14. Coding products on sale. (Design feature 7)

The image presents the shelf within the different sections in the aisles area with the blue flag and raised text (shampoo) and a red clip around the text to code products on sale.
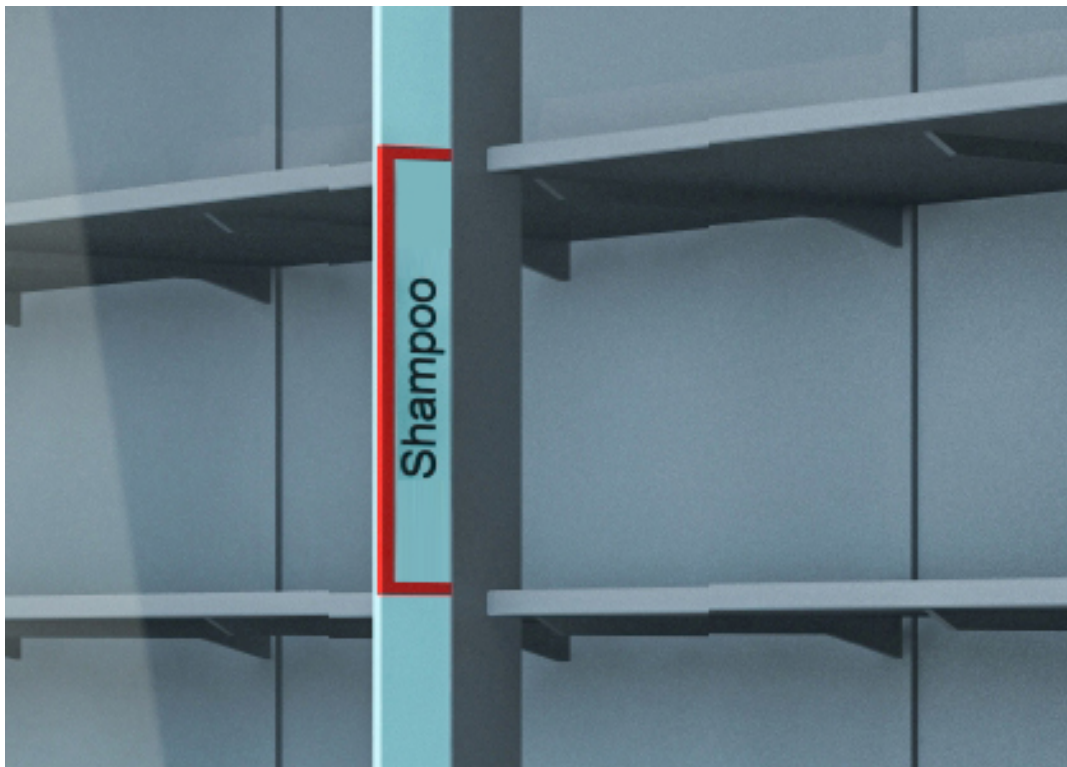
VI shoppers are not able to find the products on sale easily; the design model suggests designing a red clip to be clipped on the coloured flag beside the shelf that has products on sale.
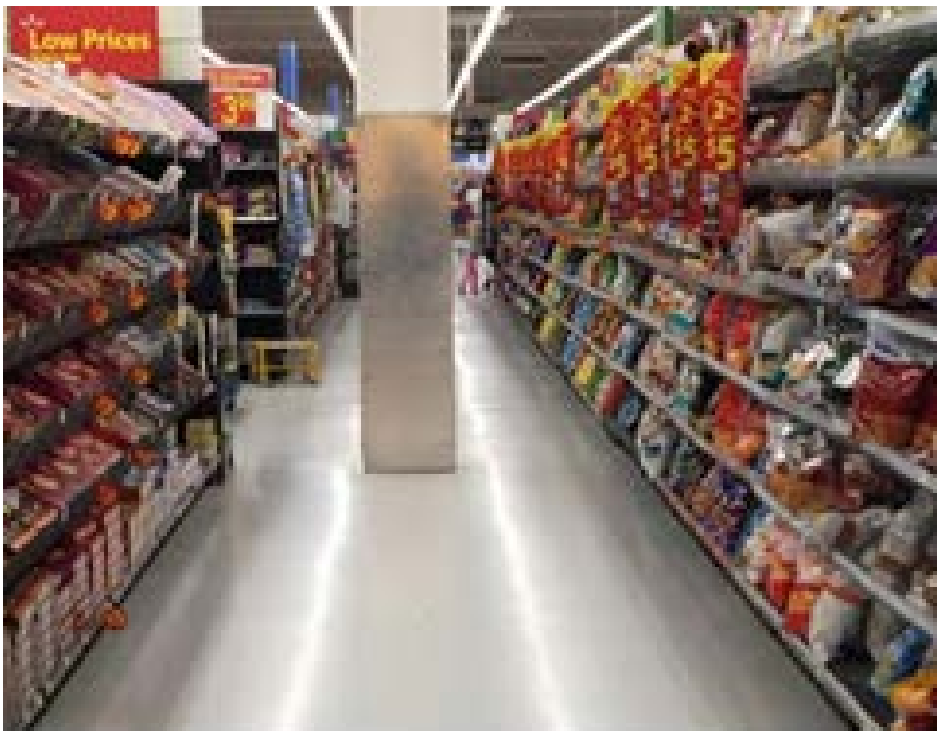
Removing the freestanding displays and columns

Figure 14. Clear pathways. (Design feature 7)

Figure 15. Column in a middle of the Pathway.

Structural column in the middle of the pathway in an existing store.

Safety is one of the main factors that should be considered while designing the building environment. Most grocery stores use freestanding displays in the pathways between different aisles or have a structural column in the middle of the pathway; as per a previous ethnography to a VI shopper doing the grocery shopping, the shopper bumped the cart many times on freestanding displays, and that made him feel unsafe in his shopping journey. Providing clear pathways with no freestanding displays or columns in the shopper's pathway in the aisles is very important.

The 3-D wayfinding model that incorporates the eight different components will be assessed by the two groups of experts in the second Delphi survey. This survey will aid in checking whether the suggested changes will enhance the shopping experience for VI shoppers and if these elements are applicable by grocery store organizations.

Results

PLs and LV experts have agreed on six design features out of eight that would improve the shopping experience for LV shoppers: (1) aisle signage, (2) product signage, (3) light-projected floor numbers, (4) raised text, (5) coding products on sale using red clips, and (6) removing all freestanding elements in the center aisles. Both group of experts did not agree on using (7) metal transition stripes (8) and coloured flags.

Aisle Signage: Removing All Freestanding and Fixed Elements from the Pathways

Both sets of experts have agreed that aisle signage and removing all freestanding and fixed elements from the pathways in the center aisles are the most effective features in relation to the five main themes: (1) appeal/comfort, (2) accessibility, (3) convenience, (4) legibility, and (5) safety. PLs have agreed that the aisle signage design feature is highly applicable by grocery store organization; also, LV experts have ensured that the design feature is usable for different shoppers with different vision impairment. Both experts have agreed that removing the freestanding displays and the fixed elements (columns) from the aisles area would

increase the safety factor for all shoppers especially when they need to escape for emergency issue, PLs' main concern is that they use the freestanding displays to display product's on sale and removing them may affect their profit.

Product Signage

PLs agreed that product signage design and colour contrast will be really effective for finding the needed section within the aisles area; also, they ensured that the proposed angle will reduce the vision effort needed for VI shoppers. Michael Farquhar from Loblaws stated, "Product signage will block the light from hitting products on shelves making it harder to see for all." Gordon Legge (LV expert) suggested to use bright letters on black background since it will be more accessible to read for shoppers with advanced cataracts.

Metal Transition Strips

PLs did not agree on the metal transition strips. Dan Philip is the only PL who strongly agreed on this design feature, and he mentioned that this element would work as a wayfinding cue to identify the two ends of the center zone. It also would work as a haptic wayfinding landmark. Moreover, it would not affect the legibility of the shopping experience for the general shoppers. According to Gordon Legge (LV expert), "VI shoppers are able to read the aisle signage, and this feature will identify the two the ends of the aisle without the haptic stripe, but this strip may be helpful for blind and severely VI shoppers, but it is narrow enough that it might be missed." The metal strip is a feature that may be considered or redesigned to enhance the shopping experience for blind shoppers, which is a population that was not considered in the original design.

Light-Projected Floor Numbers

Both group of experts agreed that the light-projected floor numbers will help VI shoppers identify which aisle they are in; also, it will provide accuracy in navigation. Three LV experts agreed that this design feature will serve all types of shoppers with different vision impairment.

Coloured Flags to Code Sections and Products

David Yehuda and Dan Philip (PLs) did not agree on using coloured flags to code sections and products. Yehuda mentioned that this design feature might annoy the general shoppers. On the other hand, Gordon Legge, who is a LV expert and a specialist in wayfinding, stated "These flags may be useful as a landmark for shoppers who become familiar with them, but we have to keep in mind that many VI people do not have good color discrimination." Sumreen Siddiqui, a LV expert from the CNIB stated, "It's important for the proposed flags to be in bright colours, as these will be much easier for people with visual impairments to see. Light coloured flags may be missed altogether."

Raised Text as a Design Feature

Both groups have agreed on using raised text as a design feature, but Gordon Legge was concerned about this design feature and stated that "this design feature will require reading vertical text, and this may be effortful for VI shoppers and may require more time."

Finally, Lawrence Polyner, a PL, stated the following, "Grocery resets are one of the biggest obstacles for a VI customer. The aisle signage, colored flags, and product signage are excellent solutions to keep this VI customer independent, but these elements would need to be designed to be flexible to ensure that the grocery could easily and accurately relocate 'inserts' or flags when their business model changes and they are required to do some type of reset. Also, I don't feel that completely removing cross merchandising (freestanding displays) opportunity via spot merchandisers is the answer. They could be reduced and placed in locations that allow adequate flow but I believe that they too could be signed correctly."

Conclusion and Recommendations

In conclusion, wayfinding is about effective communication, and it relies on successful communication cues delivered to our sensory system. Wayfinding is the ability to know where you are, where you are heading, how to reach your destination, and how to find your way independently and safely. The effectiveness of the wayfinding system is measured by the users' experience in the environment and how they communicate with the cues that take them from A to B (Innovation, 2007). The wayfinding system should provide comfort, accessibility, convenience, legibility, and safety for the user. According to Innovation's (2007) table, a successful wayfinding system should provide information for users to:

Table 1: Inclusive wayfinding system

Inclusive Wayfinding System Should Provide Information for Users	Design Feature
1. The start and finish of the wayfinding journey	Metal transition strips and aisle signage
2. Identify their location	Aisle signage, light-projected floor numbers, and product signage
3. Ensure they are travelling in the right direction	Aisle signage and light-projected floor numbers
4. Orient themselves within the space	Aisle signage, light-projected floor numbers, product signage, and metal transition strips
5. Identify their destination on arrival	Product signage and raised text
6. Escape safely in an emergency	Remove all freestanding and fixed elements

Providing proper accommodations for a group of customers (VI shoppers) not only conforms to inclusive design principles, but it will improve the quality of life for people with vision impairment and will enhance the legibility general shoppers' shopping experience. When the grocery store building environment is designed with reasonable consideration of people with vision impairments' needs, it will provide equal rights and opportunities for everyone to access their facilities and services. Removing barriers makes good business sense to the service provider. Based on the Delphi study and

the literature review, the study proposes the following recommendations be adopted by grocery store organisations in the centre zone to accommodate the needs of VI shoppers: the layout, aisle signage, product signage, haptic landmarks, light-projected floor lights, raised text and numbers, coding products on sale, and removing the freestanding displays and columns.

Grocery Store Building Environment (Center Aisles)

This research study supports that a combination of the following design principles will support the wayfinding system for LV people in grocery stores and other aisle-based spaces, such as libraries, retail stores, convenience stores, and pharmacies.

Layout

The circulation system is the key organising element in a building for people to build a mental map of the space. The center zone (aisles area) layout in grocery store should be simple enough to be memorised by VI shoppers. Grocery store experts have agreed that the grid layout will provide wayfinding comfort and ease for VI shoppers, and grocery stores should maintain the grid layout for the center zone.

Aisle Signage

It is recommended to redesign the aisle signage by providing two numbers for each aisle; each number will identify the side of the aisle so it will be more convenient for the shoppers and VI shoppers to orient themselves and to know the products in relation to the aisle number. In addition, it is recommended to change the location of the signage to be over the end cap and within the eye level (180 cm [70 inch] to 220 cm [86 inch]). The colour of numbers, text, and backgrounds should follow the AODA regulation in terms of colour contrast. Colour contrast should be at least 70% between the text colour and its background.

Product Signage

Product signage should be added over each section in each aisle. This signage should have an angle of 30 degrees because it would be more convenient for VI shoppers to read the information. The signage should be located at the top end of each aisle with the text in black or with bright letters with a dark background in order to accommodate different shoppers with different vision impairment.

Haptic Landmarks (both ends of the aisle)

It is important for VI persons to know where the aisle starts and ends. To aid VI persons, it is recommended to use floor stripes, floor grooving, or different floor material because it will work as a haptic wayfinding cue and a haptic landmark. VI people will feel the floor haptic mark by either stepping on it or moving their carts over it. This will serve as an indicator that they are entering or exiting the aisle section.

Light-Projected Floor Numbers

It is recommended to use light-projected floor numbers to identify the different aisles. Different coloured lights can be used depending on the floor colour. A light from the ceiling will project numbers on the floor for each aisle, so the shopper will learn to know which aisle they are on. In time, they will get to know what products are available on each aisle.

Raised Text and Numbers

The benefit of using raised text is it will increase the convenience and legibility in the shopping journey. The raised text will help the VI shopper identify and confirm the different types of products for each shelf. It will also enable touch reading for shoppers who are blind and touch enhancement for shoppers who are VI. It is recommended to position the text horizontally, not vertically, to be more convenient for VI shoppers.

Coding Products on Sale

VI shoppers can use a barcode reader to know if the product they are planning to buy is on sale, but this reader will not help them with unplanned and impulsive purchases. Using a red clip to code products on sale is one way to enhance the impulsive and unplanned purchase decisions.

Remove the Freestanding Displays and Columns

Safety is a main factor that should be considered when designing the building environment. Most grocery stores use freestanding displays (cross merchandise) in the pathways between different aisles or have structural columns in the middle of the pathway. VI shoppers and blind shoppers may bump their carts into the freestanding displays and columns. It is not safe for emergency escapes for all shoppers.

Limitations and Future Research

The findings of this study were based on the literature review and two rounds of Delphi survey, according to C. C. Hsu and B. A. Sandford (2007). Ten to 15 subjects will be sufficient for the Delphi survey, but most Delphi studies have used 15 to 20 participants. In future studies, it is recommended to involve a larger group of experts in the study or to use a new research method. It is recommended to use more statistical power in analyzing the data. It is also recommended to test the design model with different shoppers who have different types of vision impairments. Finally, empirical research is recommended for future study; empirical research by using a mock-up in actual spaces will facilitate and support the decision-making process.

Finally, the purpose of the study is to provide an inclusive wayfinding system that aims to remove all of the barriers that create unreasonable effort and separation. An inclusive design should enable people with different disabilities to participate independently in everyday activities.

Acknowledgements

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