DISCOVERING BARRIERS

Improving the Built Environment for Individuals with IDD



KADIJA MINI MARKET

FOREWORD PERKINS EASTMAN RESEARCH FELLOWSHIP | JULIA WILSON FELLOW

When I first read Julia's research proposal, I found her interest in design for individuals with Intellectual and developmental disabilities (IDD) a little rare and quite compelling. In her ideas, I recognized a young professional with a true passion, one that had the potential to define continued professional development and an exciting career path. However, while these are important reasons, I was mostly drawn to Julia's research because I am a parent of a young adult with Down Syndrome; to me and my family, this subject is real and has profound meaning.

Today, it might seem like advocacy for persons with IDD is fairly common and institutionalized in our federal policies for equity and inclusion, but this was not always the case. In the 1950s, families began banding together, recognizing so little was known about genetic irregularities and the resulting developmental delays. They wanted their loved ones to lead fulfilling lives in the community and not be shuttered away in dark institutions. Emboldened by a collective desire to raise their children in the home, and a refusal to accept that institutionalization was the only option, organizations like The Association for Retarded Citizens were born—later renamed The ARC. Progress and legislation evolved slowly and only became a focus of national law in the early 1970s.

Prior to the 1970s, persons with intellectual and developmental disabilities were typically categorized as "retarded" or having "mental retardation"—incredibly demeaning and derogatory terms. One of the first shared initiatives of family advocates and The ARC was to recognize that words matter, and to address changes in our language that reflect respect for individuals with intellectual disabilities. The ARC organized an annual meeting for families to gather, share practices, and legislative initiatives, and build momentum around advocacy at the local level. Today, The ARC maintains chapters in every state, partners with a variety of related organizations, funds research, and holds advisory positions on federal agency committees and panels.

A little about my family and daughter, Anna: We learned at the very beginning, with prenatal genetic testing, that Anna would have a disorder, which presents an extra 21st chromosome (Trisomy 21), more commonly known as Down Syndrome. It was shocking news at the time, followed by a flood of emotions, fears, and, at times, disappointment. However, we learned more about Down Syndrome, what to expect, and, over the course of the pregnancy, prepared ourselves for the challenges and opportunities ahead. Anna was born. We celebrated our new daughter with all the same fanfare and traditions as our neurotypical daughter, Sarah. We filed with Social Security and Medicare for supplemental disability services shortly after Anna's birth, began early intervention programs at age three months, and in-home services until Anna turned three. We enrolled her in public preschool and continued to receive intervention services including speech, OT, and PT at her school site.

As we prepared for Anna's transition to continue in the public schools, we found an overwhelmed system. We saw warehousing of students in separate special needs classrooms because they required individualized learning support or demonstrated disruptive behavior, and, in some cases, destructive and violent behavior. We found that these accommodations were not unlike the warehousing and isolation we read about in the history books. What we wanted, simply, was an environment where Anna would learn and advance with her age-appropriate peers, even though we had no expectation she would perform to the same academic level of her neurotypical classmates. Needless to say, we didn't enroll Anna in the public schools. Alternatively, we selected an inclusive program in a private school where Anna would be embedded in the mainstream classroom, supported alongside her classmates, and sometimes, supported and aided *by* her classmates. Almost 17 years later, Anna continues to thrive, and now her classes extend to the college level, focused on life-skills and future work placement. This year Anna will turn 21, graduate, and begin her transition to adulthood, employment, and hopefully, at some point, to independent community living.

Here is where Julia's research—a thoughtful probe into the idea of independence—comes in: That individuals with IDD want to share the same experiences and freedoms we all do. Using a simple yet critical element of daily life—grocery shopping—her study looks at several grocery store and market typologies. Because these environments present many of the common challenges and stressors that can inhibit individuals with IDD, by assessing their particular characteristics Julia shows how intended and unintended design choices have impact on the behavior and experience for adults with IDD. Moreover, she presents a compelling question: Is good design for individuals with disabilities also, simply, good design for everyone?

I'm encouraged to see Julia's work influence and expand our view of this important population and community. In time, and with continued research, Julia's work today might lead to a change in my daughter Anna's experience at the grocery store, bank, train station, or movie theatre. This change begins when children, teens, and young adults, have access to equitable and inclusive educational programs, like those we were so lucky to find for Anna. I urge you to bring this study and its data, hypothesis, and recommendations forward within your own work, in whatever way it might influence our understanding and commitment to equitable design for everyone.

Alan Schlossberg

Principal and Executive Director Perkins Eastman

PREVIEW A brief overview of both the study and its relation to the world.

What are stressful situations in the built environment?





Suddenly hearing loud sounds from construction or traffic

Experiencing uncomfortable temperatures and strange odors



Seeing bright flashing lights from signage, cars, bikes, or even traffic lights

These are only a few of the things that make our world stressful, but our world is full of them. For some, these are minor inconveniences, but for others they are barriers that can prevent participation in independent life.



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Individuals with IDD might have particular sensory sensitivities and difficulties with sensory integration¹³. As such, the degree that a sudden loud sound or strong smell might affect them might be higher than the degree to which it might bother their neurotypical counterparts. Stressors in the built environment can disproportionately affect individuals with IDD, creating barriers to access.⁹

The intellectual and developmental disability community is too big of a population to ignore...



Independent living is an inevitability for everyone.²⁴



Guardians will take care of their charge with IDD, but typically individuals with IDD will outlive their guardian.



This means that individuals with IDD will eventually have to live on their own and support themselves.

Although it is possible to establish trusts and future care, doing so requires time, money—resources that not every family has to spare.

It is more effective and safe to integrate people with IDD into society so they can to support themselves, and be like everyone else.



With a significant population and a true need, it becomes increasingly important to deepen knowledge on how to accomodate the needs and wants of individuals with IDD. Through this study, we strive to illustrate the point that designing for accessibility and individuals with IDD benefits all and thus improves design overall.

Key terms:

Intellectual Disability

A disability that "limits the person's ability to learn at an expected level and function in daily life...starts at any time before the child turns 18 years old"

--CDC; eg. Downs Syndrome or Fragile X syndrome

Developmental Disability 10

A disability that "begin[s] during the developmental period, may impact day-to-day functioning, and usually last throughout a person's lifetime"

-CDC; eg. autism, cerebral palsy, ADHD

Independent Living

"Both a cultural movement and program...The independent living community works towards equal opportunity for people with disabilities to share in all benefits of society"

--CA Department of Rehabilitation

Environmental Stressor

Any external stimuli that causes annoyance or irritation to the individual

ABSTRACT

Living independently is an important milestone in every young adult's life, something that should be accessible to every person no matter their ability. Unfortunately, for people with intellectual and developmental disabilities (IDD), the option to live independently is not always a right. Currently, over a third of adults with IDD live at home with a family member²⁹, creating a large population that may need to live independently later in life. Typically, children with IDD outlive their guardian^{36,51,54}. In cases when the family doesn't have adequate resources to provide for the adult, the individual must support themselves³. An estimated 4.3 million adults in the United States live with an intellectual or developmental disability^{8,11}, a number that will only grow as diagnoses of autism and other IDDs become more prevalent¹⁵. As the population of individuals with IDD grows, it is increasingly necessary to deepen our understanding of their needs and increase accessibility thereto. One way to promote accessibility is through the public spaces we design. Designing with accessibility in mind can aid a growing population with living independently and create a more inclusive public realm.

The grocery store is a microcosm of interactions for independent living as it requires wayfinding and navigation, handling tight or crowded spaces, interaction and communication with unfamiliar people, and the need for executive functioning. The skills needed to navigate the grocery store are also necessary for working in an office, dining at a restaurant, navigating a public park, or shopping at a department store. The transmissibility of these interactions make the grocery store an essential space to study how designing for accessibility might be improved in a variety of spaces. Grocery stores' mostly uniform design makes them an ideal setting to study as they possess both stressors and comforts in a controlled environment. Many grocery stores across the United States share a common organization of products: baking aisles, canned goods aisles, pharmaceutical aisles, and so on. This arrangement offers individuals with IDD structure that makes navigation easier and shopping less overwhelming. Moreover, this universality allows for findings from this pilot study to be applied to grocery stores across the United States, not just the testing region. They are a staple in the built environment and have managed to stay relatively stable during large-scale disruptions like the COVID-19 pandemic.

Five typologies were identified and studied for the field measurements portion of this study: the traditional grocery store, the farmers market, the convenience store, the health food store, and the hypermarket. At each typology, decibel level, light level, aisle width, and temperature were measured at seven different locations: produce, closed refrigeration, open refrigeration, checkout, and three distinct aisles. These measurements were paired with a survey about grocery store experiences from both individuals with IDD and the general public.

Through this pilot study we see a glimpse of the next steps we can take to improve the environment for individuals with IDD and for the public at large. This study shows that designing for accessibility at all scales can improve environmental conditions for all.

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THE GRAPHIC SUMMARY



All For One and One For All









Everyone uses the built environment. From our homes and offices, parks, transit, roads, sidewalks, and so on, humans share this space to live, but what if this shared environment wasn't built for you? For many individuals with IDD, this can be felt from the way that our cities and towns are planned and designed.



Designers have significant influence over the built environment



but face a lack of information on how to design for individuals with IDD, an issue this pilot study strives to remedy by:

Exploring these questions:

What are the primary stressors individuals with IDD face in the built environment?

How can designers mitigate these stressors through design?



Collecting field measurements of the indoor environmental quality and conditions of different grocery stores



Involving the intellectual and developmental disability community directly through a survey

Data collected from the study was compared to discover the primary envrionmental stressors that are faced by individuals with IDD.

Through this study, we strive to not only understand the needs of individuals with IDD in the physical environment, but also to improve design as a whole.

The goal of this study is to discover and understand environmental stressors that individuals with IDD face in their daily lives. From this pilot study, a series of design solutions and reforms were extrapolated and recommended.



CH. Z METHODOLOGY FIELD STUDY

Measurements were taken with a hygrometer and the following apps on the Samsung Galaxy S9: Lux Light and Decibel X. One researcher was dispatched to five testing sites over the course of one week. Every measurement was taken 3 times, except for decibel, which was meaured once. If the researcher was approached, the measurement was taken again.

Measured Aspects



GROCERY STORE TYPOLOGIES				
Туре	QTY			
1. Traditional Grocery Store eg. Safeway, Pavilions	1			
2. Farmers Market eg. Open-air markets	1			
3. Convenience Store eg. 7/11, Circle K	1			
4. Health Food Store eg. Whole Foods, Sprouts	1			
5. Hypermarket eg. Costco, Walmart	1			
	 Total			
	5			
Thank you!				

Measured at staff-reported peak store hours

Weekdays

3pm - 7pm Traditional Grocery Store Health Food Store

Weekends

3pm - 7pm Convenience Store

Sundays

9am - 12pm Hypermarket Farmers Market

Measured Locations within each store





aisle 1 (cereal & dry goods)

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aisle 2 (canned goods)



aisle 3 (coffee & tea)



closed refrigeration



open refrigeration



checkout

Data collection took place through field measurements and observations, as well as through two surveys. The results of both sections were compared in the findings along with the findings from the literature review.



Survey participants were asked to rate different environmental aspects of the grocery store on the following scale:



It was assumed that things marked as "I don't like it" were stressors for the individuals, "It's ok" was neutral, and "I like it" was positive.



In general, because this survey was targeting a population with a wide variety of cognitive and developmental ability, the language was developed to be simple and easy to understand.

The last question of the survey was a write-in that allowed participants to more specifically give their opinions about the grocery store and the positives and negatives they experience while grocery shopping. This was the only free answer on the survey.

The surveys for both populations were identical and were used to compare the experiences of individuals with IDD and those without. The survey was run for one month.

CH. 3 LIMITATIONS

Time



This study was conducted on a compressed timeframe, which gave rise to some limitations.



Because of the time constraint, only a limited amount of grocery stores could be measured because gaining permission and traveling to more stores would have required a longer timeline.

Moreover, the survey was only able to run for a little less than a month, so the number of survey particpants was not high.

Number



Because of the limited timeframe, the number of grocery stores visited for the field measurement portion and the number of survey participants were relatively small.



This made it difficult to compare populations as there were not many significant populations, making for unbalanced comparisons of 4 participants to 30.

Having a small population also caused a lot of the field data to be unusable as there were no survey participants to compare to the field measurements, which also limited diversity in typology of grocery stores.

Population



After survey responses were collected, it appeared that individuals with IDD who already lived independently had more relevant complaints about the physical environment.



If further studies are made on this topic, it is recommended that individuals who are already living independently are studied, as more feedback will be gathered about the physical environment.

It is assumed that individuals who visited the grocery store with a family member had difficulties facilitated by their companion and thus did not face the same barriers as those who went alone.

This study took place during an extraordinary time, and so faced many limitations.



CH. 4 FINDINGS

Acoustics -

Acoustics were the most complained about aspect on the survey. Those who visited the hypermarket had a more positive experience. Overall, the hyper market had the lowest decibel levels of the typologies studied.

The top three annoyances were shared by both surveys:

mechanical noises

human conversation

loudspeaker sounds

Measurements were taken at reduced occupancy due to the pandemic, so it is possible that stores could be even louder under normal circumstances.

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Lights
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Consistent lighting that is overlit is preferable to inconsistent lighting within the comfort zone.

Flickering lights were the most complained about condition for lighting.

The produce section was always the dimmest section of the store.

There were no noticeable transitions between dim and bright lights in stores.

Through this pilot study, a series of findings primarily related to the indoor environmental quality of the grocery store were discovered, shedding light on possible future improvements and study.

HVAC -----

odors from food odors from people odors from cleaning supplies

This could indicate an issue with air circulation inside grocery stores. There may not be enough circulation to dispel odors from especially pungent products and other sources of smells.

Temperature was not a major complaint from survey participants and is heavily influenced by regionality and personal preference. People

†|†|5

Both surveys yielded very similar responses between both populations.

A literature review comparing the needs of different populations with disabilities as well as different forms of human-centered design illustrated the pre-existing similarities between the needs and the methods that have been developed to accomodate them.

This means that an aspect from one design method can be used to address the need of a different population than it was made for, and utilized beyond its original intended purpose.

In this way, humancentered design is an important philosophy that should be emphasized throughout all of the design.

Wayfinding

The majority of positive sentiments from the survey about wayfinding came from participants who visited the hypermarket. From the field observations, it can be seen that the hypermarket was the only type to have:

additional subsignage in aisles

Out of all the measured aspects of the store, wayfinding had the least amount of complaints and so is a lower priority when it comes to reform and alterations.

However, amending this problem would help those who need extra help navigating and not hurt those who are fine.

CH. 5 TAKEAWAYS

What are immediate improvements?

Some immediate improvements that grocery stores and other indoor environments can take are:

• Design acoustical treatments with occupant density in mind

• Check lighting systems to ensure compatability so lights do not flicker

• Implement a lighting system that is either entirely consistent throughout the whole store or transitions to gently bring shoppers from low to high brightness and back again

• Incorporate more extensive signage by adding sub-section signs within aisles marking where different products are located

Implement iconographic signage alongside text

• Further study into air circulation within grocery stores is recommended

This study was a pilot study, meant to pique the interest and inspire further study about accessibility for individuals with IDD. If these small changes can improve the experience of individuals with IDD in any significant way at the grocery store, imagine how they can improve conditions at busier environments like public transit or busy intersections.

Hopefully, this inspires further study into accessibility for individuals with IDD moving forward.

These same suggestions can also be used to improve the conditions of other spaces like:

offices

retail stores

restaurants

outdoor spaces

THE FULL PAPER

LIVING INDEPENDENTLY WITH A DISABILITY:

The services and aid individuals receive

SOCIAL SECURITY^{24, 26} (what you

(what you need to know)

People with severe enough disabilities are guaranteed support from both the federal and state government for their entire lives, but for some with an IDD, there are added challenges to receiving assistance.^{46, 47}

This is a short summary of some of the difficulties that individuals with IDD might face when they are trying to obtain aid from the government. Seeing how complicated this process is makes the need for more accessible spaces even more pertinent so that individuals with IDD are able to support themselves through multiple means for both their quality of life and independence.

MODELS OF DISABILITY 6, 30, 45

CHARITY

The medical model blames the individual for having a disability, placing the burden on the individual.

This model was prevalent for most of history and dismisses the needs of individuals with disabilities. Individuals can't change the fact that they have a disability and should not feel pressured to try to attain an impossible condition.

The charity model treats people with

are incapable of independence-like

disabilities as objects of pity who

small children.

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Although this model comes from good intentions, it patronizes individuals with IDD by treating them as incompetent when in reality, they are able to achieve independence in the right environment.

The social model places the blame on society and the environment for disabling the individuals in the first place.

This model places blame on an aspect that can be improved. Society and the environment have changed and will ccontinue to do so, so it is important that people guide it in the direction that will be equitable for and accessible to all.

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INTRODUCTION

Within the built environment, what can designers do to mitigate the barriers faced by individuals with IDD who want to live independently?

Designers have significant influence over the physical environment, and, as such, have the ability to create environments that are more equitable and accessible for all. The main problem designers face is a lack of information. With code and ADA regulations^{1, 2}, there are many rules ensuring that those with physical and sensory disabilities are able to interact with their environment—but what about individuals with IDD, as well as cognitive and mental health conditions? What regulations are in place to ensure that persons with these kinds of invisible disabilities are able to access their environments like everyone else? This leads to the main questions of this study:

1. What are the primary stressors and barriers that individuals with IDD face in the physical environment?

2. How can designers mitigate stressors in the physical environment for individuals with IDD?

By investing in a deeper understanding about the needs of individuals with IDD in the built environment and improving accessibility, designers will be able to apply what they learn to improve design not just for individuals with IDD, but for everyone who engages with the built environment. Stressors that affect people with IDD can also affect the general population. The difference is the degree to which individuals are affected. The more research that is put into designing for accessibility, the more advanced and healthy the spaces people inhabit become.

SO, WHY GROCERY STORES?

What are necessary actions people who live independently must do in order to function in their day-to-day lives?

- Communicating with unfamiliar people
- Managing time and executive functioning

All of these functions are present in the grocery store. Shoppers must navigate and locate products around the store, interact with other shoppers in crowded aisles, communicate with strangers, and make decisions that involve themselves and other people, all within a reasonable amount of time. The skills learned at the grocery store are also necessary in order to function in other environments like office buildings, shopping centers, public parks and plazas, restaurants, and even at home. They are effective learning environments that can be used as a gateway to further independent living. In order to learn more about the needs and wants of this population, a pilot study was conducted about potential environmental stressors for individuals with IDD in the grocery store. Focused on the transition period from youth to adulthood, the goal of this study was to identify potential stressors for individuals with IDD in the grocery store through a mixture of field observations, measurements, literature review, and surveys. Along with identifying stressors in the grocery store, the study looked at positives in grocery store design that can be extrapolated and applied to other public spaces in the built environment.

By investing in a deeper understanding about the needs of individuals with IDD in the built environment and improving accessibility, designers can apply what they learn to improve design not just for individuals with IDD, but for everyone who engages with the built environment. Stressors that affect people with IDD can also affect the general population. The difference is the degree to which individuals are affected. The more research that is put into designing for accessibility, the more advanced and healthy the spaces people inhabit become.

RESEARCH FELLOWSHIP 2021

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METHODS: FIELD RESEARCH

Five grocery store typologies were identified and studied with one researcher dispatched to each store over the course of one week. Data was collected through a hygrometer and phone apps on the Samsung Galaxy S9. Each measurement was taken three times in case of error except decibel level, which was measured once. All measurements were taken without

interacting or speaking with customers or staff. If the researcher was approached, the measurement was taken again. Results from data collection were compared in the findings, along with findings from a literature review.

All measurements were taken at peak hours as reported by store staff. Measurements were taken in Orange County, California, and therefore might reflect regional patterns in foot traffic.

WEEKDAYS 3PM-7PM	>	TRADITIONAL GROCERY STORE	+	HEALTH FOOD STORE	
WEEKENDS 3PM-7PM	>	CONVENIENCE STO	RE		
SUNDAY 9AM-12PM	>	HYPERMARKET	+	FARMERS MARKET	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

GROCERY STORE TYPOLOGIES

ATTRIBUTE RECEIPT

Description

Approx. sq. ft

1. Traditional Grocery Store¹⁶.....~**12,000-46,000** eg. Safeway, Pavilions, Trader Joe's

"A store that sells food and household supplies: supermarket"

2. Farmers' Market[®].....variable

eg. all local specific

"A market at which local farmers sell their agricultural products directly to consumers"

3. Convenience Store¹⁴.....~2,500-4,000

eg. 7/11, Circle K, AMPM

"A small, often franchised store that is open long hours"

4. Health Food Market²¹.....~ **12,000-40,000**

eg. Whole Foods, Sprouts

"A type of grocery store that sells primarily health foods, organic foods, local produce, and, often, nutritional supplements"

5. Hypermarket⁷.....**~ 180,000**

eg. Costco, Walmart, Sam's Club

"A very large store that carries products found in supermarkets, as well as merchandise commonly found in department stores"

MEASUREMENT PROTOCOL

STEP 1:

Find one of seven locations to measure, make sure it is out of the way of customers

ie. Do not block shoppers in aisles

STEP 2:

Measure the width of aisle through pace

Researcher's pace is approx. 2.5'

STEP 3:

Place hygrometer at top of clipboard away from body, holding clipboard chest level, arm's length away, wait 10 minutes, record measurement

STEP 4:

Hold phone arm's length away from body, lean away to not block light sensor, open Lux Light app for 1 second, record FC snapshot

STEP 5:

Hold phone arm's length away from body lying flat at eye level, open Decibel X app, hold still for 5 minutes, save measurement to export later

REPEAT AT EACH AVAILABLE LOCATION!

MEASURED LOCATIONS WITHIN EACH STORE

Unfortunately, not every location was available at each store. As such, measurements were taken at every available location. Below is a breakdown of which location was present at each typology.

AVAILABLE MEASUREMENT LOCATION BY STORE

	produce	aisle 1	aisle 2	aisle 3	closed refrigeration	open refrigeration	checkout
TRADITIONAL GROCERY STORE	x	Х	Х	х	X	Х	x
FARMERS MARKET	Х	х	х	Х			х
CONVENIENCE STORE		X	х	х	Х	Х	х
HEALTH FOOD STORE	х	Х	Х	Х		Х	х
HYPERMARKET	Х	Х	Х	X	X		x

METHODS: SURVEY

Two surveys were developed: a survey for individuals with IDD and a survey for the general public. Both surveys were identical in questions and designed to understand possible stressors at the grocery store.

The survey for individuals with IDD was sent to a college course for individuals with IDD ranging from 18-23, a group home for young adults with IDD, and personal contacts of the researcher and employees of Perkins Eastman.

The survey for the general public was sent to individuals in Berkeley, California, ages 18-30, and employees of Perkins Eastman, ages 23-70.

Participants were asked to rate different aspects of the grocery store on the following scale:

It is assumed that aspects marked as "I don't like it" are stressors in the environment, "It's ok" are neutral, and "I like it" are positives.

For questions about the indoor environmental quality of the grocery store, participants were asked to rate each quality and mark related situations in the grocery store that they found stressful.

An example would be a list related to lighting such as:

- When the lights are too bright
- When the lights are too dim
- When the lights flicker
- When the lighting changes around the store

Participants were allowed to mark more than one situation and they were not ranked questions. The goal was to understand specifically the most common stressor for the survey participants. There was also a survey question asking participants to mark which grocery store map they found easiest to understand and use. The majority of the individuals with IDD chose no map, while the general public chose Map 2, which had the largest text.

The last question on the survey was a write-in, asking participants what would make the grocery store a better place for them. It was a space to catch any opinions or struggles that were not reflected in other parts of the survey.

WHO, WHAT, AND WHERE

Here's a breakdown on the results of the survey.

Demographic Questions

The first section of the survey esatblished participants personal and grocery store profile:

The General Public

For the survey for individuals with IDD, young adults were specifically targeted for the survey. The general public survey had no specific age range or ability level in mind and therefore had a more diverse population.

72 responses were recorded

The store was mostly visited once a week, on the weekend (Saturday, in particular), in the evenings.

97.2%

visited the grocery store and the majority visited the store alone or with a significant other.

Breakdown of the survey for individuals with IDD

There were 35 responses for this survey. The population of individuals with IDD who took the survey were:

Primarily between the ages 18-21

68.6% female, 28.5% male, and 2.9% other

85.7% visited the store

The majority visited the store once a week

Typically in the evening (5pm or later)

Decently spread throughout the week, with a slight preference to the weekend and Sundays **77.1%** went to the store with a family member

> Only **11.4%** (4 people) went alone

71.4%

marked that they enjoyed going to the grocery store.

LIMITATIONS

The limited timeframe of this pilot study constrained both the quantity of grocery stores visited in the field study, and the amount of participants in the survey. Additionally, permission to take measurements was also difficult to obtain within the short timeframe, which further restricted the amount of grocery stores visited. For each typology, only one store was measured, making the field measurements highly susceptible to irregularities and regional variables to the store typologies.

With only 35 participants in the survey for individuals with IDD and 72 participants in the survey for the general public, it was difficult to compare responses as the division between answers was not statistically significant. Although five typologies were studied in the field measurements, the survey for individuals with IDD yielded only two typologies that had enough visitors to compare: the traditional grocery store and the hyper market. The same problem was present in the survey for the general public as only enough participants visited the traditional grocery store and the health food store to gain any data through comparison. Because both populations had significant amounts of people visiting the traditional grocery store, a comparison between individuals with IDD and the general public was possible, but overall the data was limited as, at best, only three of the five typologies were present and comparable. A larger pool of participants could have yielded more data and diversity in answers. Another possibility is that the divisions in typologies need to be reworked to be more representative of grocery stores individuals visit.

One of the biggest limitations was that the wrong population may have been studied. Since this research

was focused primarily on the period of transition to adulthood and independent living for young adults with IDD, the majority of participants of the survey for individuals with IDD were young adults ranging from 18-25. This brought about some significant challenges as 83% of the survey participants visited the grocery store with a family member, while only 13.3% of participants visited the grocery store alone. When comparing the answers from both of these populations, there is a significant difference between the two. Individuals who visited the grocery store with a family member had a generally positive experience at the grocery store with very little complaints, while those who visited alone had more complaints about the environment and interactions at the grocery store. Given this comparison, it could be assumed that individuals who visited the grocery store with a family member had their shopping experience facilitated by their family member and therefore did not experience the same barriers that those who visited the store alone faced. It would seem that if the focus of this survey was instead based on whether the participant lived independently and not their age range, the survey would have been able to yield more useful information about the environmental barriers faced by individuals with IDD. Another possible avenue would have been to survey more care providers for individuals with IDD to learn about the tasks they perform and situations they facilitate for their charge at the grocery store. That way, it would be more apparent what individuals with IDD needed assistance while at the grocery store.

The survey from both populations gave similar results, but the lack of sensitivity in the rating scale may be the cause for these similarities. With only three options, the scale may not be sensitive enough to pick up on the discrepancy between the populations. Moreover, the conclusions of the neutral "It's ok" answer caused significant ambiguity in some answers and should have been eliminated altogether.

May not be sensitive enough to take into account were the restrictions brought about by the COVID-19 pandemic. Perhaps more of the young adults with IDD we surveyed would have been living independently or in a group home setting had it not been for the pandemic. It cannot be overlooked that even though grocery stores have been relatively stable during the pandemic, there have been practices put in place that reduce occupant density within the grocery store, as well as social distancing and masks that could reduce the amount of noise within the store and affect the field measurements. The distinct experience of grocery shopping during the pandemic was also a problem for the survey as it was not specified to answer the surveys with their experience before or during the pandemic, which could cause some discrepancies in responses.

Overall, the limitations of this pilot study were significant, but also led us to understand the next steps that need to be taken in order to deepen our understanding of the needs of individuals with IDDs in the built environment.

CONCLUSIONS AND FINDINGS

ACOUSTICS

Some immediate steps for improvement are possible given the findings of this pilot study. Acoustics were the main stressor from the survey and it seems to be heavily tied to the occupant density of the store. From the two comparable typologies from the survey for individuals with IDD, the traditional grocery store and the hypermarket, the participants who visited the hypermarket had a more positive experience, which is reflected in the field measurements as the hypermarket was overall quieter than the traditional grocery store.

This is most likely due to the occupant density. Hypermarkets typically have 134,000 to 168,000 more square footage than traditional grocery

Traditional grocery store decibel levels

stores, and more products and areas that disperse shoppers around the stores, meaning that the general concentration of people in the grocery store section of the hypermarket is significantly less than the traditional grocery store. From the decibel level readings, the traditional grocery store was typically ten or more decibel levels than the estimated average background noise level (40 dB). These measurements were taken during the pandemic, which means that there were less shoppers inside the store than usual, so it is possible that the store could be even louder than when these measurements were taken. More attention needs to be given to occupant density when designing effective acoustical treatments.

Hypermarket decibel levels

LIGHTING

Consistency was the takeaway from the findings about lighting systems. Flickering lights were the number one complaint for the lighting at the grocery store. Therefore, it is important to make sure that the lighting system within the store is compatible and does not flicker. Comparing both the traditional grocery store and the hypermarket, participants who visited the hypermarket had an overall more positive experience than those who went to the traditional grocery store, even though the field measurements show that the hypermarket was consistently overlit.

Traditional grocery store light levels

Hypermarket light levels

This could mean that an overlit store is preferable as long as it is consistent throughout the store. Although the majority of the traditional grocery store was within the comfort zone for lighting, there is also some significant variation in the lighting condition within the store.

At the traditional grocery store, the produce is located near the entrance of the store and is the first area shoppers encounter. It is also the most dimly lit area in the grocery store, meaning that not only is there a significant change in brightness compared to the next dimmest area of the store, 41.7 FC to 80.1 FC, but also that depending on the brightness outside, there is an immediate need for the shopper to readjust to the dimmer setting at the entrance. This could cause some visual discomfort and stress for shoppers with IDD.

The brightest place in the traditional grocery store was open refrigeration, which had many secondary lights shining from within the refrigerator. The open refrigerator aisle was located at the back of the store, far away from the checkout which was the next brightest area in the store. The difference in lighting between the open refrigeration and the next brightest area in proximity, aisle 1, was 53.2 FC. There is nothing in the layout of the traditional grocery store that indicates, or allows for, a smooth transition to adjust from low lighting to bright lighting and back to low lights. The change in lighting could cause some discomfort and stress to shoppers and individuals with IDD as the lighting conditions varies widely around the store. Further study into either better transitional lighting or more consistent lighting through the store is recommended.

HVAC

Odors and temperature were relatively minor annoyances in the grocery store but the issues that did arise could indicate a problem with the HVAC system in the grocery stores. Both survey populations marked smells coming from other people and odors from pungent products as annoyances at the grocery store, which could mean that there is a lack of proper ventilation within the grocery store. Given the oversight in instructions to answer the survey as pre-pandemic or post-pandemic experience, it is unclear if the occupant density has affected these findings. Despite the pandemic's disruption it is still informative that these odors are marked as noticeable annoyances.

For temperature, the traditional grocery store was mostly positive, with the majority of the survey participants marking that the temperature within the store did not bother them. When looking at the field data, this makes sense as the majority of the temperature within the stores were within the comfort zone. For the hypermarket, one hundred percent of participants marked that the hypermarket was too cold compared to the outside temperature despite the field measurements showing that the hyper market was consistently warmer than the comfort zone. This discrepancy between the survey and field measurements could be due to an error in measurement, a difference in regional store temperature, or practical factors like air speed, mean radiant temperature, or humidity. Overall, temperature was not a particular problem and is very regionally specific. Although, because of some odors were still were marked annoyances, further study is recommended on the air quality and HVAC systems in grocery stores.

WAYFINDING

There was a clear difference in the experience of participants who visited the traditional grocery store and the hyper market when it came to wayfinding. From field observations, the majority of the typologies only had written signage, while some had no signs whatsoever. Only the hypermarket had iconographic signage, sub-section markers within the aisles, and a wayfinding map at the entrance of the store. This could be seen as a necessity given the larger footprint and wider variety of products sold at the store, but it should be noted that the participants who visited the hypermarket had an overall positive response to the wayfinding and navigation of the store versus the lower positive and mostly neutral response to the traditional grocery store.

Even though traditional grocery stores are smaller, it might be helpful to take note of the hypermarket and add more comprehensive signage conveyed in multiple formats beyond written signs. Sub-section markers for aisles can be easily moved as products change location, making it easier to locate the desired products on the shelf. Iconographic signage could help individuals with IDD navigate the store, as well as small children and people who do not speak the primary language. Small changes and additions like that can improve the overall experience of shoppers at the grocery store.

PEOPLE

Although the rating scale of the survey was flawed and not particularly sensitive, there were some significant similarities between the survey for individuals with IDD and the general public. Sharing the same top three stressors for the indoor environmental quality stressors indicate that there are problems in the grocery store that affect everyone and should be addressed, meaning that the previous findings about acoustics, lighting, odors, and temperature, would benefit not only individuals with IDD but everyone who visits the grocery store.

In fact, if the sensitivities of individuals with an IDD like autism or Down Syndrome is compared to the sensitivities of individuals with psychiatric conditions many similarities can be seen, illustrating the wide-reaching benefits of improving design for individuals with IDD.

Comparing the similarities in design principles furthers this idea.¹

COMPARING SENSITIVITIES OF AUTISM, DEMENTIA, DOWN SYNDROME + PSYCHIATRIC CONDITIONS

AUTISM	DEMENTIA ²⁶	DOWN SYNDROME	PSYCHIATRIC CONDITIONS
acoustics	acoustics		acoustics
spatial processing	spatial processing	spatial processing	
delineation of space	delineation of space	delineation of space	; ; ,
need for personal space	because of their advancing age, many individuals with dementia use assistive technology that requires more space	need for personal space	need for personal space
likely to develop anxiety and depression among other psychiatric conditions	problems with memory and reliable information processing		includes conditions like anxiety and depression
sensory integration		sensory integration	sensory i sensory integration
visual/depth perception	visual/depth perception	visual/depth perception	visual/depth perception
visual/lighting (intolerance for glare & shadows/ silhouetting)	visual/lighting (intolerance for glare & shadows/silhouetting) Moreover, requires double the amount of light than usual	particular attraction to light/glowing objects	I all of the previous

These findings make clear that human-centered design in all its forms, universal, therapeutic, childcentered, and retail, addresses many of the needs that individuals with autism or other IDDs need in the built environment. Designing for individuals with IDD improves design and quality of life for all. As long as human-centered design is at the forefront of the design process, more needs of people with disabilities will be met. Based on these findings, greater emphasis on sensory and human-centered design is recommended.

There is something about the built environment that is deterring individuals with IDD from fully participating

in the public realm. Figuring out what those barriers are and how they can be addressed within design is an important step designers must take in order to create spaces that everyone can freely move within and enjoy. Based on the limitations of the study, it is clear that more can be learned on this topic from individuals with IDD who already live independently. In the next steps, focusing on independent individuals with IDD is recommended.

This pilot study and grocery stores are meant to be a gateway to further study and improvement for the field of universal design. If improving the acoustics, lighting, HVAC, and wayfinding at grocery stores can

COMPARING DIFFERENT DESIGN PRACTICES AND PRINCIPLES

DESIGN FOR AVTISM	THERAPEUTIC DESIGN®	UNIVERSAL DESIGN	DESIGNING FOR CHILDREN®
ACOUSTICS	ACOUSTICS	EQUITABLE USE*	EVERYONE CAN USE*
SPATIAL SEQUENCING	CLEAR WAYFINDING	FLEXIBILITY IN USE	FLEXIBILITY IN USE
ESCAPE SPACE	ESCAPE SPACE	SIMPLE AND INTUITIVE	CLEAR PURPOSE
COMPARTMENTALIZATION	PRIVACY	PERCEPTIBLE INFORMATION	UNDERSTANDABLE COMMUNICATION
TRANSITIONS	ACCESS TO NATURE OR A VIEW OF NATURE (BIOPHILIA)	TOLERANCE FOR ERROR	SAFETY
SENSORY ZONING	SENSORY ASPECTS MUST BE CONTROLLED, INCLUDING FRESH AIR AND VENTILATION	LOW PHYSICAL EFFORT	KEEP IN MIND A CHILD WILL USE
SAFETY	SAFETY	SIZE AND SPACE APPROACH AND USE	ROOM TO EXPLORE
ADAPTABILITY TO ACCOMMODATE HYPER- AND HYPO-SENSITIVITIES	ENVIRONMENTAL COMPLEXITY (ADAPTABILITY OF EXPERIENCE)		

*applicable to everything

help individuals with IDD move on to independent living easier, imagine the impact of these same kinds of improvements at busy intersections or transit hubs.

Immediate actions that to improve indoor environmental quality would be:

- Acoustical treatments focused on the relation of acoustics to occupant density
- Ensuring compatible lighting systems and either consistency in lighting or greater lighting transitions
- Further study on HVAC and air quality
- Improved and more comprehensive wayfinding and navigation
- Greater emphasis on sensory and humancentered design

All these immediate actions can also be applied to other locations. Restaurants should be more aware

of occupant density for acoustics to make sure that conversations can still take place comfortably; office buildings can check their lighting systems to ensure they do not flicker or have sudden changes in brightness; public parks can take note of wayfinding improvements; and even homes can apply all of the above suggestions.

Every designed place in the built environment can benefit from greater emphasis on sensory- and human-centered design. Although grocery stores were chosen for this pilot study, the learnings are applicable to more than just the local market. Starting from square one, if designers and researchers can continue on this path to gain more knowledge and deepen understanding about the needs and stressors of individuals with disabilities, design will become more inclusive and improved for all.

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