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Reexamining the Desert: A Study of Place-Based Food Insecurity

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REEXAMINING THE DESERT:

A STUDY OF PLACE-BASED FOOD INSECURITY

by

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REEXAMINING THE DESERT:

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Food Deserts are areas where individuals lack access to healthy and affordable food. Since 1995, the United States Department of Agriculture has been one of the leading organizations studying the phenomenon of food deserts. However, issues relating to the scale of their analysis limit their ability to gain a nuanced understanding of food insecurity. In the past decade, an increased emphasis has been placed on the importance of local factors that contribute to food insecurity and complicate the large-scale study of the phenomenon. This research explores the various place-based factors shaping food insecurity in Lincoln, Nebraska, by readapting Penchansky and Thomas' (1981) new definition and taxonomy of "Access." Using contemporary literature, this paper expands traditional food "Access" determination metrics to incorporate place-based factors of food insecurity. Observational data, collected at each of Lincoln's 52 grocery stores, is analyzed to determine the place-based characteristics that consumers experience while shopping. A quantitative analysis highlights specific instances of low Access across the City of Lincoln. Quantitative study findings are then compared to the USDA's large-scale food insecurity study to unpack the differences between varying scales of analysis. Lastly, this research concludes with a framework analysis that connects the common threads of low Accessibility grocery stores across the city and identifies commonalities that increase a consumer's risk of food insecurity.

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Throughout my life, a handful of educators have pushed me to be the student that I am today. Ranging from elementary to graduate school, each has had a profound impact on the way I view the world and the goals I set for the future. Their diligence in planning, teaching, and mentoring has compelled me to pursue everything I have achieved thus far. This thesis would not have been possible without them.

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Finally, I would like to thank my parents, Christopher and Kelsie, and my sister and brother-in-law, Lauren and Lucas. I am thankful that you all helped me during every stage of my education. Additionally, I am grateful that we no longer need to spend hours of our nights fretting over the homework assignments I forgot as an elementary student.

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CHAPTER 1: INTRODUCTION

> Sitting outside of my classroom, a group of students all peer into bags they had just received at the end of the school week. Each was packed with food for their household that they had gotten as part of the food backpack program, an effort to fight food insecurity in the district. As they traded items back and forth an administrator walked up to the students and reminded them that food must not be eaten at school. For many students, this may be the only food they receive for the weekend. (Fieldnote 1, 02/20/2019)

During the spring of 2019, I spent my days teaching high school government and history in Lincoln, Nebraska. As a novice educator, I was still learning how to teach and gaining new experiences daily. In fact, during this time I was reintroduced to the food backpack program which provides a backpack full of food for the weekend for students who qualify for the Free or Reduced lunch program. To this point in my life, I knew that food insecurity was an issue, but I had not realized that such serious issues of food security plagued some of the neighborhoods in my community. It was after this point that I became interested in issues of food security research, mainly food desert designation, grocery stores, and the landscapes of food insecure communities.

While identifying potential research topics for a master's thesis, the fond memories of working with high school students came to my mind and guided my topic choice. Thinking back on my experiences teaching high school and the issues of food

insecurity that many of my students faced, it became abundantly clear that food security and its place-based factors were an understudied phenomenon. During an initial review of current literature, regarding food insecurity, I noticed that most of the prior research, from within academia and the United States government, relied heavily on quantitative data. While these articles explained the phenomenon in-depth and argued their points saliently using data, I felt that a sheer reliance on quantitative data, at the Census tract level, may only provide a snapshot of the complexity of food insecurity. Primarily, food insecure areas are designated by the United States Department of Agriculture Economic Research Service (USDA ERS), who uses quantitative data to identify areas which lack access to healthy and affordable food. However, this is an issue because factors at the grocery store level including item price, availability, and store hours of operation are unaccounted for in the USDA ERS analysis. These factors, amongst others, form the landscapes of grocery stores that consumers transverse through as they shop for food. My understanding of the current research landscape led to this current project in which I study food insecurity using both quantitative and qualitative methodologies. As I progressed through my course work and was introduced to new fields and subfields of geography, I wove in my additional interests which amalgamated into this investigation into food security in Lincoln, Nebraska. While most of the questions asked in this research stem from contemporary literature, feedback from a local nonprofit organization was considered to identify contemporary needs within the community. What that leaves, is a project that was formed from inspiration as explained in the opening passage and has evolved with my interests as a researcher. Ultimately, this project serves as an exploration into food insecurity for the City of Lincoln that includes the feedback of

several stakeholders to ensure that the output will be meaningful to both academics and members of the community.

Placing Lincoln on the Landscape

Lincoln, Nebraska is a community comprised of roughly 290,000 people, and is the second largest city in the state (United States Census Bureau, 2019). Of the total population, a majority (79.6%) is white, with Hispanic (7.6%) Asian (4.6%), and African American (4.4%) populations comprising the next largest race and ethnicity percentages respectively (United States Census Bureau, 2019). Lincoln's population is more ethnically and racially diverse than, Bellevue, the third largest city in the state, while being significantly less diverse than, Omaha, the largest city. Roughly 13.5% of Lincoln's population lives in poverty, which is slightly higher than the cities of Bellevue and Omaha (United States Census Bureau, 2019). The following sections of this chapter will look at the objectives of this paper, provide key definitions, and look at my positionality as a researcher.

Research Objective

The purpose of this thesis is to expand the study of access in food insecurity research and apply these methods to the City of Lincoln. Therefore, this work will analyze factors which impact food security, compare traditional methods to place specific methods, identify areas of need for the city, and identify specific factors which inhibit access for areas of need in the city. To understand factors which impact the food environment, readers will be introduced to the USDA's method of food insecurity research and the misconceptions associated with the food desert metaphor. After introducing and explaining food security, contemporary food security research will

justify place specific data collection, new variables of interest, and analysis methods. Grocery store level data is collected and analyzed in conjunction with traditional data to identify food insecure areas of the city. Lastly, a qualitative analysis provides an enhanced understanding of the needs of the grocery stores which serve individuals at the highest risk for food insecurity. By answering these questions, I provide readers with a concise introduction to the issue of access, dispel common misconceptions regarding the phenomenon, and highlight how the study of access at different scales provides new insights in the measurement of food insecurity.

Central Research Question:

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How does redefining the USDA's metric of "access" change the measurement of food security?

Additional sub-questions will add multiple avenues of inquiry which will increase the complexity of the findings of this study's central research question (Creswell & Poth, 2018).

Sub-Questions:

SubRQ1: What are factors which impact the local food environment?

SubRQ2: What are the areas of need for Lincoln, Nebraska?

SubRQ3: How do traditional methods compare to place specific methods?

SubRQ4: What are the needs of the grocery stores that serve potentially food insecure areas?

Thus, this thesis will explore these research questions first, with a literature review which identifies potential variables of Accessibility. A subsequent quantitative analysis

identifies areas of low Accessibility for the City of Lincoln. The findings of this quantitative analysis are then compared to the traditional methods employed by the USDA ERS. Finally, a qualitative analysis unpacks the needs of grocery stores who serve individuals who are at risk of food insecurity. Consequently, these methodologies will produce a more nuanced understanding of food insecurity for Lincoln, Nebraska and provide grocery stores with specific methods to improve customer Accessibility.

Definition of Terms for This Study

The definitions of key terms from this paper come from the work of Penchansky and Thomas (1981) who first created a new definition of Access during their analysis of health care systems. Their groundbreaking research pinned down an all-encompassing definition of access and identified five taxonomic variables: Availability, Affordability, Accommodation, accessibility, and Acceptability. Since its publication, in 1981, their article "The concept of access: definition and relationship to consumer satisfaction" according to Google Scholar, has been cited 2,945 times by researchers in the fields of health care, geography, economics, and marketing. Penchansky and Thomas' long-lasting work, has proven to be adaptable to situations which involve consumers seeking access to goods and services.

Access: "… a concept representing the degree of 'fit' between the clients and the system" fit, here, describes how both the environment and practitioner impact the consumer's understanding of the quality of the location and service (Penchansky & Thomas, 1981, p. 128).

To accompany this "degree of fit" Penchansky and Thomas theorized five dimensions of access which provide additional avenues of measurement. Through their

analysis of patient survey and go-along interview data the authors were able to deduce that access was developed from a multitude of factors ranging from geographic proximity and affordability to characteristics such as neighborhood quality and provider attributes (Penchansky & Thomas, 1981). Accordingly, these factors led to the creation of the five dimensions of access which contribute to an individual's ability to use a facility

Availability: "… the relationship of the volume and type of existing services… to the clients' volume and types of needs…" (Penchansky & Thomas, 1981, p. 128).

Acceptability: "… the relationship of clients' attitudes about personal and practice characteristics of providers to the actual characteristics of existing providers, as well as to provider attitudes about acceptable personal characteristics of clients." (Penchansky & Thomas, 1981, p. 129)

Affordability: "… the relationship of prices of services and providers' insurance or deposit requirements to the clients' income, ability to pay..." (Penchansky & Thomas, 1981, pp. 128-129)

Accommodation: "… the relationship between the manner in which the supply resources are organized to accept clients… and the clients' ability to accommodate to these factors and the clients' perception of their appropriateness." (Penchansky & Thomas, 1981, p. 128)

(a)ccessibility: "… the relationship between the location of supply and the location of clients, taking account of client transportation resources and travel time, distance, and cost." (Penchansky & Thomas, 1981, p. 128) Historically, the measurement of distance to a location has been understood by using Euclidean, Manhattan, or other distance measurements. Euclidean, or "as the crow flies" distances accounts for straight line

distances between the consumer and the good/service of interest (Curran & Kitchin, 2019, p. 6).

Accessibility: The capitalized A is used to denote anytime the concept of Accessibility is discussed without a direct measurement of travel time. For instance, a store is Accessible if it scores well on each of the five variables of Accessibility, identified by Penchansky and Thomas (1981). Inversely, a block group's accessibility may be measured by calculating the average travel time to the three closest grocery stores.

Block group: The United States Census Block group is used as a statistical division which contains between 600 to 3,000 people. The cluster of blocks, that comprise a block group, are within the same Census tract (United States Census Bureau , 2022).

Researcher Position and Bias

Reflexivity is essential for any research using qualitative data because it provides readers with a background of the researcher's life experiences, which can alter a study's findings (Creswell & Poth, 2018). A researcher's background, unless accounted for, has the potential to bias the outcome of any findings derived from a qualitative analysis. Hence, providing the author's position allows the reader to form their own understanding of the study's findings. I, Morgan Ryan, the graduate student writing this research, was first introduced to the issue of food security, in Lincoln, while working as a volunteer at an after-school program at a local elementary school. Each Friday afternoon, students were given a grocery bag of food that was meant to last them through the weekend. As I progressed through college and became a student teacher, I was reintroduced to the food backpack program. Like before, students were given food, but this time I noticed that additional food had been given out to ensure that families would have enough to last

through the weekend. It was these exact observations that made me interested in food landscapes and the different scales of data, which impact food insecurity

After completing a degree in secondary education, I chose to pursue an advanced degree in geography to analyze place identity using a geographic lens. Specifically, I envisioned applying a spatial perspective to social issues which impact the quality of life for less fortunate members of society. Within my field, I have traditionally used a critical lens to investigate issues of hegemony and ethnocentrism in education and geography (see Curran & Kitchin, 2019; Green T. L., 2015; Klaf, 2013; Lawson & Elwood, 2013). These previous experiences researching issues with a critical lens have impacted the way I view the world. As a cisgender, white, male researcher from a middle-class background, my worldview has developed from a place of privilege. However, I continuously work to understand my biases by reading research from Dr. Lawson and Dr. Elwood, amongst others, who study issues of inequity. I use these readings to acknowledge and understand my blind spots as both a researcher and a member of society.

A postpositivist understanding of reality will be employed for this study of food security. This paradigm asserts that reality exists, however, "… because of the limitations of human inquiry, the inherent order of the universe can never be known completely" (Hatch, 2002, p. 14). Accordingly, an understanding of reality is dynamic across individuals, meaning that each individual constructs their sense of reality and place differently. To implement this perspective in my research, I use observations that measure place specific variables which impact Accessibility. All data were collected with a dynamic nature of reality in mind. To ensure that study data reflected multiple realities, extended structured observations, field notes, and multiple forms of data were

implemented in this study's methodology. Thus, the analysis methodologies created for this thesis will produce a series of maps which highlight areas of need for the city of Lincoln. The discussion section will unpack these findings and place them on Lincoln's food security landscape. Most importantly, my experience working with individuals at risk of food insecurity and my experience teaching have shown me that hunger can take many forms. I am conducting this research to further the discourse regarding an expanded definition of Access and to help the residents of Lincoln have greater Access to food.

CHAPTER 2: LITERATURE REVIEW

Over the course of this chapter, I outline the evolution of geographic food security research. In recent years, many researchers have evolved from a traditional focus on spatial access and Census tract level analysis to an expanded definition of Access at a local scale. The beginning portion of this review will introduce the standard method of food desert identification, used by the USDA, to identify food-insecure areas. After this groundwork is laid, I use current research to introduce the need for a critical praxis of food security research, highlight the method of qualitative analysis used in this study, and introduce a quantitative methodology that employs Penchansky and Thomas' (1981) definition of Access to study food insecurity. This review unpacks my exploration into the intersection of food geography, cultural geography, and health geography. I used aspects from all three sub-fields to construct an understanding of the food landscape of Lincoln, Nebraska.

The USDA and the Desert

Contemporarily, one of the largest organizations in the United States researching food desertification is the United States Department of Agriculture (USDA). More specifically, the USDA's Economic Research Service (ERS) has been conducting research on the issue of food desertification since 1995 (USDA Economic Research Service, Food Security in the U.S., 2014). Currently, the USDA ERS defines a food desert as " neighborhoods that lack healthy food sources" (USDA Economic Research Service, Documentation, 2016, p. 3).

One of the most widely cited USDA ERS resources, regarding fooddesertification, is the "Food Access Research Atlas," which provides a spatial data set covering food desertification at the Census Tract level (USDA Economic Research Service, Documentation, 2019). To calculate at-risk tracts the USDA uses three metrics to estimate an area's susceptability to food desertification. First, the USDA relies on metrics from the Treasury's New Markets Tax Credit (NMTC) program to designate low income neighborhoods (LI). Under the NMTC program, tracts with a poverty rate greater than or equal to twenty percent are considered low-income (USDA Economic Research Service, Documentation, 2019). Additionally, tracts with a median family income less than or equal to eighty percent of the state-wide median family income and tracts in a metropolitan area with a median family income less than or equal to eighty percent of the metropolitan area's median family income are considered low-income (USDA Economic Research Service, Documentation, 2019). Once these low-income tracts are identified, access is determined by analyizing variables which impact the spatial relationship between consumers and grocery stores.

The USDA (2019) defines low-ccess (LA) as "being far from a supermarket, supercenter, or large grocery store. A Census tract is considered to have low access if a significant number or share of individuals in the tract is far from a supermarket." As of 2017, the USDA defines a supermarket or large grocery store as "a store that reported at least $2 million in annual sales and contained all the major food departments found in a traditional supermarket…" (USDA Economic Research Service, 2017, p. 1) To measure distance, the USDA converts vector demographic data into one half kilometer-square grid cells (USDA Economic Research Service, Documentation, 2019). The geographic center

of each grid is then identified and used to measure the distance of consumers to the geographic center of the closest grid with a grocery store. Spaitially, the atlas uses three distances to identify different levels of access for Census tracts. The distance that identifies the largest portion of individuals as low-access uses a distance of greater than ½ mile in an urban area, and greater than ten miles in a rural area. In total, this method of measurement identified 53.6 million people, or just over seventeen percent of the U.S. population lived in a low-income low-access tract as of 2015 (USDA Economic Research Service, 2019). Since the 2015 analysis, the USDA has added more conservative measurements to their classification system. Currently, their most conservative estimate places a one mile benchmark in urban areas and a twenty mile benchmark in rural areas. Lastly, the USDA ERS calculates vehicle availability for low-access low-income (LALI) tracts to measure food desertification.

To calculate vehicle availability, the Census' American Community Survey (ACS) data relied upon to provide an estimate of vehicle availability for the LALI tracts. A tract is designated as low vehicle availability if 100 or more households lack a vehicle and are farther than ½ mile away from a supermarket in an urban area. In total, the USDA ERS found that 1.7 percent of all housing units in the United States are low income, low Access and do not have a vehicle (USDA Economic Research Service, 2019). While the Food Access Research Atlas is comprehensive in both scope and scale, contemporary food security researchers argue that representing food insecurity with the desert metaphor has led to confusion.

Shifting Discourses

Widener (2018) notes in his paper "Spatial access to food: Retiring the food desert metaphor," that the desert metaphor over simplifies the complex issue of food security. The term food desert, used to describe food insecurity, provides policy makers, researchers, and politicians a method to locate areas of land where food is impossible to obtain. Relying on the desert metaphor over simplifies the issue of food insecurity and distills food Access into a study that is primairly concerned with location. Food security, then, becomes an issue that policy makers seek to solve by adding grocery stores to areas with a disparity of access. Unfortunately, proximity is not the only determining factor when an individual or family seeks out healthy food, for instance price, quality of produce, and store operational hours have been shown to impact consumer decisions. Through the use of generalized data, many of the factors which impact a household's ability to obtain food are lost, making this issue easily misunderstood when it is analyzed through a blury lens which does not consider local contextual data. Thus, the use of the food desert metaphor renderes any solution or analysis of the topic moot. If researchers disregard many of the confounding varriables taken into consideration when a consumer selects a grocery store, we are not likely to make progress in the fight for food security (Widener, 2018).

To combat the misconceptions of food insecurity coaxed by the use of the term food desert, three methods act as viable solutions to increase the accuracy of contemporary research (Widener, 2018). First, researchers must use a holistic approach when identifying areas of need. Through a readaptation of Penchansky and Thomas' (1981) framework to study consumer satisfaction of health services, Widener (2018)

proposes that food insecurity may be accurately studied. Availability, accessibility, accommodation, affordability, and acceptability serve as viable factors consumers consider while selecting grocery stores. Widener (2018) notes that in addition to this newly adapted framework, researchers must be wary of the various issues of communicating food security to a general audience.

As with many other studies that implement a spaitial perspective, researchers are likely to overlook issues of data reliability and representation. Notably, static maps often misrepresent data through "the fallacy of division…the modifiable areal unit problem… and boundary effects" (Widener, 2018, p. 258; see also Chen, 2017; Schwartz, 1994; Wong, 2004). The fallacy of division, first postulated by Aristotle, states that a member of a group is often misassociated with the group itself (Schwartz, 1994). Within a study of food insecurity, the fallacy of division may lead a researcher to believe that someone living within a "food desert" does not have access to healthy food despite the fact that they have the means to seekout and obtain healthy food by traveling to farther grocery stores. This poses an issue to food insecurity researchers because it may lead to an overestimation of need resulting in the misallocation of resources.

Next, the modifiable areal unit problem (MAUP), is a phenomenon that causes derived study values to vary widely depending on arbitrary geographical areas determined by a census. The varriable nature of admininstrative boundaries and the frequencey at which they are redrawn leads to inconsistant findings across analyses for a geographic area. Wong (2004) notes that the zoning effect and scale effect are two sub problems which lead to the MAUP. Zoning effects occur when varrying administrative boundaries are used in an analysis and yeild inconsistent results despite geographic

location. The scale effect transpires when data with two different spaitial resolutions are used in conjunction and produce different statistical findings (Wong, 2004). Accordingly, these two effects of the MAUP have led researchers to misinterprit the findings of their analysis.

In addition to the zoning effect and scale effect mentioned by Wong (2004), Dr. Xiang Chen postulates that boundary effects, or the statistical bias present when an analysis is conducted, in a "finite geographic region…" have led to a misrepresentation of study findings (Chen, 2017, p. 150). As Chen (2017) noted, the edge effect states that data from outside of the study region can be unintentionally captured during the analysis process. Within the study of food access, the edge effect has led many researchers to produce inconsistent findings, which are highly variable depending on the study's areal unit, consumer neighborhoods, and activity spaces. Consequently, food security researchers, may likely misidentify the location and prevalence of houses which do not have access to supermarkets or Supplemental Nutrition Assistance Program (SNAP) retailers simply due to the fact that stores often straddle enumerated boundaries (Shannon, 2014, as cited in Chen, 2017).

After considering the various issues with measuring and representing food Access, Widener (2018) provides some alternatives for conducting this research. Among these alternatives is a call for increased consideration on place based factors which impact an individual's likelihood of using a grocery store. As Widener (2018, p. 259) notes, a systematic measure of the food environment can tap unexplored and meaningful implicit variables such as "economic accessibility, cultural appropriateness, and temporal

availability of stores…" these varriables play an immense role in determining if a grocery store will be used by community members.

The remainder of this review uses Widener's proposed place-based alternative of measuring food security as a jumping off point to explore theoretical approaches to study food insecurity, variables for risk measurement, data collection, literature regarding the qualitative and quantitative methods used for this analysis, and applied food security research. Notably, Widener was not the first researcher to call for the expansion of food security analysis. In fact, there has been a growing movement within food security studies, which seeks to include variables of place that impact food insecurity (see Hammelman, Reynolds, & Levkoe, 2020; Morgause-Faus & Sonnino, 2019; Parzer & Astleithner, 2018; Sonnino, Marsden, & Moragues-Faus, 2016). Over the last decade several researchers using quantitative, qualitative, and mixed methods have begun to unpack areas of need often missed by the Food Access Research Atlas

Alternatives on the Food Landscape

Contemporarily, there are several theoretical approaches that drive the study of food security in the field of geography (Sonnino, Marsden, & Moragues-Faus, 2016). As Sonnino et al. (2016) note, several conflicts exist within these current frameworks, which cause them to be problematic. Notably, "oppositional narratives" and "obsolete dichotomies" have left food security scholars searching for a new way to holistically represent food insecurity (Sonnino, Marsden, & Moragues-Faus, 2016, p. 477). As a consequence, issues within the traditional theoretical frameworks of food security studies have led to a misunderstanding of both the processes which led to food insecurity and methods which will alleviate food insecurity. Thankfully, Sonnino et al. (2016) provide a

substantial overview of contemporary food security frameworks in their article "Relationalities and convergences in food security narratives: towards a place-based approach." For their work, on understanding the contemporary frameworks of food security, Sonnino et al. (2016) surveyed 44 European food security exeperts from both the private and public sector. Unanimously, survey results showed that contemporary food security frameworks failed to consider the connection between global and local place making processess. From these findings, the authors suggest that an inclusive and appropriate food security framework must account for embedded relocalisation, embedded translocalisation, and seek to construct, progress, and reassemble food places (Sonnino, Marsden, & Moragues-Faus, 2016).

Embedded relocalisation acknowledges that food processes universally transpire at a local level (Sonnino, Marsden, & Moragues-Faus, 2016). Embedded relocalisation places an emphasis on the importance of the horizontal and vertical dimensions of food security by studying the role of place and power in food production, processing and consumption. As Sonnino et al. (2016) note, food security discourse typically transpires at a national level. For instance, research conducted by the USDA ERS, provides a glance at data without exploring the place-based construction of food access (Sonnino, Marsden, & Moragues-Faus, 2016). With the call for relocalisation in food production, processing, and retail distribution, it is important to note that "all food practices are indeed local…" and thus food security research must be conducted at a local level to truly encapsulate the unique landscapes and discourses surrounding a community (Sonnino, Marsden, & Moragues-Faus, 2016, p. 484).

Larger calls, made by Sonnino et al. (2016), to conduct both food process and food security research at the local level provide an opportunity to analyze food allocation actors, activities, and interventions at a granular level. When an increased emphasis is placed on the local, as opposed to the global, the expanding frontier of food security research will undoubtedly provide community-level insight that is often missed. Notably, prior research, conducted at a local level, has indicated that municipal governments can intervene and reconfigure policy to improve relationships between food producers and consumers. Therefore, with an increased awareness of the importance of local research in food security discourses, the power of place-based constructs such as "rights, assets, participation and citizenship" become intergral to the study of food Access, consumption and production (Sonnino, Marsden, & Moragues-Faus, 2016, p. 484).

While re-imagining the role of local geography in food systems and food security research, the importance of focusing on the spread of knowledge between food systems becomes fundamental to place-based research. To account for such elements, Sonnion et al. (2016) identify a need for embedded translocalisation in the shifting discourses of current research.. The prospect of food systems interacting with, and sharing resources amongts themselves transcends any conventional food security framework and is an untapped boone for researchers interested in the intersection of place and food systems. Contemporary systems of governence, research, and society's overall understanding of the causes of food insecurity are lagging behind the reality that food insecurity in the result of the disconect between consumers, grocery stores, and the government. Notably, Sonnino et al. (2016, p. 485) state that "food security innovations today operate across and between scales and traditional jusridictions. This challenges existing and formal

systems of governance, and creates new spaces and places of possibility for producers and consumers…" With the shifting tides of food security operations, researchers must push the field towards a study of cross-scale food systems and their jurisdictions. Sonnino, Marsden, and Moragues-Faus' article calls for place-based research because it has the potential to unlock a greater understanding of the intricacies of local food insecurity.

Several factors are responsible for contextualizing food security and the food landscape. Current qualitative factors of placed-based food security research align with three catagories: social construction, progressive assembling of place, and fluidity of place are likely to be the most influential on consumer behaviors (Sonnino, Marsden, & Moragues-Faus, 2016). Justifiably, these three variables serve as avenues to reframe contemporary food security research and provide a more holistic view of the issue. Following in the footsteps of David Harvey, researchers must question what social processes contribute to the food landscape and how these processes are reorganized "across and through place…" (Sonnino, Marsden, & Moragues-Faus, 2016). Scrutinizing the organization of food landscape calls into question various power dynamics which have traditionally been responsible for creating food insecurity and act as a way to democratize food Access. In conjunction with the democratization of food Access, researchers must use a progressive understanding of place. The implementation of a progressive sense of place acknowledges that place construction is a multifacited process in which each actor (government or individual) controls food Access. When a progressive sense of place is implemented in food security research, it is then when the scales at which food processes take place are blured and both the public and private actors may

work together to alleviate insecurity. Finally, researchers must treat place, and more specifically, places where food is accessed as being fluid. Increaseing focus on the fluidity of place provides the researcher with new avenues of study by specifically focusing on the qualitative possibilities of place-based food inequity.

Painting the Food Insecurity Landscape with Qualitative Analysis

Issues of place-based food inequity can be tackled by analyzing both quantitative and qualitative variables (Widener, 2018). Accordingly, both quantitative and qualitative analyses were employed to derive the findings of this research. Quantitative aspects of this research are employed to highlight new areas prone to food insecurity and the qualitative portion develops a "thick description" of the Accessibility characteristics of grocery stores (Creswell & Poth, 2018; Merriam & Tisdell, 2016). To collect data, a structed observation was conducted at each of Lincoln's grocery stores. This data collection methodology follows the employed by both Martin et al. (2014) and Zhang (2017). Additionally, structured observations were employed for this analysis because it provided the researcher the opportunity to gain first-hand experience of the layout and composition of each of Lincoln's grocery stores. The resulting qualitative themes, developed from the analysis, highlight the commonality of grocery stores in areas where food insecurity may be prevalent (Creswell & Poth, 2018). The categories studied during each observation were adopted from Penchansky & Thomas (1981) and modifided using contemporary literature to analyize the qualities of a grocery store. To describe these grocery stores, the framework method was employed because it helps to identify the similarities between units of analysis and encourages creativity while communicating study findings. This study's intention is to use this qualitative analysis to study the place-

based variables which contribute to food insecurity at the grocery store level and to separate these grocery stores into different thematic categories. Additionally, this analysis attempts to identify any clustering of like grocery stores in the different areas of Lincoln. This methodology provides an additional rich understanding of low Access grocery stores which will complement the quantitative data collected for this study (Guetterman & Babchuk, n.d.).

The Stages of a Qualitative Framework Analysis

Framework analysis, or simply framework, was first formulated as a way for researchers working in social policy fields to conduct research in an efficient manner (Ritchie & Spencer, 1994). Specifically, the Social and Community Planning Research Institute intended for this method to be used in applied research. Since Framework's development, researchers have employed the method to analyze issues in health policy and psychology, to name a few fields (see Goldsmith, 2021; Parkinson, Eatough, Holmes, Stapley, & Midgley, 2015; Ritchie & Spencer, 1994). The most appealing aspects of framework are the level of versatility possible, the transparency required, and the simplicity that this methodology provides during each stage of analysis. As Ritchie and Spencer (1994) note that, data familiarization, framework identification, indexing, charting, and mapping, guarantee that the researcher completes a strategic and documented qualitative analysis. However, a researcher employing framework must remember that at the heart of any qualitative analysis is an iterative nature which drives inquiry. Keeping this in mind, researchers employing this method must remember that the five steps of framework are not mechanical, and instead explore various new avenues of inquiry at every stage.

During the initial stage, data should be reviewed several times. Familiarization is meant to help researchers gain deeper insights on their study. In fact, this process is so key, that it is commonplace for literature to discuss the initial missteps in the familiarization process (see Goldsmith, 2021; Parkinson et al., 2015). In their paper, describing the framework methodology, Goldsmith (2021) highlighted that after a first review of data, guided by an irrelevant research question, they let their data and their research interests guide the familiarization process. Upon a second review, guided by specific commonalities in the data, Goldsmith (2021) was better informed about the research data. After familiarization is complete, key themes are derived from this initial step. The sharing of themes identified from the first step is a method researchers use to boost clarity and increase the validity of the framework analysis. These key themes are then carried over to be used in the identification of a study framework.

Armed with a set of descriptive themes derived from the familiarization process, the researcher seeks to identify a framework, or a common set of abstract connections linking different observations together. As discussed by Parkinson et al. (2015), the basis of the framework employed for a research project should focus on the themes derived during the familiarization process. Aditional insights, regarding the formation of a framework, may be derived by consulting theories or themes which originiated from other research.

A priorty of the framework formation process should be to follow the research question outlined by the research design; however, a boone of framework analysis, and qualitative research in general, is that the exploration and use of intriguing themes found in the data set is encouraged while formulating a framework (Goldsmith, 2021). After

hiting saturation, or the point at which data repeats itself, the researcher must decide if the framework is appropriate for the project. As Goldsmith (2021) demonstrated, a final framework must provide avenues of inquiry which are consistent across the dataset, and aspects of the framework should evolve from the familiarization process. Many framework analyses elect to use a table to display an initial framework and final framework. The discussion of the processes of formulating the finalized framework, required by a framework methodology, demystifies the qualitative process. Validity is added at this phase because the audience may use the framework table to identify the connections that are made through the qualitative process. With the finalized framework in hand, indexing may begin.

Researchers apply the study framework to each observation during the indexing step. Indexing is used to focus the analysis, pulling directly from observations, interviews, or other qualitative materials to place datainto different thematic catagories. Guided by the framework, the researcher consistently combs through data to begin tying the common threads of the study back to the central research question and other interesting avenues of inquiry. It is important to note that qualitative researchers are expected to use an iterative mindset during the indexing phase. Parkinson et al. (2015), note that when data points exist between framework themes or belong to multiple catagories it may be helpful to rework the framework to include these data. Researchers may use examples of how a data point fits within their framework to dispell any issues of analysis reliability. After the data is catogorized using the lense of the framework, and applicable data has been indexed, charting may begin.

Charting is the process of systematically organizing data. The charting step ensures that the study data is placed in a managable format creating an efficient and consistent analysis process. Indexed data is used during this stage to help make the process of connecting threads transparent and managable. Researchers may take this last step, before the final connections are formed, to revisit the units of analysis employed by the method, framework components, and the viability of the framework that they have created (Goldsmith, 2021). If the research question has been adequately answered, and no new data emerge from the units of analysis, all of the necessary components to move on to the final analysis of the qualitative data have been complete.

During the final stage of framework analysis, researchers compare cases to each other to uncover trends and commonalities in data. During this time, they look for variation amongst the entire dataset, variation between observations in the same category, or clustering of data (Goldsmith, 2021). Ritchie and Spencer (1994), highlight that the final product of a framework analysis can be presented in many forms: key concepts of the study may be identified or described, threads which tie phenomena, from different observations, can be explored, or topologies regarding the study may be formulated. A qualitative researcher is encouraged to create compelling stories with their data and to convey their findings in creative ways.

Achieving Rigor in Qualitative Data Analysis

Qualitative data analysis requires a certain level of data abstraction during the analysis phase. A researcher's findings may be explicitly shaped by the literature, or implicitly shaped by their own understanding of the topic. Accordingly, qualitative scholars have come to acknowledge this as an area they can both account for and

embrace through reflexivity and rigorous analysis. Reflexivity, via positionality, is essential for any qualitative study because it provides readers with an understanding of the researcher's life experiences, which can alter a study's findings (Creswell & Poth, 2018). Thus, the goal of qualitative research is not to provide a singular understanding of the realities of the subject, instead, the technique attempts to describe a phenomenon with an understanding that reality is dynamic between different contexts and different individuals. Qualitative researchers do not propose that their research offers a "God's eye view," or a holistically objective recounting of the study data (Putnam & Conant, 1990 as cited in Kiernan & Hill, 2018). Therefore, qualitative research must be undertaken in a systematic and rigorous way if it is to be considered valid for application and publication (Kiernan & Hill, 2018).

Grodal et al. (2021) highlight this call for an increase in rigor for qualitative research in their article "Achieving Rigor in Qualitative Analysis: The Role of Active Categorization In Theory Building" Rigor, or the intensity and clarity of methods performed by qualitative researchers, ensures that the findings of a study have been diligently formulated. Grodal et al. (2021) assert that increased transparency, while transitioning from data to theory, will clear up skepticism that has been common place for readers who view qualitative research from a positivist lens. Historically, it was common for qualitative researchers to report the findings of their analysis without discussing how data led to the creation of theory.

To demonstrate the validity and rigor of this study's findings and to negate any questions of subjectivity, each of the methodological steps of the framework is discussed using study data. Additionally, this study's framework is rooted within literature which

studies placed-based Access (see Aragon, Armstrong Shultz, Bush-Kaufman, & Barale, 2019; Cannuscio, Hilier, Karpyn, & Glanz, 2014; Major, Delmelle, & Delmelle, 2018; Martin, et al., 2014; Shannon & Widener, 2014). Reflexivity, via positionality, is essential for any qualitative study because it provides readers with an understanding of the researcher's life experiences, which can alter a study's findings (Creswell & Poth, 2018). Consequently, the validity of the findings that qualitative researchers formulate is often called into question. Adapting a framework from prior research ensures that study findings are not simply the author's own personal beliefs. This study seeks to expand current methodological practices, in food security research, by analyzing the themes of Penchansky and Thomas' (1981) new taxonomy of Access at different scales. Additionally, qualitative portions of this analysis provide a method to identify and describe threads of commonalities between grocery stores. The uncovered threads are then mapped out to explore the spatial patterns of qualitatively clustered grocery stores. However, before grocery store level findings can be discussed, the literature which shaped the quantitative methodologies, used by this research, must be explored.

Exploring the Quantitative Components of Food Insecure Landscapes

Shifting from qualitative to quantitative methods of analysis, Major, Delmelle, and Delmelle (2018) unpack food Access using geodemographic segmentation. Geodemographic segmentation analysis is the practice of classifying neighborhoods based off of similar demographic and socioeconomic (SES) characteristics (Troy, 2008). A majority of food security research focuses primarily on spatial access. Unfortunately, the neighborhood food environment is comprised of numerous dimensions, which impact an individuals ability and desire to shop at the closest store with healthy food (Major,

Delmelle, & Delmelle, 2018). Therefore, an analysis of neighborhood level factors provides a comprehensive synthesis of household food Access.

Through the collection and combination of data from the Census ACS, Walk Score, and MapQuest, at the block group level, Major, Delmelle, and Delmelle, were able to complete their geodemographic segmentation analysis. Data from the Census ACS were included, but were not limited to median age, median income, percent of population below poverty line, percent of renters, and percent of households without vehicles at the block group level. The authors used Walk Score data to identify walkability index scores of neighborhoods. Lastly, Mapquest data provided Major, Delmelle, and Delmelle (2018) the minimum distance of a block group's population centroid to grocery stores, convenience stores, and farmers markets, in the State of North Carolina. After collecting this data, the researchers used it to predict how various neighborhood variables impacted the food Access landscape of the state of North Carolina.

During the initial analysis, the authors considered over twenty-five variables as neighborhood based predictors of food Access. While pruning variables from the original list of twenty-five, the authors concluded that various SES variables including: median income, percent car ownership, and percent of households with children that are headed by a single parent, played a significant role in determining food insecurity probability (Major, Delmelle, & Delmelle, 2018). Paralleling in importance to SES variables, the authors used distance to grocery stores and WalkScore data to determine the Accessibility of food. After completing segmentation and running a cluster analysis, it was determined that neighborhood level variables highlighted block groups in need that the USDA and

other researchers had missed. As Major, Delmelle, and Delmelle (2018) found, the large scale analysis provided an understanding of regional food insecurity.

Unfortunately, because of the scope of the study methodology methodology, additional nuances of place-based data, for studying food security, such as the impact of the percivied quality and price of goods sold at a store, were missed (Major, Delmelle, & Delmelle, 2018). Consequently, place-based variables stand as one of the most important and understudied variables in the food insecurity field. Fortunately, researchers in the field of geography have begun to explore place-based aspects of food security, Widener's (2018) call for an expansion of study of the local food environment and Zhang's (2017) recent adaptation of Penchansky and Thomas' (1981) taxonomy of Access has opened new avenues for the classification of food insecurity.

Current Use and Readaptation of Accessibility

Recent calls in the geographic study of food insecurity and food sovereignty seek to expand the research discourse outside of traditional analysis methods (see Hammelman, Reynolds, & Levkoe, 2020; Sonnino, Marsden, & Moragues-Faus, 2016; Widener, 2018). To combat the over-simplification of food security research qualitative or mixed-methods studies may provide critical insights into understudied realms. To date, several authors (see Morgause-Faus & Sonnino, 2019; Parzer & Astleithner, 2018) have worked to conduct qualitative studies of food insecurity in urban environments using survey and go-along methodologies. These articles shift discourse away from the strictly quantitative focus to a holistic analysis of the food environment. One such example comes from Dr. Mengyao Zhang's (2017) dissertation, which incorporated a neighborhood and a place-based analysis of food Access in Hartford, Connecticut.

Through the reimagining of the food environment to incorporate Penchansky and Thomas' dimensions of Access, Zhang provided a fresh look at the place-based variables that impact food Access by formulating a survey to conduct a systematic analysis of availability, accommodation, affordability, and acceptability, for 99 grocery stores in the greater Hartford community.

Zhang (2017) determined store level availability by recording a percentage of food items available at each store. Thirty-eight predetermined foods, ranging from ground beef to Frosted Flakes were searched for, in each store, to determine an availability score of each grocery store. If an item were not available, the author would note the food, which would negatively impact the store's availability percentage. Price of each of the thirty-eight food items were also record on the survey. If an item was not available, it was marked with an NA, and the average cost of the product, across every store, was used to determine the missing item price (Zhang, 2017). To ensure that data was comparable across stores availability and price of all thirty-eight items was added together to create basket availability and basket price data.

Acceptability was measured by internal and external characteristics and quality of produce. Zhang (2017) used interior characteristics such as appearance, lighting, cleanliness, and organization to understand one-third of a store's acceptability rating. External acceptability was measured using appearance, lighting, parking, and neighborhood data, including income and crime data. Lastly, produce quality was measured with a Likert scale where zero indicated that produce was the worst possible quality and five indicated that the produce was the best possible quality (Zhang, 2017). To standardize all survey values, a ratio system was implemented to ensure that data

could combined into categories. After ensuring that all values were standardized, the acceptability score was then calculated with each of the three variables (internal, external, and produce) having the same weight. Accommodation was calculated by reporting each store's hours of operation, the total number of people waiting, and the number of open store lines.

The place-based Access characteristics, formulated by Zhang (2017) were adopted and modified to conduct structured observations to study the food security landscape of Lincoln, Nebraska. Following the work of Zhang and the calls of Widener, Penchansky and Thomas' understanding of Accessibility is used to frame the collection and analysis of data. Additional literature is used to justify this study's methodology and adds additional variables to the study of food insecurity. Lastly, this study fills a gap in the literature by paring a quantitative analysis with a framework analysis to explore how Penchansky and Thomas' (1981) new taxonomy of Access changes Lincoln's food security landscape (Ritchie & Spencer, 1994). The pairing of these methods allows for the identification of key characteristics of grocery stores that serve potentially at-risk block groups. Neighborhood and place-based Accessibility variables are used to determine low Access block groups. After areas of low Access have been identified, a framework analysis categorizes similar grocery stores who serve at-risk block groups. This analysis highlights the limitations of Access that individuals living in the most food insecure block groups face while shopping for groceries at their three closest stores. It is my hope that these methods create a more representative portrait of the food security landscape of Lincoln, Nebraska.

CHAPTER 3: METHODOLOGY

Sources of Data

Four types of data were collected and implemented into the study of food Access for Lincoln, Nebraska. The first dataset, a list of grocery stores, was compiled using data from the Lincoln, Nebraska, SafeGraph (2021) grocery store list. These data were collected by querying SafeGraph's (2021) Core Places dataset to identify businesses in Lincoln which were listed as grocery stores. To ensure that the list was as inclusive as possible, the SafeGraph data was compared to an additional list of grocery stores from the USDA's (2019) SNAP Retailer Locator. Any grocery store that was left off was added to the SafeGraph list. The final list was comprised of fifty-two grocery stores which were then cross-referenced, using Google, to ensure that these stores were still open. After creating the first dataset, additional ancillary data were needed for this analysis. Many of the datasets regarding Lincoln, Nebraska were collected from the NebraskaMAP, an open GIS data portal which is hosted by the Nebraska Office of the Chief Information Officer (OCIO). In total, a roads shapefile for Lancaster County (Wolff, 2021), and the 2010 Census Tracts and Block groups of Lancaster County, Nebraska (Watermolen, 2020) were collected from the NebraskaMAP website.

To gauge commute times, two data sets were used to create a mean center of living space for each Census block group. First, Microsoft Bing's (2021) building footprint dataset of Nebraska was pruned down to only include buildings for Lancaster County. Then, a spatial join was used to pair Lancaster County parcel data to the building footprint shapefile. The land parcels for Lancaster County were obtained from Lincoln Open data (McReynolds, 2021). Once the datasets were joined, the select by attributes

function was used to identify all the livable buildings for the county. The remaining buildings were then split by block group using the split tool. With all the livable space for each block group identified, the mean center of livable buildings for each block group was calculated. The resulting mean livable space points were used to calculate accessibility to the three closest grocery stores. A mean livable space centroid was implemented for this analysis instead of a standard block group centroid. Mean livable space was chosen because many of the houses in large block groups were closer to the edges of the defined boundaries than the center of the block group, thus tying grocery stores that were closer to the average area where the consumers of a block group lived, instead of the center of a block group. Additionally, the mean livable space centroids were used over household level centroids because this cut down on the processing power required to analyze grocery store accessibility. Lastly, data for each of the 52 grocery stores were gathered by conducting structured observations of each store for an hour and a half and filling out the accompanying form located in Appendix A. Typically, during observation, tracking availability and price of items took roughly forty-five minutes. After these data were recorded, an additional fifteen-minute walk-through of the store was conducted to record internal acceptability. Before leaving the store, fifteen minutes was spent tracking the total number of cash registers and customers waiting in line. Lastly, fifteen minutes was spent recording external acceptability to track over Accessibility for the store.

Data Collection and Observation Variables

While first proposing the collection of grocery store data via a structured observation, several issues regarding consistency arose. First, food prices for all grocery

items are variable when considering time of year. However, because, theoretically, each of the fifty-two grocery stores are competing in a "open market" it has been determined that the variability of prices is not large enough to disrupt this analysis. Second, observations were conducted during the spring semester of 2021, and reflect fruits and vegetables which were most likely available at each grocery store during the given timeframe. During data collection, an hour and a half was spent in each grocery store to ensure that accommodation variables regarding customer number and cash register number were uniformly recorded. Additionally, data for each store was collected from four to seven o'clock at night to ensure consistency across all observations. Lastly, food items selected for this observation were purposefully chosen by reviewing literature from similar studies in adjacent fields.

After critically thinking about Zhang's (2017) research regarding Hartford's food environment, several changes were made to the structured observation and data analysis methodology to be more place-specific for the city of Lincoln. A literature review of research methods was conducted to create a tool that could accurately measure grocery store viability based on the availability of fruits, vegetables, and staple goods. First, the work of Glanz, Sallis, Saelens, & Frank (2007), who created a survey to measure food environments using the NEMS-S survey method, was used to identify the inter-rate reliability and test-retest reliability of food items in grocery stores. Notably, it was determined that cantaloupe, cucumbers, and skim milk would be present in most United States grocery stores (Glanz, Sallis, Saelens, & Frank, 2007). This research provided a list of prevalent fruits and vegetables that could be used for a grocery store observation form. With key fruits and vegetables identified for this study's field observation, the

literature review shifted focus to identify important dairy, grains, beverages, and other staples that would accurately gauge a store's food environment.

Two additional articles were used to create the rest of this study's structured observation. Tester, Yen, Pallis, & Laraia (2010) created a list of healthy food items while researching different SES school food environments. The work of Tester et al. (2010) indicated that yogurt, rice, canned beans, and dried beans such as lentils would be important items to add to the field observation. Lastly, the work of Lindsey Anderson (2018), who researched the behaviors and perceptions of Access to healthy foods in Nebraska, identified various meats, grains, and dairy products that are important when determining if a food environment is proficient for consumers. In summation, reviewing the work of these scholars ensured that this field observation would accurately measure the food environment of Lincoln. After tailoring the food items on this observation form to be more place specific, variables which impact acceptability were expanded to better understand Accessibility in Lincoln.

Table 3. 1: Structured Observation Produce List Sources

Glanz, Sallis, Saelens, & Frank, 2007	Bananas, apples, oranges, grapes, cantaloupe, carrots, sweet peppers, broccoli, cucumbers, and cabbage.
Tester, Yen, Pallis, & Laraia, 2010	Skim milk, 1% milk, low-fat or non-fat yogurt, low or reduced-fat cheese, brown rice, and beans.
Anderson, 2018	Whole-wheat tortillas, tortillas, pasta, chicken, ground beef, fish, whole wheat bread, white bread, etcetera.

Socioeconomic factors of Food Insecurity

Using the work of Major, Delmelle, and Delmelle (2018), additional areas of acceptability were considered for this research. Major et al., noted "… the unique combination of these factors (socioeconomic status indicators) can give rise to place-specific remedies that address the particular conditions of a neighborhood" (Major, et al., 2018, p. 3). Out of the total variables included in the segmentation analysis some of the key variables tied to a higher risk of food insecurity were the percent of household below the federal poverty line and percentage of renters in each block group. To make this study's analysis more comprehensive, these Census demographic variables were included in the acceptability portion of this analysis. This calculation of acceptability differs from

Zhang (2017) who used income and crime block group data to produce a final acceptability value.

Lincoln's crime data was excluded in this analysis because several issues arise when including crime statistics as a metric for overall neighborhood safety. First, issues of over-policing in the United States are rampant in diverse and lower SES areas (Owusu-Bempah, 2016). As Owusu-Bempah (2016), and others studying criminology have noted, African Americans and other minorities are highly overrepresented in crime statistics due to both implicit and explicit biases found in policing. Additionally, several areas in Lincoln, which have relatively low populations, experience higher instances of crime due to confounding variables which are not representative to the populations living in these areas. For instance, the block groups which surround downtown Lincoln experienced a larger number of crimes in 2019 than other areas of the city. To contextualize these substantial number of crimes, a deeper understanding of the unique characteristics of these block groups is necessary. Notably, a sizeable number of bars, night clubs, and other businesses, where crimes are more prevalent, are in these block groups (Lincoln, Nebraska Crime Data, 2021). While there is a small chance that all the crime in these areas is committed by the residents of these block groups, it is highly unlikely that only individuals living in these areas are responsible for all the reported crime. Lastly, measuring crime statistics through occurrence is potentially misleading. An equal weight analysis technique can produce misleading findings. For instance, an area with several thefts is likely to be seen as more dangerous than an area with one murder. Accordingly, the inclusion of additional variables, other than crime, will provide greater insight to a block group's ability to "Access" each grocery store when using acceptability as a

determinant. While all these data are important in terms of the place specific factors of food insecurity, it is important to mention that using Census geographic units, and tabular data comes with several limitations.

The largest issue with using Census data is the fact that government-defined administrative boundaries distort the clarity of data through the simplification and homogenization of data collected (Wong, 2004). This analysis attempts to avoid issues associated with the MAUP by using block group level data, which is the second smallest unit that demographic data is publicly available. The use of a small areal unit, limits variability of data by ensuring that areas are localized to a small geographic location. Specifically, block groups are comprised of between 600 and 3,000 people and are smaller in area and population than Census tracts (United States Census Bureau, 2022). Lastly, scaling and zoning effects are negated by using Census data at the block group level consistently across this study's analysis (Wong, 2004). Despite accounting for issues of the MAUP, some margin of error exists within Census data that could impact the accuracy of the study. However, researchers typically embrace the issues of variability and use Census data (Major, Delmelle, & Delmelle, 2018). Through the analysis of variables identified by Major et al. (2018) this research will provide a holistic analysis of the various SES data that are seen as indicators of food insecure block groups.

Data Analysis Methodology Using the Expanded Taxonomy of Access

Availability:

Availability is the public's ability to use a good or service in an area. In their analysis of the temporality of food deserts, Shannon & Widener, (2014) determined that store hours of operation were one of the aspects of temporality neglected from current

measurements of Accessibility. Furthering this logic, Chen & Clark (2016), account for store operation hours in their creation of a spatiotemporal Access measurement of grocery store availability. In terms of this analysis, availability is measured, at the grocery store level, through the counting of observation items in stock. An additional variable, store operating hours, was included in the availability calculation because several block groups in Lincoln become "food deserts" once stores close for the day. This is problematic for workers who do not have the privilege of working traditional hours and consequently must then travel outside of their normal route to secure food.

Item availability

At each store, availability was measured by locating observational items, if an item was not present when looking, it was noted on the form with an "NA" mirroring the method employed by Zhang (2017) and Martin et al., (2014). An item availability score was then calculated by dividing the total number of items by the expected number of thirty-five. Stores which had more observational items scored higher in terms of item availability.

Hours of operation

A store's hours of operation for the week were collected at the store's location and these times were then double-checked using the businesses reported hours on Google. Once the store operational hours were collected, the total number of hours was divided by the total number of hours for the week to create a percentage. These two values where then added together and divided by two to create an availability index for each of the grocery stores in this analysis area.

$$\text{Availability Index} = (IA + HP) / 2$$

IA: Item availability;
HP: Hours of operation;

For example, stores such as Walmart, which is open for seventy percent of the week and had every item on the Observation form, received high scores on the availability index. Other stores such as Natural Grocers, which did not have all the observation items and had a limited number of operating hours, scored lower on this index.

Acceptability:

The acceptability index represents the external and internal characteristics of each grocery stores in this analysis. While interviewing 194 low-income consumers in Washington state, Aragon, Armstrong Shultz, Bush-Kaufman, & Barale (2019) found that, shoppers were more likely to purchase fruits and vegetables if a store was visually appealing, had high quality produce, was clean, and was safe. With place-specific factors in mind, a collection of data regarding the acceptability of Lincoln's grocery stores will describe the landscape in and around grocery stores. For instance, customer shopping patterns are determined by internal and external store variables, such as cleanliness, and safety. Therefore, collecting internal and external acceptability data on cleanliness, lighting and visual appeal will provide insights on the acceptability of a store.

Produce quality

At each store, the quality of each vegetable was ranked on a scale of one to five, one being vegetables which were of inferior quality and five being high quality vegetables. The vegetable quality Likert scale, used during each visit, is available for viewing in Appendix C. To ensure that each store was graded fairly on produce quality,

all 52 grocery stores were visited around peak business hours which were from four to seven pm on the weekdays. After these scores were collected, the ratings were added together and divided by the max produce item quality score of 50. A higher ranking indicated that the store had the freshest produce possible.

Internal acceptability

To gauge internal acceptability, four variables, appearance, lighting, cleanliness, and organization were evaluated for the internal components of each store. Mirroring Zhang's (2017) analysis of internal acceptability, facets which might deter consumers from shopping at a given location were explored through the internal acceptability variable. Hence, internal acceptability was measured through appearance, lighting, cleanliness, and organization because these variables cover the gambit of qualities that could hinder an individual's ability to shop at a store (Aragon, Armstrong Shultz, Bush-Kaufman, & Barale, 2019). Each of the four variables were scored on a one through five system, with a score of one indicating that a store lacked lighting, was unclean, was unorganized, or had a poor internal appearance. The Likert scale used to grade each store is available for review in Appendix D. The Internal acceptability observation strategy was adopted from the work of Martin et al. (2014). The work of Aragon et al. (2019) was used to expand the observation Likert scale. The sum of internal acceptability variable scores was then divided by the maximum score possible to produce an internal acceptability percentage.

External acceptability

External acceptability is comprised of the external appearance of the building, the lighting which surrounds the building and the parking available to consumers. Lighting

and parking were chosen for this observation because these variables ensure that the customer will safely and easily be able to use the building (Martin, et al., 2014). Additionally, external appearance was taken into consideration because this is likely to play some role when consumers are deciding which shops they visit for groceries (Aragon, Armstrong Shultz, Bush-Kaufman, & Barale, 2019). The categories, that comprise external acceptability were developed by consulting the work of Martin et al. (2014) and Aragon et al. (2019) and these factors were scored on a one through five scale. Each of the values were then added together and divided by the maximum score to produce an External Acceptability percentage. Stores who scored lower on external acceptability lacked lighting around the store, did not provide enough normal or handicap parking, and did not maintain the outside of the building including parking areas. A copy of the Likert scale, used during each store visit, is available for review in Appendix E. Once each of the three grocery store level acceptability values were collected, they were added together and divided by three, this produced an index value which represented grocery store level acceptability (GAi).

Grocery Store Acceptability Index = (iA + eA + PQ) / 3
iA: Internal Acceptability;
eA: External Acceptability;
PQ: Produce Quality;

Grocery Store Affordability:

Affordability measures the overall price of the thirty-five goods at each grocery store. If an item was not available at a grocery store the average price of the missing good, across each observation, was used as a filler value. Replacing the missing price

with the average cost of the missing good matches the method that Martin et al. (2014), employed in their analysis of urban food environments.

Basket Price

At the grocery store level, total basket price was calculated by adding the price of each of the observation goods (Martin, et al., 2014). To maintain consistency across all stores, the lowest priced item was selected for each of the thirty-five food items. Once this basket price was calculated, grocery store level price data needed to be converted to the block group level.

Accommodation:

Grocery store accommodation represents the likelihood that all consumers, regardless of socioeconomic status, will be able to purchase the goods that are for sale in a store. Past research has shown that consumer shopping patterns are contingent upon intrapersonal determinants and interpersonal interactions, amongst other variables (Cannuscio, Hilier, Karpyn, & Glanz, 2014). Consumers noted that they preferred to shop at stores that aligned with their socioeconomic status, in one such instance of self-sorting, participants indicated that they preferred to shop at stores where using WIC was an easy and discrete process because other stores had made this a difficult and embarrassing task (Cannuscio et al., 2014). Interpersonal interactions at grocery stores, such as positive staff interactions, increases customer satisfaction, especially if there are an adequate number of workers to make the shopping experience convenient (Cannuscio et al., 2014). Accordingly, the accommodation index was particularly important because it measures intrapersonal determinants through the collection of data regarding government benefit acceptance. To intrapersonal determinants, the acceptance of government benefits, such

as SNAP, was noted for each store during observation. Acceptance of social programs was later corroborated by using the USDA's (2019) SNAP retailer locator database. Additionally, interpersonal interactions were recorded during a prolonged observation of the checkout process. Data regarding the number of open cash registers and number of people waiting in line provided an estimate of the prevalence of positive or negative social interactions that transpired at a grocery store level. Relating these variables back to the overall analysis of Accessibility, high accommodation scores identify stores who accept government assistance and have a quick checkout. While conducting the store level observation, between fifteen and thirty minutes was spent counting cash register variables. Additionally, check-out data represent the maximum number of cashiers working and people waiting in line during the fifteen-to-thirty-minute checkout observation window, this ensured that the observation recorded the peak rush and maintained consistency across each observation.

Number of people working cash register

During each grocery store observation, one of the last data points collected were the number of people working cash register. Over half of the large chain stores adopted a form of self-checkout, and these stations were counted on each observation. To make this number useable in this analysis, total number of open registers at each store was divided by the maximum number observed across every observation. This produced a percentage that would score each store by the number of registers available out of the maximum observed.

Number of people in line

To balance out the accommodation index, the number of consumers waiting in line at each store was also recorded. Logically, large grocery stores are more likely to have many cash registers open, but these stores are also likely to have a greater number of people waiting in line at a given time. Thus, the incorporation of number of people in line is meant to balance out the prior data point to ensure that local grocery store accommodation index values are fairly represented. To get a percentage of people in line, the maximum number of customers observed across all stores was used as a denominator for a customer percentage calculation for other stores. One was then subtracted from these values to ensure that many people waiting in line negatively impacted the accommodation score.

Government Assistance Program Acceptance

Lastly, stores which accepted government assistance were noted on the observation form. These produced Boolean values where stores that accepted assistance programs received a 1 for yes and stores who did not received a 0 for no.

To calculate an overall Accommodation index the three variables were then added together and divided by three. The resulting calculation identified stores which would be the most accommodating for a diverse range of consumers.

Accommodation index = (PerP + PC + GA)/3
PerP: Percentage of people waiting;
PC: Percentage of open cash registers;
GA: Acceptance of government assistance programs.

accessibility:

A consumer's ability to access a store is often measured using the geographic proximity between a service or good and the consumer (Widener, 2018; Zhang, 2017). Therefore, to measure geographic access of grocery stores, Zhang's methodology was modified and applied to this study of Access. To derive accessibility data, a script was written which used Google's Distance Matrix API to measure travel times between an origin pair of coordinates and a destination pair of coordinates. Additionally, ancillary data including time of day, mode of transportation, and quickest route were accounted for in this calculation of travel time. Specifically, origin points for the script were represented by each block group's mean center of livable space and travel times were calculated from these points to the three closest grocery stores. The Google Distance Matrix API was used to calculate travel time because it accounted for real time traffic and road condition to produce the three quickest route travel times to each grocery store. Additionally, for transit times, the api estimated walking time and distance from block group centroid to bus stop. The script for these calculations was run between four and five pm, during a weekday, when traffic would be busiest. One set of travel time values were used for the analysis because no significant variation on travel time calculations were recorded upon subsequent calculation.

Data Preparation:

The ESRI closest facility tool was used to analyze the relationship between block groups and grocery stores. During the analysis, a network of streets was used to pair each block group mean livable space centroid with the three closest grocery stores. The tool emulated driving conditions such as road access to ensure the accuracy of the

calculations. Additionally, the tool ensured that place-specific grocery store data regarding availability, accommodation, affordability, and acceptability were joined to the correct block group. Once each centroid was paired to three grocery stores, an Excel pivot table was used to create block group level averages of the grocery store level data. After completing the pivot table, block group level data consisting of socioeconomic variables, median income, and travel time were still missing from the Accessibility analysis.

Merging Grocery Acceptability and Block group SES variables

Two Census variables, determined to be correlated with food insecurity, were used to create a block group level SES index for the acceptability calculation (Major, Delmelle, & Delmelle, 2018). First, renting population data for each block group was divided by the total population of a block group to produce a percentage of total renting population. One was then subtracted from the total renting population to produce the total non-renting population for each block group. Additionally, population percentage over the poverty line was calculated by taking the number of individuals under the poverty line and dividing it by the total population of a block group. Once poverty population percentages were calculated, one was subtracted from the value to indicate what percentage of the population resided above the poverty line. Both SES variables were then added together and divided by two to create a SES index value for each block group. The resulting values indicated that block groups with lower SES scores are more likely to be susceptible to food insecurity. Finally, a block group level acceptability index was calculated by adding grocery store level acceptability and SES index values together then dividing by two to produce an acceptability score.

Block group Acceptability Index = (GAi + SESi) / 2
GAi: Grocery Store Acceptability index;
SESi: Socioeconomic Index

Block group Level Affordability Index

The collection of food item price at a grocery store level does not provide enough information to estimate a block group's overall ability to purchase goods from their three closest grocery stores. To fully understand affordability, contextual data, such as income, must accompany grocery store level data to measure consumer purchasing power and overall Accessibility to food (Carson & Boege, 2020). After calculating the basket cost for each grocery store, a method to measure the affordability of an average basket at the block group level was needed. To do this, each block groups' gross monthly median income was calculated by taking the total gross median income and dividing it by twelve. Block group level price data was derived by adding the basket cost of a block group's three nearest grocery stores and dividing it by three. The average basket value was then multiplied by four, indicating that each household in a block group shopped for groceries at least once a week. A monthly grocery expenditure for each block group was then calculated by taking the average monthly price data and dividing it by the monthly gross median income. To ensure that monthly grocery expenditures were accurate, price data was compared to the monthly food spending estimates calculated by the USDA Food and Nutrition Service (Official USDA Food Plans: Cost of Food at Home at Four Levels, U.S. Average, May 2021).

Block group Affordability Index= (MBP / MMI)
MBP: Monthly Basket Price;
MMI: Monthly Median Income

The resulting calculation indicated what percentage of median income was spent on groceries for each block group. To ensure that lower values did not impact the Accessibility analysis negatively, one was subtracted from the percentage of median income spent. The resulting number indicated what percentage of income would be left after purchasing groceries each month.

Transit Travel Time

Transit travel time provides an estimation of bus travel times from each block group's mean livable space to the three closest grocery stores. While calculating transit times with the Google API a few assumptions about the average consumer were made to produce accurate travel times. First, the script ensured that the API limited the amount of walking necessary to travel from the mean center of livable area to the destination grocery store. This is not to say that walking was not considered a part of the travel time calculation. Instead, the API determined walking times from the point of origin to the closest bus stop. Walking times and bus travel times were then added together, reflecting a one-way trip that an individual without a car will take. Second, the API was directed to calculate travel times for the most direct, and simple bus route to each grocery store. Lastly, travel times were calculated using real time traffic data, between four and five pm during the middle of the week.

Car Travel Time

Car travel time calculation required fewer assumptions than the transit travel time. First, this calculation assumes that all members of the block group have a car. Unfortunately, this is a large assumption, but this fact was taken into consideration by using Zhang's (2017) method to calculate comprehensive travel time. After making this

assumption, the calculation of car travel times from block group mean livable space centroids to the three nearest grocery stores was complete.

Comprehensive Travel Time

Several block groups in Lincoln have limited car ownership. To account for car availability issues in each block group Zhang's (2017) method of calculating a comprehensive travel time was implemented in this study. Consequently, by incorporating household car availability percentages, this calculation accounts for areas with low car availability, providing a more realistic depiction of geographic access for each block group.

Comprehensive Travel Time = NV x PT + (1 – NV) x CT
NV: Percentage of households without vehicles in a block group;
PT: Average Public transit time;
CT: Average Car travel time.

As Zhang (2017) highlights in their research, the incorporation of the percentage of households without vehicle availability is especially important to consider when calculating accessibility. For instance, areas with significant vehicle availability issues are not likely to be able to shop for groceries whenever they would like because they rely on other forms of transit. Thus, the use of vehicle availability, in the formula above, weights each travel time based off the percentage of households in a block group which have cars. The output of the formula, then, is a travel time that is based off an average between public transit travel time and car travel time which takes into consideration a block group's overall percentage of households with a vehicle. A percentage of accessibility was calculated by dividing each block group Comprehensive Travel Time (CTT) by the largest CTT. To ensure that higher CTT values impacted block groups

negatively, one was subtracted from the percentages. These percentages were then used as the accessibility index for each of the block groups in Lincoln, during later portions of this analysis.

Study Differentiation and Addition to the Current Literature

Through the incorporation of Penchansky and Thomas' (1981) taxonomy of Access, and contemporary literature, new perspectives on the different branches of Accessibility were formed. An expanded understanding of Access was facilitated by the calculation of new Accessibility variables in Lincoln. Additional variables were added to the calculations of acceptability, accommodation, and availability to gain a new perspective on the place-specific nature of food insecurity. As mentioned in previous paragraphs, Zhang's (2017) use of crime rate in an acceptability index is problematic because several confounding variables exist within crime rate datasets. In lieu of crime data, some of the SES variables proposed by Major, Delmelle and Delmelle (2018) were used to create an SES index that identified block groups, which had an increased risk of food insecurity. Through substituting these variables, the acceptability index calculation will provide a more comprehensive and accurate measurement of a block group's acceptability and improve the accuracy of this Accessibility analysis.

Each store's acceptance of government assistance programs was included to better understand a block group's accommodation index. Notably this broke from Zhang (2017), who only included hours of operation in their accommodation index. After consulting additional literature, government assistance acceptance was determined to provide a better understanding of the place-specific nature of accommodation,

specifically for low-income consumers. As Cannuscio et al. (2014) found, customers can be detered from shopping at a store if social benefits are not accepted.

Lastly, the availability index was changed for this Accessibility analysis. While calculating an availability index, Zhang (2017) used one variable — the percentage of observation items at each store —to calculate availability. This is problematic because availability is contingent upon both the temporal and physical variables of a grocery store (Chen & Clark, 2016; Shannon & Widener, 2014). Accordingly, studying observation items and hours of operation provides a more nuanced understanding availability.

Quantitative Data Modeling

With the Accessibility variables calculated for each grocery store, and the block group level Accessibility indices calculated for Lincoln, the final portion of the quantitative analysis for this thesis is now possible. The numerous variables, which comprise this analysis, provide some leeway while forming the findings of this research. For instance, it is possible that one variable of Accessibility is more important to forming an understanding of the place specific nature of food insecure landscapes in Lincoln. As Zhang (2017) noted in their analysis, to date there is an insufficient amount of literature and statistical evidence regarding the causality of factors which comprise a multi-dimensional study of food insecurity. Fortunately, it is possible to account for the potential influence that each Accessibility index may carry. First, an equally weighted model of the Accessibility variables assumes that an individual places an equal importance on all Accessibility variables. Using an equal weight analysis is considered appropriate for exploratory analyses where there is little understanding of the relationship of study variables (Wood, Burton, & Cutter, 2010).

Table 3. 2: Accessibility Analysis Weight Testing Percentages

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Availability	20	40	15	15	15	15
Acceptability	20	15	40	15	15	15
Affordability	20	15	15	40	15	15
Accommodation	20	15	15	15	40	15
accessibility	20	15	15	15	15	40
Total	100	100	100	100	100	100

After the initial equal weight analysis, each of the five variables were weighted differently to provide a comprehensive understanding of the impact of each index on the block groups in Lincoln. Each model, two through six, assigns an arbitrary weight to the variable of focus. Thus, these models are meant to account for the different areas of inaccessibility present across the study variables in each block group. Model one assumes that each of the index values impacts each block group similarly, while this is unrealistic, the additional models account for the impact of availability, acceptability, affordability, accommodation, and accessibility issues that may be prevalent in any given block group in Lincoln. For instance, model two assumes that the availability index is most important to a consumer. Viewing data through the lens of this model provides insight on consumers who value operational hours and observation item availability at each grocery store more than the other Accessibility variables. After the calculation of the food insecurity models a framework analysis unpacks the commonalities of grocery stores who serve at-risk block groups, as identified by the equal weight model. Importantly, qualitative analysis adds a “thick description” (Geertz, 1973) of the stores and identify commonalities between individuals living in the most at-risk block groups in the city (Creswell & Poth, 2018; Merriam & Tisdell, 2016).

Qualitative Analysis Methods

Qualitative Data Preparation

Data collected for this research is comprised of structured observational data and fieldnotes that were recorded while in each store. To make this data more manageable, purposive sampling was employed while identifying participant stores. This qualitative analysis will identify the place-specific Accessibility deficiencies of grocery stores who serve at-risk block groups. To identify areas with the greatest risk of food insecurity, block groups from the lowest classification group of the equal weight model were used as the focus of this analysis. The equal weight model was used for this portion of the analysis because there is not enough current literature which analyzes the causal effects of place-specific variables and food insecurity (Widener, 2018; Wood, Burton, & Cutter, 2010; Zhang, 2017;). The equal weight model provided a starting point and identified an initial sample size of thirty-eight for this qualitative analysis.

To ensure that the initial sample focused on grocery stores with significant Access issues, both quantitative and qualitative data were explored in greater detail. During this exploration, there were several instances where grocery stores with higher Accessibility scores were grouped with less Accessible stores. It was determined that including these stores in the qualitative analysis would skew the findings of this study because these stores' Accessibility indices were relatively high, compared to their block group counterparts. Therefore, the inclusion of these stores in the qualitative analysis could create a case that does not reflect the ground truth for many living in the at-risk block groups. Additionally, analyzing any inconsistent data would hinder an exploration into the needs of grocery stores in food insecure areas. To further pair down the sample, it was

determined that consulting initial grocery store level Accessibility indices would help to create a more representative sample of grocery stores with lowered Accessibility. Hence, a cutoff line for each grocery store level Accessibility index value was created based off the lowest classification for each variable. Stores were categorized as either low acceptability or low availability by comparing the quantitative data. After using these classification values to prune the data, the study sample size shifted to nineteen which created a more representative sample that will better fulfill the goals of this section.

Framework Analysis Procedures

Data Familiarization

During store observations, detailed fieldnotes of the environment were taken to accompany the structured observation form. To gain a greater understanding of each study grocery store, fieldnotes from each visit were transposed into a Word document. The process of reading and copying the data served two purposes for this analysis. First, this continuous familiarization process helped to construct a deeper knowledge of what was observed in the field. Second, now that the data was in an electronic document, it became possible to search for specific words, or phrases that were repeatedly written down. With the data copied into a manageable format, it was now possible to look for commonalities between the grocery stores.

During this review of common phrases identified in the word document, specific variables of Access were coded using different colors (Penchansky & Thomas, 1981). A search for qualitative information on accessibility and affordability did not return store level data because these variables were measured at a block group level. Additionally, after a second attempt at identifying commonalities in accommodation between grocery

stores, no threads linked groups of grocery stores together. Akin to Goldsmith's (2021) experience, it was determined that this data may not be appropriate for analyzing all five variables of Accessibility. Consequently, the focus of this qualitative study was realigned to analyze the availability and acceptability of the study grocery stores. The adaptation of a new focus, for this analysis, ensured that this study was an iterative process. Grodal et al. (2021) reinforce the necessity of an iterative qualitative process in their research by highlighting the benefits of a fluid research methodology. "We argue that qualitative researchers who adopt such an (iterative) approach to data analysis will not only improve the transparency and rigor of their work but also be better equipped to develop powerful theories…" (Grodal et al., 2021, p. 605). Table 3.2 provides an example of how observational data was organized after familiarization. Using the highlighted key phrases, potential barriers of Accessibility were identified for each store. After a third review of data, issues that were common between stores were coded and compiled in the familiarization matrix until saturation was hit. In this instance, saturation was achieved when five cases demonstrated characteristics of low acceptability and five cases demonstrated characteristics of low availability. Additionally, saturation was reaffirmed when issues impacting acceptability and availability began repeating themselves across cases.

Table 3. 3: Familiarization Matrix

Key Themes	Asian City Mart	Viet Hao Market	Hong Kong Market	Mia's Market N
What factors negatively impact Availability for the case (store)	• This store is lacking a significant number of observation fruits and vegetables. • Many of the other observation items are not present.	. • After reading the hours posted it seems that this store is open for about 40% of the week. • Workers with non-traditional working hours may struggle to Access the store due to specific operating hours.	–	–
Which factors negatively impact Acceptability for the case (store)	–	–	• The parking lot has pallets, boxes, and machinery, making the area potentially hazardous. • 25% of the parking lot has lighting, sides of the store, the sidewalk and the front of the store are dark making it potentially dangerous at night. • Less than ten parking spots and no handicap parking available	• Multiple areas inside the store had chipping paint, and the fridges and other equipment looked visibly worn. • Walkways were blocked by food boxes and aisles were difficult to navigate • checkout was congested with store items such as sale displays, stocking items, does not appear navigable for customers.

Framework Identification

Upon finishing four sessions of data review, it was determined that employing the new taxonomy of Access, theorized by Penchansky and Thomas (1981), as a framework for this qualitative analysis would return a rich understanding of the study context for each case (Guetterman & Babchuk, n.d.). After measuring Accessibility quantitatively, it was decided that a qualitative analysis would identify the nuances that create Lincoln's food insecurity landscape. Thus, the initial framework allowed for the identification of factors that negatively impact availability and acceptability for grocery stores. After applying this framework to the familiarization matrix, the qualitative analysis was expanded to identify how each sub-component of availability and acceptability negatively impacted Accessibility. The revised framework allows for a thorough analysis of place-specific components limiting store Accessibility.

Table 3. 4: Framework Identification

Initial Framework	Revised Framework
What factors negatively impact availability for the case (store) What factors negatively impact acceptability for the case (store)	Factors that negatively impact availability • Store operation hours • Observation Item Availability Factors that negatively impact acceptability • External Acceptability • Internal Acceptability • Produce Quality

The iterative framework formation process employed by this study ensures that findings will be exhaustive. Additionally, showing how this framework has developed through the course of analysis has provided additional transparency to this study (Goldsmith, 2021; Grodal et al., 2021; Parkinson et al., 2016;).

Indexing

After identifying a framework that fit the study goals the next step of this analysis was to Index the data for the nineteen qualitative study grocery stores. Indexing, or the application of the framework to study data, provided the opportunity to check each grocery store against the framework (Ritchie & Spencer, 1994). Typically, researchers use this period to identify any additional avenues of inquiry not covered by the framework. Indexing was a straightforward process because the study observation form was formulated to analyze the variables of Penchansky and Thomas' (1981) taxonomy of Accessibility. Consequently, while indexing, no additional areas of inquiry were identified. With the framework set, and the data indexed, charting became the focus of this qualitative study.

Charting

While charting, a researcher may determine if the unit of analysis is appropriate for the study (Ritchie & Spencer, 1994). Again, as in each of the prior steps, this is another opportunity to ensure that the framework is appropriate for the study data. For this qualitative study, it was determined that it is appropriate to use each grocery store as a unit of analysis because detailed qualitative data regarding availability and acceptability were collected for each of the nineteen grocery stores in the study. Tables 3.4 and 3.5 demonstrate how data was abstracted for grocery store availability and acceptability.

Table 3. 5: Availability Indexed Data Chart

		Low Availability Grocery Stores
Factors that negatively impact availability	Store Operation Hours	• Stores with low hours of operations were open between 67 and 91 hours a week and are located near each other. • Field notes reference that the hours of operations for these stores all have the potential to neglect third shift workers or people with non-traditional working hours. Specifically, most of the stores with low availability close around 8pm and are concentrated near each other.
	Observation Item Availability	• Stores have between fifteen and twenty-five of the items from the observation. • Most of the items missing from these stores were produce. • Many low availability stores are near each other. • Individuals, without Access to produce may need to find farther stores to purchase the items they need. • Lack of availability is problematic for families who do not have a car or the free time to travel an extra mile or two to shop.

Issues of availability may come with unintended consequences for individuals or families who do not have a car, who work multiple jobs, or who have non-traditional work hours. Unfortunately, individuals living in block groups with low availability may have a difficult time getting the items they need. For instance, if a family living in an area with low availability chooses to shop at one of their closest grocery stores, the produce they need might not be available or the store may be closed. The consequences of low availability increase the overall time a shopper must spend looking for groceries.

Table 3. 6: Acceptability Indexed Data Chart

		Low acceptability grocery stores
Factors that negatively impact acceptability	External acceptability	• buildings often have excess wear and tear IE chipping paint, sun faded signs, obstacles in parking lot, no indication that the store is open or when it opens • Parking lots are not lit well at night, creating a potentially unsafe environment. • Small amount of parking usually less than 10 spots with around one handicap spot not located near the door.
	Internal acceptability	• Stores have excess clutter often blocking walkways, fixtures such as aisles or fridges have damaged parts or worn paint • Around a quarter of inside the store is lit adequately • There is either trash or old signage around the store cluttering walkways.
	Produce quality	• In most instances fruit was overripe, some are even to the point of molding/rotting • A majority (>50%) of the vegetables available are old showing wrinkled skin, brown spots, or white rust

When a grocery store has a low external acceptability the outside of the store may not have enough parking, lighting or appear unappealing to potential customers. Similarly, internal acceptability variables measure the appearance and overall cleanliness of the inside of the store. Lastly, bad produce may force shoppers to make additional trips to other stores, increasing the time an individual must spend shopping. With each of the steps of framework analysis complete, the final interpretations and maps of the qualitative analysis will be discussed in the findings section. After explaining how both

methodologies of this analysis were employed, the findings section discusses the outcomes of each analysis.

CHAPTER 4: FINDINGS AND DISCUSSIONS

The following chapter of this thesis will situate grocery store data on the food insecurity landscape of Lincoln. These sections detail specific areas where residents may encounter difficulties while trying to shop at their closest grocery stores. While it is important to note that the data used for the quantitative analysis are index values, which are not universal truths for all individuals, these findings provide insights on the multidimensional nature of food insecurity for residents. Findings are broken down into four separate sections, first, Accessibility index scores highlight different areas and levels of need. Subsequently, findings of the weighted analyses demonstrate how each component of the Access calculation changes Lincoln's food security landscape. Before finishing interpretations of the quantitative analysis, the findings of the equal weight model are compared to the USDA food desert analysis. Finally, this section concludes by unpacking the findings of the qualitative analysis which identifies the themes that connect grocery stores who serve at-risk block groups.

Food Insecurity Indices

Availability

Results of the availability analysis, indicate that 88 of 182 block groups in Lincoln fall below the median availability percentage value of 91%. More importantly, 42 of the 182 block groups have an availability percentage which is less than or equal to 84%, or the upper limit of the lowest block group availability classification on the map.

In total, roughly 53,000 individuals live in these areas and have a decreased availability when shopping at their three closest stores. The block group with the lowest Availability index, Block group 2, Census Tract 9, is located approximately one-half mile to the east of the

Figure 4. 1 Grocery Store Availability (PDF, 393 KB)

University of Nebraska-Lincoln, which is the uncounted population polygon near the middle of the city. There is a significant number of low availability grocery stores in this area which limit consumers in two important areas. First, lower operational hours limit an individual's ability to shop for food. Specifically, the temporal nature of food insecurity impacts the consumers of these block groups because the grocery stores serving these areas close, cutting off Access to consumers who need to shop late at night (Shannon & Widener, 2014). Secondly, many of the stores in these areas had a lower item availability percentage than their counterparts in other areas of the city. For instance, the grocery stores in these areas had an average of eighteen of thirty-five observational items. Inversely, grocery stores in other areas of Lincoln averaged thirty-two of thirty-five observational items. Lower observation item availabilities indicate that consumers may need to visit multiple stores, outside of their block group, to complete their shopping.

Acceptability

Data from the acceptability analysis indicates that 88 block groups of Lincoln's 182 block groups fall below the median acceptability index of 83 %. Spatially, the thirty-eight block groups, in the lowest block group acceptability class, spread from areas around the University of Nebraska-Lincoln to the northeast and northwest of the city. In total, an estimated 43,000 consumers live in block groups with the lowest rates of

acceptability. Contextualizing acceptability to food insecurity, consumers are more likely to purchase items from grocery stores that are clean, safe, and have high quality produce (Aragon, Armstrong Shultz, Bush-Kaufman, & Barale, 2019). For instance, Block group 4, Census Tract 17, scored an acceptability index value of 42%. The three grocery stores, which serve the consumers of this block group, received mixed acceptability index results. The block group's closest store received an external acceptability percentage of 68%, which ranked in the lowest classification of stores. A low external acceptability index indicated that a store needed to improve external appearance, external lighting, and available parking.

Figure 4. 2 Grocery Store Acceptability (PDF, 394 KB)

These factors could limit a consumer's desire and even willingness to shop at these establishments (Aragon et al., 2019). Shifting towards internal acceptability, the block group's second closest store scored a 71% on internal acceptability which indicates that variables such as internal organization, cleanliness, appearance, and lighting were weak points of the store. Lastly, the third closest grocery store offered lower quality produce. Most fruits at the store had visible mold, and many of the vegetables were old and wilted. The combination of these grocery store level values from the three stores and the Block group's low SES index indicator led to the determination that the customers of this block group lack Access to grocery stores (Penchansky & Thomas, 1981) and consequently are at an increased risk of food insecurity (Widener, 2018).

Affordability

Across Lincoln, the affordability analysis indicated that 83 of 182 block groups fell below the median affordability index percentage of 86%. Additionally, thirty-eight

block groups had an affordability index which was in the last block group affordability class. These thirty-eight block groups account for roughly 45,000 individuals and are spread through portions of central, southeastern, and northeastern Lincoln. While looking at the Affordability Index map there are two distinct observations that can be made: First, grocery stores around the university are fairly spread in terms of basket price, with a mixture of grocery stores offering goods across all four price classes. However, low block group gross median income decreases the affordability index in these areas,

Figure 4. 3 Grocery Store Affordability (PDF, 394 KB)

highlighting the relationship between consumer variables and basket price (Carson & Boege, 2020). Next, there are several low affordability block groups outside of the main cluster around the university. These block groups, all have at least one grocery store with a basket price that ranks in the highest basket price class, decreasing the overall affordability index for the area. For instance, one of Lincoln's most expensive grocery stores has an average basket price of 175 dollars and is in a block group with a relatively low median income. Accordingly, this store is not a viable option for all individuals living in this block group, decreasing the overall Accessibility for this area (Carson & Boege, 2020).

Accommodation

The findings of the accommodation index analysis indicate that 88 of 182 block groups fall below the median accommodation value of 73%. Of the 88 block groups, 56 fall into the lowest accommodation index class, that ranges between a 40 and 64 percent accommodation index. These 56 block groups have an estimated population of roughly 66,000 consumers. Spatially, low accommodation index block groups are spread between

three areas of the city, with the largest cluster located south of the university. The block group with the lowest Accommodation Index value, Block Group 2, Census Tract 8, is located less than one mile southeast of the university. All three of the closest stores had an average number of customers and two cash registers open; however, these stores lacked in their acceptance of government assistance.

Figure 4. 4 Grocery Store Accommodation (PDF, 394 KB)

Two of the three grocery stores, which serve this block group, do not accept SNAP benefits, causing this block group's accommodation index to be the lowest in the city.

accessibility

The block group accessibility index is broken into three components: a car travel time estimate, a public transit time estimate, and a composite of both methods. Several observations emerge after looking at the map of car travel times. First, areas lacking a significant number of grocery stores have an increased expected travel time. For instance, the block group with the highest car travel time, from centroid to destination, is within one and a half miles from its nearest grocery store.

Figure 4. 6 Block Group Car Travel Time (PDF, 393 KB)

However, the next two nearest grocery stores are over three miles away from this block group centroid. This block group is located on the outskirts of the city, where much of the area is covered by residential developments. Inversely, most block groups in older, more urban areas have faster travel times because shorter distances exist between block group origin points and grocery stores. Lastly, distance is just one of several factors that determines the travel time of a block group. A variety of variables including traffic, road

network design, and car availability, impact travel times. This fact is illustrated by the car travel time map, where travel times increase south of the university despite the proximity to grocery stores.

Transitioning to transit travel times, over twenty-eight block groups have a substantial lack of vehicle availability. Consequently, it is necessary to include transit travel time into this analysis to gain a holistic understanding of accessibility. Statistically, between fifteen and fifty-four percent of households do not have a vehicle in these block groups. Therefore, calculating accessibility with only car travel time does not reflect some consumers' reality. After an initial visual analysis of transit travel time, similar trends begin to appear between the transit travel time analysis and the car travel time analysis. For instance, areas near downtown Lincoln, where there are many grocery stores, low travel times are observed on both maps.

Figure 4. 6 Block Group Transit Travel Time (PDF, 394 KB)

Travel times increase as an individual moves away from the heart of the city towards the periphery. The exception to this phenomenon being areas with multiple grocery stores located near bus stops. Consumers in the largest class division experience travel times which range from a half an hour to over an hour. A large takeaway from this map is that transit times across the board are high for Lincoln. Notably, areas which suffer from the largest travel times have a lower number of bus stops available. The direst case of this phenomenon occurs in Block group 5, Census Tract 2.01, which has an average transit time of 41 minutes. The block group, which is in the northeastern portion of the city, is located within a two -mile radius of three grocery stores. Unfortunately, this area has the highest transit travel time due to an increased number of stops those busses must take on

these routes and a limited bus schedule. Specifically, this block group's transit travel time is important to note because it has the highest percentage of households who are likely to rely on public transit.

Accounting for instances of low car availability, such as the case of Block group 5, Census Tract 2.01, Zhang's (2017) comprehensive travel calculation provides a depiction of accessibility that includes car availability. With an adjusted depiction of accessibility, we see that several areas of Lincoln have higher than expected travel times. The thirty-six block groups, with an increased prevalence of low car availability, paired with infrequent bus stops had the highest composite travel times across the city.

Figure 4. 7 Block Group Composite Travel Time (PDF, 423 KB)

Spatially, there are three clustered areas where composite travel time falls into the highest classification. The largest cluster is observed in the northwest part of the city where residents experience lengthy composite travel times because there are few grocery stores that serve these areas. Pairing these variables with a high number of block groups with low vehicle availability leads to lengthy composite travel time observed on the map. With all five index variables explored, the role of place specific measurements of Access in the demarcation of food insecure areas can be explored.

Sub-Research Question One: What are factors which impact the local food environment?

Researchers in the field of geography and public policy have recently shied away from using the term "food desert" because this label has caused issues of food Access to be simplified to the study of spatial relationships between consumers and stores (Widener, 2018). Instead, contemporary researchers have begun to develop a place-specific understanding of food insecurity (see Blake, 2019; Blake, Mellor, & Crane,

2010; Hammelman, Reynolds, & Levkoe, 2020; Morgause-Faus & Sonnino, 2019; Sonnino, Marsden, & Moragues-Faus, 2016). As the afformentioned articles disucss, place-specific measurements of food security provide a neuanced understanding of Access by incorporating grocery store measurments which have traditionally been neglected by researchers. Mirroring these trends, this research used a multidimensional analysis to garner a greater understanding of the place specific nature of food insecurity for the residents of Lincoln, Nebraska.

Variables that comprised the availability, acceptability, and accommodation indicies provided measurements of the place specific food environment of Lincoln. Results of the availability analysis depict the temporal nature of food insecurity, and highlight that consumer purchasing habits are partially dependent upon the operational hours of grocery stores. Additionally, selected item availability depicted a ground-truthed understanding of the selected items that customers could purchase from their closest stores. The acceptability index analyzed internal and external grocery store quality variables, that prior research has shown to have a direct relationship to consumer shopping patterns (Aragon, Armstrong Shultz, Bush-Kaufman, & Barale, 2019). Additionally, block group level socioeconomic status indicators of food insecurity contexutalized the setting of each block group in relationship to acceptability (Major, Delmelle, & Delmelle, 2018). Finally, the accommodation index highlighted the overall ease of the customer shopping experience by exploring intrapersonal determinants of government benefit acceptance and interpersonal interactions which manifested at each grocery store during observations of the checkout process (Cannuscio et al., 2014). Place-specific data regarding grocery store availability, acceptability, and accommodation

provided added insight while determining food insecurity. These variables tie qualities of grocery stores directly to the block groups they serve and provide place-specific factors which impact the local food environment. Final values of each index merged block group and place-based variables to uncover the neuances of Lincoln's food environment.

Food Insecurity Models

Equal Weight Final Map

The first map produced for the Accessibility analysis, displays each of the variables of Access equally. The equal weight map identifies block groups that struggle with all five Accessibility variables. Areas with the highest risk of food insecurity are placed in the lowest classification which ranges from 68 to 81 percent. The individuals living in these struggling areas are likely to see that their three closest grocery stores are lacking a combination of availability, accessibility, accommodation, affordability, and acceptability factors.

After taking some time to analyze the map, we see that a significant portion of the lowest attribute class is clustered together near the University of Nebraska-Lincoln.

Figure 4. 8 Equal Weight Accessibility Analysis Model (PDF, 364 KB)

These results mirror the findings of the prior index value maps, highlighting that this area struggles with most of the Accessibility variables. Specifically, availability, affordability, accommodation, and acceptability variables are rather limited for individuals living in these areas. Weighting the individual determinants of Access demonstrates the importance of a multidimensional place-based calculation of Access. Through incorporating an expanded definition of Access, spatial proximity as well as grocery store and block group variables highlight the nuances of food insecurity typically missed by

traditional methods. With this base understanding of food insecurity for the city, we can now focus on the level of impact that each of the five variables has.

Weighted Final Maps

A weighting scheme was applied to each index to visualize need around the city, based on the different variables that comprise this multidimensional and place-based definition of Accessibility. The following maps are intended to show how each of the five variables impact each block group. For instance, for individuals who live below the poverty line, models two, four, and six would account for the variables which impact their ability to shop at the three closest grocery stores. These models place a greater importance on availability, affordability, and accessibility, and for consumers who face increased economic hardship, these variables would likely be some of the attributes they rely on while selecting a grocery store.

Availability

Situating availability within the Accessibility analysis, we notice that there are a significant number of block groups downtown with a low availability index. Scores slowly improve as block groups move away from the areas near the University of Nebraska. Specifically, block groups that contain supermarkets score the highest on this analysis because of the increased hours of operation and the availability of all observed items. Inversely, block groups with locally owned grocery stores tend to do poorly. A clear example of this phenomenon can be seen while looking at the block groups next to the University.

Figure 4. 9 Availability Weighted Model (PDF, 364 KB)

In total, twelve grocery stores surround the streets next to the University; however low hours of operation and item availability cause residents in these areas to experience an elevated risk of food insecurity. Looking at this data holistically, 66 of Lincoln's 182 block groups were less than or equal to the median availability model percentage of 85%. Grocery store level data indicate that consumers who live in block groups which received availability weighted index values between 83 and 85 percent all rely on multiple low availability grocery stores. These findings suggest that when availability is the most important factor for consumers, individuals living in block groups with an availability index ranging from 66 to 85 percent will all have at least one grocery store which closes early or does not have the item they need, reaffirming the temporal nature of food insecurity (Shannon & Widener, 2014).

Acceptability

Moving to the third map, this model placed an emphasis on the quality of fresh produce, internal characteristics, external characteristics of a grocery store, and block group level SES variables.

Figure 4. 10 Acceptability Weighted Model (PDF, 364 KB)

Like availability, supermarkets and other chain stores typically scored higher on acceptability measurements. Block group level SES data added some variability to the measurement of acceptability and highlighted additional block groups that might not be considered food insecure based off grocery store level measurements alone. For instance, several block groups in the eastern portion of the city are surrounded by areas with a high acceptability index. Despite being located near high acceptability grocery stores these block groups have an increased risk of food insecurity based on these SES indicators

(Major, Delmelle, & Delmelle, 2018). Thus, combining both sets of data into a multidimensional and place-based analysis provides additional insights that are often missed when viewing these variables as independent from each other. Contextualizing this data to other areas of Lincoln, 95 of the city's block groups were equal to or below the median acceptability model percentage of 86%. Accordingly, individuals in one of these 92 block groups are likely to experience issues related to grocery store produce quality, external acceptability or be at an increased risk of food insecurity because of block group level food security indicators.

Affordability

The fourth model places an emphasis on the affordability of a block group's three closest grocery stores. To do this, the model places a higher weight on the affordability index which compares average grocery store basket price to a block groups gross median monthly income.

Figure 4. 12 Affordability Weighted Model (PDF, 364 KB)

In total, 91 of the 182 block groups in Lincoln, had weighted affordability model scores which were equal to or below the median value of 86%. Notably, these findings suggest that slightly less than half of grocery store basket prices are unaffordable to the nearest consumers, making them inaccessible (Carson & Boege, 2020). Results of the model show that block groups with some of the lowest median monthly incomes are located near locally owned grocery stores and score the lowest in the affordability weighted model. These findings are supported by the increased basket price observed at some locally owned grocery stores. Inversely, individuals with a relatively higher gross median

income, who also live near supermarkets, have consistently higher weighted affordability scores.

Accommodation

The penultimate model, of the Accessibility analysis, weights accommodation as the most important factor when determining areas of possible food insecurity. Accommodation, or the number of individuals waiting in line, number of open cash registers, and acceptance of government assistance programs, is meant to help consumers estimate the difficulty of shopping. Consequently, this model is meant to identify any areas where intrapersonal determinants may inhibit customers from purchasing their groceries due to a lack of government assistance acceptance (Cannuscio, Hilier, Karpyn, & Glanz, 2014). Additionally, the increased time cost associated with a lack of open cash registers and high numbers of individuals waiting in line creates interpersonal conflict between the consumer and the store (Cannuscio, Hilier, Karpyn, & Glanz, 2014). The potential for negative interactions or experiences has been shown to decrease a consumer's willingness to shop at their most convenient store (Cannuscio, Hilier, Karpyn, & Glanz, 2014).

Figure 4. 12 Accommodation Weighted Model (PDF, 364 KB)

While analyzing this map we see a continuing trend which indicates that areas with lower availability, acceptability, and affordability also struggle with accommodation. Contextualizing this data at the block group level, 92 block groups in Lincoln had weighted accommodation model scores, which were equal to or below the median value of 81%. Grocery store level data indicates that 89 % of grocery stores in Lincoln accept government assistance programs. The remaining eleven percent of grocery stores are

located just east and southeast of the University where the accommodation model indicates that residents are likely to suffer from food insecurity. Other areas of low accommodation present on the map were a direct result of high customer to open cash register counts, resulting in increased waiting times for the consumers. Notably, this means that over 47% of the block groups in Lincoln lack Access when acceptability is the most significant determinant.

accessibility

The final model, of the Accessibility analysis, weights travel time (accessibility) as the most important factor when determining areas of possible food insecurity. To estimate travel time, a composite calculation weighted both car and transit times by percentage of households without a car. This model provides additional insights on the overall spatial accessibility of grocery stores for individuals at all socioeconomic levels. Contextualizing this data, 84 block groups in Lincoln had weighted accessibility model scores which were equal to or below the median value of 85%. Data from the analysis suggests that a slightly smaller number of block groups, near the university, are at risk of food insecurity when accessibility is considered the most important factor. The increased prevalence of grocery stores and the availability of bus routes offset the lack of car availability in this area, increasing overall Accessibility for these consumers.

Figure 4. 13 accessibility (Travel Time) Weighted Model (PDF, 364 KB)

On the map, block groups with low accessibility are grouped into two main clusters which are located northwest and southeast of the University. Other small areas of lower model scores are scattered around the city and can be explained by two factors. First, relatively high travel times are due to an increased distance to grocery stores. Second, bus

scheduling and the overall prevalence of bus stops negatively impact the consumers living in these areas. Data used for this analysis indicates that there is a relationship between a tract's accessibility and vehicle availability. For instance, nearly twenty seven of the thirty-eight block groups, with the lowest vehicle availability, had some of the lowest accessibility risk index scores.

Sub-Research Question Two: What are the areas of need in Lincoln, Nebraska?

Findings from the weighted analysis suggest that the cluster of block groups near the University of Nebraska have considerable needs in four of the five Accessibility indices. Most significantly, availability is particularly low for this area meaning that the grocery stores who serve these consumers have a combination of few hours of operation and observational item availability. Compounding on issues of availability, affordability percentages for this area indicate that a basket of groceries is less affordable because of the disconnect between gross median income and average basket price. Lastly, findings of the acceptability index indicate that residents living in these areas may rely on stores with lower acceptability scores, these block groups have higher rates of poverty, and higher rates of renting populations which place these areas at an increased risk of food insecurity.

Aside from the main cluster of food insecure areas, four block groups, which scored in the lowest classification, are located on the eastern side of the city. Spatially, a pair of block groups and two singular block groups are located east and southeast of the main cluster. Data from initial indexed variables indicate that affordability and accessibility values are causing each of these block groups to be considered at risk for food insecurity. Gross median income in these areas is significantly lower than their

neighboring block groups. Compounding the prevalence of lower median income, higher average basket prices cause these block groups to have lower affordability values.

Comparison of Findings to the United States Department of Agriculture

Returning to the origins of this thesis, several discrepancies exist between what the USDA considers to be food insecure areas and what a localized measurement of Access has identified as at-risk areas. First, a visual analysis of one-mile LALI tracts indicates that thirty-six block groups, at the greatest risk of food insecurity, fall outside of the tracts that the USDA considers to be low access (greater than one mile from store) and low income. Notably, this indicates that the USDA potentially undercounted over 41,000 consumers with their methodology.

Figure 4. 14 USDA Low Access Low Income Census Tract 1 Mile (PDF, 404 KB)

The USDA's misidentification of at-risk block groups at the one-mile designation of Access is likely due to the high number of grocery stores present in these areas. However, this study's findings indicate that despite proximity and prevalence of grocery stores, individuals living in these areas are at risk of food insecurity because of grocery store level variables including low affordability, acceptability, and availability. These results demonstrate why a measurement of food insecurity which only considers distance, income, and transportation can be problematic. Without the inclusion of place specific variables, a plethora of factors which inhibit an individual's ability to Access a grocery store may be overlooked. Therefore, food insecurity researchers must continue to expand the measurement of Access to include place specific grocery store variables such as hours

of operation, price, and item availability because traditional metrics of measurement can be inaccurate.

Shifting to the USDA's half mile LALI analysis, we see that the implementation of a distance measurement of a half mile provides a more accurate representation of the food insecurity prevalence in Lincoln. Unfortunately, the increase in accuracy is not due to a more complex understanding of Access. A visual analysis of the half mile LALI map of Lincoln indicates that the USDA potentially undercounted eleven highly susceptible block groups. Findings from the comparison between these two methodologies indicate that at the half mile designation, the USDA undercounts over 10,000 potentially food insecure individuals. The exclusion of these areas confirms that the analysis employed by the USDA is unlikely to identify areas where a combination of block group level data and grocery store data intermingle to increase consumer risk of food insecurity.

Figure 4. 15 USDA Low Access Low Income Census Tract 0.5 Mile (PDF, 414 KB)

For instance, the block groups which went unidentified by the USDA's LALI .5 have several grocery stores which are close to them. However, a combination of relatively expensive stores, with low availability (operational hours), and higher travel times have caused these areas to be at an increased risk for food insecurity.

Sub-Research Question Three: How do traditional methods compare to place specific methods?

Reviewing the map which compared a multidimensional Access methodology and the Food Access Research Atlas methodology a few notable differences in food insecurity risk identification exist. First and foremost, at both half mile and one mile designation, the USDA misses between eleven and thirty-six block groups, respectively.

These areas account for an estimated four and fourteen percent of the population of Lincoln. The undercounting of at-risk areas indicates that the USDA's method of food insecurity identification, even at the most stringent level, is likely to undercount the true number of individuals who struggle with Access. Consequently, cities larger than Lincoln are likely to have a significant population of individuals who are food insecure but unidentified by the USDA. Next, the scale of data that the USDA uses impacts the accuracy of their methodology. As the comparison maps show, the one-mile LALI map does not identify block groups, which surround the University of Nebraska, as food insecure. According to the USDA, these block groups are not at an increased risk of food insecurity; however, when an analysis uses both Census data and grocery store level data, these block groups have an increased chance of food insecurity. A comparison of the USDA's traditional methodology to this paper's findings indicates that an expansion of variables, at the grocery store level, provides a thorough analysis on food insecurity (Widener, 2018). Lastly, data collected at the grocery store level revealed a few place specific deficiencies, including observational item availability, operational hours, external and internal acceptability, which limit Access for individuals living in food insecure block groups. Without a place specific method of studying food insecurity these observations would likely go unmeasured.

Qualitative Data Interpretations

The following sections discuss issues of Accessibility for stores located in block groups which are at the highest risk of food insecurity, as identified by the equal weight model. A qualitative analysis was performed to provide greater insight to the areas of improvement for stores that served block groups that are at risk of food insecurity. This

analysis is meant to identify the specific needs of grocery stores who serve consumers in block groups with the highest risk of food insecurity.

Figure 4. 16 Qualitative Analysis Grocery Store Identification (PDF, 369 KB)

The maps derived from this analysis identify the spatial threads which connect stores that have similar limitations of Accessibility. Translating this data back to the equal weight maps, stores who served block groups with an equal weight model score between 68 and 81 % were considered for the qualitative portion of this study. Initial variable index values were then used to prune the dataset to create a representative sample. The nineteen study stores are primarily centered around the downtown/campus area with the other stores spread throughout the rest of the city.

Acceptability Findings

Overall, five out of the nine stores with acceptability issues were related to the external acceptability of the store. Looking at the map, four of six grocery stores which struggled with external acceptability are closest to individuals who live near the University of Nebraska, or downtown Lincoln. Primarily, these stores lacked necessary parking for customers, this was especially problematic because two of the five did not have any handicapped parking. Additionally, each of the five stores that struggled with external acceptability, did not have enough lighting in and around the parking lot. Next, two of the nine stores had significant issues with internal quality. In terms of location, one store is located near downtown Lincoln, and the other is in the southern portion of the city.

Figure 4. 17 Qualitative Analysis Acceptability Risk Characteristics (PDF, 373 KB)

Commonalities of these two stores include multiple instances of incorrectly labeled aisles, permanent fixtures congesting walking areas, and noticeable dirty areas. Lastly, two stores had significant issues with produce quality. Looking at the map, we see that the one store serves consumers in the downtown cluster, and the other serves a single at-risk block group in the eastern portion of the city. Specifically, nearly half of all the produce at one store was close to spoiling during observation and the other store had significant issues with the quality of their bananas, grapes, carrots, broccoli, and cucumbers.

Availability Findings

Nine out of ten of the stores, which suffered from lower store availability, were clustered by each other near downtown Lincoln. Unfortunately, potential shoppers living in these block groups face decreased shopping time and do not have the same Access to fresh fruits and vegetables as the other shoppers in Lincoln. In total, seven of the ten stores with low availability had limited hours of operation. On average, the stores in this clustered area are open for roughly forty-one percent of the week and all but one of these stores closes before 9PM.

Figure 4. 18 Qualitative Analysis Availability Risk Characteristics (PDF, 371 KB)

Unfortunately, early closing times in this area limits the availability of these stores, especially for individuals who work a non-traditional work schedule. The remaining three stores had significant issues with observational item availability. Nearly all the stores that lacked item availability were missing a significant number of produce items. In addition to a lack of produce, these stores did not have at least five of the twenty-five observation items. Hence, individuals living in block groups with lower item availability may be

more likely to shop at other grocery stores farther away because of this lack of availability.

Sub-Research Question Four: What are the needs of the grocery stores located in potentially food insecure block groups?

Findings from the equal weight model identified one cluster of food insecure block groups, a pair of block groups that rely on the same store, and lastly two lone block groups. Qualitative findings link the grocery stores that serve at-risk block groups, based on grocery store Accessibility variables, thus identifying common threads, which lower Accessibility across Lincoln. First, grocery stores that serve the downtown cluster of block groups have consistently lower availability than any other grocery stores in Lincoln. In fact, these stores have some of the fewest hours of operation and observation item availability across the city. Shifting to acceptability, store level observations highlighted that variables related to external acceptability are the most prevalent concern for this cluster. Overall, issues of availability in the downtown cluster would decrease if the study stores increased their hours of operation (Shannon & Widener, 2014). In terms of acceptability, additional external lighting and handicap parking would increase overall acceptability, making these stores more Accessible to consumers.

Switching focus to the pair of at-risk block groups on the northeastern side of Lincoln, acceptability is the main concern identified during qualitative analysis. Two grocery stores, with lower external acceptability, serve the consumers of these block groups. Observations from these stores indicate that external lighting, and exterior appearance are the most significant issues impacting Accessibility for these stores. Both stores rely on a limited number of lights in each parking lot. Additionally, the buildings

and surrounding areas are beginning to show visible signs of aging, including discolored paint, cracked sidewalks, and poor-quality parking lots. These factors have been proven to dissuade consumers from purchasing from stores, decreasing overall Accessibility of the block group (Aragon, Armstrong Shultz, Bush-Kaufman, & Barale, 2019). Increasing the number of lights surrounding the store, filling in parking lot potholes, or repainting the exterior of the building are three ways which shop owners could improve acceptability for these grocery stores, increasing overall Accessibility for these block groups (see Appendices F and G).

The final lone block groups are spread between eastern and southeastern Lincoln. In total three study grocery stores served these areas, specifically the study grocery stores near the eastern block group experienced low Accessibility stemming from both acceptability and availability. Acceptability of the study store in the eastern block group is a significant concern. During observations nearly half of all produce available was of a lesser quality than that of other stores in the city. The prevalence of lower quality produce acts as a deterrent for residents seeking to shop at their closest grocery store, hence decreasing overall Accessibility of the block group (Aragon, Armstrong Shultz, Bush-Kaufman, & Barale, 2019). To a lesser extent, a lack of overall observation item availability, at the second study store, puts the eastern block group at an increased risk of food insecurity. During observation, thirty percent of produce items were unavailable for shoppers contributing to the lowered Accessibility. Increasing the overall produce quality available to consumers at the first store, or stocking additional observation items at the second store are two ways that this block group's overall Accessibility could be improved. Shifting to the southern block group, one instance of lowered internal

acceptability has increased this block groups risk of food insecurity. Observational data indicates that peeling paint, mismarked aisles and cluttered aisles decrease the study store's overall acceptability. Repainting the interior of the store, increasing space between aisles, and removing excess store advertisements are three ways that this store can increase overall acceptability and Accessibility.

CHAPTER 5: STRENGTHS AND WEAKNESSES

There are several areas of this research that demonstrate the overall strength of this manuscript. First, the study methodology employed in this paper created a place specific inquiry and highlighted the need for an expansion of the study of Access. Methodologically, these techniques are at the cutting edge of research in the field of geographic food insecurity research. As this research and the field continues to evolve, a continuation of place specific inquiry will unlock previously understudied variables of Access. Secondly, this paper's quantitative and qualitative methodology were designed to serve as a starting place, or a framework, to research food insecurity from a place-based perspective. In addition to the creation of a new framework, the implementation of a quantitative analysis followed by a subsequent qualitative analysis were meant to highlight place specific methods to improve block group food Access (Penchansky & Thomas, 1981; Widener, 2018). Lastly, the observation and methodologies used for this research were grounded in contemporary literature and several moments of transparency, regarding data analysis, were provided throughout this paper which demonstrates both qualitative rigor and the legitimacy of the quantitative methodologies employed to research food insecurity.

While trying to ensure that only strengths would be reported in this section of this thesis, several weaknesses exist in this methodology due to a lack of time and resources. First the structured observations, which collected all grocery store level data was only performed once for each store. Unfortunately, during data collection, there was not enough time to collect multiple data sets for each grocery store. All data for this thesis were collected during the COVID-19 pandemic, consequently the findings of this thesis are likely impacted by various supply chain issues and worker shortages, amongst other impacts that the pandemic had on Lincoln's local economy. Additionally, without the funds to recruit and hire a research assistant, only one individual was responsible for data collection for this project. However, to combat issues of subjectivity, the author of this work disclosed their positionality as a researcher, provided the Likert rubrics used at each store, and described both analysis methodologies in detail. Additionally, because a version of the NEMS-S survey was adopted for this study, availability findings may be skewed towards a Eurocentric diet that does not include a significant number of staple produce from other cultures. To combat issues of observational accuracy in diverse areas, aspects of this observation were reformulated, using contemporary literature, to better study Lincoln's food environment (see Anderson, 2018; Glanz, et al., 2007; Martin, et al., 2014; Tester, et al., 2010; Zhang, 2017). In regards to this level of study, prior literature reaffirms that quantitative analysis, observational data, and lastly qualitative analysis fit the goals of this research and serve as an appropriate starting place for an exploration of place-based food insecurity in Lincoln, Nebraska (Martin, et al., 2014). Looking towards the future, the addition of indepth interviews of consumers, residents, and store owners in addition to other qualitative analysis methods, such as structured interviews and surveys

with stakeholders and consumers, will be added to increase understanding of the place specific nature of food insecurity. In addition to an expansion of qualitative methods, additional statistical analyses must be completed to understand the weight of each of the five variables of Access.

CHAPTER 6: CONCLUSION

Coming full circle, the primary goal of this thesis was to explore how redefining the USDA's metric of "access" changes the measurement of food security risk. Additionally, this thesis' sub-research questions explored what factors impact the local food environment, determined areas of need for Lincoln, compared traditional methods of food insecurity measurement to place specific methods, and identified the needs of grocery stores who serve the potentially food insecure areas of Lincoln. As this thesis draws to a close, the students who sparked my initial interest in food security and food insecure landscapes weigh on my mind. Given the evidence presented in this work, it is fair to assume that many of the students I taught live in areas which are deficient in one, if not multiple, of the variables of Accessibility.

After spending a considerable amount of time reading literature, conducting field work, analyzing data, and interpreting findings, this research asserts that variables at both the block group and grocery store level are inportant determinants of Access. Studying distance to grocery stores, poverty levels, transportation availability and income only paint a portion of the landscape of the local food environment. Consequently, it is important that researchers continue to shift from traditional metrics of Access to new frameworks which adress Accessibility and food insecurity as an interaction between the

consumer, the community and the grocery store. With new frameworks come additional opportunities to expand qualitative and mixed methods research methodologies because, as this work has demonstrated, the full landscape of food insecurity cannot be understood through traditional and often solely quantitative methods.

Historically, methods of food insecurity related-risk have overlooked place specific and important factors that truly represent Access. The analysis of place specific metrics of Access, primarily availability and acceptability, has identified some shortcomings of the stores which serve food insecure block groups in Lincoln. For instance, measuring availability by the number of items available, from a modified NEMS-S observation form, has identified grocery stores which need to increase the number of products they offer to be seen as a viable option to consumers. Item availability, in conjunction with the operational hours of a grocery store, are variables that significantly impact block group resedient grocery store choice. Additionally, acceptability acts as a measurement of visible external and internal characteristics of grocery stores, which often impact the likelihood of residents relying on a store for food. Stores with lower acceptability scores have lower parking availability, lower internal/external lighting, and are hard to navigate. Accordingly, place specific factors provide additional insights on Access that are missed when food insecurity risk research is reduced to the study of spatial proximity.

As the quantitative and qualitative analysis has displayed, one cluster, one pair and two individual areas of food insecurity exsist in the city. It is important to note, that while comparing these findings to the findings calculated by the USDA, eleven previously unidentified at-risk block groups were identified. This is not to say that the

USDA's findings are incorrect, instead this research demonstraits that a more intensive measurement of Access, that analyzes block group data in conjunction with grocery store data, can predict food insecurity in ways previously not studied. It is important to note that the identified at-risk block groups are prone to a continuous evolution of Access, because of the nature of place specific variables. This does not mean that the findings of this research are invalid, it simply means that a continuation of observational data collection will be necessary to track the changes in place specific Accessibility over time. This is a strenght of the methodology rather than a weakness, because it highlights the precarity of food security. Consquently, two things must transpire to ensure that this data is comparable acrossed multiple years. First, data must be collected, and measured from a Census tract level to ensure that data can be compared across time. Second, study data and models created for this project should be continuously collected and re-ran on a semi-regular basis to ensure that stakeholders, and the public are given the best infromation possible regarding the food insecurity landscape of Lincoln. While this may be more work than what is required for traditional methods, a continuous collection and analysis of data should be seen as a way to formulate a better understanding of Access and provide a more accurate measure of the food insecurity landscape.

The insights derived from this methodology offer a unique opportunity in that they provide suggestions to improve Accessibility at a grocery store level across the city. Specifically, many stores who serve block groups with the highest risk of food insecurity struggle with hours of operation. Additionally, many of the stores, which served at-risk block groups also need to improve overall acceptability to ensure that residents will be willing to shop at their stores. Specifically, efforts to increase lighting and parking for

grocery stores, which serve potentially food insecure block groups, are the most viable methods to ensure that acceptability is increased for at-risk block groups. Therefore, improving the variables which limit Access, as identified by the framework analysis, could serve as goals for each of the nineteen qualitative study grocery stores. Once these Accessibility weaknesses are addressed, individuals living in the at-risk block groups may have increased Access to food.

Wrapping up this thesis, three main points must be considered while determining the viability of this research methodology moving forward: First, and formost, collecting data for this research and keeping it current will take a significant amount of time from both students and facutly. However, as demonstrated in the literature review, the field of food insecurity research is evolving to include more place specific factors of measurement. As the field continues to evolve, additional research methodologies, surveys, interviews, and variables must be included to grow our understanding of food insecurity. Qualitative methodology as well as quantitative methodology belong in the field of food insecurity research, and there must be a greater push to intermingle these methods while researching insecurity if we want the full landscape to be painted. Specifically for the upkeep of this data, a continuous cycle of visits would ensure that the data remains accurate and would helpt to increase Accessibility to all consumers in Lincoln, Nebraska.

APPENDICES

APPENDIX A: FIRST PORTION OF OBSERVATION TEMPLATE FOR DATA COLLECTION. Produce selection, on the observation form, was chosen by consulting the work of Anderson (2018), Glanz et. al (2007), Tester et. al (2010), and Zhang (2017).

Appendix_A (PNG, 43 KB)

APPENDIX B: SECOND PORTION OF OBSERVATION TEMPLATE FOR DATA COLLECTION

Appendix B (PNG, 40 KB)

APPENDIX C: GROCERY STORE MEASURMENTS OF ACCESSIBILITY WERE BASED UPON

The sources used to develop grocery store level measurements of accessibility

Appendix_C (PNG, 69 KB)

APPENDIX D: PRODUCE QUALITY LIKERT SCALE

Produce Quality Likert scale used during each grocery store walkthrough.

Appendix D (PNG, 85 KB)

APPENDIX E: SECOND PORTION OF PRODUCE QUALITY LIKERT SCALE

Produce Quality Likert scale used during each grocery store walkthrough.

Appendix E (PNG, 90 KB)

APPENDIX F: EXTERNAL GROCERY STORE QUALITY LIKERT SCALE

External Grocery Store Quality Likert scale used during each grocery store walkthrough.

Appendix F (PNG, 95 KB)

APPENDIX G: INTERNAL GROCERY STORE LIKERT SCALE

Internal Grocery Store Quality Likert scale used during each grocery store walkthrough.

Appendix G (PNG, 222KB)

APPENDIX H: QUALITATIVE FRAMEWORK MAPPING STORES 1-9

Appendix H (PNG, 139 KB)

APPENDIX I: QUALITATIVE FRAMEWORK MAPPING STORES 10-19

Appendix I (PNG, 114 KB)

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