Using Virtual Reality Food Environments to Study Individual Food Consumer Behavior in an Urban Food Environment

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ABSTRACT

The objective of this research was to explore whether virtual reality can be used to study individual food consumer decision-making and behavior through a public health lens by developing a simulation of an urban food environment that included a street-level scene and three prototypical stores. Twelve participants completed the simulation and a survey. Preliminary results showed that 72.7% of participants bought food from the green grocer, 18.2% from the fast food store, and 9.1% from the supermarket. The mean presence score was 38.9 out of 49 and the mean usability score was 85.9 out of 100. This experiment demonstrates that virtual reality should be further considered as a tool for studying food consumer behavior within a food environment.

CCS CONCEPTS

• **Human-centered computing** → **Virtual reality**; *Usability testing*.

KEYWORDS

virtual reality, food environment, food choice, nutrition disparities

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1 INTRODUCTION

Food environments are critically linked with food-related health outcomes and disparities across groups in the United States [5]. Current research around food environments focuses on differential geographic access to healthy and unhealthy food outlets such as supermarkets and corner stores[6]. However, public health researchers are questioning the assumption that proximity to nutritious food is a primary driver of dietary quality and food-related health disparities [4]. Where geographic analyses may be inadequate, virtual reality (VR) may be a tool to examine individual interactions within food environments. Food retail industry studies have shown that

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Figure 1: Street and store scenes from simulation.

VR is effective in studying food consumer behavior. Several studies have shown a high correlation between choices made in virtual and physical stores [8]. VR has also been used to study food purchasing behaviors and to understand dietary influences in a public health context. A systematic review summarizing the application of VR in food consumer behavior research [8] included 34 articles that examined point-of-sale or point-of-consumption moments from VR supermarket and buffet settings. The authors found that VR shows promise in generating controlled and manipulable food environments and when combined with tracking technologies, allows researchers to gain detailed insight into how and why people make purchasing decisions. Yet, there are few studies simulating multilevel decision making, and the primary of which is based in a food court setting [1]. In this pilot study, we propose to model an urban food environment that includes navigating store choice at the street level and point-of-purchase item selection within the stores. This work pushes forward the field of VR to study food consumer behavior in bringing the multi-stage choice design into an urban shopping environment with a street-level setting.

The objective of this research is to explore the potential for VR to be used as a tool for studying how individuals behave and make decisions within a multilevel food environment.

2 METHODOLOGY

2.1 Simulation Overview

The simulation was designed to model two layers of a food environment. The user starts in the street scene, and the simulation begins with the user's position moving along a fixed path (the user is able to look around freely) that simulates walking past three potential food source options (a fast food restaurant, a supermarket, and a green grocer). After seeing all three stores, the user selects where they would like to enter.

In the second layer of the simulation, the user is inside their selected food source. Participants are presented with a variety of food items available for purchase, either on a shelf (in the store settings) or on a menu board (in the fast food restaurant setting). The user interacts with the store by hovering their laser over a food

item to view the item's information panel (name, price, and the number of calories) and clicking "A" to add or remove the food item from a "Cart" (store setting) or "Order" (fast food restaurant setting) panel. Participants have the option to either leave and enter another store or make a purchase of the items in their "Cart" or "Order" (referred to as either "Check out" or "Place order"). Participants could only purchase from one food source.

2.2 Study Procedure and Measures

Twelve participants were recruited by personal outreach. They were informed of the purpose, the potential benefits of the study, and the risk of motion sickness, before giving verbal consent to participate. This study was approved by the Institutional Review Board of Hunter College (protocol 2022-0588-Hunter).

Using the head-mounted display and controllers, participants were presented with the task of purchasing themselves dinner with a budget of around $10.00 (chosen so that any given food item was within budget while maintaining some degree of financial constraint). After the simulation, the participants completed a survey.

The post-simulation survey asked the subject to rank between four and six factors that influenced the choices made in the simulation around three decisions points: choosing the initial store to enter, choosing to exit the initial store (if applicable), and choosing specific food items.

Ten questions in the survey focused on system usability, derived from the system usability survey developed by Brooke [3]. The user ranked each question from 1 (Strongly disagree) to 5 (Strongly agree), and the maximum possible score is 100. The final seven questions on the survey surrounded presence and were sampled from the 32-item Presence Questionnaire [7], each question measured on a 7-point scale to yield a maximum score of 49.

3 RESULTS

Twelve participants completed the simulation and study. Due to complications with the simulation, the first participant's results were excluded, yielding a result group of eleven. The participant group included individuals familiar with virtual reality and individuals who had no prior engagement with virtual reality.

The three food source options in the simulation were named Burger Joy (fast food), Fresh Market (green grocer), and K Foods (supermarket), and at least one participant purchased food from each. 72.7% of participants checked out from the Fresh Market, 18.2% from Burger Joy, and 9.1% from K Foods. The most commonly purchased food items were the bottle of water, apple, and yogurt from the Fresh Market, with 64%, 55%, and 55% of participants purchasing each, respectively. 75% of the people who purchased these items from Fresh Market chose only to enter the Fresh Market, while the other 25% also entered Fresh Market first, but then went into K Foods and Burger Joy before returning to Fresh Market. For factors influencing store choice, those with the highest total rankings were the assumed nutritional value of items in store (46), followed by the assumed selection of items in store (43). For the eight participants who chose Fresh Market, the factors with the largest cumulative score remain nutrition (35) and selection (35).

For factors influencing item choice, nine people answered the survey questions regarding the factors that influenced their choice of food item. Taste had the highest ranking sum across these nine participants (38), followed by the price of the food item (34).

The mean usability score was 85.9 out of 100 with a standard deviation of 8.2. The scores ranged from 67.5 to 100. 90.9% of participants' usability scores were over 70 (a score of 70 and over indicates promising acceptability in the field [2]). The mean presence score was 38.9 out of 49 with a standard deviation of 2.8. The scores ranged from 34 to 42.

4 CONCLUSION AND FUTURE WORK

The VR urban food environment enabled the collection of behavioral insights as participants moved throughout the food environment. Participants visited and purchased from the Fresh Market more than any other food outlet. The most commonly purchased food items were the bottle of water, yogurt, and the apple.

The high usability score denotes that participants accepted VR as a viable tool for the selection of food and store choices. For measuring presence, questions were selected to span all four factors thought to underlie presence: Control Factors, Sensory Factors, Distraction Factors, and Realism Factors [7]. The presence scores denote that the participants found the VR application to be involved and immersive. Reflected by the successful purchasing of food by each participant, users accepted the street-level setting and each of the food sources' environments for making food consumer decisions and enacting consumer behaviors.

This pilot study had a limited number of participants. Nevertheless, the results provide a baseline that supports further investigation. Additionally, there were restrictions on the degree to which one could interact with the environment, namely that individuals could not move around freely nor pick up and inspect food products. Further iterations of the simulation should include an enhanced level of detail and interaction capacity with the environment.

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