

Restaurant Point-of-Sale Interfaces: Comparisons in Menu Organization and User Efficiency

by

Cheryl Caresse Wang

An Applied Project Presented in Partial Fulfillment
Of the Requirements for the Degree
Masters of Science

ARIZONA STATE UNIVERSITY

May 2016

ABSTRACT

Careful considerations in designing and organizing information for restaurant point-of-sale (POS) systems can affect user experience. Unfortunately, usability guidelines are sparse for these systems. Applications from other studies, such as categorical organization and F-shape, are implemented in an experimental interface as a starting point of discussion. A control interface was designed after the default version of NCR Aloha's POS program: Aloha Table Service. Novice and expert order taking strategies were also observed to compare input differences. This study examined selection time, total time, and selection accuracy across both order and interface types. The results show that time and number of key presses are significantly reduced under the treatment interface, and that teaching expert order taking strategies to novice users may help reduce cognitive load.

Keywords: restaurant point-of-sale, interface, design, usability

ACKNOWLEDGMENTS

I would like to express my gratitude to Dr. Russell Branaghan for his guidance and support throughout this research. Special thanks to Dr. Nancy Cooke for her expert advice, critique and encouragement, and to Dr. Scotty Craig for making this project happen.

TABLE OF CONTENTS

	Page
LIST OF TABLES.....	vi
LIST OF FIGURES.....	vii
INTRODUCTION.....	1
Mental Models.....	2
Expert Waiter.....	3
Functional Categories.....	3
Menu Organization.....	4
Positional Constancy.....	4
Alphabetized and Random Lists.....	4
Alphabetized, Categorized, and Random Lists.....	5
Menu Organization Paired with Tasks.....	6
Different Restaurant Scripts.....	7
Screen Viewing Behavior.....	7
METHOD.....	11
Participants.....	11
Materials and Design.....	11
Software Design.....	11
Hardware.....	11
Order Lists Design.....	11
Treatment Design.....	12
Control Design.....	14
Study Design.....	14

METHOD	Page
Measures.....	15
Measuring Learning Efficiency.....	16
Procedure.....	16
Session A.....	16
Session B.....	17
RESULTS.....	17
Comparing Prototypes.....	17
Selection Time.....	17
Total Time.....	18
Errors.....	18
Total Selections.....	19
Inverse Efficiency Scores.....	19
Survey Results.....	20
DISCUSSION.....	21
Selection and Total Time.....	21
Errors.....	21
Total Selections.....	22
Efficiency.....	22
Participant Surveys.....	22
Limitations.....	23
CONCLUSION.....	23
REFERENCES.....	25

APPENDIX

Page

A ORDER TASKS.....	28
B TREATMENT INTERFACE STEPS.....	31
C CONTROL INTERFACE STEPS.....	37
D CONSENT FORM.....	43
E SURVEY FORM.....	45

LIST OF TABLES

Table	Page
1. Menu Organization Types and Examples.....	5
2. Organizational Task Types and Examples.....	6
3. 2 x 2 Conditions.....	14
4. Selection Time for Each Condition in Seconds.....	18
5. Total Time Spent on Each Condition in Seconds.....	18
6. Errors Made on Each Condition.....	19
7. Selection Amounts for Each Condition.....	19
8. Inverse Efficiency Scores for Each Condition.....	20
9. Order Tasks (categorized).....	29
10. Order Tasks (uncategorized/restaurant scripted).....	30

LIST OF FIGURES

Figure	Page
1. NCR Aloha default Table Service layout.....	2
2. General layout of the treatment interface.....	13
3. Sub-category selection and item appearance.....	13
4. Visual example of the study design.....	15
5. Participants' ease of use score for control and treatment interfaces.....	20

INTRODUCTION

New employees frequently make mistakes in the hospitality industry—generally due to inexperience with the environment, such as the technology. Most of these businesses invest in point-of-sale (POS) systems to streamline business operations. Restaurants, for example, can become dependent on the success of these systems; an inoperable system experiencing extended downtime may force management to stop service until the system is online. The technology consists of hardware and software that affects both the front and back-of-house. Despite being relatively easy to use, new restaurant hires must be trained to successfully use the POS system for its basic functions: order input and payment management. Learning the system layout is not necessarily intuitive. Currently, the research usability guidelines on restaurant point-of-sale interfaces are lacking; therefore, user-centered refinements may produce an efficient interface that improves the learning curve of new users.

A POS system allows user interaction from a touch-based interface that is designed by a technician with regard to the owner's menu and preferences. The interface can be generated through pre-determined templates or manually programmed, depending on the simplicity of the menu. Due to time constraints, the technician often programs without consideration of usability and focuses on functionality. The owner has the ultimate say regarding the design, yet he or she does not use the ordering program as extensively as the workers. Additionally, the owner has free reign to edit or input more menu items when the need arises. Depending on its arrangement, an interface can be difficult to use for a first-time user. Most buttons are grouped based on simple categorical relationships (e.g., soda products found under the drinks category), causal events (e.g., selection of steak opens a list of dependencies: rare, med rare, well done, etc.), or individual assignment (e.g., an order button that sends the information to the back of house), but the organization of these groups are spread inconsistently across the interface (see Figure 1). As a result, the servers must remember where the buttons are displayed and when they will be prompted.

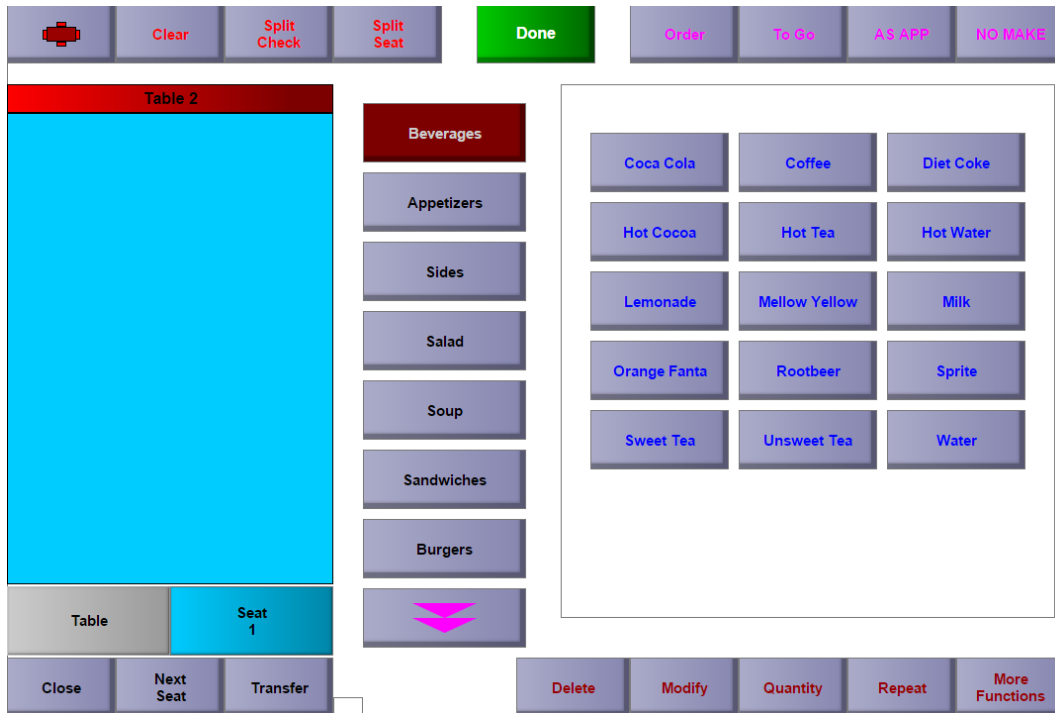


Figure 1. NCR Aloha default Table Service layout. Categorical arrangements (e.g., Coca cola, coffee, diet coke, etc.), causal events (e.g., Modify or quantity), and individual assignments (e.g., Done or to go) are main functions of a POS interface.

Employee mistakes may be due to an intrinsic cognitive load from tasks and demands, but learning how to navigate a disorganized interface with elements of high interaction exacerbates the issue by increasing extraneous cognitive load (Chandler and Sweller, 1996). Intrinsic cognitive load comes from internal pressures that may disrupt performance, such as memorizing multiple table orders. Extraneous cognitive load are external issues that may affect performance, such as a poorly organized interface. If the program is difficult for a new server to use, mistakes can cause customer dissatisfaction, user frustration, and loss of profits. Observing and implementing users' mental models, menu organization types, and screen viewing behavior into the interface may alleviate these problems by forming usability guidelines for POS restaurant technicians. Background on these concepts is provided in the following sections.

Mental Models

Expert waiter. Improvements to the interface begin by understanding novices' capabilities and limitations. Evidence from Ericsson and Polson's (1988) study revealed different cognitive schemas between experienced and inexperienced servers. The memory of expert waiter, JC, was tested in four experiments to model his mental skill. Each experimental trial simulated verbal dinner orders from seating arrangements of three, five, or eight customers. Newspaper clippings of faces served as placeholders on each table. Study time, recall accuracy, recall order, and the amount of repetitions requested before recitation were recorded. Results examined JC's recall pattern, wherein starches, entrees, meat temperatures, and salad dressings were organized together. It was determined that JC encoded items mnemonically and in spatial graphs. He also separated tables of five and eight into two groups, with four maximum seats per group. JC's memory skill was applicable outside of dinner orders. Given animals for entrees, flowers for salad dressings, metals for starches, and time for meat temperatures, he proceeded to encode similarly. In contrast, novices spent more time studying items, made more mistakes, asked for more repetitions, and memorized orders chronologically.

Functional categories. Huet and Mariné (2005) also found an organizational discrepancy among experienced, beginner, and non-waiters. After memorizing a list of 23 beverages, all subject groups were equally capable of categorizing recalled items into common groups (e.g., hot vs. cold or alcoholic vs. non-alcoholic). However, only experts organized into functional categorizations (e.g., bottled vs. unbottled). Functional categories are more salient to experienced servers, because they must know the product before relaying the order. For example, if a table must receive all beverages at once, the worker must know that bottles do not have a preparation time and should be communicated to the bartender last. Therefore, the drink with the longest mixing time is conveyed first, followed by the next longest, and so on. Understanding that beginners and novices do not have the appropriate schemas to organize information, the interface design will use expert cognitive model implications to help new users learn efficient order taking strategies.

Menu Organization

Positional constancy. Most POS systems already incorporate categories into the interface with shallow layers. For example, selecting “beverages” populates the menu with carbonated, non-carbonated, and hot drinks at once. This type of organization uses positional constancy design (i.e., button locations that always remain the same). Without the inclusion of rule-based considerations, such as alphabetical or categorical orderings, positional constancy harms learners. Somberg (1987) found this effect when he tested reaction times from four menu constructs: positionally constant, alphabetical, relevant, and random order. Participants were randomly assigned to conditions, given a target word, and instructed to select the match from a list of twenty. Each participant completed six experimental blocks with 86 trials per block. Alphabetical and relevance lists produced the fastest reaction times in the first two blocks, but after the second block, the positional constant group surpassed the others. In contrast, the random group performed significantly slower on all blocks. This study implies positional constant lists can be learned after extensive practice. Conversely, alphabetical and functional groups give consistent performance over time, implying that training is not needed with these organizational patterns. Considering servers do not work every day of the week, positional constancy design has slow learning gains. Therefore, careful attention to item organization is very important when constructing a user friendly interface.

Alphabetized and random lists. Customer orders are explicit objectives that result in a search task through the POS. Rule-based considerations can help guide item arrangement, but using the appropriate rule can positively affect efficiency. Card (1981) tested reaction time on editing commands (e.g., delete, undo, bold, etc.) using alphabetical, categorical, and randomized lists. Given a target word, participants selected the match from an eighteen-item menu over 43 trials per block. Card observed faster selection times on alphabetical menus and slow selection times when randomized. Arguably, using a list of editing commands may have been too specialized at the time of the study. Users

unfamiliar with a list of terms can benefit from alphabetical organization, but typically, food items are not obscure.

Alphabetized, categorized, and random lists. McDonald, Stone, and Liebelt (1983) saw this gap and compared word-targets to definition search tasks in a 4-column, 64-item menu over common topics: food, animals, minerals, and cities. Subjects completed five conditions, three of which divided columns by categories: alphabetical, random, categorized-alphabetical, categorized-random, and categorized-categories (See Table 1).

Table 1

Menu organization types and examples

Organization type	Animal and mineral examples
Alphabetical	List arranged in alphabetical order. Cat, Copper, Coyote, Diamond, Dog, Emerald, Gold, Goldfish, Iron, Lion, Ruby, Shark, Tiger, Wolf
Random	List arranged randomly. Dog, Wolf, Gold, Lion, Copper, Ruby, Coyote, Iron, Diamond, Shark, Goldfish, Tiger, Cat, Emerald
Categorized-alphabetical	List arranged in alphabetical animal and mineral categories. Animals: Cat, Coyote, Dog, Goldfish, Lion, Shark, Tiger, Wolf Minerals: Copper, Diamond, Emerald, Gold, Iron, Ruby
Categorized-random	List arranged in random animal and mineral categories. Animals: Lion, Cat, Goldfish, Dog, Wolf, Coyote, Shark, Tiger Minerals: Diamond, Copper, Gold, Ruby, Emerald, Iron
Categorized-categories	List separated in categorical categories. Felines: Cat, Lion, Tiger Canines: Dog, Wolf, Coyote Aquatic: Goldfish, Shark Native metals: Copper, Iron, Gold Gemstones: Diamond, Ruby, Emerald

Concerning explicit targets and definition tasks, participants were quicker with explicit. Furthermore, faster reaction times were observed in categorized-category lists, but explicit targets had equal reaction

times under categorized-categorical and alphabetized conditions. A categorical-categorized menu organization was recommended because it modeled expert schemas, supporting a learning environment that could help new users. Parkinson, Sisson, and Snowberry (1985) also found that alphabetized and categorized menus had shorter search times under word-target tasks, but alphabetizing or categorizing within categories did not matter when using common words. Additionally, organization by columns produced faster response times than rows, as well as adding spaces between categories. Parkinson et al. proposed that categorical organization had certain advantages in learning situations. All of these studies reported equal reaction times on all list types after extended practice. This means any layout can be learned over time, but similar to positional constancy, inefficient organizational techniques are not suitable for new users in a restaurant setting.

Menu organization paired with tasks. McDonald, Dayton, and McDonald (1988) tested these practice effects by constructing a menu using fast food items. Three layouts were examined: similar, frequency, and personal keyboards. Similar keyboards grouped similar items together (e.g., coffee, coke, sprite, etc.); frequency keyboards grouped items by co-occurrence, or common food combinations (e.g., coke, hamburger, fries); and personal keyboards were organized by participants to serve as a control for practice effects. The experiment held one hour sessions over three days with 240 orders per session. Subjects were assigned to a layout and given different types of tasks (See Table 2): complementary (common food combinations), similar (similar food groups), and odd (random combinations).

Table 2

Organizational task types and examples

Task type	Four-item examples
Complementary	Sprite, hamburger, fries, wrap
Similar	Ham sandwich, hamburger, cheeseburger, chicken sandwich
Odd	Chicken nuggets, hash browns, ham sandwich, apple pie

The tasks, or simulated customer orders, consisted of one to four items and appeared on the screen for 0.5 seconds before selections could be made. Task time and number of errors were measured. The results found that the type of organization aided respective tasks; for example, complementary tasks were faster on frequency keyboards, and similar tasks had better performance on similar keyboards. Odd tasks had poor performance overall and personal keyboards improved over time. While practice effects occurred in personal keyboards, frequency and similar keyboards had consistent performance across sessions. In other words, the design of the interface should be based on the type of task because it is intuitive to new users.

Different restaurant scripts. However, fast food and traditional restaurants do not necessarily operate the same. Fast food menus are smaller and the customer approaches the food service worker to place an order from start to finish, whereas servers in traditional restaurants approach the customer and space the service to allow time for decision-making. As such, servers follow a “script” that naturally organizes items categorically. For example, at the start of service, the waiter or waitress collects drink and appetizer requests, leaves to fulfill the task, returns with the orders, gathers entree choices, and leaves again to relay the information through the POS. Organizing a restaurant interface by category is logical because it follows the job function. The new POS design will separate food items by broad (e.g., drinks, appetizers, entrees, sides, and desserts) and narrow (e.g., cold drinks, hot drinks, and sodas under “Drinks”) categories. Items within the narrow categories will display in relevant, spaced columns. Increasing the visual salience of these categories can be investigated from eye tracking studies, which identify important areas for initial gaze.

Screen Viewing Behavior

Research by Goldberg, Lewenstein, Scott, Stimson, and Wichansky (2002) examined the influence of a participant’s gaze by: website pages or user actions; horizontal or vertical viewing; and

portlet order significance. Seven participants completed six tests while attached to an eye tracking device. Each test asked the user to find specific information from a website by free navigation within twenty minutes. The independent variable in this design was the task; the dependent variables were the eye tracking data, audio and video recordings of the users' motivations, and screen changes. The results indicated that participants' viewing patterns were influenced by webpages over actions, had no preference for horizontal or vertical page viewing, and fixated on left side navigation links longer while header bars were ignored. This implied that users could be led to other parts of the website through link hints and by keeping crucial information on the left side of the page. Furthermore, the vertical and horizontal indifference could have been due to the inability of the users to visualize the novel pages. As such, the POS's menu categories will be contained on the left side. Different background colors and animation will allude to the next step of the ordering process. Also, as the user inputs orders, the next step will always occur in close proximity, so as they move with the interface, their eyes are naturally guided in that direction.

On the topic of left-side viewing, there is a general "F-shaped" pattern that occurs when users view webpages (Nielsen, 2006). Much like the shape, viewing behavior begins at the top-left of the page, moves across to the right, and continues in a downward pattern along the left side. This pattern exhibits on list formats, such as search engine result pages (SERPs), suggesting an expected hierarchal structure for information at the top (Sherman, 2005). The eye tracking study by Sui and Chaparro (2014) was conducted to determine viewing behavior of search engine results pages in a Windows 8, gridded layout, of which each result was contained in its own box. Forty-five students were asked to find information from mocked up list and grid SERPs while performing six information foraging and six navigational tasks. The SERPs were unbranded to prevent user bias. Participants were given five minutes per task and asked to read tasks aloud before commencement. The independent variables were the tasks and layout type, and the dependent variables were the eye tracking data and post-experiment

satisfaction survey scores. The researchers found that users generally fixated on the top-left corner first and gazed at the top results longer in both layouts. Satisfaction surveys revealed that people did not understand the hierarchal structure in grids; some believed important results were displayed in the first few results of all columns and others thought the important results were only contained in the first column. These findings indicate gridded layouts require careful design considerations. At best, the most important information should be restricted to the top and left areas.

Similarly, an empirical study by Buscher, Cutrell and Morris (2009) quantified the eye tracking behavior of their users in two parts. Their research questioned whether the type of task could guide user browsing behavior and whether that data could help generate predictive webpage models. The independent variable for the first question was the task, categorized as information foraging or page recognition. Twenty participants were given eight information-foraging tasks that asked a question about varying topics; each topic had nine related links that were randomly listed and of various webpage layouts. Participants were allotted five minutes per task, but also allowed to freely browse the web. At the end of the study, users were tested on page recognition. They were asked to rate their familiarity of common websites, some of which were in the foraging tasks. The dependent variable was the eye tracking data. For the second research question, a predictive model was created from Document Object Models (DOMs) of the webpages; DOMs are the HTML elements that make up a webpage. The independent variable was the same as the first research question, task. The dependent variables were the DOM files, the eye tracking data, and screenshots of the webpages. Results in user gaze behavior indicated that they preferred the left side of a page regardless of the task. The predictive model suggested that size was the most salient part of a webpage, followed by the left side. The researchers advised that information be placed in the left hand area and to include expandable visual representations.

Certainly, the eye tracking studies suggest the same idea: placement of important objects on the left side. This bias to view left, called pseudoneglect, also occurs in other settings. A meta-analysis by Jewell and McCourt (2000) compiled 73 studies on bisection tasks to compare 26 performance factors. Overall, the results of the individual studies were mixed, as some concluded a rightward bias and others claimed the opposite. Despite this, they found a significant left bias effect size of -0.37 to -0.44 that was slightly affected by individual factors, such as age and gender, but applicable to cultures that read right to left.

Forming a POS interface that encompasses the design elements mentioned should improve the learning curve of new restaurant workers by increasing efficiency. If the learning curve is reduced and efficiency is increased, less time will be spent on the system hunting for order buttons. A user who does not have frustrations with the technology could potentially save the business money with fewer errors, thus positively affecting customer experience. Organizing information in categories helps new users build expert schemas (Ericsson & Polson, 1988; Huet & Mariné, 2005) and lower reaction times (Somberg, 1987; Card, 1981; McDonald et al., 1983; Parkinson et al., 1985) when working with complementary and similar tasks (McDonald et al., 1988). Constricting these categories to the left demonstrates to be effective in web (Buscher et al., 2009; Goldberg et al., 2002; Jewell & McCourt, 2000) and F-shaped studies (Nielsen, 2006; Sherman, 2005; Sui & Chapparo, 2014) by respecting the user's natural gaze. Therefore, both categorical design and left side emphasis would impact restaurant POS interfaces by separating selection elements in rule-based groups and leading the user to the next step by visual suggestion. Based on this, the current study predicts that when left side emphasis and categorical design are implemented in restaurant POS interfaces, these usability guidelines will increase efficiency by positively impacting the accuracy of selection, selection time, and total time spent on related type of tasks for novice users.

METHOD

Participants

A power analysis conducted through G-Power estimated the number of participants needed for a Cohen's medium effect size of $f = 0.25$. With number of groups set to 1, number of measurements set to 4, power of 0.80, and $\alpha < 0.05$, the total sample size was 24. The sample size was increased to 32 to accommodate for errors.

Thirty-two adults (aged 18-45; 25 males and 7 females) were recruited from Arizona State University's subject pool. Participation was compensated with one course credit for one hour of testing. In order to participate, students were required to read and understand the consent form and have little to no experience using restaurant POS systems. The experience level was roughly defined as five months or less of restaurant working experience within the last ten years.

Materials and Design

Software design. The control and treatment prototypes were created using Axure RP Pro 7.0, a wireframing program for user interfaces (Axure, 2015). The control was modeled after NCR's Aloha POS system interfaces, which followed the default layout and graphics of the designing software: Aloha Table Service. The prototypes were hosted through AxShare, Axure's cloud hosting program, and accessed from Google Chrome in full screen mode.

Hardware. Participants were able to interact with the interface using a mouse in a standard desktop setup, however, a keyboard was not available for use. Computers operated under Windows 7 in 1440 x 900 screen resolutions. Prototypes were restricted to 1024 x 768 pixels because it was one of the common screen sizes of restaurant terminals.

Order lists design. Two types of lists were provided to participants to examine expert and novice order taking strategies within both prototypes, as well as task type effects. These lists simulated customer orders from a table of five. One type organized food and drink items categorically (see

Appendix A; Table A1) and the other organized by customer, or restaurant script (see Appendix A; Table A2).

Treatment design. The treatment interface favored categorized-categorical relationships and left side orientation; therefore, the working total was placed on the right hand side. F-shape was incorporated by placing main categories, such as drinks and entrees, along the top-left corner (see Figure 2, for general interface set-up). On selection of a main category, a sliding panel to the left of the screen drew the participant's attention. This panel contained sub-categories related to the main category. For example, the sub-categories of drinks were water, soda, cold drinks, hot drinks, and alcohol. Choosing a sub-category caused a fade-in effect of its items on the right, which could be added to the working total. Selecting an item in the working total highlighted and revealed options in close proximity: delete item, increase quantity, and decrease quantity for ease of use (see Figure 3, for sub-category and item visual). Additional features to modify item details (e.g., extra salt, no ice, less dressing, etc.) were situated in an animated panel to the right of the working total (see Appendix B, for treatment interface steps). For this study, the treatment interface was not designed to be a full program with every function available, but enough for a use case test (i.e., only entrees, drinks, and appetizers were fully operational).

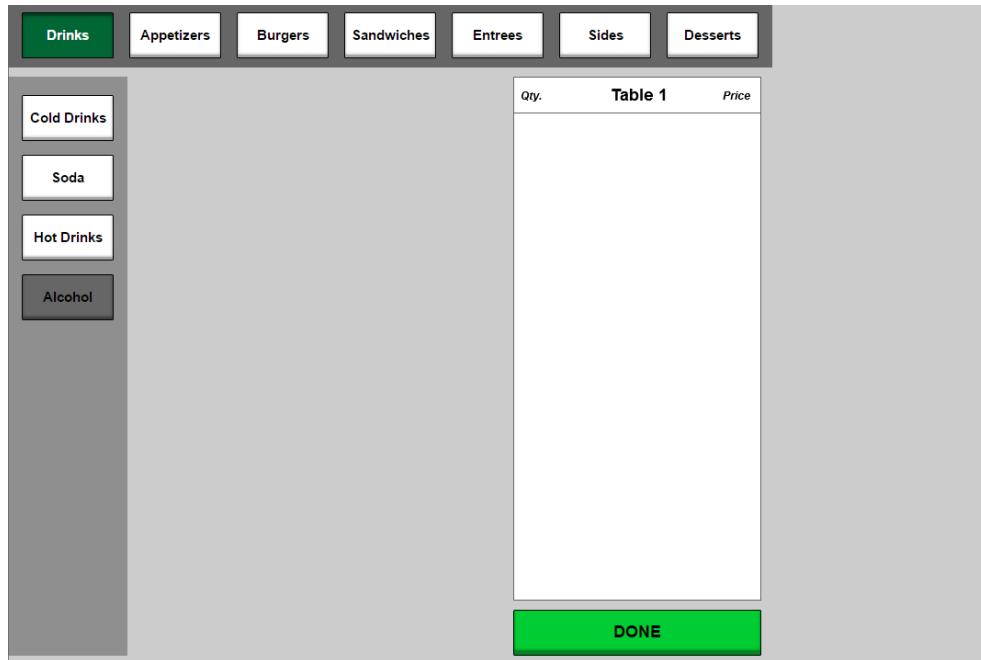


Figure 2. General layout of the treatment interface. Main categories were placed along the top-left to follow the F-shape guideline and working total was placed to the right.

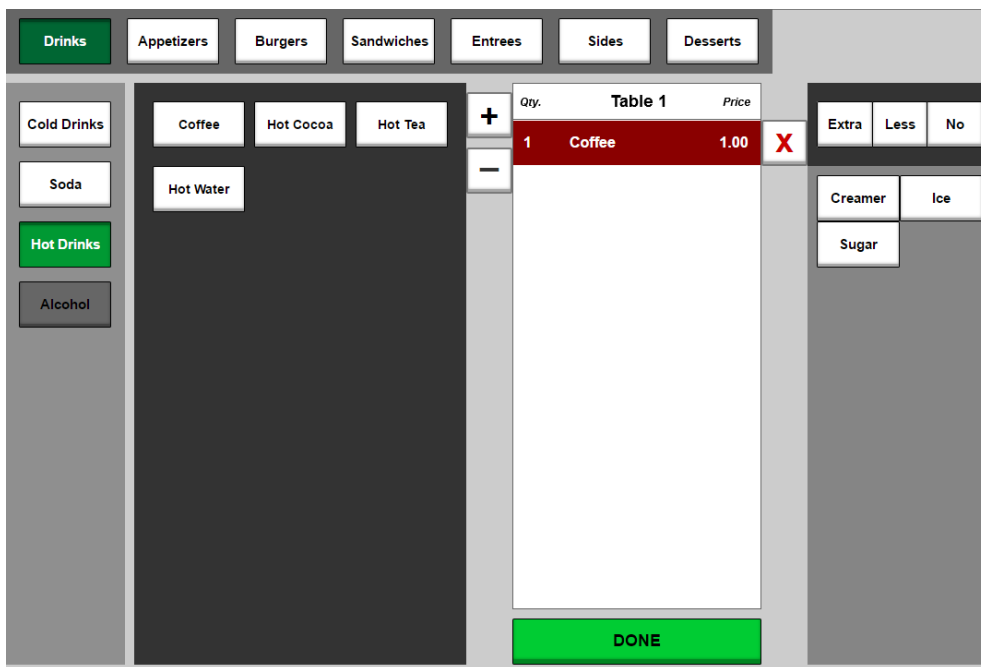


Figure 3. Sub-category selection and item appearance. Selection of an item in the working total highlighted red and allowed simple editing.

Control design. Similar to the treatment, the control did not feature a full program. Figure 1 shows the mockup of the default interface used in NCR Aloha terminals. On the left was the working total, where items entered could be selected or deselected with a click. Selection was required for editing or deletion. To the right of the working total was the submenu, where additional categories could be found further along the list by selection of the respective arrows. For example, in order to access the entree submenu, the user had to scroll down. As an added note, any function (e.g., submenu, item menu, working total, etc.) that exceeded the bounds of the screen could only be accessed by scrolling. In order for participants to experience this essential functionality of the interface, some of the assigned tasks required the use of arrow keys (see Appendix C, for control interface steps).

In general, this industry interface alphabetically organized food and drink items under categories (e.g., beverages, appetizers, entrees, etc.), however, categories were organized based on complementary characteristics. For example, burgers preceded entrees as a separate button because more customers ordered burgers over other meals, even if a burger was considered an entree. Within the main categories, items with different characteristics (e.g., hot or cold) were either spatially grouped apart or alphabetically organized together. The control prototype modeled these arrangements as closely as possible.

Study design. The study was designed to be 2 x 2 repeated measures with counterbalancing. All users participated in the list type, control, and treatment conditions (See Table 3).

Table 3

2 x 2 Conditions

List Type	Interface Type
Categorized List	Treatment interface
Uncategorized List (Restaurant Script)	Control interface

Both lists, categorized and uncategorized, were performed on each interface type. As such, the control and treatment interfaces were treated as two separate sessions, aptly named Session A and B. Lists within each session were treated as tasks. For session A, a random number generator randomly assigned participants to a control or treatment interface (Graphpad, 2015). Categorized and uncategorized lists were similarly assigned for the first task and alternated on the second task. For example, if the first task in Session A was determined to be a categorized list, the second task for session A involved the uncategorized version of the same list. Session B assigned the interface that was not received in Session A with a randomized task (see Figure 4). The independent variables were the prototypes and the list types. Snagit software recorded the screen output to help code for dependent measures (Snagit, 2015).

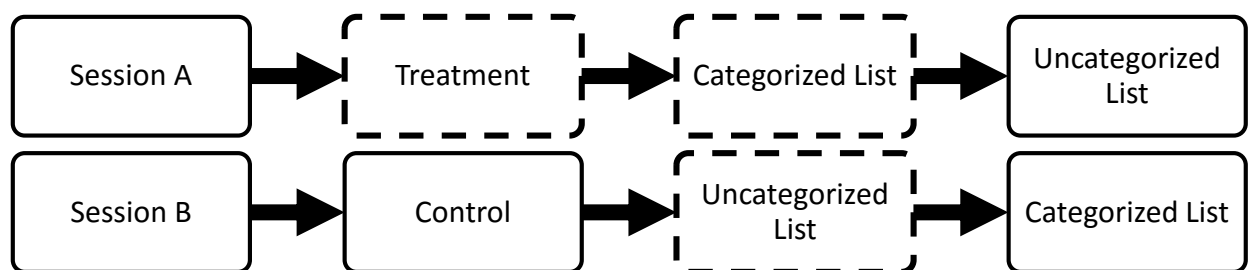


Figure 4. Visual example of the study design. Dashed boxes represented areas of randomization. Randomization was partially counterbalanced among participants.

Measures. Dependent measures for this study were selection time, total time, errors, and total selections. In order to measure selection accuracy, errors and total selections were secondary measurements for learning efficiency. Selection time was the amount of time, in seconds, between two inputs. Total time was tracked for each task, which began when the “start” button was pressed and ended when the “done” button was pressed. Times were recorded from reviewing videos in VLC Media Player (VLC). Errors were defined as selections that required deletion or editing. Total selections tallied all inputs, including search behavior (e.g., moving between multiple food categories to find the right item).

Measuring learning efficiency. Predicting efficiency required error percentages and reaction time measurements. Reaction time was represented as selection time due to the nature of the study design, which presented multiple stimuli and response variables at once. This study used the inverse efficiency score (IES) by Townsend and Ashby (1978) to measure efficiency. The equation below was from an analysis paper by Bruyer and Brysbaert (2011) on the inverse efficiency score:

$$IES = \frac{RT}{1 - PE} = \frac{RT}{PC}$$

RT was reaction time in milliseconds, PE was the percentage of errors, and PC was the percentage of correct responses. Because selection time replaced RT, its measurements in this equation were represented in milliseconds. A higher IES score implies lower efficiency and a lower IES score implies higher efficiency. The intent was to calculate the score for each participant and average separate results across list and interface types.

Procedure

Before each trial, prototypes were preloaded on separate browser tabs in full screen, and Snagit was set to record. Upon arrival, participants read and verbally agreed to the consent form before briefing (see Appendix D). If technical errors occurred, participants were encouraged to ignore them and to keep going, as some of the interface buttons only existed for presentational purposes. The goal was to enter all food and drink orders into the interface in any sequence within 10 minutes. An order was completed successfully when the appropriate items and modifiers were selected and displayed in the working total. Two letter-sized envelopes contained the categorized and uncategorized lists, marked #1 and #2, for each interface session.

Session A. Participants began with envelope #1 and pressed the “start” button when ready; this prompted the interface to load on the next page. When satisfied with the inputs on the working total,

participants pressed the “done” button. This displayed onscreen instructions for the next task with another “start” screen. The process for the next task was the same, except the countering list type in envelope #2 was used and the “done” button led to a blank screen.

Session B. Participants were given the option of a five-minute break between sessions while the researcher changed browser tabs to the alternate interface and prepared the next pair of tasks. Some participants opted to continue working without waiting for the full five minutes. The instructions for the second session were exactly the same as the first. Envelope labels were underlined to help the researcher differentiate between sessions (e.g., #1 and #2). After each trial, participants completed a nine-question survey on demographics and preferences (see Appendix E). Screen recordings were also stopped and saved at this time.

RESULTS

Comparing Prototypes

Several 2 (interface type: control or treatment) x 2 (list type: categorized or uncategorized) repeated measure ANOVAs were conducted for the respective dependent measures: selection time, total time, errors, and total selections. These variables were necessary to determine efficiency, which was examined in a separate analysis further below. Of the thirty-two participants, four participants were removed due to incomplete tasks. This left twenty-eight participants that met the experience criterion.

Selection time. A two-way repeated measures ANOVA compared differences in interface and list type selection times. The descriptive statistics summary is presented in Table 4. A significant main effect of interface was found in the analysis, $F(1,27) = 8.815, p = .006, \eta_p^2 = .246$. Examination of the main effect revealed that the control interface had longer selection times than the treatment. List type did not reveal any significant effects, $F(1,27) = .282, p = .600, \eta_p^2 = .010$, which indicated that selection time

did not differ when given categorized or uncategorized lists. There was also no significant interaction, $F(1,27) = 3.211, p = .084, \eta_p^2 = .106$.

Table 4

Selection time for each condition in seconds

Interface Type	Categorized list		Uncategorized list	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Control	3.66	1.63	3.22	.88
Treatment	2.71	.67	2.96	.81

Total time. Analysis of total time showed no significant effect for list type, $F(1,27) = 3.877, p = .059, \eta_p^2 = .126$, and no significant interaction between list and interface, $F(1,27) = 2.780, p = .107, \eta_p^2 = .093$. But a significant main effect was observed for interface type, $F(1,27) = 10.898, p = .003, \eta_p^2 = .288$, in that participants spent more time with the control interface over the treatment (see Table 5).

Table 5

Total time spent on each condition in seconds

Interface Type	Categorized list		Uncategorized list	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Control	156.36	76.84	163.64	81.21
Treatment	100.64	39.82	143.11	58.13

Errors. The measurement for errors did not exhibit significant effects in interface ($F(1,27) = .774, p = .387, \eta_p^2 = .028$), list ($F(1,27) = 2.465, p = .128, \eta_p^2 = .084$), or interaction ($F(1,27) = .738, p = .398, \eta_p^2 = .027$). This suggested that administering different lists and interfaces did not have notable differences in errors (see Table 6).

Table 6

Errors made on each condition

Interface Type	Categorized list		Uncategorized list	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Control	2.07	3.01	1.79	2.04
Treatment	2.11	2.18	1.36	2.04

Total selections. The amount of inputs made between interfaces, $F(1,27) = 10.438$, $p = .003$, $\eta_p^2 = .279$, had a significant effect. In addition, a significant main effect was found between list type, $F(1,27) = 12.981$, $p = .001$, $\eta_p^2 = .325$. The control interface had more selections than the treatment interface, and uncategorized lists caused participants to make more selections over categorized lists (see Table 7). A significant interaction, however, was not observed, $F(1,27) = 1.067$, $p = .311$, $\eta_p^2 = .038$.

Table 7

Selection amounts for each condition

Interface Type	Categorized list		Uncategorized list	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Control	44.89	17.20	51.36	16.16
Treatment	37.54	9.43	47.75	12.11

Inverse efficiency scores. Inverse Efficiency Scores (IES) were calculated by converting selection time to milliseconds for RT and dividing errors by selection amounts for PE. A 2 x 2 repeated measures ANOVA found a significant interface effect, $F(1,27) = 7.238$, $p = .012$, $\eta_p^2 = .211$. Compared to the treatment interface, the control had higher scores indicating lower efficiency (see Table 8). IES significance was not found for list type, $F(1,27) = 1.897$, $p = .180$, $\eta_p^2 = .066$, and there was no significant interaction, $F(1,27) = 1.923$, $p = .177$, $\eta_p^2 = .066$. Selection time and error percentages were averaged across each participant to find a significant positive correlation, $r(26) = .425$, $p = .024$.

Table 8

Inverse efficiency scores for each condition

Interface Type	Categorized list		Uncategorized list	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Control	4124.780	2396.857	3422.956	1053.137
Treatment	3074.258	996.295	3071.863	831.199

Survey Results

Participants rated each interface’s ease of use along a seven-point Likert scale (1 = *easy* and 7 = *hard*). Control ($M = 2.96$, $SD = 1.644$) and treatment ratings ($M = 2.68$, $SD = 1.492$) are represented in Figure 5. A Wilcoxon signed rank test determined that the median control ratings ($Median = 3.00$) were not significantly higher than the median treatment ratings ($Median = 2.50$), $Z = -.671$, $p = .502$.

Participants also chose a preferred interface, of which 9 participants favored the control and 19 participants favored the treatment. A chi-square goodness-of-fit test was conducted to examine if the interfaces were equally preferred. Preference was not equally distributed among the participants, $\chi^2(1, N = 28) = 3.571$, $p = .059$.

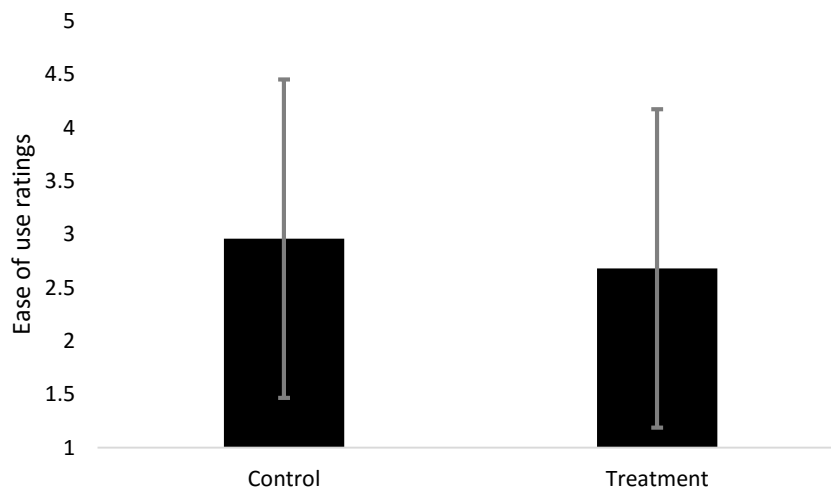


Figure 5. Participants’ ease of use score for control and treatment interfaces on a scale of seven points (1 = *easy* and 7 = *hard*). Mean and standard deviations are visually represented.

Discussion

This study hypothesized that point-of-sale interfaces designed using left side emphasis and categorical organization would help increase efficiency for new users. Expert and novice order taking strategies (categorized and uncategorized lists, respectively) were introduced as tasks to observe input differences. Selection time, total time, and selection accuracy were predicted to improve, which received support.

Selection Time and Total Time

Based on the results, treatment design implementations positively impacted user interaction. This was expected and consistent with past research (Somberg, 1987; Card, 1981; McDonald et al., 1983; Parkinson et al., 1985). Structuring the interface in categorized-categories and F-shape resulted in faster selection and total times. This finding confirms previous claims that menu organization should align with task type (McDonald et al., 1988). It was also possible that F-shape design contributed to lower selection and total time because both measures included search time. One implication is that menu buttons should appear simultaneously; interactive elements should not be separated by windows (e.g., a modify button that takes the user to a completely different screen) or scrolling arrows. Future interface studies should explore F-shape and scrolling effects from eye tracking tests.

Errors

Input errors did not reveal any differences in the analysis. In other words, the number of errors made from entering orders was not related to the way the interfaces were organized. This was unexpected, but it should have been assumed that participants would try to make the right selections regardless of interface type. It must be noted that of the participants who made errors, six participants never modified their orders (e.g., extra salt or less sugar). It is possible that modifications on the tasks or the interfaces were not visually obvious and ignored. Perhaps the task modifiers should not have been

italicized, and an extra modifying button should have been incorporated in the treatment interface. In addition, search behavior was not considered to be an error. Future studies may want to explore errors applied to restaurant interface search behavior.

Total Selections

Fewer selections in the treatment and categorized lists suggested reduced search behavior and increased selection accuracy. Similar to time implications, the number of selections may have benefitted from F-shape and categorical organization. More importantly, the treatment interface had a total of 77 buttons and the control had 76. Therefore, participants made more misguided search inquiries in the control. The list condition is consistent with previous findings (Ericsson & Polson, 1988; Huet & Mariné, 2005), because it represents an efficient order taking strategy that models expert schemas. Hence teaching new servers to organize items by category may help them plan inputs ahead of time, reducing cognitive load.

Efficiency

Efficiency was markedly higher in the treatment condition, which was alluded by the other measurement results. Taking error rate into account, the IES determined that selections made were faster and more accurate, even though total errors did not differ. Search behavior was also observed in this case. Higher search, longer selection times, and inaccurate search selections in the control were highlighted by the IES.

Participant Surveys

It was interesting that participants felt both interfaces were relatively easy. Most participants reported a preference for the treatment over the control because they felt the layout was more organized and intuitive. On the other hand, participants who preferred the control felt that treatment

sub-categories hindered tasks, as items were easier to scan when all of them were displayed at the same time. Despite results illustrating more time and effort investments in the control, perhaps searching is a minor frustration.

Limitations

A few limitations may have influenced the results. First, 13 participants pressed the “done” button too early. This meant the previous webpage had to be reloaded and orders had to be re-entered. It is possible that small practice effects emerged from these repeated inputs, but the issue was non-specific towards the type of interface and only occurred once per affected participant. Changes to the button’s name may have prevented this error (e.g., finish or send), because users were not sure whether “done” was to be pressed after each customer or after each category. Second, six participants stopped in the middle of their uncategorized task to ask if orders could be separated by customer on the interface. Because five of these participants asked this question during the control, their time measurements may have been inflated from 5 to 10 seconds. Perhaps the seat number below the control’s working total caused users to believe it was functional. Future studies should exclude customer names on task lists and only organize by numbers to avoid confusion. Finally, participants were screened for restaurant experience, but there are other industries that use point-of-sale systems (e.g., retail, banking, grocers, etc.). It is unclear if past exposure to POS in these jobs can affect new restaurant workers. Future studies should consider screening for these occupations or testing the skill transfer of these technologies.

CONCLUSION

Interface design is important for user experience. General guidelines, such as categorical organization and F-shape, should be established to simplify the design process. We demonstrated that design aided task efficiency by lowering selection time, total time, and total number of selections.

Additionally, teaching novices to take orders efficiently can help decrease workplace pressures. The results in this study can expand in future studies through eye tracking or workplace implementation. If support is found, this can help with the general frustrations of learning to use a restaurant POS system. Not only would restaurant profits see a positive effect from increased efficiency, but the servers' quality of life would improve within the workplace from less cognitive load. Additionally, customers would have an extra level of service, generating satisfaction.

REFERENCES

- Axure (Version 7.0) [Computer software]. (2015). Available from <http://www.axure.com/>
- Bruyer, R. & Brysbaert, M. (2011). Combining speed and accuracy in cognitive psychology: Is the inverse efficiency score (IES) a better dependent variable than the mean reaction time (RT) and the percentage of errors (PE)? *Psychologica Belgica*, 51, 5-13.
- Buscher, G., Cutrell, E., & Morris, M. R. (2009). What do you see when you're surfing? Using eye tracking to predict salient regions of web pages. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. Retrieved from <http://dl.acm.org/citation.cfm?id=1518705>
- Card, S. K. (1981). User perceptual mechanisms in the search of computer command menus. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. Retrieved from <http://dl.acm.org/citation.cfm?id=801779>
- Chandler, P. & Sweller, J. (1996). Cognitive load while learning to use a computer program. *Applied Cognitive Psychology*, 10, 151-170.
- Ericsson, K. A. & Polson, P. G. (1988). An experimental analysis of the mechanisms of a memory skill. *Journal of Experimental Psychology*, 14(2), 305-316.
- Goldberg, J. H., Lewenstein, M., Scott, N., Stimson, M. J., & Wichansky, A. M. (2002). Eye tracking in web search tasks: Design implications. *Proceedings of the 2002 symposium on Eye Tracking Research & Applications*. Retrieved from <http://dl.acm.org/citation.cfm?id=507082>
- Graphpad. (2015). [Calculator for randomly assigning subjects to treatment groups]. *QuickCalcs*. Retrieved from <http://graphpad.com/quickcalcs/randomize1/>

- McDonald, J. E., Dayton, T., McDonald, D. R. (1988). Adapting menu layout to tasks. *International Journal of Man-Machine Studies*, 28(4), 417-435.
- McDonald, J. E., Stone, J. D., & Liebelt, L. S. (1983). Searching for items in menus: The effects of organization and type of target. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, 27(9), 834-837.
- Huet, N. & Mariné, C. (2005). Clustering and expertise in a recall task: The effect of item organization criteria. *Learning and Instruction*, 15(4), 297-311.
- Jewell, G. & McCourt, M. E. (2000). Pseudoneglect: A review and meta-analysis of performance factors in line bisection tasks. *Neuropsychologia*, 38, 93-110.
- Nielsen, J. (2006). F-shaped pattern for reading web content. *Nielsen Norman Group: Evidence-Based User Experience Research, Training, and Consulting*. Retrieved from <http://www.nngroup.com/articles/f-shaped-pattern-reading-web-content/>
- Parkinson, S. R., Sisson, N., & Snowberry, K. (1985). Organization of broad computer menu displays. *International Journal of Man-Machine Studies*, 23(6), 689-697.
- Sherman, C. (2005). A new f-word for google search results. *Search Engine Watch*. Retrieved from <http://searchenginewatch.com/sew/news/2066806/a-new-f-word-google-search-results>
- Snagit [Computer Software]. (2015). Michigan: Okemos.
- Somberg, B. L. (1987). A comparison of rule-based and positionally constant arrangements of computer menu items. *Proceedings of the SIGCHI/GI Conference on Human Factors in Computing Systems and Graphics Interface*. Retrieved from <http://dl.acm.org/citation.cfm?id=275639>

Sui C. & Chaparro, B. S. (2014). First look: Examining the horizontal grid layout using eye-tracking.

Proceedings of the Human Factors and Ergonomics Society 58th Annual Meeting, 1119-1123.

Townsend, J. T., & Ashby, F. G. (1983). *Stochastic Modeling of Elementary Psychological Processes*.

Cambridge: Cambridge University Press.

VLC Media Player [Computer software]. (2015). Retrieved from <http://www.videolan.org/vlc/index.html>

APPENDIX A
ORDER TASKS

Table A1

Order Tasks (categorized)

List 1	List 2
<p>Drinks</p> <ol style="list-style-type: none"> 1. Lemonade (<i>no ice</i>) 2 Waters Sweet Tea <ol style="list-style-type: none"> 2. Coffee (<i>extra creamer</i>) <p>Appetizers</p> <ol style="list-style-type: none"> 3. Caesar salad (<i>extra cheese</i>) Strawberry spinach salad <p>Entrees</p> <ol style="list-style-type: none"> 4. Chicken Pot Pie <ol style="list-style-type: none"> 5. Fettucini Alfredo (<i>less sauce</i>) Pesto Pasta (<i>extra pasta</i>) 	<p>Drinks</p> <ol style="list-style-type: none"> 1. Rootbeer (<i>less ice</i>) Mellow Yellow Sprite <ol style="list-style-type: none"> 2. Hot Tea (<i>extra sugar</i>) Hot Cocoa <p>Appetizers</p> <ol style="list-style-type: none"> 3. Cucumber salad (<i>no dressing</i>) <ol style="list-style-type: none"> 4. Veggie soup <p>Entrees</p> <ol style="list-style-type: none"> 5. Steak (<i>extra salt</i>) Shepherds Pie <ol style="list-style-type: none"> 6. Grilled Marinated Chicken (<i>extra sauce</i>)

Note. Orders listed are of the drink, appetizer and entree functions only. These tasks were sorted by category. Participants were asked to complete each item in any order.

Table A2

Order Tasks (uncategorized/restaurant scripted)

List 1	List 2
<p>1. Customer 1</p> <ul style="list-style-type: none"> - Water - Caesar salad (<i>extra cheese</i>) - No entree <p>2. Customer 2</p> <ul style="list-style-type: none"> - Coffee (<i>extra creamer</i>) - No Appetizer - Chicken Pot Pie <p>3. Customer 3</p> <ul style="list-style-type: none"> - Lemonade (<i>no ice</i>) - No Appetizer - Fettucini Alfredo (<i>less sauce</i>) <p>4. Customer 4</p> <ul style="list-style-type: none"> - Water - Strawberry Spinach salad - No Entree <p>5. Customer 5</p> <ul style="list-style-type: none"> - Sweet tea - No Appetizer - Pesto Pasta (<i>extra pasta</i>) 	<p>1. Customer 1</p> <ul style="list-style-type: none"> - Sprite - No Appetizer - Grilled Marinated Chicken (<i>extra sauce</i>) <p>2. Customer 2</p> <ul style="list-style-type: none"> - Rootbeer (<i>less ice</i>) - Veggie soup - No entree <p>3. Customer 3</p> <ul style="list-style-type: none"> - Mellow Yellow - No Appetizer - Shepherds Pie <p>4. Customer 4</p> <ul style="list-style-type: none"> - Hot Tea (<i>extra sugar</i>) - Cucumber salad (<i>no dressing</i>) - No Entree <p>5. Customer 5</p> <ul style="list-style-type: none"> - Hot Cocoa - No Appetizer - Steak (<i>extra salt</i>)

Note. Tasks in uncategorized lists were sorted by customer. Participants received both lists.

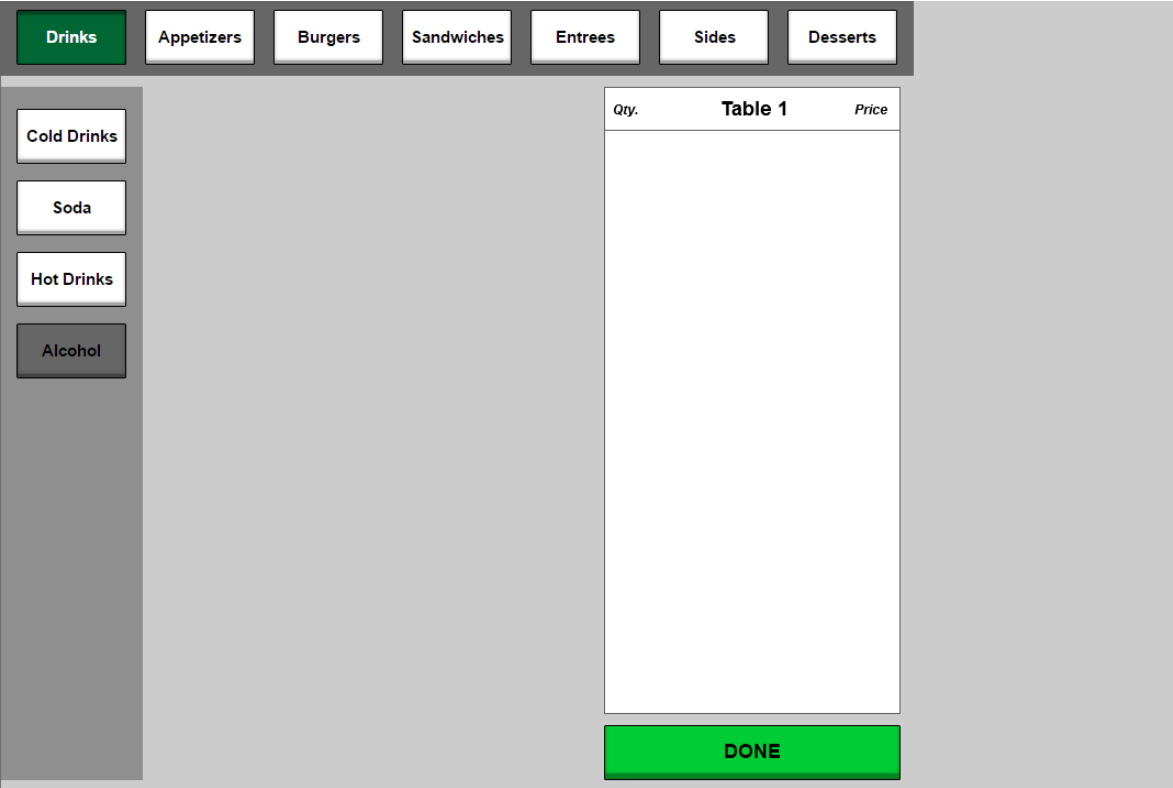
APPENDIX B
TREATMENT INTERFACE STEPS

START

Welcome! Today you will play waiter and input drink, appetizer, and entree orders into restaurant computer screens.

You will use the list from envelope #1. When you are finished entering all orders from #1, hit the "Done" button. Remember to work as quickly and accurately as possible. If you have any questions, ask now!

When you are ready, hit the "START" button!



Drinks Appetizers Burgers Sandwiches Entrees Sides Desserts

Cold Drinks Soda Hot Drinks Alcohol

Lemonade Milk Sweet Tea
Unsweet Tea Water

Qty.	Table 1		Price

DONE

Drinks **Appetizers** Burgers Sandwiches Entrees Sides Desserts

Soups Salads Meat Vegetable

Chicken Dumpling French Onion Spicy Tortilla
Veggie

Qty.	Table 1		Price
1	Water		0.00
1	Milk		1.00

DONE

Drinks Appetizers Burgers Sandwiches **Entrees** Sides Desserts

Chicken Beef **Pasta**

Fettucini Alfredo Pesto Pasta Spaghetti

Qty.	Table 1	Price
1	Water	0.00
1	Milk	1.00
1	Veggie soup	2.00
1	Strawberry Spinach salad	3.75
1	Pesto Pasta	9.20
1	Fettucini Alfredo	9.20

+ -

Extra Less No

Beef Chicken

Vegetable Pasta

Salt Sauce

DONE

Drinks Appetizers Burgers Sandwiches **Entrees** Sides Desserts

Chicken Beef **Pasta**

Fettucini Alfredo Pesto Pasta Spaghetti

Qty.	Table 1	Price
1	Water	0.00
1	Milk	1.00
1	Veggie soup	2.00
1	Strawberry Spinach salad	3.75
1	Pesto Pasta	9.20
1	Fettucini Alfredo	9.20

+ -

Extra **Less** No

Beef Chicken

Vegetable Pasta

Salt Sauce

DONE

Drinks Appetizers Burgers Sandwiches **Entrees** Sides Desserts

Chicken Beef **Pasta**

Fettucini Alfredo Pesto Pasta Spaghetti

Qty.	Table 1	Price
1	Water	0.00
1	Milk	1.00
1	Veggie soup	2.00
1	Strawberry Spinach salad	3.75
1	Pesto Pasta	9.20
1	Fettucini Alfredo	9.20
	** Less SAUCE	0.00

Extra **Less** No

Beef Chicken

Vegetable Pasta

Salt Sauce

DONE

START

Great work!

Go ahead and open envelope #2 for your next table.

When you are ready, hit the "START" button!

		Table 1	
		Qty.	Price
Drinks			
Appetizers			
Burgers			
Sandwiches			
Entrees			
Sides			
Desserts			
Cold Drinks			
Soda			
Hot Drinks			
Alcohol			
			DONE

Thank you for taking part in this study!
Please wait for further instructions!

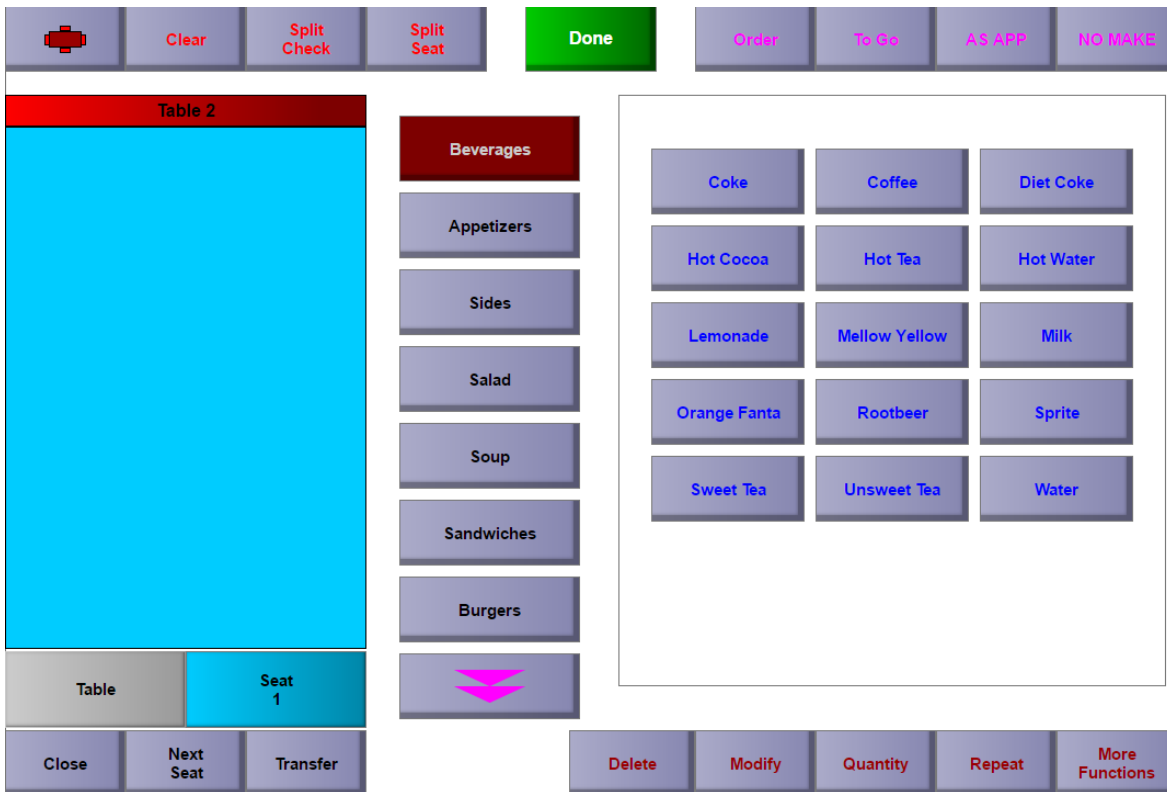
APPENDIX C
CONTROL INTERFACE STEPS

START

Welcome! Today you will play waiter and input drink, appetizer, and entree orders into restaurant computer screens.

You will use the list from envelope #1. When you are finished entering all orders from #1, hit the "Done" button. Remember to work as quickly and accurately as possible. If you have any questions, ask now!

When you are ready, hit the "START" button!



+ Clear Split Check Split Seat Done Order To Go AS APP NO MAKE

Table 2	
Coke	1.45

Beverages
Appetizers
Sides
Salad
Soup
Sandwiches
Burgers
▼

Coke	Coffee	Diet Coke
Hot Cocoa	Hot Tea	Hot Water
Lemonade	Mellow Yellow	Milk
Orange Fanta	Rootbeer	Sprite
Sweet Tea	Unsweet Tea	Water

Table Seat 1
Close Next Seat Transfer Delete Modify Quantity Repeat More Functions

+ Clear Split Check Split Seat Done Order To Go AS APP NO MAKE

Table 2	
Coke	1.45
Mellow Yellow	1.45
Pita & Hummus	5.00
Stuffed Mushrooms	3.25
Caesar salad	2.50

Beverages
Appetizers
Sides
Salad
Soup
Sandwiches
Burgers
▼

Caesar	Cucumber	Kale & Feta
Spinach Pomegranate	Strawberry Spinach	

Table Seat 1
Close Next Seat Transfer Delete Modify Quantity Repeat More Functions

+ Clear Split Check Split Seat Done Order To Go AS APP NO MAKE

Table 2	
Coke	1.45
Mellow Yellow	1.45
Pita & Hummus	5.00
Stuffed Mushrooms	3.25
Caesar salad	2.50

Beverages Appetizers Sides **Salad** Soup Sandwiches Burgers

Caesar Cucumber Kale & Feta
Spinach Pomegranate Strawberry Spinach

Table Seat 1

Close Next Seat Transfer Delete **Modify** Quantity Repeat More Functions

Done

Table 2	
Caesar salad	2.50
** NO Dressing	0.00

Table Seat 1

No Extra Less
Cheese Dressing Salt
Spicy
Delete

OK CANCEL

The screenshot shows a restaurant POS interface. At the top, there is a navigation bar with buttons: a red cross icon, 'Clear', 'Split Check', 'Split Seat', 'Done' (highlighted in green), 'Order', 'To Go', 'AS APP', and 'NO MAKE'. Below this is a menu for 'Table 2' with a list of items and prices:

Table 2	
Coke	1.45
Mellow Yellow	1.45
Pita & Hummus	5.00
Stuffed Mushrooms	3.25
Caesar salad	2.50
** NO Dressing	0.00

To the right of the menu is a vertical list of categories: Beverages, Appetizers, Sides, Salad (highlighted in red), Soup, Sandwiches, Burgers, and a pink arrow icon. To the right of the categories is a large white area containing buttons for specific items: Caesar, Cucumber, Kale & Feta, Spinach Pomegranate, and Strawberry Spinach. At the bottom of the interface, there are buttons for 'Close', 'Next Seat', 'Transfer', 'Delete', 'Modify', 'Quantity', 'Repeat', and 'More Functions'.

START

Great work!

Go ahead and open envelope #2 for your next table.

When you are ready, hit the "START" button!

	Clear	Split Check	Split Seat	Done	Order	To Go	AS APP	NO MAKE															
Table 2 <div style="background-color: cyan; width: 100%; height: 150px;"></div>				Beverages Appetizers Sides Salad Soup Sandwiches Burgers 		<table border="1"> <tr> <td>Coke</td> <td>Coffee</td> <td>Diet Coke</td> </tr> <tr> <td>Hot Cocoa</td> <td>Hot Tea</td> <td>Hot Water</td> </tr> <tr> <td>Lemonade</td> <td>Mellow Yellow</td> <td>Milk</td> </tr> <tr> <td>Orange Fanta</td> <td>Rootbeer</td> <td>Sprite</td> </tr> <tr> <td>Sweet Tea</td> <td>Unsweet Tea</td> <td>Water</td> </tr> </table>			Coke	Coffee	Diet Coke	Hot Cocoa	Hot Tea	Hot Water	Lemonade	Mellow Yellow	Milk	Orange Fanta	Rootbeer	Sprite	Sweet Tea	Unsweet Tea	Water
Coke	Coffee	Diet Coke																					
Hot Cocoa	Hot Tea	Hot Water																					
Lemonade	Mellow Yellow	Milk																					
Orange Fanta	Rootbeer	Sprite																					
Sweet Tea	Unsweet Tea	Water																					
Table		Seat 1																					
Close	Next Seat	Transfer	Delete Modify Quantity Repeat More Functions																				

Thank you for your participation!
Please wait for further instructions.

APPENDIX D
CONSENT FORM

Title of research study: Usability Effects on Restaurant Point-of-Sale Interfaces

Investigator: Cheryl Wang

Why am I being invited to take part in a research study?

We invite you to take part in a research study because you have little or no experience in using a restaurant computer with little or no serving experience in a restaurant.

Why is this research being done?

Currently, there are no quantitative measures in research that can tell us if the computer interface you use in a restaurant is efficient. We want to figure out these measures.

How long will the research last?

We expect that individuals will spend 45 minutes participating in the proposed activities.

How many people will be studied?

We expect about 28-32 people will participate in this research study.

What happens if I say yes, I want to be in this research?

You get to play waiter! You will be given ten food and drink orders from two tables. Your job is to enter them into the computer (ordering station) one by one and send them off to the kitchen. These orders are to be done on two ordering stations for a total of 20 food and drink orders. You will have 20 minutes to complete all your orders at each computer, with a 5 minute break between stations. The actions taken on the computer screen will be recorded. You are free to decide whether you wish to participate in this study.

What happens if I say yes, but I change my mind later?

You can leave the research at any time. It will not be held against you. You will still receive credit for your class.

Will being in this study help me in any way?

You will receive 1 course credit for your class after completion of the tasks.

What happens to the information collected for the research?

Efforts will be made to limit the use and disclosure of your personal information, including research study records and computer screen recordings, to people who have a need to review this information. We cannot promise complete secrecy. The results of this study will be used in a master's applied project, possibly in conferences and publications, but your name will not be used.

Who can I talk to?

If you have questions, concerns, or complaints, you may contact the research team: Russell Branaghan at Russell.Branaghan@asu.edu or Cheryl Wang at ccwang4@asu.edu

This research has been reviewed and approved by the Social Behavioral IRB. You may talk to them at (480) 965-6788 or by email at research.integrity@asu.edu if:

- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.
- You want to talk to someone besides the research team.
- You have questions about your rights as a research participant.
- You want to get information or provide input about this research.

Please let me know if you would like to participate in this research.

APPENDIX E

SURVEY FORM

