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Cross-Cultural Comparative Study of Users’ Perception of the Navigation Organization of an E-Commerce Web Application

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Cross-Cultural Comparative Study of Users’ Perception of the Navigation Organization of an E-Commerce Web Application

by

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SCHOOL OF COMPUTING

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ABSTRACT

The object of this study was to assess the influence of native language, as a principal cultural characteristic, on users’ behavior when using a web-based e-commerce application. The study expands on previous research by comparing English and Russian users. The research also considered demographic data to assess additional factors that influence behavior and task performance. The research design encompassed an online shopping application with two different navigation menus. One menu was based on the action-object model and the other was based on the object-action model. The user interface was created in two different languages (Russian and English). This study suggests that language, as a cultural indicator, has a direct relationship to user satisfaction and performance in e-commerce web applications.
Chapter 1

INTRODUCTION

As the World Wide Web continues to grow, distance is no longer a limitation in allowing massive amounts of information to be shared worldwide instantaneously. Every country has its own language, history, traditions, religions and other unique characteristics that influence the use of Internet resources and the effectiveness of sharing information. These cultural differences influence human behavior and decision-making processes related to web application usage. IT professionals realize that website structures and user interfaces should be designed to accommodate cultural behaviors and preferences so as to increase the usability and effectiveness of web applications. The study of cultural behavior has had a significant influence on human-computer interaction (HCI) research. These studies suggest that web designers should build web interfaces that reflect multiple cultural behavior patterns.

1.1 E-commerce Interface Design Challenges and Considerations

Developing cross-cultural e-commerce applications that account for the delicate psychological aspects inherent in each culture has been a significant challenge for web developers. It is important to take into consideration meaningful differences in the way people across different cultures think, behave and assign values using the web resources.
Further, online technologies often lack content, structure and organization sensitive to the complexity of a user’s domestic and individual understanding of how a web application works, which is usually based on past experience or cultural background. Based on learned cultural cognition, a user employs a mental model to help him to understand how to use a web application. Failure to be sensitive to the complexity of cross-cultural cognition can result in an ineffective web platform that promotes user confusion and ultimately decreases use across multiple cultures.

Where an application does not account for cultural mental models, people will cease to use it and seek alternative web applications. This ultimately reduces the global reach of the application. For example, if a user has difficulties understanding a navigation menu, then the user will likely waste significant amounts of time accomplishing desired tasks. If end users cannot find a desired product or service, then they are less likely to make a purchase. Facilitating purchases is the underlying commercial objective, which could be averted by an ineffective web application. A web application should be designed to facilitate use and not act as an obstacle to use because users evaluate web applications based on their ability to assist users in successfully accomplishing desired tasks.

1.2 System Interaction Models: Action-Object and Object-Action

There exist two basic interaction models for any system: (1) object-action model and (2) action-object model. In object-action model, a user first selects an object and then selects
an action related to the selected object. Figure 1 shows an example of navigation menu based on object-action configuration.

![Figure 1: An Example of the Object-Action User Interface](image1.png)

On the other hand, in the action-object model, a user first selects an action that needs to be done and then selects one or more objects for which this action should be performed. Figure 2 shows an example of navigation menu based on action-object configuration.

![Figure 2: An Example of the Action-Object User Interface](image2.png)

The user interface allows users to interact with the Internet and with any web application. User interfaces are considered to be one of the important ingredients of web application satisfaction. As Carter stated “the more a web application structure and organization emulates the user’s perception, the easier the user interface will be to use” [Carter91]. The user converts his mental model of the desired task or activity into the navigation menu items that can be described as actions and objects.
1.3 Statement of the Problem

The navigation menu is the primary tool used by end users to make decisions and take actions. In essence, it is roadmap for the given web application. Similar to a roadway where inadequate signage can cause a driver to become lost, a poorly configured navigation menu could lead a user down the wrong application pathway. Navigation menus that do not account for a given user’s mental model in their design will make it more difficult for that user to implement mental decisions into application action. It is expected that failure to account for mental models will cause users to be misdirected to the wrong information and cause confusion. Ultimately, user satisfaction will suffer and could cause users to employ other, competing applications. Simply, if web buyers cannot find the product or service they desire, then the purchase will be made on other websites.

The navigation menu, like most spoken languages, has its own syntax for various objects and actions. Therefore, recognition of a given navigation menu is directly related to recognition of the syntax structure of the menu. The more the navigation menu’s syntax resembles the user’s native language, then the greater the chance of recognition. The user’s language has a defined structure and linguistic order of actions and objects. The grammatical structure of a user’s native language will dictate the user’s mental action processes. For example, if the user’s language focuses on action as it relates to objects, it will be difficult for the user to complete tasks using an object-first menu configuration. The syntax of the user’s native language (object and action order) is a significant influence on how the user makes decisions and implements those decisions through
action choices. However, it is important to note that “the task may influence how the user employs language to construct the mental model” [Arnold89].

Language is the key human-factor for web application interface design. Accurate and understandable wording is required to clearly convey the intended meaning. In computer terms, natural language uses human-readable labels for files, folders, links, etc. A label is a word or short phrase that efficiently describes an object or action. Generally speaking, most menu interfaces utilize the English grammar structure. The “user is expected to be able to enter a command in the correct sequence by structuring it mentally in the grammatical order of an English sentence” [Carter91]. If a user is unfamiliar with the English syntax and has a mental model that utilizes a different syntax structure, then the user’s choice of command sequences would likely be contrary to the web application’s structure and thus ineffective.

1.4 Study Contribution

Due to both social and commercial globalization, consideration of the navigation design has become increasingly more important for global web applications. The ability to successfully navigate a given website is likely the most crucial element in the effectiveness of a website. Recognizable navigation configuration orients end users and provides a usable roadmap that can guide them through the web application. Using a website with an unrecognizable interface would be akin to driving in an unfamiliar city without a roadmap and without street signs. In such cases, successful navigation is a
game a chance. In order to avoid reliance on luck, it is important to customize navigation menus to account for the user’s mental mode so that the interface truly navigates the user to the desired location or information.
Chapter 2

USER INTERFACE THEORIES

For the past decade, the impact of cultural differences on the development, understanding and use of information and communication technologies has been a growing interest to IT professionals. The Internet affords many companies the luxury of having a global reach at relatively low cost. Knowing your target market is a fundamental business practice. Because the Internet easily allows for the dissemination of information across several countries, the numbers of cultural factors that must be considered are dramatically increased. Further, the impacts of cultural differences are extremely broad, including such perspectives as cultural patterns, linguistics, models of cultures, and cognitive style. All of the foregoing should have an influence on cross-cultural design of web applications.

2.1 E-commerce User Interface and User’s Behavior Research

The web interface allows users to interact with the Internet and with the given web application. The quality of the interface is directly dependent on the efficiency of the interface design. The more efficient the interface design the greater the user’s capacity to find, process and understand the information on the website. The Forrester Research statistics emphasize the point that successful website use is dependent on recognizable navigation menu. Studies by Forrester Research estimate that around 50 percent of
potential sales are lost because web users could not find information and that 40 percent of users do not return to a web site when their first visit is a negative experience and almost 50% of users do not come back if they found it hard to find relevant information on the web site [Peynot01]. Studies by User Interface Engineering, Inc., shows that people cannot find the information they are seeking on a web applications about 60 percent of the time [Janke99]. Whether it is an e-commerce web application, blog or another type of web application, having a recognizable interface should be a high priority.

Singh and Pereira’s research demonstrated that consumers prefer shopping online using websites that were specially designed in their native language [Sign03]. Lynch’s research showed that French and Spanish Internet users had a strong preference for sites in their native language [Lynch01]. Studies by Luna confirmed that country-oriented web content increase use efficiency, perceived usefulness, and lead to higher purchase transactions [Luna02].

A mental model is what users think they know about any system, including web applications. What the user believes he knows about a web application significantly influences how he will use that system. A user bases his predictions about the system on his mental model and then plan his future activities based on how that model predicts the appropriate course. Therefore, a web application will be efficient if its user interface design is compatible with the user's mental model.
Language is an important, human-factor aspect of a web application interface design. A sentence cannot exist in any language without a verb or noun. Research by two Spanish psychologists and a German neurologist (Anna Mestres-Missé, Antoni Rodriguez-Fornells and Thomas F. Münte) demonstrated that “the brain part that activates when a person learns a new noun is different from the part used when a verb is learned” [Mestres-Missé10]. Antoni Rodriguez-Fornells, co-author of the study, and an researcher at the Cognition and Brain Plasticity Unit of the University of Barcelona stated that "learning nouns activates the left fusiform gyrus, while learning verbs switches on other regions" [Mestres-Missé10]. These three scientists discovered that children first learn nouns and then verbs. Also, they found that adults learn quicker and react faster to nouns during testing. This research, if employed, could significantly influence development strategies, information organization and syntax for web content. In a web development environment, the noun usually describes an object and the verb represents an action. Considering that people react and memorize nouns faster than verbs, web application designers should emphasize nouns in the organization and syntax of a navigation menu. As Shneiderman indicated, the navigation menu should require minimum learning/memorization and provide a clear structure for the decision making process [Shneiderman92]. If it is quicker and easier to learn nouns, then the use of nouns in a navigation menu should be employed to allow users to select the correct items efficiently.

2.2 Action-Object Research

Carter subscribed to a different mental model known as the action-object approach. Based on information system action-object model (which is comparable to verb-object in
the English language), Carter created a hierarchical taxonomy called Action-Modifier-Object-Attribute (AMOA) [Carter91]. He described that for a given task, a user will first identify an action (first level of the AMOA hierarchy). The second level is the modifier that modifies the action. Following the modifier, the user will process the object of the action and finally select the attribute (the fourth and final level). While Carter’s research is valuable, it would be more complete if Carter researched languages that have significantly different syntax than the English language. Carter’s AMOA model was based only on English syntax, which is understandable because the English language dominated software development during the early 1990’s. However, Carter’s research is dated by the rapid globalization of the Internet and communication. Therefore, Carter’s research may still be relevant for development of English-based applications. However, for applications that are intended for use by non-Romance language-based cultures (i.e., Russian), Carter’s mental model may not accurately describe how these cultures organize and verbalize commands.

Carter’s action-first approach was verified by Castro-Quesada’s research. He was exploring the influence of cultural background between native Spanish and English speakers on menu configuration [Castro-Quesada93]. He experimented with two type of menu organization for librarians: action-object and object-action oriented configurations. He found a significant preference for the action-object menu organization for both cultures. The action-object menu configuration showed the most efficient task performance with the lowest number of errors. It is likely that Castro-Quesada’s research did not discern a cultural deviation because both subject languages are Romance languages.
Scott Roycraft researched whether cultural background influences menu usage in a control environment. He developed a user interface to control a robotic arm. He used two different menu configurations. His research design initially placed actions on the top menu levels. During the testing, the menu was subsequently changed so that the object was on the top menu level. The participants were native English and Chinese speakers. He found that both English and Chinese test subjects preferred the action-object ordering. He explained this similarity on the fact both languages shared similar language grammar. Roycraft explained that the Chinese and English languages share the same sentence syntax such as subject-verb-object. He also concluded that action-object menu organization had the best performance based on the task errors results.

2.3 Object-Action Studies

Although, Lola Arnold’s research explored the influence of menu organization based on action-object approach, her results demonstrated a higher preference for the object-action model. Arnold utilized the Query Management Facility (QMF) report generator for the study. The QMF menu consisted column names (objects) first, followed by definitions of mathematical functions and expressions (actions) used for the calculations within columns [Arnold89]. In her query management prototype, the correct sequence for selecting menu items was action and then object, otherwise an error would occur. Arnold created her prototype based on McDonald’s research that suggested “subjects should have performed effectively in the categorically arranged menu if they had a clear understanding of the action selection items in the menu” [McDonald83]. However,
Arnold’s action-object approach resulted in a high level of errors; and unanticipated result contrary to MacDonald’s proposed menu organization. Test subjects selected the object item first, which also contrary to the English syntax of verb then object. The research results were analyzed using a proportion measure analysis of variance, indicating that the syntax structure of the task influenced the selection of the object first. The linguistic sequence in which users perform a task directly influences the syntax of the task queries. Arnold’s research also indicates that users will predominantly choose the object first unless the action items precede the object items in the menu. Arnold’s research was verified by Tullis’ research, which focused on sorting techniques and hierarchical clustering. Tullis concluded that when subjects are performing a task, they focus more on object first then on action [Tullis85].

Sukaviriya and Moran’s research also discovered cultural influences in menu selection strategy [Sukaviriya90]. They theorized that native language influences command syntax of menu navigation organization. They selected Thai, Indian and American participants. During the experimental phase, test subjects used spatially and linguistically-oriented devices (i.e., task locator and keyboard). Sukaviriya and Moran were trying to answer the following questions: 1) Does the input device influence command syntax preferences; 2) Does the cross-cultural background have a greater influence on numeric values over the English alphabet with regard to preferences. Sukaviriya and Moran concluded the lexical organization of actions and objects of the native language will determine the test subject’s menu item selections. However test subjects using the spatially-oriented input device preferred the object-action selection strategy and were not influenced by native language.
2.4 The Current Research Focus

Various research studies have been conducted assessing cultural influences on the design of user interfaces. Unfortunately, those studies have mixed results regarding navigation menu organizational strategies. Despite the previously studies, the impact of cultural on web-based user interfaces has not been fully explored. The purpose of this study was to expand upon previous research by comparing English and Russian speaking users. The research also considered demographic data to assess factors that influence behavior and task performance. The English and Russian languages are significantly different in syntax and origin and provided a valuable comparison of how language influences the mental model and ultimately web application usage. Russian users share the same native language roots and similar mental models with other Slavic countries such as Ukraine and Belarus. Therefore, this research can be useful across multiple Slavic countries.

The English language is a Romance based language whereas the Russian language is Slavic-based. The two languages have significantly different syntax structure. For example, the English language has a very strict word order in sentences such as subject–verb–object (SVO). Conversely, the Russian language has a very flexible syntax whereby verbs and objects can be in different order without changing the overall meaning of the sentence.
Chapter 3

METHODOLOGY

The purpose of this research was to explore the influence of native language, as a principal cultural characteristic, on customer’s behavior using a web-based e-commerce application. A primary assumption of the research was the notion that the navigation menu organization is critical to any web application including web-based e-commerce. Another assumption was that navigation menus should be designed so that the end user can easily and quickly find desired products and buy them. The research expanded on previous study designs to assess the influence of significantly different syntax of the Russian and English languages on web user performance and task completion. Demographic data also were collected and assessed for each test subject. This research analyzed demographic factors such as age, gender, and computer experience to determine any influence on web navigation efficiency.

The research protocol was approved by the UNF IRB #316658-2. The approval is found in Appendix I. The basic research design encompassed an online shopping application with two different navigation menus. One menu was based on the action-object model and the other was based on the object-action model. The user interface was created in two different languages (Russian and English) in order to study the influence of language on user’s preferences. The Table 1 shows the research design structure.
As stated earlier, Russian and English were the chosen languages due their significantly different origins and syntax structure.

3.1 Experimental Environment

The experiment was performed at the University of North Florida’s Graduate lab. In order to avoid Internet delays in task performance, the application was deployed on one computer only. All participants performed tasks on the same computer to control the research environment and ensure consistent external variables.

The web application design was compatible with Microsoft Windows. The online shopping application was developed using Microsoft Visual Studio 2010. User activities and task performance time were evaluated using Usability Testing System software.

The application interface was created in English and Russian. The interfaces for each language were designed relatively identical considering the language differences. To insure the accuracy of navigation menu labels, the menu labels were verified by Irina P.

<table>
<thead>
<tr>
<th>Language</th>
<th>Object-Action Model</th>
<th>Action-Object Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>English (American)</td>
<td>10 participants</td>
<td>10 participants</td>
</tr>
<tr>
<td>Russian</td>
<td>10 participants</td>
<td>10 participants</td>
</tr>
</tbody>
</table>

Table 1: Research Design
Conway, who was a University of North Florida language professor and currently ESOL teacher of Crown Elementary.

The navigation menus were organized in two different formats: one based on action-object approach and one based on object-action approach. Even though the navigation approaches are different, they both were functionally equivalent.

The following navigation menu structure was created based on action-object model:

![Figure 3: Action-Object Approach of Navigation Menu Organization](image)

The following navigation menu structure was created based on object-action model:
3.2 Experiment Participants (Subjects)

The test sample encompassed forty people differing in age and gender. Participants were students and employees at the University of North Florida, relatives, friends and other volunteers recruited via poster advertisement and emails. The posters were distributed around the University of North Florida campus and emails were sent to some active students to their personal emails. The Russian participants were limited to those persons who have lived in the United States for less than 10 years. It is assumed that after 10 years of living in the United States, any potential Russian participant would have been significantly integrated into the English (American) cultural modes. There were twenty English (American) speaking participants and twenty native Russian speaking participants. The participants used the application interface of their respective native
language. Ten participants from each language group used the action-object configured navigation menu. The remaining test subjects used the object-action navigation menu.

3.3 Testing Variables

The research had independent and dependent variables. The independent variables were the languages themselves, which represents the cultural background and navigation configurations of the online shopping application. The dependent variables of experiment were compose of: (1) the time needed to complete each individual task; (2) the cumulative time needed to complete all tasks; (3) the number of errors for each individual task; (4) the number of errors for all tasks; (5) the number of mouse clicks during each individual task; (6) the total number of user’s actions; and (7) the number of correctly completed tasks. Time was measured as the time it took for each test subject to complete a given task. The first task was a trial run and was excluded from the assessment. The total time was measured as well from the beginning of the first task until completion of the last task. The number of errors was referred to the number of times the test subject provided a wrong task answer or selected the incorrect menu item during each assigned task. Errors, if any, made by the participants, were calculated for each individual task and cumulatively for the entire exercise. The number of user actions referred to total number of mouse clicks made by each test subject during each individual task performance. The number of correctly completed task was defined as selections made without errors. There was a five minutes time limit for each task. If a test subject did not answer a question
within the five minute time limit, then the task was considered incomplete and was counted as an error. Table 2 shows the research design including all variables.

<table>
<thead>
<tr>
<th>Language</th>
<th>Object-Action Model</th>
<th>Action-Object Model</th>
</tr>
</thead>
</table>
| English (American) | • Time  
• Accuracy (Errors)  
• User’s actions  
• Number of correct completed tasks | • Time  
• Accuracy (Errors)  
• User’s actions  
• Number of correct completed tasks |
| Russian        | • Time  
• Accuracy (Errors)  
• User’s actions  
• Number of correct completed tasks | • Time  
• Accuracy (Errors)  
• User’s actions  
• Number of correct completed tasks |

Table 2: Complete Research Design with Variables

3.4 Experiment Procedure

The first step implementing the research was the invitation to participate. Once the test group was assembled, each test subject sat at the designated workstation. All participants used the same workstation to ensure uniform conditions.

The test subjects were given general instruction in English and Russian languages. See Appendix A and Appendix E. Participants were asked to strictly follow these instructions. The test subjects then filled out a demographic data sheet detailing their age, gender, handedness, vision, native language, computer experience, and years of residency in the United States, color blindness, average time per month spent on the
Internet, and the average time per month shopping online. The Demographic data form in English and Russian is attached as Appendix B and Appendix F. In order to preserve the confidentially of the test subject, participants were not asked to provide private information including their name.

After the orientation, each participant opened the web application and began to answer the test questions. The experiment’s questions in English are presented in Appendix C and the same experiment’s questions were translated in Russian and presented in Appendix G. The thesis researcher was present in the room at all times. Participation in the research was completely voluntary. Therefore, each test subject had the option to terminate their participation at any time. If a test subject terminated their participation, their data would have been excluded from the assessment; however during the experiment there were no cases of participation termination by subjects.

Twenty participants used action-object model navigation configuration, the other twenty used object-action navigation menu organization. There were 21 questions asked during the experiment. The first question was discarded from the final analysis as a trial question. It was expected that the maximum time of completion of all 21 experimental questions would be 105 minutes (each task had a five minute time limit).

The test questions were displayed on the top center of the screen. The Usability Testing System tracked all mouse clicks and time of completion for each task. In addition to displaying the questions on the screen, a hardcopy of the questions was provided to the
participants to hand write their answers. The hardcopies were used to verify the participation of forty different test subjects.

The test questions were designed to repeat expected shopper behavioral patterns. The questions reflected interests such as picking the right products, comparing products and returning products. In order to answer the questions, the test subjects had to navigate the interface, which was based on either the action-object or the object-action model. Test subjects used a two-button mouse to navigate the interface and to make selections. The questions were identical for both navigation models. All test questions were written in a linguistic order that would not influence the subjects’ decision making process. For example, questions were not worded using the same words as the menu items. That was necessary to prevent the test questions from influencing the menu choices.

When the participants completed all the test questions, they were asked to complete a final survey. The final survey asked the participants to rate such items as system satisfaction, question clarity, task completion, etc. The final survey in English and Russian is presented as Appendix D and Appendix H. Once the survey was completed, and then the experiment for the subjects was deemed completed.

3.5 Data Analysis

Descriptive, factorial and relational statistics were used to evaluate the data. The Statistical Package for the Social Sciences (SPSS) software was used to analysis the test
results and compiles the data. Descriptive statistics were used to analyze all dependent variables and final survey data (i.e., frequency of result data, gender, and other demographic variables).

The factorial analysis followed the research design as showed in Table 2. The Analysis of Variance (ANOVA) was used to analyze the factorial design and to find out the effect of dependent variables such as time, accuracy (errors) and user’s actions and number of correct completed tasks. ANOVA is a statistical model that includes a statistical test of different groups to determine if group characteristics are equal or different. ANOVA was also used to analyze the survey answers.

The relational statistic was also used to analyze the data in this research. It was used to determine cross correlation of each variable (full correlation matrix variables) and to analyze the final survey data.
Chapter 4

RESULTS

The Statistical Package for the Social Sciences (SPSS) was used to perform the analysis of collected data from the research experiment. Descriptive, factorial and relational statistics were used to evaluate all dependent variables and final survey data. Summary statistics were used to describe the demographic data and data collected from the final survey. Correlations among all variables were calculated to define any significant relationships between variables. An Analysis of Variance (ANOVA) was used to discover the effects of dependent variables such as time, accuracy (or errors) and user’s actions, and number of correctly completed tasks.

4.1 Demographic Data of the Participants

Forty participants were invited to take part in the research experiment. All participants were volunteers and did not receive any compensation for their participation in the research. The project was approved by Institutional Review Board (IRB).

Each participant was asked to provide his or her demographic data. The age range of the participants was 22–59 years. According to the research design shown in Table 2, subjects were divided into four different groups: English Object-Action (English O-A),
English Action-Object (English A-O), Russian Object-Action (Russian O-A) and Russian Action-Object (Russian A-O) groups.

The gender distribution of the participants was presented in Table 3.

<table>
<thead>
<tr>
<th>Language</th>
<th>Object-Action Model</th>
<th>Action-Object Model</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>English (American)</td>
<td>F=5 M=5</td>
<td>F=5 M=5</td>
<td>F=10 M=10</td>
</tr>
<tr>
<td>Russian</td>
<td>F=7 M=3</td>
<td>F=5 M=5</td>
<td>F=12 M=3</td>
</tr>
<tr>
<td>Total</td>
<td>F=12 M=8</td>
<td>F=10 M=10</td>
<td>F=22 M=18</td>
</tr>
</tbody>
</table>

Table 3: Gender Distribution by Native Language and Menu Organization

Participants were asked if they had 20/20 vision. A total of 17 subjects reported that they did not have 20/20 vision. Those who reported that they did not have 20/20 vision were asked to wear corrective glasses or contact lenses during the experiment. The summary of subjects who reported they did not have normal vision presented in Table 4.

<table>
<thead>
<tr>
<th>Language</th>
<th>Object-Action Model</th>
<th>Action-Object Model</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>English (American)</td>
<td>4</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Russian</td>
<td>3</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>7</td>
<td>10</td>
<td>17</td>
</tr>
</tbody>
</table>

Table 4: Participants Who Reported that They Did Not Have 20/20 Vision
Handedness of the participants was collected as part of demographic data. Only six left-handed participants were in the experiment: two left-handed participants in Russian O-A group and in English A-O group; one in each of the other groups. Table 5 shows the handedness of participants in each of the four groups.

<table>
<thead>
<tr>
<th>Language</th>
<th>Object-Action Model</th>
<th>Action-Object Model</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>English (American)</td>
<td>L=1 R=9</td>
<td>L=2 R=8</td>
<td>L=3 R=17</td>
</tr>
<tr>
<td>Russian</td>
<td>L=2 R=8</td>
<td>L=1 R=9</td>
<td>L=3 R=17</td>
</tr>
<tr>
<td>Total</td>
<td>L=3 R=17</td>
<td>L=3 R=17</td>
<td>L=6 R=14</td>
</tr>
</tbody>
</table>

Table 5: Handedness of the Participants

Participants also reported whether they have any colorblindness. Two Russian participants from object-action group checked that they had some color blindness.

Participants were asked about their computer experience. The average computer experience of the participants was 13 years. The average computer experience among the four groups is shown in Figure 3.
Russian participants were asked how long they had lived in the United States to identify how they have adapted to the English language. The average years of residence in the United States for the Russian participants was 8 years.

All participants were asked to calculate how many hours per month they spend on the Internet and how many hours they spend shopping online. The average time of all participants spent on the Internet was 71 hours per month with 4 hours per month spent shopping online. Figure 4 shows the mean of hours spent on the Internet per month compared to the mean shopping online.

Figure 5: Mean Computer Experience

Figure 6: Mean Hours Spent in the Internet to Compare Hours Shopping Online per Month
Russians spent around 80 hours per month on the Internet compared to the 62 hours spent per month by English-speaking participants. However, English participants spent 5 hours per month shopping online compared to the 3 hours spend by the Russian participants.

4.2 Analysis of Variance

During the experiment, total time, total errors, completed tasks and total clicks were measured. An Analysis of Variance (ANOVA) was performed to determine whether a significant difference existed in the mean total completion time between the two languages and different menu organizations. Table 6 shows the summary of this procedure.

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>30665.100^a</td>
<td>3</td>
<td>10321.700</td>
<td>2.044</td>
<td>.125</td>
</tr>
<tr>
<td>Intercept</td>
<td>28254246.100</td>
<td>1</td>
<td>28254246.100</td>
<td>5594.445</td>
<td>.000</td>
</tr>
<tr>
<td>Type</td>
<td>2502.100</td>
<td>1</td>
<td>2502.100</td>
<td>513</td>
<td>.478</td>
</tr>
<tr>
<td>Native Language</td>
<td>1020.100</td>
<td>1</td>
<td>1020.100</td>
<td>202</td>
<td>.858</td>
</tr>
<tr>
<td>Type * Native Language</td>
<td>27352.900</td>
<td>1</td>
<td>27352.900</td>
<td>5.416</td>
<td>.026</td>
</tr>
<tr>
<td>Error</td>
<td>161814.800</td>
<td>36</td>
<td>5050.411</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>28467028.000</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>212779.900</td>
<td>39</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6: ANOVA Summary Table with Total Completion Time for Menu Type and Native Language

The effect of interaction between language and type of menu organization was found significant (p < 0.026). The difference between the language groups in the means of completion time was not significant. The difference between the mean of types of the menu organization groups was also not significant.

Figure 5 shows the mean total completion time among the four groups.
Participants from the Russian O-A group spent less time than participants from Russian A-O group to complete all tasks; however, the effect is not statistically significant.

An ANOVA was performed to determine whether a significant difference existed between the mean number of the errors between the two languages and between the two menu types. According to the ANOVA there was not a significant difference between languages or menu types. Table 7 shows a summary of the procedure.

![Mean Total Completion Time](chart)

**Figure 7: Mean Total Completion Time**

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>3.275(^a)</td>
<td>3</td>
<td>1.092</td>
<td>.311</td>
<td>.818</td>
</tr>
<tr>
<td>Intercept</td>
<td>1525.225</td>
<td>1</td>
<td>1525.225</td>
<td>434.056</td>
<td>.000</td>
</tr>
<tr>
<td>Type</td>
<td>2.025</td>
<td>1</td>
<td>2.025</td>
<td>.576</td>
<td>.453</td>
</tr>
<tr>
<td>Native Language</td>
<td>625</td>
<td>1</td>
<td>.625</td>
<td>.178</td>
<td>.676</td>
</tr>
<tr>
<td>Type * Native Language</td>
<td>625</td>
<td>1</td>
<td>.625</td>
<td>.178</td>
<td>.676</td>
</tr>
<tr>
<td>Error</td>
<td>126.500</td>
<td>36</td>
<td>3.514</td>
<td>.676</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1655.000</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>129.775</td>
<td>39</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^{a}\) R Squared = .025 (Adjusted R Squared = .056)

**Table 7: ANOVA Summary Table with Total Errors for Menu Type and Native Language**
Figure 6 shows the mean of the total errors among the four groups that were made by participants during the experiment.

![Mean Total Errors](image)

Figure 8: Mean Total Completion Time

The fewest errors were made by the Russian A-O group, and the English O-A and Russian O-A groups had the most errors; however, these differences were not statistically significant.

An ANOVA was used to test whether the mean number of correctly completed tasks was significantly different between two languages and between two menu organizations.

Table 8 shows the summary of the results.

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>5.300</td>
<td>3</td>
<td>1.767</td>
<td>.853</td>
<td>.474</td>
</tr>
<tr>
<td>Intercept</td>
<td>8352.100</td>
<td>1</td>
<td>8352.100</td>
<td>4030.504</td>
<td>.000</td>
</tr>
<tr>
<td>Type</td>
<td>1.600</td>
<td>1</td>
<td>1.600</td>
<td>.772</td>
<td>.385</td>
</tr>
<tr>
<td>Native Language</td>
<td>3.600</td>
<td>1</td>
<td>3.600</td>
<td>1.737</td>
<td>.196</td>
</tr>
<tr>
<td>Type * Native Language</td>
<td>.100</td>
<td>1</td>
<td>.100</td>
<td>.048</td>
<td>.827</td>
</tr>
<tr>
<td>Error</td>
<td>74.600</td>
<td>36</td>
<td>2.072</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>8432.000</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>79.900</td>
<td>39</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 8: ANOVA Summary Table with Mean Completed Tasks for Menu Type and Native Language
The results did not indicate a significant effect for language, menu type or interaction between language and two menu types.

Figure 7 shows the mean total of completed tasks among the four groups.

![Mean Total Completed Tasks](image)

The Russian A-O group completed the most tasks, and the English O-A group completed the fewest tasks; however, the differences were not statistically significant.

An ANOVA was done to determine whether a significant difference existed in the mean number of the mouse actions (clicks) between the two languages and between the two menu types. According to the ANOVA there was not a significant difference between languages, menu types or interaction between them. Table 9 shows a summary of the procedure.
Table 9: ANOVA Summary Table with Total Mouse Actions for Menu Type and Native Language

Figure 8 shows the mean total among the four groups of mouse action (clicks) made by participants during experiment.

![Mean Total Mouse Clicks](image)

Figure 10: Mean Total Mouse Clicks

Participants in the Russian O-A group were more efficient with mouse actions and made the fewest mouse clicks to complete all tasks while participants from English A-O group made the most mouse clicks; however, the differences were not significantly different.

All participants were asked to complete an exit survey. All survey questions were measured on a scale of one to four, with one meaning poor and four meaning excellent.
An ANOVA was completed to determine whether a significant difference existed in the mean satisfaction of the clarity of the instruction between the two languages and between the two menu types. According to the ANOVA there was not a significant difference between languages, menu types or interaction between them. Table 10 shows a summary of the procedure.

Table 10: ANOVA Summary Table with Satisfaction of the Clarity Instruction for Menu Type and Native Language

Figure 9 shows the mean satisfaction of the clarity of the instructions among the four groups.

Figure 11: Mean Satisfaction of Clarity of Instructions
The English A-O and Russian A-O groups were equally satisfied with instructions, and the Russian O-A group was the least satisfied; however, the differences were not statistically significant.

An ANOVA was performed to determine whether a significant difference existed in the mean satisfaction of the task complexity between two languages and two different menu types. A difference between the means of language groups was found significant ($p < 0.012$). The effect of interaction between language and type of menu organization was not significant, and difference between the means of type of the menu organization groups was also not significant. Table 11 shows the summary of this procedure.

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>4.275 \a</td>
<td>3</td>
<td>1.425</td>
<td>3.268</td>
<td>.032</td>
</tr>
<tr>
<td>Intercept</td>
<td>497.025</td>
<td>1</td>
<td>497.025</td>
<td>1139.675</td>
<td>.000</td>
</tr>
<tr>
<td>Type</td>
<td>.625</td>
<td>1</td>
<td>625</td>
<td>1.433</td>
<td>.239</td>
</tr>
<tr>
<td>Native Language</td>
<td>3.025</td>
<td>1</td>
<td>3.025</td>
<td>6.936</td>
<td>.012</td>
</tr>
<tr>
<td>Type * Native Language</td>
<td>.625</td>
<td>1</td>
<td>625</td>
<td>1.433</td>
<td>.239</td>
</tr>
<tr>
<td>Error</td>
<td>15.700</td>
<td>36</td>
<td>436</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>517.000</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>19.975</td>
<td>39</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\a. R Squared = .214 (Adjusted R Squared = .149)

Table 11: ANOVA Summary Table with Satisfaction of the Task Complexity for Menu Type and Native Language

Figure 10 shows the mean satisfaction of tasks complexity among the four groups.
Participants from English O-A and Russian O-A groups were equally satisfied with task complexity. The Russian O-A group was the least satisfied with task complexity.

An ANOVA was completed to determine whether a significant difference existed in the mean satisfaction of the menu organization between the two languages and between the two menu types. According to the ANOVA there was not a significant difference between languages, menu types or interaction between them. Table 12 shows a summary of the procedure.

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>.600*</td>
<td>3</td>
<td>.200</td>
<td>.555</td>
<td>.585</td>
</tr>
<tr>
<td>Intercept</td>
<td>518.400</td>
<td>1</td>
<td>518.400</td>
<td>1696.582</td>
<td>.000</td>
</tr>
<tr>
<td>Type</td>
<td>.400</td>
<td>1</td>
<td>.400</td>
<td>1.309</td>
<td>.260</td>
</tr>
<tr>
<td>Native Language</td>
<td>.100</td>
<td>1</td>
<td>.100</td>
<td>.327</td>
<td>.571</td>
</tr>
<tr>
<td>Type * Native Language</td>
<td>.100</td>
<td>1</td>
<td>.100</td>
<td>.327</td>
<td>.571</td>
</tr>
<tr>
<td>Error</td>
<td>11.000</td>
<td>36</td>
<td>.306</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>530.000</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>11.600</td>
<td>39</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. R Squared = .052 (Adjusted R Squared = -.027)

Table 12: ANOVA Summary Table with Satisfaction of the Menu Organization for Menu Type and Native Language
Figure 11 shows the mean satisfaction of menu organization among the four groups.

![Mean Satisfaction of Menu Organization](image)

Figure 13: Mean Satisfaction of Menu Organization

Participants from English O-A and Russian O-A groups were equally satisfied with menu organization. The English A-O group was the least satisfied with menu organization. The differences were not statistically significantly.

An ANOVA was completed to determine whether a significant difference existed in the mean satisfaction of the menu selection between the two languages and between the two menu types. According to the ANOVA there was not a significant difference between languages, menu types or interaction between them. Table 13 shows a summary of the procedure.
Table 13: ANOVA Summary Table with Satisfaction of the Menu Selection for Menu Type and Native Language

Figure 12 shows the mean satisfaction of menu selection among the four groups.

The English O-A and Russian O-A groups were equally satisfied with menu selection while the English A-O group was the least satisfied. The differences were not statistically significant.

An ANOVA was completed to determine whether a significant difference existed in the mean system performance between the two languages and between the two menu types.
According to the ANOVA there was not a significant difference between languages, menu types or interaction between independent variables. Table 14 shows a summary of the procedure.

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>0.075a</td>
<td>3</td>
<td>0.025</td>
<td>0.091</td>
<td>.985</td>
</tr>
<tr>
<td>Intercept</td>
<td>483.025</td>
<td>1</td>
<td>483.025</td>
<td>1756.455</td>
<td>.000</td>
</tr>
<tr>
<td>Type</td>
<td>0.025</td>
<td>1</td>
<td>0.025</td>
<td>0.091</td>
<td>.785</td>
</tr>
<tr>
<td>NativeLanguage</td>
<td>0.025</td>
<td>1</td>
<td>0.025</td>
<td>0.091</td>
<td>.785</td>
</tr>
<tr>
<td>Type * NativeLanguage</td>
<td>0.025</td>
<td>1</td>
<td>0.025</td>
<td>0.091</td>
<td>.785</td>
</tr>
<tr>
<td>Error</td>
<td>9.900</td>
<td>36</td>
<td>0.275</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>493.000</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>9.975</td>
<td>39</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 14: ANOVA Summary Table with Satisfaction of the Task Complexity for Menu Type and Native Language

Figure 13 shows the mean satisfaction of system performance among the four groups.

![Mean Satisfaction of System Performance](image)

Figure 15: Mean Satisfaction of System Performance

Satisfaction was measured on a scale of 1 to 4, with 1 meaning poor and 4 meaning excellent.
The Russian O-A, English A-O and Russian A-O groups were equally satisfied with system performance, and the English A-O group was the least satisfied with how the system was performed; however, the differences were not statistically significant.

An ANOVA was completed to determine whether a significant difference existed in the mean satisfaction of the different menu organization between the two languages and between the two menu types. According to the ANOVA there was not a significant difference between languages, menu types groups or interaction between them. Table 15 shows a summary of the procedure.

Table 15: ANOVA Summary Table with Satisfaction of the Different Menu Organization for Menu Type and Native Language

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>2.000*</td>
<td>3</td>
<td>.067</td>
<td>.112</td>
<td>.952</td>
</tr>
<tr>
<td>Intercept</td>
<td>336.400</td>
<td>1</td>
<td>336.400</td>
<td>565.907</td>
<td>.000</td>
</tr>
<tr>
<td>Type</td>
<td>.100</td>
<td>1</td>
<td>.100</td>
<td>.168</td>
<td>.664</td>
</tr>
<tr>
<td>Native Language</td>
<td>.100</td>
<td>1</td>
<td>.100</td>
<td>.168</td>
<td>.664</td>
</tr>
<tr>
<td>Type * Native Language</td>
<td>.000</td>
<td>1</td>
<td>.000</td>
<td>.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Error</td>
<td>21.400</td>
<td>36</td>
<td>.594</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>358.000</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>21.400</td>
<td>39</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

R Squared = .009 (Adjusted R Squared = .073)

Figure 14 shows the mean of the final survey question about different menu organizations among the four groups.
The English O-A group gave the highest scores in the last survey question regarding different menu organization. The Russian A-O group gave the lowest score for the same survey question. The differences were not statistically significant.

4.3 Correlation

Correlation analysis was used to measure the relationship between all variables of the research experiment. Significant relationships between variables are described below.

There was a significant relationship between total errors and completed tasks. However, these variables were inversely related. The more errors participants made during experiment, the fewer completed tasks they had. The correlation coefficient was -0.895 and probability (p) was 0.000 (p< 0.05).
Participants with more errors also made more mouse clicks during experiment. The correlation was significant and positive between total errors and total number of mouse clicks. The correlation coefficient was 0.558 and probability was 0.000 (p < 0.05).

Completed tasks and total number of mouse clicks were inversely related. Participants who made more mouse clicks had fewer completed tasks. The correlation coefficient was -0.448 and probability < 0.004.

Older participants took more time to complete all tasks. The age of participants and total time tended to be directly related. Correlation coefficient between these variables was 0.581 and probability was 0.000 (p < 0.05).

Participants who spent less time on the Internet took more time to complete the tasks of the experiment. Internet experience and total time were inversely related. Correlation coefficient was -0.383 and probability < .015.

Participants who made more errors in the research experiment gave lower scores for the question related to different menu organization in the final survey. Correlation between satisfaction with menu organization and total number of errors was -0.365 and probability < 0.021. Subjects were less satisfied if they made more errors while subjects with fewer errors tended to have higher satisfaction.
Participants who did not have 20/20 vision spent more time completing all the tasks of the research experiment. The correlation coefficient between vision and total time was 0.463 and probability < 0.003.

Among the Russian participants, a significant relationship was noted between age and the number of years residing in the United States. The older the participant the longer they had had lived in the United States. The correlation coefficient between these variables was 0.535 and probability was 0.000 (p < 0.05).

As the age of the participants increased, the less time the participant spent on the Internet per month. The correlation coefficient between age and hours on the Internet per month was -0.487 and probability < 0.001.

Participants who spent more hours on the Internet per month also spent more time shopping online. A positive correlation was noted between hours on the Internet and hours of shopping online. The correlation coefficient was 0.316 and probability < 0.046.

Participants who spent more hours on the Internet per month indicated a higher system performance satisfaction in the final survey. The correlation coefficient was 0.372 and probability<0.018.

There was a significant positive relationship between age and vision. The correlation coefficient was 0.727 and probability was 0.000 (p < 0.05). This relationship indicates
that older participants more often reported that they do not have 20/20 vision. The specification for 20/20 vision equals one, and for not full vision equals two in correlation analysis.

Participants who were more satisfied with task complexity were also more satisfied with menu selection. The correlation coefficient was 0.393 and probability < 0.012.

Menu organization and menu selection also had a significant correlation. Participants who were more satisfied with menu organization were also more satisfied with menu selection. The correlation coefficient was 0.567 and probability was 0.000 (p < 0.05).

Participants who were more satisfied with task complexity gave higher scores for the question about different menu organization in the final survey. Correlation coefficient was 0.342 and probability < 0.031. More satisfied subjects would like to have different menu organization.
Chapter 5

DISCUSSION

As discussed in Chapter 2, multiple research studies have been performed assessing cultural effects on the design of menu interfaces. Unfortunately, those studies have shown mixed results regarding organization of navigation menu selections. Some studies suggest organizing the menu selections in the same order as the subject’s native language lexical order of verbs and nouns. This approach was supported by Sukaviriya and Carter’s research studies stressing action-object preferences ([Sukaviriya90], [Carter91]). Other studies recommended ordering menu section items based on how the user would physically make selections while performing a task. Tullis concluded that users focus on objects first when they are performing a task [Tullis85]. In addition, some researchers acknowledged that the location of actions and objects on the screen influence the user’s selection strategy [Arnold89]. Finally, another common conclusion derived from the literature was that the best menu items organization should depend on the application itself; its purpose and content. The purpose of this study was to expand upon previous research by comparing English and Russian users. The research also considered demographic data to assess factors that influence behavior and task performance. According to the data collected during of this research, Russian speaking people prefer object-action model of menu organization. A significant difference was found in completion time between Russian A-O and Russian O-A groups of participants. As for English speaking groups, a significant difference between completion time for the English A-O and English O-A groups was not found.
5.1 Analysis Conclusion

Analysis of Variance (ANOVA) was used determine if a significant difference existed in the mean total completion times between the two languages and two different menu organizations. The effect of interaction between the language and type of menu organization was found significant. The difference between language groups in the means of completion time was not significant. The difference between the means of type of the menu organization groups was also not significant. The Russian O-A group had the lowest mean of total completion time, and the Russian A-O group had the highest mean of completion time within all four groups. English speaking participants had different results. The English A-O group spent less time to complete the tasks than the English O-A group. These results indicated that Russian participants preferred the Object-Action Model and English participants preferred the action-object model of menu interface.

A significant difference existed in the mean satisfaction of the task complexity between the two languages and two different menu types. A difference between the means of the language groups was found significant \( (p < 0.012) \). English speaking participants were more satisfied with tasks complexity than Russian speaking participants. According to correlation analysis, participants who were more satisfied with task complexity were also more satisfied with menu selection. Therefore, the English speaking participants were more satisfied with menu selection as well. However, another positive significant relationship between menu organization and menu selection satisfaction was shown. According to collected survey data, Russian speaking participants were more satisfied
with menu organization. In addition, the analysis did not find a significant correlation between task complexity and menu organization satisfaction.

No other significant differences in the mean of total errors, total of completed tasks, number of the mouse actions (clicks) between the two languages and between the two menu types were found. A significant correlation was shown between total number of errors and number of completed tasks. The fewer errors the participants made; the more tasks they completed. Further, a significant correlation was found between total number of errors and number of mouse clicks. Participants who performed more mouse actions made more errors during the experiment.

The correlation analysis found a relationship between age and total completion time. Older participants took more time to complete all tasks. The mean age within the three groups (English A-O, English O-A and Russian A-O) was 35-36 years, and mean of age for Russian O-A group was 31 years. The research did not find a significant correlation between age and native language or menu type. However, a significant difference was found in the mean total completion times between the two languages and the two different menu organizations. Therefore, there was a relationship between age and interaction between language and type of menu organization.

The correlation analysis also showed that Internet experience and total time were inversely related. Participants who spent fewer hours on the Internet took more time to complete experiment tasks. On average, the English A-O group participants spent more time on the Internet than the English O-A group. The mean total completion time of the
English A-O group is less than the English O-A group’s total completion time. Conversely, the Russian A-O group was less experienced using the Internet than the Russian O-A group. The total time of task completion for the Russian A-O group was greater than the total time of task completion for the Russian O-A group. Another significant correlation between hours spent on the Internet and hours spent shopping online was shown whereby more experienced Internet users spend more time shopping online. Therefore, it is reasonable to conclude that the more experienced English A-O and Russian O-A participants were more comfortable with the system possibly because the application was web-based and focused on online shopping. In addition, participants who spent more time on the Internet per month demonstrated higher system performance satisfaction in the final survey. In conclusion, English A-O and Russian O-A participants were more satisfied with system performance.

It was also demonstrated that participants who did not have 20/20 vision spent more time completing the experiment’s tasks. Also, older participants tended to be the users that did not have 20/20 vision. However, the analysis results did not show any correlation between vision and menu organization or language type.

According to the data analysis, it appears that Russian participants preferred the object-action model of menu organization and English participants preferred the action-object model. This supports Carter’s study, as it relates to English speakers, and his hierarchical taxonomy, AMOA. The AMOA model was based on English syntax, which has a very strict word order in sentences (i.e., such as subject–verb–object (SVO)). However, the Russian speaking group’s results does not support Carter’s AMOA model. This may be
explained by the fact that the Russian language has a very flexible syntax whereby verbs and objects can be in different order without changing the overall meaning of the sentence. The Russian language allows all possible combinations Subject–Verb–Object (SVO), Object–Verb–Subject (OVS), Subject–Object–Verb (SOV), Object–Subject–Verb (OSV), Verb–Subject–Object (VSO) and Verb–Object–Subject (VOS). Overall, Russian participants were more focused on object first and then on actions related to that object.

English speaking preference for the Action-Object model was confirmed by the Castro-Quesada’s and Scott Roycraft research ([Castro-Quesada93], [Roycraft93]). Both studies concluded that users that spoke languages that shared the same subject–verb–object syntax performed better in action-object menu configuration. Both researchers mentioned that English, Spanish and Chinese speakers may prefer different menu interfaces because of the different syntax order of their respective languages. This conclusion was supported by this research, which demonstrates that Russian speakers had varying results and performed better in object-action menu organization.

5.2 Future Research

This research could be expanded to include participants from other countries especially native languages that have flexible syntax ordering similar to the Russian language. Languages that have strict word order syntax would likely show varying results. Languages that have Subject–Object–Verb (SOV) structure include Hindi, Japanese. It would also be interesting to use languages that have Object–Verb–Subject (OVS) and
Object–Subject–Verb (OSV) structures. In addition, to avoid different factors that affect people who live in foreign countries, future experiments could be located in the participants’ native countries. The relationships between variables and the statistical analysis could be strengthened by having a greater sampling size in future experiments.

The results of this research found that Russian speaking participants preferred the object-action approach in task performance suggesting that new research could be performed to test and recreate Carter’s hierarchical taxonomy study for the Russian speaking population. Also, the research could be expanded upon by including languages with different syntax. The hierarchical taxonomy that Carter created was based on English speaking participants; therefore, the research would be more robust if participants with varying languages and language syntaxes were included in future studies.

In conclusion, web developers should take into account cultural differences and preferences of users when developing menu interfaces. Linguistic syntax and mental models significantly influence user task performance and overall satisfaction with the given web application. Therefore, these considerations should be incorporated into the application design phase. Simply stated, users with different cultural backgrounds have different Internet experience and accordingly different experience buying products online.
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APPENDIX A

General Instruction

Please read the detailed instructions carefully before beginning.

Step 1: Please sit down at the assigned workstation.

Step 2: Feel free to correct the position of the monitor and mouse for your comfort.

Step 3: Please read all instructions and questions carefully.

Step 4: If at any time you have any questions please ask the researcher that is supervising the experiment.

Step 5: Complete the demographic questionnaire. All information provided will be secure and confidential.

Step 6: Begin the experimental by opening the online shopping application.

Step 7: Read the question first then use the mouse provided to browse through navigation menu and find required information to answer the given question. After completing a question, move on to the next question. You will be asked 21 questions. The questions will be shown on the top center of the screen and will match the hard copy that will be provided to you to write down the answers. You must write down the answers to each question. You will be given maximum five minutes to answer each question. If you are unable to answer the question within five minutes, no additional time will be provided and the next question will be shown.

Step 8: After completing the experiment, you will need to complete a final survey.
APPENDIX B

Demographic Questionnaire

Please complete the demographic form filling the blanks with appropriate values.

Age: __________ (years)

Gender: ___________ (Male/Female)

Do you have 20/20 vision? _____ (Yes/No)

Handedness: ____________ (Right/Left)

Do you have color blindness? _____ (Yes/ No)

Native Language: __________________ (English (American)/Russian)

Computer Experience: __________ (years)

How long have you lived in USA? _______ (years)

How many hours per month do you spend on the Internet? ________ (approximate hours)

How many hours per month do you spend buying something online? ________

(approximate hours)
APPENDIX C

Experiment’s Questions

Please fill the blank with appropriate values.

1. How much does the McAfee Plus antivirus software cost? ________________

2. You would like to send your broken HP printer back to the manufacture; what is the address that you should ship the printer to? ________________________

3. Which company has the lightest laptop, Asus or Toshiba? ________________

4. What is the cost of the cheapest web camera made by Logitech? ______________

5. What is your opinion of the laptop that you bought last month from the Dell store?

6. Which printer has the faster print speed, Cannon or Samsung? ______________

7. What is the cost for a new video card for a Sony computer? ______________

8. In general, what is the popular opinion of Microsoft Office 2010 (negative or positive)? ____________________________________________________________________________

9. Which computer is on sale, Sony or Gateway PC? _________________

10. You want to return a recently purchased Asus laptop. What is phone number of the appropriate department for the return? ___________________________

11. Which brands of PCs have touch screens? ____________________________

12. What is the cost for updating your Windows XP to Windows 7? __________

13. What is the expected shipping time for a purchased keyboard? ____________
14. How many people provided positive comments/feedback for the Cannon printer? 
____________________________________________________________________

15. What company with a (904) 555 5555 phone number accepts broken laptops? 
____________________________________________________________________

16. What is the cost for a new Samsung ink cartridge? ______________

17. Which laptop includes a built in web camera, Asus or Toshiba? __________

18. What is the price for a Toshiba laptop with 14” screen? _________________

19. What company offers a wireless mouse, Dell or Logitech? _______________

20. What was Tony Jones’ reason for stating that he will never buy Dell laptop again? 
____________________________________________________________________

21. You like to play video games and would like to add additional memory for your computer. What is the maximum memory allowed for your Sony PC? ______
APPENDIX D

Final Survey

Please complete the final survey by circling the rate number from the right that matches your feeling.

Legend:
1 – Poor
2 – Average
3 – Good
4 – Excellent

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APPENDIX E
Общая Инструкция

Пожалуйста, ознакомьтесь с подробными инструкциями, прежде чем начать.

Шаг 1: Пожалуйста садитесь за обозначенный компьютер.

Шаг 2: Вы можете поправить положение монитора и мыши для вашего комфорта.

Шаг 3: Пожалуйста прочитайте все инструкции и вопросы внимательно.

Шаг 4: Если у вас есть какие-либо вопросы пожалуйста задайте их исследователю в любое время.

Шаг 5: Заполните демографического данные. Вся предоставленная информация будет защищена и конфиденциальна.

Шаг 6: Начните эксперимент, открыв веб приложение интернет-магазина.

Шаг 7: Сначала прочитайте вопрос затем с помощью предоставленой мыши ознакомтесь с навигационным меню и найдите необходимую информацию, чтобы ответить на поставленный вопрос. После завершения одного вопроса, переходите к следующему вопросу. Вам будет предложено 21 вопросов. Вопрос будет показан на верхней центральной части экрана и будет соответствовать вопросу на печатной копии, которая будет предоставлена вам чтобы записывать ответы. Вы получите максимум пять минут, чтобы ответить на каждый вопрос.

Шаг 8: После завершения эксперимента, вам нужно заполнить завершающий опростный лист.
APPENDIX F

Анкета Демографических Данных

Возраст: __________ (лет)

Пол: __________ (мужской/женский)

У вас зрение 100%? ______ (да/нет)

Вы правша или левша: ______________

Есть ли у вас ахроматоп(с)ия (цветовая слепота)? ______ (да / нет)

Родной язык: ____________________ (английский (США) / Русский)

Опыт работы с компьютером: __________ (года)

Как долго вы жили в США? _______ (лет)

Сколько часов в месяц вы проводите в Интернете? _____ (приблизительно часов)

Сколько часов в месяц вы делаете покупки онлайн? _____ (приблизительно часов)
Вопросы для эксперимента

1. Сколько стоит McAfeePlus антивирусное программное обеспечение?__________
2. Вы хотите отправить сломанной принтер HP обратно производителю; по какому адресу вы должны отправить принтер? ________________________________
3. У какой компании ноутбук весит меньше Asus или Toshiba? _________________
4. Сколько стоит самая дешевая веб-камера, от Logitech? ____________________
5. Каково ваше мнение о ноутбуке Dell который вы купили в прошлом месяце? ________________________________________________________________
6. Какой принтер имеет быстрее скорость печати, Cannon или Samsung? ______
7. Какова стоимость новой видеокарты для компьютера Sony? _________________
8. В целом, какое общественное мнение о Microsoft Office 2010 (отрицательное или положительное)? ________________________________
9. Какой компьютер находится на распродаже, Sony или Gateway? __________
10. Вы хотите вернуть недавно приобретённый ноутбук Asus. Какой номер телефона соответствующего отдела для возврата? ____________________________
11. Какие бренды персональных компьютеров имеют сенсорные экраны? ______
12. Сколько стоимость обновить Windows XP до Windows 7? ____________________
13. Сколько дней доставки для купленной клавиатуры? ______________________
14. Сколько людей оставили положительные комментарии/отзывы о принтере Cannon? _____________________________________________________________

15. Какая компания с телефоном (904) 555 5555 принимает сломанные ноутбуки? _____________________________________________________________

16. Какова стоимость нового картриджа Samsung? __________________________

17. Какой ноутбук имеет встроенную в веб-камеру, Asus или Toshiba? __________

18. Какова цена на ноутбук Toshiba с 14" экраном? __________________________

19. Какая компания продает беспроводную мышь Dell или Logitech? __________

20. Почему Тони Джонс не будет покупать ноутбук Dell снова? _______________

21. Вы любите играть в видео игры и хотели бы добавить дополнительную память на ваш компьютер. Какой максимальный объем памяти разрешен для персонального компьютера Sony? ________________________________
Пожалуйста, заполните опросный лист, обводя номер справа, соответствующий вашему мнению.

Обозначения:
1 - плохо
2 - средне
3 - хорошо
4 - отлично

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APPENDIX I

Approval from the IRB committee

MEMORANDUM

DATE: May 30, 2012

TO: Ms. Tetiana Bilyayeva

VIA: Dr. Layne Wallace
Computing

FROM: Dr. Katherine Kasten, Chairperson
On behalf of the UNF Institutional Review Board

RE: Review of New Submission by the UNF Institutional Review Board IRB#316658-2:
“CROSS-CULTURAL COMPARATIVE STUDY OF USERS’ PERCEPTION OF THE NAVIGATION ORGANIZATION OF THE E-COMMERCE WEB APPLICATION”

This is to advise you that your project, “CROSS-CULTURAL COMPARATIVE STUDY OF USERS’ PERCEPTION OF THE NAVIGATION ORGANIZATION OF THE E-COMMERCE WEB APPLICATION” underwent “Exempt category 2” review on behalf of the UNF Institutional Review Board. Your reviewer recommended approval.

This approval applies to your project in the form and content as submitted to the IRB for review. Any variations or modifications to the approved protocol and/or informed consent forms that might increase risk to human participants must be submitted to the IRB prior to implementing the changes. Please see the UNF Standard Operating Procedures for additional information about what types of changes might elevate risk to human participants. Any unanticipated problems involving risk and any occurrence of serious harm to subjects and others shall be reported promptly to the IRB within 5 business days.

Your study has been approved as of 5/30/2012. Because your project was approved as exempt, no further IRB oversight is required for this project unless you intend to make a change that might elevate risk to participants. As an exempt study, continuing review will be unnecessary. When you are ready to close your project, please complete a Closing Report Form, which can also be found in the documents library called “Forms and Templates” in IRBNet.
As you may know, CITI Course Completion Reports are valid for 3 years. Your completion report is valid through 2/29/2015 and Dr. Wallace’s completion report is valid through 5/08/2015. If your completion report expires within the next 60 days or has expired, please take CITI’s refresher course and contact us to let us know you have completed that training. If you have not yet completed your CITI training or if you need to complete the refresher course, please do so by following this link: http://www.citiprogram.org/. Should you have questions regarding your project or any other IRB issues, please contact the research integrity unit of the Office of Research and Sponsored Programs by emailing IRB@unf.edu or calling (904) 620-2455.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within UNF’s records. A copy of this approval may also be sent to the dean and/or chair of your department.

UNF IRB Number: 316658-2
Approval Date: 06-30-2012
Expiration Date: Exempt - None
Processed on behalf of UNF’s IRB KLC.
VITA

Tetiana Bilyayeva earned undergraduate degrees in Information Systems and Business Administration in Finance from Ukraine's Zaporizhzhya National Technical University, where she graduated with high honors. She was enrolled in the University of North Florida's master's degree program for computer and information science. While pursuing her master's degree, Tetiana works for Leadingstar Events and Media, Inc. Her responsibilities include website design and maintenance for several large non-profit, healthcare-oriented professional associations.