Process, Preference and Performance: Considering Ethnicity and Socio-Economic Status in Computer Interface Metaphor Design

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ABSTRACT

This research addresses a problem that centers on the persistent disparities in computer use and access among racial minorities, particularly African-Americans and Latinos, and persons of low socio-economic status (SES) here in the USA. "Access" to computer technology maintains a dual meaning. Access may refer to having a computer and software available for use or it may refer to having a computer interface that effectively facilitates user learning. This study conceptualizes "access" as the latter – having an interface that facilitates user learning. One intervention for this problem of access, from a Human Factors perspective, is in recognizing and accounting for culture's influence on one's cognition. Both qualitative and quantitative approaches were integrated to effectively determine a process for engaging typically marginalized groups, interface metaphor preferences of African-Americans, and user performance with varying types of interface metaphors. The qualitative aspects of this study provided a basis for understanding how entry was obtained into the participants' community and for obtaining richer descriptions of user successes and challenges with the various interface designs.

The researcher developed a culturally valid interface design methodology, i.e., Acculturalization Interface Design (A.I.D.) methodology, which was used to identify meaningful computer interface metaphors for low SES African-Americans. Through the A.I.D. methodology and an associated field study, a group of African-American novice computer users determined that the home, the bedroom and comfort were meaningful computer interface metaphors to integrate into a letter writing task. A separate group of African-Americans performed benchmark tasks on an interface design that utilized the home, bedroom and comfort metaphors or Microsoft Word 2003. The African-American group performed significantly better on the novel interface than on Microsoft Word 2003 for several benchmark tasks. Qualitative analyses showed that low acculturation African-Americans were particularly challenged with those same tasks. Regression analyses used to determine the relationship between psychosocial characteristics and user performance were inconclusive.

Subject matter experts (SME), representing low SES Latinos, discussed potential learnability issues for both interface designs. Furthermore, results from the African-American group and the SMEs highlight the critical importance of using terminology (i.e., verbal metaphors) and pictorial metaphors that are culturally and socially valid.

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GRANT INFORMATION

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DEDICATION

I dedicate this dissertation to my mommy, Maria Fisher.

You are my greatest supporter and the founder & CEO of my fan club ☺. All of my successes start with you. You were my first friend and my first teacher. You love so simply and give most freely. Your dedication to me and all of my endeavors is one of my greatest blessings. Your unconditional love has shaped me into the woman that I am today. You are the virtuous woman that I admire most. I praise God that He gave me to you. Thank you for loving me through this PhD process. I promise to share every success and reward with you! I LOVE YOU!!

Your daughter,

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Mommy: This work is dedicated to you. I love you more than any words could express!

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(The Ministry of Kirk Franklin, 2002)

CHAPTER I. INTRODUCTION

Considering the rapid movement of the United States and other countries towards an information society, it is vital to provide the masses with access to computer technology and its ever-growing benefits. In many cases, "access" means having the computer hardware; other times "access" means having a computer interface that effectively facilitates user learning (Smith-Jackson & Williges, 2001). This study conceptualizes "access" as the latter – having an interface that facilitates user learning. Furthermore, this research addresses the issue of the enduring inequity in computer access among racial minorities, including the economically underserved, and mainstream America (N.T.I.A., 2002). Despite these inequities, American society is becoming progressively more information driven; individuals who lack access will continue to be disenfranchised.

One potential foundation of the "access" crisis is the lack of cultural relativism in the computer interface development process. Cultural relativism (Herskovits, 1972) is the notion that the behavior of one group of people should not be judged by the standards and values of another group of people (Blomberg, Giacomi, Mosher, & Swenton-Wall, 1993). Hofstede (Hofstede, 1997) describes culture as being "software of the mind"(p. 4). He states that an individual's mental programs are a result of the social environment where one grew up and gathered one's life experiences. There are a myriad of cultures present in the United States. These cultures may be characterized by: ethnicity, class, geography, religion, gender, age, and proclivity towards technology use. Two particular cultural groups who have experienced problems with access are African-Americans and Hispanic-Americans (Lenhart, 2003). This lack of access is partly due to the lack of consideration during computer interface design. While there may be some individual members of the African-American and Hispanic-American ethnic minorities who have a high level of acculturation toward the dominant American culture, there

still remains a substantial group of ethnic minorities that have not adapted well to the dominant culture; those individuals are left with the nuances associated with various aspects of mainstream American culture. Theoretically, the process of acculturation is supposed to concern the mutual exchange of characteristics/attributes of two distinctive cultural systems. However, often the outcome of acculturation is the loss of original cultural values and the adoption of new cultural values (Berry, 1980). Every citizen of the United States not may welcome the idea of losing their cultural values in order to fit more closely into the mainstream culture.

Cultural relativism, as it relates to economically/educationally underserved Americans (including groups of Hispanic-Americans and African-Americans) and their participation in computer interface design decision-making, is a philosophy that has generally been overlooked during the computer interface development process. Presently, our most pervasive computer interfaces appear to represent middle- to upper-class-American culture.

According to Nesbitt and Norenzayan (2002), cultural practices guide certain kinds of cognitive processes; they further specify that cultural schemata and cultural models are produced within a cultural group. Differences that result from variations of cultural practices should be a consideration for designing effective computer interfaces. For that reason, one intervention that may ameliorate the problem between the technology "haves" and "have-nots" is to consider the effect of culture on cognition and implement those ideas into the interface design process.

A part of the problem of access is related to the overall design and application of interface metaphors. More specifically, the problem of access may be addressed by examining the cultural relevance of interface metaphors. Interface metaphors provide the benefit of user familiarity (Neale & Carroll, 1997), and allow the user to exploit their current knowledge when learning how to use a new computer system (Preece, 1993). Authors Holyaock and Thagard

according to (Neale & Carroll, 1997) contend that metaphors permit the transference of knowledge from a source domain (familiar area of knowledge) to a target domain (unfamiliar area or situation), thereby allowing humans to use specific prior experience and knowledge for understanding and behaving in situations that are new or unfamiliar.

Despite our awareness of the cognitive benefits of computer interface metaphors toward user performance, there is little empirical research that explores and applies interface metaphor design in the context of culture. The mission of the proposed research is to address the development and design of interface metaphors from the perspective of users' cultural worldviews, and users' additional cognitive and socio-cognitive attributes.

Originally Proposed Research Objectives

Upon the proposal of this dissertation research there were a number of pre-defined objectives that were to be addressed with four separate studies. The original objectives were designed based on the assumptions that both African-Americans and Hispanics/Latinos would be available for participation in each of the studies. The central idea was to have a comparative study where both African-Americans and Latinos, in separate research sessions, had an opportunity to design a novel interface to support a letter-writing task. The goal was to (a) cross-test African-Americans and Latinos on both designs and (b) to evaluate both groups' performance on those designs. The basic question to be answered was, "What role does culture (ethnicity and socio-economic status) play in the (1) development of effective computer interface metaphor and (2) user performance with different interface metaphor designs?" Due to unforeseen circumstances, which are described later in another section, a proxy for the Latino group was utilized. As a result, the original methodology required adjustments as well. An

alternative research methodology, described at length in the body of this document, was administered to achieve the new research objectives and goals of this endeavor.

Objective I

This initial research was designed to address the problem of access in two ways -- as a process problem and a product problem. The first objective was to identify and implement a systematic process for obtaining interface metaphor themes for cultural groups (African-Americans and Hispanics/Latinos) that are generally marginalized during the interface design process. To achieve this objective, methods common to social constructivism and action research philosophies of science were aggregated. More specifically, the methods for acquiring information included qualitative and phenomenological means, as well as, participatory design and ethnographic techniques. Since one's culture influences his/her cognition (Nesbitt & Norenzayan, 2002), it was appropriate to employ a user requirements process that aided designers/developers to produce interface designs with a greater level cultural competence.

Objective II

The second objective was to develop the interfaces -- interfaces that accommodate the metaphor preferences of both African-American and Latino groups. The purpose of this phase was to develop a single interface for each cultural group represented. The process discussed in objective one was expected to lead to products, which can be tested with both cultural groups.

Objective III

The third objective was to determine the relationship between the user task performance (of both cultural groups) with a specified interface metaphor design and cognitive and socio-cognitive attributes. This objective would have been achieved using both qualitative and quantitative methods.

Latino Participant Recruiting Challenges

Numerous attempts were made for more than a year to recruit Latino participants for this research project. Both the Latino and African-American groups of participants were supposed to be from the same community. Various methods of gaining entry and recruiting participants were employed. The primary resources that the researcher needed to host Latino participants were: (1) a physical location for the research sessions, (2) a Latino research assistant who would facilitate the research sessions and assist the Latinos with any necessary translations, (3) and a stream of eligible Latino participants. The researcher was able to locate several public libraries, which were in the targeted community, where both groups (African-American and Latinos) could be hosted. There were several Latino and/or Spanish-speaking individuals in the community who were willing to serve as a research assistant. However, finding Latinos to participate was a continual challenge that remained unconquered.

The researcher solicited the help of local Latino serving organizations, programs, schools and grocery stores to recruit participants. The researcher provided the IRB approved informed consent forms at each location solicited. The local schools and grocery stores were generally helpful with allowing the researcher to post up flyers for the parents and shoppers to take and with word-of-mouth communication about the project. However, the Latino serving outreach programs and organizations were not as accommodating. One of these organizations emphatically stated they would not assist me with recruiting participants from their organization (or the community) because they did not want this research endeavor to minimize participation in their research projects. Another, organization stated that they would not allow flyers posters of any other recruiting materials because this research endeavor would be too difficult for those individuals that they serve. Finally, after many inquiries, one Latino-serving outreach program

director explained to me that the Latino serving programs in the targeted neighborhoods were generally understaffed and lacked the appropriate resources to assist in any recruitment efforts.

Other inquiries were made to local colleges for leads on any programs that they were partners with that serviced Latinos in the targeted locations. Each of these inquiries led to organizations that said, "No" or that they could not do more than post flyers. The researcher accompanied these inquiries with walks through the local community handing out flyers and having conversation with Latinos and others about the project. Most Latinos encountered during the walks through the community were not interested in the project because it was not a job. Many flyers were distributed. Two appointments for potential Latino participants were set-up with a place, date and time; both of those individuals did not show up for their appointments.

Alternative Research Objectives

Objective I

This research was designed to address the problem of access in two ways -- as a process problem and a product problem. The first objective was to identify and implement a systematic process (design methodology) for obtaining interface metaphor themes for cultural groups that are generally marginalized during the interface design process. To achieve this objective, methods common to social constructivism and action research philosophies of science were applied. More specifically, the methods for acquiring information included qualitative and phenomenological means, as well as, participatory design and ethnographic techniques. Since one's culture influences his/her cognition (Nesbitt & Norenzayan, 2002), it was appropriate to employ a user requirements process that aids designers/developers to produce interface designs with a greater level cultural competence.

Objective II

The second objective was to develop the interface -- one that accommodates the metaphor preferences of the African-American cultural group surveyed and queried. The purpose of this phase was to develop a single interface for the cultural group represented. The design methodology mentioned in objective one was the method employed to develop the product, which was then tested with a representative group of African-Americans.

Objective III

The third objective was to determine the relationship between the users' task performance with a specified interface metaphor design and cognitive and psychosocial attributes. This objective was investigated using both qualitative and quantitative methods.

Glossary of Terminology

AAII: African-American Inspired Interface

Access: "Access" means having a computer interface that effectively facilitates user learning (Smith-Jackson & Williges, 2001).

Culture : Software of the mind (Hofstede, 1997, p. 4). An individual's mental programs are a result of the social environment where one grew up and gathered one's life experiences. Cultures may be characterized by: ethnicity, class, geography, religion, gender, age, proclivity towards technology use, etc.

Cultural aspects for usability: Various considerations that may improve learnability for users of a given cultural background.

Inappropriate metaphor: Cultural differences unaccounted for in an interface design result in implementation of inappropriate metaphors.

Interface Metaphor: Interface metaphors provide the benefit of user familiarity (Neale & Carroll, 1997), and allow the user to exploit their current knowledge when learning how to use a new computer system (Preece, 1993).

"Meaningful" [metaphor]**:** Metaphors that are socially and culturally valid for the user. These metaphors are identifable and familiar concepts for the user.

MSWord 2003: Microsoft Word 2003™

Study 1: Psychosocial Characteristics Data

Study 2: Implementation of the A.I.D. Methodology

Study 3: Interface Implementation and Formative Evaluation

Study 4: Testing African-Americans on the AAII and MSWord 2003

Emergent Study 5: SME Cognitive Walkthrough

CHAPTER II. REVIEW OF LITERATURE

Interface Metaphors

"People from different cultures are different in their appearances, perceptions, cognitions, and thinking. They may hold different cultural assumptions and values, they may view the world differently, and they may have very different customs, all of which make them culturally unique (Choong & Salvendy, 1999, p.30)." One would presume that differences in culture would be an essential consideration for effective interface design. Interface design rationales and development have historically rested in the hands of the interface developer(s). In many cases interface designers have taken the liberty of implementing interface metaphors that have little-to-no value to the broad group of end-users (Duncker, 2002). One method to address the problem of access inequality among cultural groups is to select meaningful interface metaphor(s). As stated previously, interface metaphors provide the benefit of user familiarity (Neale & Carroll, 1997). These metaphors assist users in their expectations and predictions of the computer system behavior or functionality (Neale & Carroll, 1997). The most common example of an interface metaphor is the "desktop" metaphor, which is the primary interface model for desktop/personal computing.

Metaphors are also a facilitator of learning (Neale & Carroll, 1997). Metaphors permit users to rely on their mental models (previously developed knowledge about experiences and interactions in the world) to make sense of new situations that they encounter. Interface metaphors can be employed to aid users' comprehension in a variety of contexts. For example, Neale and Carroll (1997) present four different contexts for metaphor use in Table 1. Table 1 offers an in depth view of the types of interface components that interface metaphor can support and the knowledge bases that they draw upon.

Table 1: Examples of User Interface Metaphors (Neale and Carroll, 1997)

Context of Metaphor	Target Domain	Source Domain (Metaphor)	Exploits Knowledge of
Information Structures	Information browsing and searching	Storehouse / House / Room	Stores, rooms, malls, shelves
		Library	library catalogues, books, page turning, shelves, indexes
		Landscape	roads, junctions, signs, maps, mountains, lakes
		Space, conference, rooms, auditoriums, lobbies	navigation: shortcut, go to, travel between sites, links, movement
		Travel / Tourist activities	exploring, guided tours, maps, indexes, asking questions
		Book / Dictionary	pages, bookmarks, tabs, indexes
	Organizing documents	Piles	physical piles of paper, categories
	Organizing and viewing information	Bags and Reviews (filters)	bags for hold items, viewers with different filtering capabilities
Multimedia	Presenting multimedia	Television, compact disks, photographs, film	albums, photo holders, TV programs & channels, VCRs, CD tracks
	Working with large video sources	Magnifying lens	Lens, changing resolution, changing viewing area, filters
Group Work	Shared work spaces, video conferencing, distance learning	Rooms, TVs, slides whiteboard, phone video	group interaction, meeting tools, chalkboard, phones, TV
Virtual Reality	Navigating	Flying hand / Floating guide / Lean-based	physical/spatial world, flying, moving objects
		Eyeball & Scene in hand / Flying vehicle control / Push-pull	Attributes in and movement of physical space, camera control, flying, moving objects

Designers have used a number of metaphors for computer interfaces. Several examples of interface metaphors are present in Figures 1.

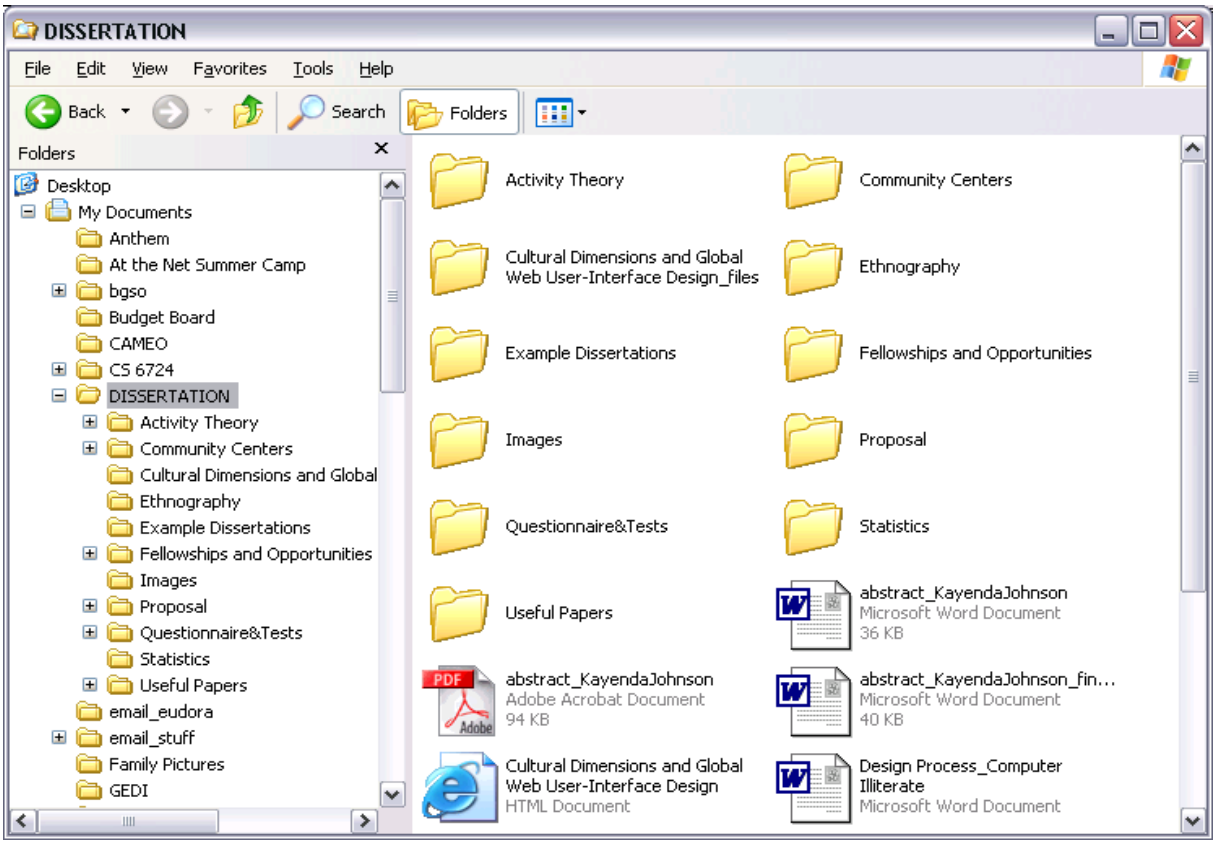

Figure 1. Example of the "File System" Metaphor Used by the Windows XP™ Operating System

Figure 1 is actually a composite metaphor—a conglomeration of different metaphors. The primary functional metaphor represented is the "File System." Here the file metaphor is used to provide the user with some indication of how items (namely files) can be stored, organized and retrieved. There are objects such as the "back" arrow and the "search" magnifying glass that are used to metaphorically represent the program's functionality; in addition there is the general "window" metaphor, which a drives all of the Windows™ operating system applications (except the DOS mode). Those representative object metaphors potentially provide some indication as to what functions are available at that time. Meanwhile, the "windows" metaphor is used to help the user understand how to change the physical size/dimensions (in terms of appearance to the user)

of, change the current information displayed in (using the scroll bars), and exit/close the active computer application.

Metaphor usage can potentially accelerate the learning process because the mind is reasoning about new situations by borrowing from the user's current knowledge stores (Streitz, 1986). While metaphors can be a source of benefit for learners, they can be an impediment for learning/usability, if the metaphors are inappropriate (Erickson, 1990). For this reason, it is pertinent that care is taken to provide appropriate interface metaphors for different user classes; this is especially important for novice computer users who are just learning how to operate a computer.

Problems With Inappropriate Metaphor(s)

Study of appropriate metaphors for various cultural groups is a growing area of work and research (Duncker, 2002; Johnson, 2003). From a conceptual perspective, an appropriate metaphor is one that is matched to a user's current knowledge. A number of authors discuss the importance of interface metaphors in the design of computer systems, and assert that mapping matches between the source domain and the target domain are the strength of computer interface metaphors. In metaphor mappings, the source domain refers to the familiar area of knowledge for the user; the target domain refers to the situation or area that is unfamiliar to the user. The function of a metaphor is to act as a bridge from the source domain to the target domain. Similarities between the source and target domains characterize a match; dissimilarities between the two domains typify metaphor mismatches (Neale & Carroll, 1997).

Example: Usability Problems with Interface Metaphor Mismatches

Metaphor mismatches are the nemesis to good interface design, and can be the very agent that disenfranchises users/potential users of various cultural groups. Duncker (2002) performed

a cross-cultural usability study of the "library" interface metaphor with white New Zealanders of European decent and the Maori people who are indigenous to New Zealand. To understand the cultural schemas, the researcher studied different aspects of Maori culture. The study of the Maori uncovered information about their history, values, customs (including the way they pass on knowledge from generation to generation), and perceptions about the Westernized library system that is used in New Zealand. When the Maori, who have distinct perspectives about the purpose of/service in a physical library, were asked to perform a number of tasks using a library interface metaphor, various issues arose. Those issues later became usability problems for the Maori students when executing tasks using the digital library designed according to Westernized standards.

Among Duncker's (2002) list of general Maori character traits (where some are general and others are specific to digital libraries) is their inclination for:

- Being oriented towards collectivism and tribal unity,
- Holding their genealogy, sacred objects (of their culture), tribal privacy, and property rights in great esteem,
- Being oriented towards the past (They view the past as the forward direction and pay no attention to the future. They see time progressing towards the past and those of an Westernized culture view time as progressing towards the future),
- Believing that representations of people (whether in text, pictures, or carvings) are very sacred and should only be used in their sacred tribal environments,
- Being partial to face-to-face communication,
- Disagreeing with the openness of the Web (concerning Maori content or information),

- Feeling unwelcome in the library, even when the library staff is friendly by western standards,
- Disagreeing with the use of the English classification systems for Maori content (they are not familiar with the Western formats), and
- Being unfamiliar with publication formats: journals, series, and proceedings.

The use of Westernized libraries, including digital libraries, appears to be a difficult undertaking for Maori college students. The cultural characteristics described above are in most cases the root of the Maori's usability problems with the digital libraries. The Duncker (Duncker, 2002) study was actually performed in New Zealand using a local college's digital library. Libraries in New Zealand are often a repository for Maori artifacts – artifacts that include Maori genealogies and other aspects of their history. Furthermore, as a general note, the Maori sometimes feel that the history of their people does not receive the respect that it deserves and should not be available for viewing by the general public.

The usability problems that surfaced from Duncker's study were understood to have the following foundations:

1. Libraries emphasize individualism and the Maori Culture is characterized as being collectivist in nature,
2. Maori are partial to face-to-face communication, which is not generally supported in Western libraries,
3. Maori value their sacred objects, tribal privacy, and property rights; library policies generally do not reflect those values,
4. Maori do not agree with the openness of the Web,

5. Maori do not feel welcome in the library, even when the library staff is friendly by western standards,
6. English classification systems are not appropriate for Maori historical content (they are not familiar with the Western/Anglo-American formats and categorization), and
7. Maori have trouble with publications formats: journals, series, proceedings (they do not generally know what these are).

Duncker (2002) found that the Maori are able to work with digital libraries, but certain aspects of the library metaphor break down. These breakdowns make working with digital libraries arduous for the Maori and fraught with negative critical incidents. Below is a negative critical incident, which occurred during a usability session with a Maori student that demonstrates usability problem # 7.

Participant stops working. Silence.

Researcher: "What is the matter?"

Participant: " I don't know."

Researcher: "What are you doing?"

Participant: "I am not sure. Maybe go there?" (Points at the link 'Journal and Proceedings')

Participant: "Perhaps?" (Looks at the researcher)

Researcher: "It depends on what you want to do."

Participant is silent and looks at the screen.

Researcher: "Do you know what journals and proceedings are?"

Participant: "No."

Researcher explains what journals and proceedings are.

Participant carries on. (Duncker, 2002, p.228)

Desktop Metaphor

As stated previously, the most ubiquitous user interface metaphor is the desktop metaphor. Smith and colleagues (as reported in Neale & Carroll, 1997) state that the desktop metaphor depicts the computer's operating system as analogous to the objects, tasks and behaviors of an office environment. These office workers are more than likely proficient in their knowledge of documents, files, file folders, windows, wastebaskets and so forth. Therefore, the argument can be made that the desktop (office) metaphor is relevant and can potentially facilitate user learning of computerized office tasks and equipment (at least in Americanized office environments).

While some believe in the desktop metaphor's potential for universal relevance for office working environments, others contend that the desktop metaphor, which is influenced by mainstream American culture, is not fully applicable outside the borders of the United States. For example, Duncker (2002) discusses computing metaphors and emphasizes that while the general concept of a desktop metaphor transfers across cultures, the components of the metaphor do not transfer. In American culture, folders are made from firm pieces of paper and have a tab for labeling; these folders are stored horizontally in filling cabinets and or drawers. In other cultures like Japanese and European countries, folders are handled and stored differently. For instance, Japanese and European cultures store their files in lever arch files, which look like cardboard box containers. File users punch two holes in the sheets of paper and place them into rings connected to the lever arch file. These lever arch files are stored in an upright manner on shelves and pulled off the shelves by the way of a small hole in the vertical backside of the folder; the vertical backside of the folder is also used for labeling (this labeling system has a

larger surface area than American folders) the file as well. Furthermore, the labels in the lever arch files are always visible, while American file labels are obscured being stored in drawers or filing cabinets (Duncker, 2002). Considering these subtle differences, one could imagine how the desktop metaphor developed in the United States would not provide visual cues that are readily recognizable in other countries.

Considering these examples, it is evident that the globalization and localization of computer interface metaphors cannot be attained by simply translating idiomatic expressions and icons from one cultural situation to another (Duncker, 2002). These cultural differences in metaphor comprehension must be equated to more than the superficial meanings of color and shapes of icons. Rather, cultural differences or meanings among groups of people are rooted in their history. Conflicts in metaphor meaning from group to group result from having (and employing) different cognitive, emotional, behavioral, and social structures and processes. Therefore, it is essential to use metaphors that maintain relevance when the users consider the related physical object/source domain (Duncker, 2002).

Occupational Reports in the United States

There exists a population of computer users (and/or potential users) that do not work in office environments; this fact is evident in the United States Department of Labor, Bureau of Labor Statistics occupational employment reports for 2003. These occupational employment statistics reports include occupational employment and wage estimates from a national survey of employers of every size. Employers of all industry sectors in metropolitan and non-metropolitan areas of each state were surveyed. Estimates were calculated from data complied from employers in each industry division; however, individuals who are self employed were not included in the survey of the calculated estimates (http://www.bls.gov/oes/current/oes_abo.htm).

Moreover, according to the national estimates, there are 127,420,170 persons employed in various occupations across the United States. Forty-nine million five thousand ten people of 127,420,170 employed individuals do not perform their work in an office environment; this group of workers represents nearly 38.5% of those employed, according to the Bureau of Labor of Statistics estimates (http://www.bls.gov/oes/current/oes_00al.htm.)

A similar pattern of non-office workers also appears in more localized statistical regions. The Bureau of Labor Statistics organizes the statistical regions based on categories such as Metropolitan Statistical Areas (MSAs) and Primary Metropolitan Statistical Areas (PMSAs). "An MSA consists of an urbanized county or group of counties that demonstrate very strong internal economic and social links and close ties to other portions of the larger area; a PMSA is one of a group of contiguous MSAs whose total population exceeds one million (http://www.bls.gov/bls/blswage.htm)." A more localized region within MSAs or PMSAs is a central city. A central city can be defined in as many as six different ways. Three of the six criteria for defining a region as a central city are: (1) "The city with the largest population in the MSA, (2) each additional city with a population of at least 250,000 or with at least 100,000 persons working within its limits, and (3) each additional city with a population of at least 25,000, an employment/residence ratio of at least 0.75, and at least 40 percent of its employed residents working in the city (http://www.census.gov/population/www/estimates/mastand.html)."

According to the 2003 United States Department of Labor Statistics report on Baltimore, Maryland (http://www.bls.gov/oes/current/oes_0720.htm), it was determined that of all the recorded employed individuals (1,223,480 people) there are approximately 398,480 non-office workers. Baltimore is categorized as a PMSA, which includes Baltimore City and six neighboring counties. Baltimore City is the central city of the Baltimore PMSA. These non-

office workers comprise nearly 1/3rd of the working population in Baltimore. Similarly, in the state of Maryland non-office workers represent over 1/3rd of all workers (http://www.bls.gov/oes/current/oes_md.htm). In the state of Maryland there are approximately 817,120 non-office workers of 2,448,580 workers in that region.

Non-office work occupational categories included in the counts provided above are:

1. Food preparation and serving related occupations,
2. Building and Grounds Cleaning and Maintenance occupations,
3. Personal Care and Service occupations,
4. Farming, Fishing, and Forestry occupations,
5. Construction and Extraction occupations,
6. Installation, Maintenance, and Repair occupations,
7. Production occupations, and
8. Transportation and Material Moving occupations.

Some of these jobs include carpenters, plumbers, bakers, commercial pilots, parking lot attendants, tool and die makers, farm equipment mechanics an so on (http://www.bls.gov/oes/2003/may/oes_0720.htm). (It is possible that there are additional non-office occupations embedded in other Labor of Statistics occupational categories. Nevertheless, the eight categories listed above are occupation were it is most obvious that related work is not performed in an office setting.) This working portion of the population may not benefit from the pervasive "desktop" user interface metaphor design.

The question then becomes, "Will the desktop metaphor be appropriate for all computer users?" This question is not presented to invoke debate or to argue against the idea that the desktop metaphor works well for American "office" workers, but rather to elucidate the thought

that not all people work (or spend a substantial amount of time) in an office environment. Consequently, different metaphors may be more suitable for those who do not have strong office environment schemata or mental models.

African-Americans, Hispanic-Americans and Computer Use

Cultural Attributes

Members of an ethnic group generally possess some level of consensus about the fact that they have common origins and interests. This group of individuals is a self-conscious collection of people who are related as a result of shared experience. Often those shared experiences are associated with hardship (Stein, 2004). For example, migrants that leave their homelands to improve their lifestyles or that have been forcibly removed from their lands have often found themselves being overtaking by the dominant culture.

African-Americans and Hispanic-Americans are among the many ethnic and cultural groups represented in the United States. As a matter of fact, African-Americans and Hispanic-Americans are the two largest minority groups in the United States. As with every cultural population, there are certain attributes that are ascribed to Hispanic-Americans and African-Americans. The Family, Youth and Community Sciences project at the University of Florida has enumerated attributes of various ethnic groups. Among their discussion are the different attributes of Hispanic/Latino and African-American cultures. Hispanics/Latinos cultural attributes include: valuing cooperation—not competition, being committed to the Spanish language, being relaxed with time, and being more given to non-verbal communication, gestures, and expressions. African-Americans are characterized as: having a strong connection with heritage and history, having a strong oral history tradition, having an ability to navigate between two cultures, being competitive and achievement oriented, and valuing the importance of music

(http://fycs-diversity.ifas.ufl.edu/diversity%20website/unit2attachments.pdf). These cultural factors are the kinds of attributes/practices that drive the cognitive processes that Nesbitt and Norenzayan (2002) describe in their research.

Computer (Internet) Use of Hispanic-Americans and African-Americans

In the mid-nineties the issue of the digital divide surfaced, as the Internet became a major communication medium here in the United States. Unfortunately, there are still those who lack access to the Internet. Two such groups are African-Americans and Hispanic-Americans (Lenhart, 2003). Lenhart reports that even when income is held constant, African-Americans still access the Internet less than Whites. Among those whose income is less than $20, 000 per year, 24% of African-Americans and 28% of English-speaking Hispanics are online, as compared to 32% of Whites. In homes where income level is $50, 000 per year or more, there are 65% of African-Americans online as opposed to 82% of Whites (Lenhart, 2003). Interestingly enough, African-Americans and Latinos who have higher acculturation toward mainstream American values (which possibly include adaptation concepts like the "desktop" metaphor) tend to also have higher incomes (Snowden & Hines, 1999). This idea may in fact be a reason for greater computer access among ethnic minorities who rank higher on the socio-economic scale.

These are simply a few of the recent statistics on the persisting digital divide in the United States. From these statistics it is apparent that the African-Americans and Hispanic-Americans have a lower penetration rate (access) for computer use, thereby, providing some justification for targeting the Hispanic-American and African-American cultural groups for this research. There are a variety of potential reasons for the persisting lack of access for these minority groups. Moreover, since the problem of access is influenced by factors internal and

external to the user and the interface designer, a socio-technical systems view is necessary to understand the interactions between culture, interface design, and processes.

Macroergonomic Approach

Socio-technical systems theory (Trist & Bamforth, 1951) posits that there must be congruence between people (personnel subsystem), work systems, and technology (technological subsystem) to achieve optimal effectiveness of work systems within an organization (Hendrick & Kleiner, 2001). Each of the elements of socio-technical systems theory (personnel subsystem, work system and technological subsystem) is subject to an external environment.

The personnel subsystem considers issues such as cultural and psychosocial characteristics (Hendrick & Kleiner, 2001). The technological subsystem refers to how the work or task(s) is performed, and also considers the methodologies and tools used to perform the work (Bancroft, 1992; Cummings, 1978). The work system refers to the manner in which people are organized in order to perform their work and their related processes (Hendrick & Kleiner, 2001).

One macroergonomics model of socio-technical systems theory states that there are three major constructs associated with socio-technical systems theory: joint causation, joint optimization, and joint work design. Joint causation, in concept, suggests that both the technological and personnel subsystems are affected by causal events in the external environment (e.g. competition and new government regulations). Joint optimization suggests that both the technological and personnel subsystems should be jointly optimized in order to effectively respond to causal events in the external environment. Joint design is the idea that both subsystems should be designed together to produce the most optimal fit (Hendrick & Kleiner, 2001). Hendrick and Kleiner also discuss the mutual interdependence of the four socio-technical elements (personnel subsystem, work systems, technological subsystem and the

external environment). If any aspect of one element is modified, there will be subsequent effects on each of the remaining elements. It is essential to recognize and plan for the interdependencies of the system; it is likely that ignoring the interdependence of the subsystems will have a sub-optimal result on the system as a whole. Consequently, it is necessary to jointly consider the personnel subsystem, technological subsystem, the work system and the external environment. Figure 2 is a conceptual model of how this research problem fits into a human factors/macroergonomics framework.

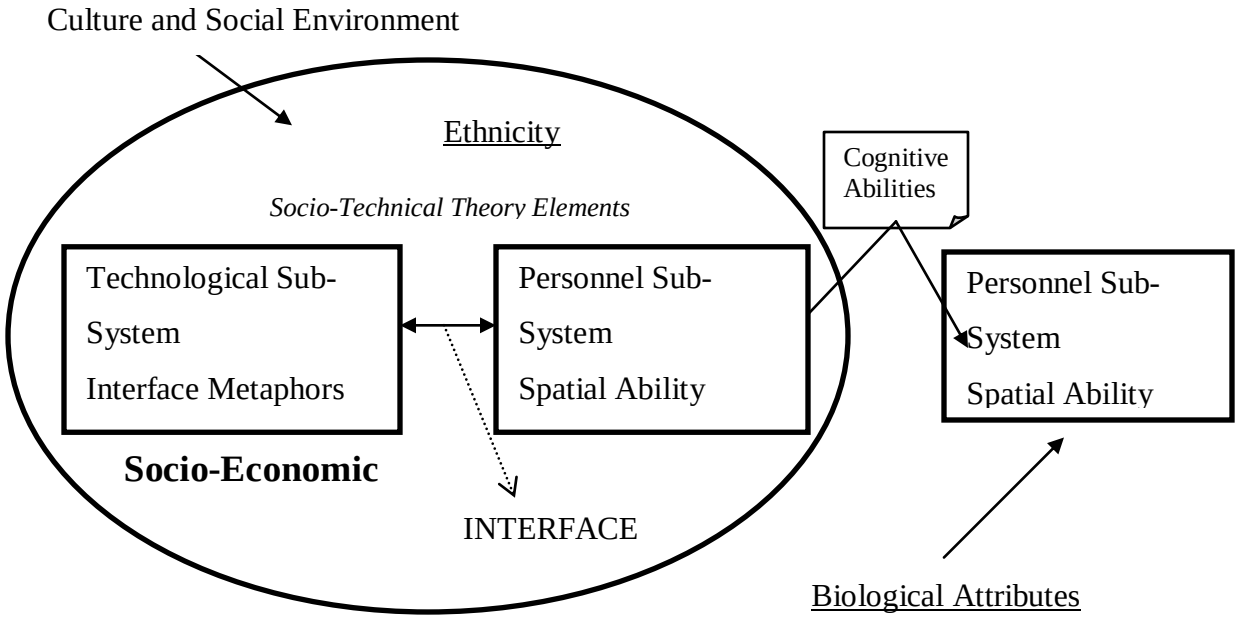

Figure 2: Socio-Technical Systems Theory Applied to Interface Design (Adapted from Hendrick and Kleiner, 2001).

While the impetus for this research was developing a methodology that will facilitate increasing computer access to typically disenfranchised cultural/ethnic groups, by the way of including theirs needs, thoughts and ideas into the interface design, there is a system of factors that influence a design's effectiveness for a given population(s) of users/potential users. The individuals (personnel sub-system) targeted for this project are representatives of an ethnic

minority and are individuals of lower socio-economic status. Each of these individuals is situated within a culture and its associated social environment. Furthermore, an individual's culture becomes the cognitive framework through which he/she views and conceptualizes the world.

The posited links between culture (representing the external environment) and an individual's cognitive abilities, as illustrated in the socio-technical systems model in Figure 2, have support in various research literature. Cognitive abilities, in totality, are attributes that are unique to an individual; however, psychological research (Berry, 1976; Berry, 1992; Dawson, 1967; Greenfield, 1968; Hvitfeldt, 1986; Nesbitt & Norenzayan, 2002) provides an array of support for socio-cultural influence on an individual's cognitive development. In the case of this research, cognitive abilities are demonstrated by one's (1) spatial abilities, (2) perceptual style, and (3) general self-efficacy. Cognitive abilities, which are attributes of the personnel subsystem, are known to have an impact on individual's interaction with a computer system.

In 1967, Dawson wrote concerning the Temne and Mende tribes of Sierra Leone and contended that variation in psychological differentiation, i.e., the separation of psychological activities, including attributes such as being field-dependent or field-independent (as stated in (Hvitfeldt, 1986), was the product of child-rearing practices. Furthermore, Berry (1976) notes that ecological demands of a given cultural group can drive the development of a particular cognitive style. For example, in societies where agriculture and animal husbandry are prominent, securing a food supply occurs best when there is strict adherence to the routines that afford a healthy herd and a good harvest; members of this type of cultural environment discourage individual exploration and initiative. In contrast, in cultural societies where hunting and gathering are prominent, members accentuate the necessity of independence/self-reliance,

visual discrimination and spatial skill (Berry, 1976). In Berry's et al. (1976) later works, he and his colleagues put forth their position of psychological universalism. The view of universalism asserts that psychological processes are common to all human beings, regardless of their cultural background. Additionally, those psychological processes are developed and displayed in divergent ways based on one's ecological and cultural influences. Therefore, including cognitive abilities in this study was an opportunity to determine if spatial ability, perceptual style and self-efficacy still serve as performance predictors of for the cultural groups of interest: African-Americans. Additional information about the remaining constructs: spatial abilities and self-efficacy, in the above socio-technical system are provided below.

Spatial skill/ability is argued to have a dual source. According to Berry, spatial ability draws influence from one's socio-cultural environment. However, there is support in neuropsychology research concerning the biological impacts on spatial cognition (Devlin, 2001). More specifically, a hormonal effect is posited to be a contributor to variation in spatial ability that exists among humans. Often times it has been said that the males generally score higher on spatial abilities test than the females, and are typically more spatially oriented. The work of Resnick et al. (as reported in Devlin, 2001) argues that women diagnosed with Congenital Adrenal Hyperplasia (CAH), a disorder that masculinizes females as a consequence of elevated prenatal adrenal androgen levels, out-perform their unaffected women relatives on spatial abilities tests. Resnick and colleagues were able to rule out environmental variables as a source for the difference. They resolved that the influence of the pre- and perinatal androgenizing hormones is the reason for the differences in spatial ability.

Self-efficacy, by the nature of its sources (i.e., mastery experience, vicarious experience, verbal persuasion, and physiological and emotional state) (Bandura, 1986), implies its

connectedness to a socio-cultural influence (Earley, 1994; Klassen & Fraser, 2004). For example, verbal persuasion or coaching serves as a conduit for receiving information about performance norms, future expectations, and past performance; thereby, persuading the person that the goal in question is achievable (Bandura, 1986).

The final element of the model is technology. Interface metaphor is the technology given for examination in this research. Considering the apparent impact of the socio-cultural environment on an individual's perceptual style, spatial ability, and self-efficacy, it becomes essential for the technology to be designed based on the needs and capabilities of the user group. Furthermore, the design of the technology should be driven by the nature of one's social environment for maximum effectiveness. The single arrow between the personnel sub-system and the technological sub-system is a depiction of that relationship. The best overall system will optimize both sub-systems jointly. Therefore, it is essential to provide the user with a system design that will be congruent with the user's mental model and cognitive abilities.

Culture and Cognition

The definition of culture adopted for this research belongs to Hofstede (1997). Culture is "software of the mind." He uses the analogy to liken an individual's pattern of thinking, feeling, and acting to the way a computer is programmed. He states that an individual's mental programs are a result of the social environment where one grew up and gathered one's life experiences. More specifically, those mental programs are collected within families, neighborhoods, at school, among youth groups, at work, and in living communities. Hofstede (1997) states that culture (mental software) "is always a collective phenomenon, because it is at least partly shared with people who live or lived within the same social environment, which is where it is learned (Hofstede, 1997, p.5)." This definition of culture includes art, literature, and education, but also

includes more ordinary things like: eating, greeting, and showing feelings or not showing feelings.

More discussion about culture is highlighted in the work of Nesbitt and Norenzayan (2002). Nesbitt and Norenzayan (2002) established four basic cognitive commonalities that exist among all people (regardless of the cultural experience): (1) in the absence of cognitive disabilities, all individuals have a universal set of cognitive processes including attentional, memorial, learning and inferential procedures, (2) those universal cognitive processes operate in the same manner regardless of the content it manipulates, (3) basic learning and inferential processes give developing children all they need to learn about the world, and (4) since individuals are influenced by different political, social, and economic worlds, the content of the human mind (i.e., beliefs, values, and theories) is potentially different.

To further substantiate the relationship between culture and cognition, Nesbitt and Norenzayan (2002) posit that cultural practices and cognitive processes are tied together. They also state that those cultural practices in turn guide certain kinds of cognitive processes. Furthermore, they highlight a theme in modern cognitive anthropology. This theme embraces the idea that culture greatly influences the content of the mind by way of knowledge structures. These knowledge structures, better known as schema, drive an individual's thoughts by selective attention, retention, and use of information concerning specific aspects of the world. Construction of a schema provides information about how the various parts of the schema fit together and relate to the whole (Nesbitt and Norenzayan, 2002). Schema, which can include interconnected behaviors, may be about objects, people, events, situations, and sequences of events. Drawing from the discovery of the schema concept, cognitive anthropologist Roy D' Andrade developed the idea of cultural schemas. Cultural schemas are patterns of schemas that

create a meaning system for a particular cultural group. Those shared cultural schemas within a group are called cultural models (as stated in Nesbitt and Norenzayan, 2002). It is the cultural models that an individual uses to drive the interpretation of their experiences and to govern their actions. Nesbitt and Norenzayan (2002) further specify scripts (Schank & Abelson, 1977) as a special type of cultural model, which is an event schema that appropriately connects people with events, the social roles that they play, the objects they use, and the order of actions that they take. These scripts are the tools that individuals in cultural groups use to moderate how they function, perform rituals, and play games (Nesbitt and Norenzayan, 2002). In parallel, individuals within cultural groups develop abilities that may directly or indirectly impact their performance using certain technologies such as computers.

Factors Influencing Computer Performance

There are a number of factors that play a key role in computer performance. These factors include: visual spatial ability, perceptual style, computer attitudes and general self-efficacy. Therefore, investigation for this research extended beyond computer interface metaphors previously mentioned to other performance factors. Spatial ability concerns mental manipulations of objects (Westerman, 1997). Perceptual style is a component of the cognitive style theory. Cognitive style refers to an individual's consistent method of conceptualizing and processing information, as it relates to one's perception, memory and thought. Perceptual style refers to whether one is considered field-dependent of field-independent (Vaske & Grantham, 1990); (Witkin, Oltman, Raskin, & Karp, 1971), which is one of four cognitive style dimensions that have been suggested to important for human-computer interaction (Vaske & Grantham, 1990). A field dependent person relies more on the context (background) than the field independent person (Vaske and Gratham, 1990). More specifically, perceptual style refers to a

person's ability to distinguish a foreground object from the background. Another factor that influences computer performance is self-efficacy. Self-efficacy is an individual's belief about his/her capabilities to achieve designated levels of performance (Bandura, 1986).

Egan (1988) reports that individual differences play a critical role in determining if individuals will be able to use computers effectively. In order to accommodate a diverse population of computer users, it is essential for software designers to be cognizant of the interaction of individual characteristics and computer interface designs (Westerman, 1997). In this section of the document, the influence of individual differences on computer performance is explored.

Spatial Abilities

Spatial visualization, spatial relations, and visuospatial perceptual speed are referent of the term spatial abilities (Miyake, Friedmen, Rettinger, Shah, & Hegarty, 2001). Spatial visualizations reproduce processes of apprehending, encoding, and mentally manipulating spatial forms (as stated in Miyake et al., 2001). Spatial relations is similar to spatial visualizations considering that they both involve mental rotations; however, spatial relations tests typically involve planar rotations of 2-dimentional objects with a focus on the speed of the rotation. Finally, visuospatial perceptual speed tests detect individual differences in speed and efficiency in perceptual judgments. More specifically, perceptual speed involves the ability to quickly identify which one of five alternative patterns is a match with the model pattern (Miyake et al., 2001).

Several researchers have explored the effects of spatial abilities on performance using a command line interface for manipulating files. Davis and Bostrom (1992) discovered that individuals with overall high spatial ability showed greater system understanding than low

spatial ability individuals. Gomez et al. (1983) also found that spatial ability predicts an individual's success with learning to use a computer text editor. Westerman's (1997) work examined the differences in individual characteristics in their relationship to the use of command line and menu interface for file management. It was found that participants with high spatial visualization and high spatial memory perform faster than those participants with low spatial abilities (Westerman, 1997).

Additionally, a number of other studies have revealed that individuals with higher spatial abilities are better able to learn to perform interactive computer tasks. A study of novice computer users and their mental model formation process of an electronic mail filing system showed that high-visual individuals performed better that the low-visual individuals (Sein & Bostrom, 1989). Vicente and Williges (1988) determined that spatial ability was a predictor of the participants' ability to retrieve information from a hierarchical database. In a different information retrieval study Vicente et al. (1987) reported that two variables: spatial ability and vocabulary accounted for 45% of the variance in information retrieval search latencies. As stated in Freudenthal (2001), spatial abilities appear to not only predict user performance in general, but may potentially be the factor that explains the differences in performance among young and older computer users (as individuals increase in age, spatial ability has been shown to decrease).

Perceptual Style

Cognitive style influences human-computer interaction when there are discrepancies between (1) the prescribed operations for the software functionality and (2) the individuals' mental model of system operation. Cognitive styles potentially affect how people categorize significant information of any context, what and how people commit things to memory, and how

people approach various problem situations (Vermigli & Toni, 2004). One dimension highlighted in Vaske and Grantham's (Vaske & Grantham, 1990) discussion concerning cognitive style, and its influence on human-computer interaction, is perceptual style. This dimension involves a person's ability to distinguish the foreground object from the background. More specifically, an individual with a field-dependent perceptual style sees a given field in terms of its overall organization; thereby, merging the field's components with the background. On the other hand, field-independent individuals are more analytical in their approach to perception, and separate out simple figures immersed in a background (Vermigli & Toni, 2004). In other words, the field dependent person relies more on the context of an object for perception than the field independent person (Vaske & Grantham, 1990).

Computer Related Attitudes and General Self-Efficacy

Self-efficacy is defined as an individual's belief about their capabilities to achieve designated levels of performance that have influence over events that affect their lives. Self-efficacy beliefs mediate how people feel, think, motivate themselves and behave (Bandura, 1994). A strong sense of personal efficacy is associated with better health, more social integration, and higher achievement. Self-efficacy, as a construct, is applicable to mental and physical health, emotional disorders, school achievement, career choice, and socio-political change.

While there are certainly occasions to assess an individual's general sense of efficacy, which is indicative of a global confidence in one's ability to cope with a diverse collection of demanding or unfamiliar situations (http://userpage.fu-berlin.de/~health/world14.htm), a number of researchers have applied self-efficacy to computing. Reports suggest that computer-training designers should be aware of the trainees' attitude about computers, in order to achieve

successful computer training (Zoltan & Chapanis, 1982). Negative attitudes foster poor computer usage in decision-making and employment of information technology; negative attitudes are potentially the result of computer anxiety (as stated in Torkzadeh & Koufteros, 1993).

Furthermore, an individual's attitude concerning computers is expected to affect that individual's computer related self-efficacy (Torkzadeh, Pflughoeft, & Hall, 1999). Gist (1987) asserts that self-efficacy will affect a person's task effort, expressed interest, persistence, and the level of goal difficulty selected for performance. Therefore, if one expects to perform well (high self-efficacy) with a task, it is very probable that they will perform well (Olivier & Shapiro, 1993). Furthermore, Mentro et al. (1980) reported that perceived task ability significantly influenced task performance when controlling for other variables.

Gist (1987) provides some explanation for the positive correlation between self-efficacy and task performance. People with relatively high self-efficacy appear to engage in task-related activities more often and persist in coping efforts for a longer time; their persisting effort leads to more task mastery and experience, which augments their self-efficacy. People with low self-efficacy appear to spend less time in coping efforts, and quit on a task sooner. Their lack of persistence leads to less task mastery and reinforcement of low self-efficacy. Considering Gist's (1987) explanation concerning the relationship between self-efficacy and performance, it is evident that self-efficacy should be a consideration during the design of computer training.

From a view of universalism, the idea that psychological processes are common to all human beings, but are developed and displayed in different ways based on one's ecological and cultural influences. Including cognitive abilities in this research provided an opportunity to

assess the role of spatial ability, computer attitudes, perceptual style and self-efficacy in predicting performance for the cultural group of interest: African-Americans.

Interface Design Methodology

This section of the discussion brings to light an acculturalization interface design model, which is an extension of Rosson and Carroll's (2002) Scenario Based Development (SBD) user-centered interface design methodology. An acculturalization model is one that is customized for multiple cultural groups. This design methodology is a step toward adapting the culture of the current interface design community into one that is more inclusive of the computing population at large. This model is titled the Acculturalization Interface Design (A.I.D.) model because its purpose is to bring the current interface design community into a design culture that understands the importance of considering the computing perspectives of people in general, not simply select populations of people. Hopefully, as time passes, acculturation among interface designers will occur in the direction of implementing design strategies that are inclusive and representative of all populations here in the United States. This model advocates designers adapting their methods to the users, verses what is most common—the user adapting to the designers' design assumptions.

The A.I.D. methodology serves to provide a systematic process for developing culturally appropriate interface designs. A.I.D. is currently an extension/contribution to the SBD, thereby, providing a method for a more culturally competent design methodology. Administering the A.I.D. model in this research project provided an opportunity to establish further recommendations for later development of a stand-alone interface design methodology. (At this point it is not designed to be a completely separate methodology.) This methodology is an

essential mechanism for structuring the interface needed in this research endeavor, and, potentially, interface design in general. This process benefits interface designers and design companies, by providing a model that facilitates design for special user populations (i.e., the economically/educationally underserved).

Scenario Based Development was selected as the primary framework for the extended model because of its use of: (a) scenarios, (b) its iterative user-centered design approach, and (c) its recognition of the importance of a socio-technical systems approach to interface design. It is certainly reasonable to have used another user-centered design process, to develop the extended model. However, SBD's scenarios encourage the use of more naturalistic and/or ethnographic methods for understanding user preferences and requirements. These kinds of knowledge gathering techniques provide a basis for constructing interface designs that have been established upon real-world actions and meanings (Dourish, 2001). The extended and integrated interface design methodology presented here centers on merging (1) the SBD, (2) various elicitation methods for determining user needs and requirements, and (3) noted design considerations for marginalized and/or minority groups here in the United States. Since this extended interface design methodology emphasizes the methods for typically marginalized groups (and may vary in their level of education attainment), it is essential to employ effective tools for eliciting user requirements and preferences. Scenarios and/or storytelling (Moggride, 1993) can be effective ways to uncover design attributes and characteristics with almost any user type.

Socio-Technical Systems Theory and Scenario Based Design

As previously stated in the socio-technical systems theory discussion, both the human (with their inherent capabilities and limitations) and the technology should be developed together to produce an optimized design for the human-technology interaction. SBD discusses the use of

various methods to include the user into the actual design phases. Table 2 below shows the various methods that can be used to learn about the user or to actually involve the user in the design process.

Table 2: Methods/Means/Approaches for User Inclusion in the Scenario Based Development (SBD) Interface Design Process

SBD Design Phase	Method/Means/Approach
Analyze	○ User Activity Analysis ○ User Artifact Analysis ○ Social Context Analysis ○ Field Studies ○ Observations ○ Interviews ○ Ethnographies
Activity Design	○ Cooperative Design ○ Participatory Design
Information Design	○ User Information Perception ○ User Interpretation of Information ○ Making Sense of the Information (User) ○ Consistency and Coherence (for User)
Interaction Design	○ Norman's (1988) Gulf of Execution framework

Prototyping	○ Explore User Requirements
	  ○ Storyboard technique
	  ○ PICTIVE method (Muller, 1991)
	○ Usability Testing

Usability Evaluation	

In just about every stage of the design process, SBD directs the designer's attention toward the user. In the analysis phase, SBD guides the designer to begin understanding the user, their characteristics, and the context within which the user performs his/her work. The various methods listed include: user activity analysis, artifact analysis, field studies, and ethnography, to mention a few. These methods/means, especially those elicitation methods that occur in the user's natural environment, may be avenues toward greater understanding and more

generalizable characteristics of the user group(s). In the activity design, phase the user is given an opportunity to participate in the actual designing of the technology/interface. The user's active participation in the development process increases the likelihood that the user's mental model of the technology/interface will match the system's design; thereby, providing the user with a product that matches his/her expectations. In information design and interaction design, the designer develops the information and interaction of the interface in such a way that fosters good user perception and interpretation. In prototype design, the designer uses methods that help define an effective low-to-moderate fidelity prototype for usability testing.

SBD supports socio-technical systems theory first by recognizing the need to consider the user's requirements and expectations, and use those requirements as a guide for further development of the technology. While, there are other interface design and systems design methodologies that designers can use, SBD presents more opportunities for designers to acquire the more detailed aspects of the user, user's tasks, and their cultural and ecological settings.

Some systems design techniques (from software design/engineering) are the waterfall method and the spiral method. The waterfall method uses a top-down approach and a life cycle where the designers sequentially progress through a number of stages: systems analysis, requirements specification, design, prototyping, implementation, and testing (Hix & Hartson, 1993). The spiral method takes into account large and complex systems where it is not feasible to sequentially progress through the top-down waterfall method. The spiral method emerged from the necessity for iteration in the software development process. In the spiral methodology designers progress through the entire top-down process with multiple passes, extending the circle (the cycle nature of the process) to include more system details (Hix & Hartson, 1993). Neither of these design methods is user-centered; they do not offer an opportunity to understand the user

(and their eco-cultural setting) or to even involve the user in the process of designing the actual interface. In SBD the technology development is primarily driven by user's needs, based on what has been uncovered in the need analysis and the use of scenarios. In this way, the user is not given a product to use that completely alienates them.

There are several other design approaches that have been used for interface development: case-based reasoning and use-case reasoning. Case-based reasoning is a tool that can be applied to various types of design applications (www.aiai.ed.ac.uk/links/cbr.html#intro). The key to case-based reasoning is the library of previous design cases (Maher, Balachandran, & Zhang, 1995). These cases are defined in terms of a problem description, a solution and/or an outcome. The reasoning process is not included in these case descriptions, but is intended to be inferred based on the solution presented (www.aiai.ed.ac.uk/links/cbr.html#intro). In case-based reasoning solutions to old design cases are considered in order to determine feasible solutions for new design problems (Maher et al., 1995). Case-based reasoning functions only as a tool for retrieving previous cases, it would have to be supplemented with other types of reasoning in order to support the full design process.

Use case modeling (Bitter & Spence, 2003) is a more user-centered design methodology. Use cases typically contain a bulleted list of steps necessary to achieve a very specific task with a given system. For example, the use case could describe the process flow for getting cash from an Automated Teller Machine (ATM). The primary purpose is to help system developers form a conceptual model of the system in question; the goal is to match the users'/stakeholders' mental model with that of the system developer.

User engagement in the actual design process is non-existent or limited in the systems design and interface design methodologies just discussed. The user's involvement in the use

case process is limited to participating in sessions designed to verbally elicit system requirements, and there is no direct user involvement in the case-based reasoning approach. However, SBD provides the user an opportunity (1) for the interface designers to better understand the user by actually going into the environment where users do the task, and (2) for the users to participate in the process of designing the system.

Scenarios

Go and Carroll (2004) identify a scenario as a description that contains (1) actors, (2) background information about the actors and assumptions about their environment, (3) goals or objectives of the actors, and (4) sequences of events and actions. Scenarios, of course, can be expressed in terms of a textual narrative; however, scenarios are produced as storyboards, video mockups, or scripted prototypes. Furthermore, these scenarios can be in developed in formal, semi-formal, or informal notation (Go & Carroll, 2004). Below is a simple example of a narrative (problem) scenario:

> Marissa was not satisfied with her class today on gravitation and planetary motion. She is not certain whether smaller planets always move faster, or how a larger or denser sun would alter the possibilities for solar systems. She stays after class to speak with Ms. Gould, but she isn't able to pose these questions clearly, so Ms. Gould suggests that she re-read the text and promises more discussion tomorrow (Rosson & Carroll, 2002, p.2).

Scenario use in human-computer interaction usually represents "a day-in-the-life" of the user or potential user, as opposed to a larger scope like "a-year-in-the-life" (Go and Carroll, 2004).

In SBD, scenarios are developed and analyzed to assist designers with requirements analysis, system functionality, information presentation, interaction methods, documentation, the design of the prototypes and the usability evaluations. SBD employs three major phases:

analysis, design, and prototype and evaluation. Rosson and Carroll's (2002) SBD occurs in the order shown in Figure 3.

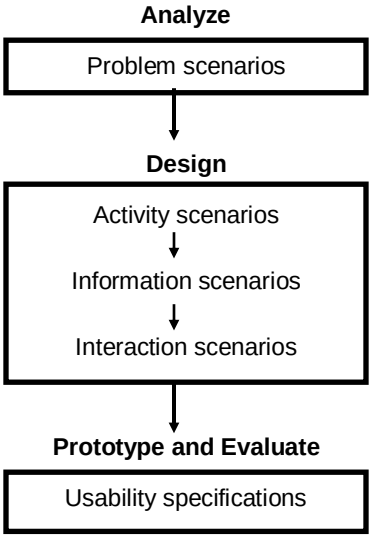

Figure 3: Scenario Based Development (adapted from Rosson and Carroll, 2002)

The analysis phase begins the process with requirements analysis and problem development. In this analysis, the problem and its context are studied using interviews with the users (including clients and stakeholders), field studies of the current practices, and brainstorming with both users and developers. The findings from this analysis become input for the scenarios (often in an iterative manner), which then demonstrate important characteristics about users, the tasks they perform, the tools they use and the context within which they work. At this point the scenarios are essential because they produce discussion about the current situation and how it works; they also raise questions about other situations and how they may work differently. The discussion and results from the formation of scenarios are beneficial in that they help the developers to better envision the problem.

Rosson and Carroll's (2002) discussion about analyzing requirements suggest analyzing work practices and getting users involved in identifying their work related needs. They recommend analyzing work practices in terms of (1) activities, (2) artifacts, and (3) social

context. Considering these activities, the developers would ask questions concerning the organizational and/or personal goals that users pursue, and the actions they perform to achieve these goals.

This approach to requirements analysis is certainly appropriate for potential system users who have specific organizational goals to achieve; however, additional considerations and measures must be made to address users who are not typically represented during design and development. Consider a project aimed at designing a computer interface for computer illiterate adults. These adults could vary in occupation (or may not work at all), organizational structure, amount of formal education, or daily home-related tasks. While an individual may have activities, artifacts and a social context that he/she works or operates in, as a group their work practices will potentially be diverse.

It is here that the SBD can be amended to address the needs of a diverse population of computer illiterate individuals. Furthermore, the addendums (and specifications) to the current SBD were implemented in an attempt to produce a methodology that would support development of computer interfaces that employ innovative, yet suitable computer interface metaphors. The augmented analysis procedures include the following addendums:

1. Specified the task(s) that would be implemented with computer application. Gave participants an opportunity to reflect on the task done by hand. Finally, encouraged them to photograph (Johnson & Griffin, 1998; Rosson & Carroll, 2002) the key elements associated with completing that task by hand.
2. Conducted videotaped focus groups with participants; the ultimate goal of the focus group was to uncover the salient design (interface metaphors) features for the interface. These focus group recordings were used to construct design scenarios to aid interface

design development. In addition, conversation about what they photographed was integrated into the focus group discussion to uncover any notable themes (by the way of probing questions).

3. Performed a basic task analysis, artifact analysis, and theme analysis with the participants of the focus group. The emerging theme(s) became the interface metaphor(s) used in the model.
4. Instructed the users to draw how the interface should look based on the focus group discussions (Muller, 1993; Rosson and Carroll, 2002).

Second in the SBD is the design phase. The design stage addresses three sub-stages: activity design, information design and interaction design. Activity design is concerned with identifying the basic ideas and services of the new system. The final goal in this sub-stage is to determine the system's functionality. Functionality specifications would include the types of operations that could be performed and the result of those operations.

SBD highlights the importance of designing effective, comprehensible, and satisfying activities. Activity design is the first sub-stage within the SBD's design stage. The scenarios in activity design provide reasoning about which features of the activity are best suited for computer application. In these scenarios the designers can explore the possibilities of new technology in the work related context. In addition, the scenario development and transformation will help provide ideas about the appropriate level of design generality. The authors' discussion about designing comprehensible activities further supports the emphasis on specifying system functionality. The key to presenting comprehensible activities is to specify system models that match the user's mental models. The final consideration for the quest to

determine system functionality is to design satisfying activities. It is important that users are able to perform activities on the computer that are of value (not just tedious and irritating tasks).

In the second sub-stage, information design, the ultimate goal "..is to support the perception, interpretation, and comprehension of computer-based information (Rosson and Carroll, 2002, p. 115)." Perceiving information is concerned with creating a design where viewers can clearly distinguish structures in an information display. In an information display (or an interface) the structures are assembled with pixels, colors, or tones. Moreover, the authors of SBD put forward several principles to follow for constructing perceivable information structures. First, they highlight Gestalt principles. These principles describe the architectural properties of visual information. More specifically, they describe "how individual bits of information are grouped together, what elements will be seen as a coherent figure, and what elements will appear as background (Rosson and Carroll, 2002, p. 113)." This principle emphasizes guiding rules about proximity, similarity, closure, area, symmetry, and continuity; all of which have an impact on an individual's low-level perception. Low-level perception may involve perceiving details about size, position, shape and color (Rosson and Carroll, 2002).

Furthermore, Rosson and Carroll (2002) recommend using the Gestalt principles for perceptual matters that occur at a higher level. High-level perception transcends the basic perception of pixels, colors and shapes, and is extended to the perception of menu bars, scroll bars, paragraphs, file lists, radio buttons, and icons.

Discussion concerning Gestalt principles for perceptual matter presents an opportunity for cultural awareness in the design process. When the designers consider using the Gestalt principles, they should also be aware of areas of potential cultural difference in perception. One cultural concern pertains to holistic versus analytic thinkers (Nisbett and Norenzayan, 2002).

Those who use a holistic approach to thought pay close attention to an object within its context or field. In most cases this type of thinker prefers to predict or explain events in terms of object-to-context relationships. Analytic thought entails separating the object from its context, in order to use categorization rules to predict and explain the object's behavior (Nisbett and Norenzayan, 2002). A similar dimension is field dependence versus field independence (Nisbett and Norenzayan, 2002; Vaske and Grantham, 1990). This dimension involves a person's ability to distinguish the foreground object from the background. The field dependent person relies more on the context than the field independent person (Vaske and Grantham, 1990). Both holistic versus analytic reasoning and field dependence verses field independence are areas of potential difference, as it relates to perception (possibly high or low level perception) among cultural groups. Therefore, designers need to be aware that they may need to adopt perception principles for information design that would be most appropriate for a particular group of users.

"Interpreting information" is defined as determining what the display elements mean and how those elements fit into the context of the interface. Perception is one phase of human information processing. The next phase would be cognition, where reasoning and interpretation is performed (Wickens & Hollands, 2000). Perceiving the information display as objects or sets of objects allows for interpretation to take place (Rosson and Carroll, 2002). Hence, the next portion of information design in SBD concerns "interpreting information." They define interpretation as determining what the display elements mean and how these elements fit into the context of the interface. Rosson and Carroll (2002) elaborate on the concept of using elements/items of familiarity and meaning, such as, words, images and symbols to assist users with display information interpretation.

Here is another opportunity for designers to be cognizant of culture differences. As stated previously, the designers should be aware of potential differences in how cultural groups think and reason (in terms of perceptual styles). For instance, field dependent individuals may perceive and interpret a set of drop down menus and the organization of it content in a different manner than field-independent individuals. Furthermore, there may be other cultural differences between groups that affect interpretation of an information display.

A number of researchers have studied cognitive styles from the viewpoint that certain cognitive performances/abilities may be more or less critical in particular ecological and cultural contexts. Using an ecological context refers to considering the setting in which humans interact with their environment and the set of resulting relationships that present a variety of life possibilities for a population. An ecological analysis of the demands of an environment would include investigating questions such as: what are the necessary things that need to get done (in the environment) in order to survive? and what cultural norms/practices or social situations lead to the development of the necessary cognitive performances (as stated in Berry, 1992)? This ecocultural framework is one that has served as a general conceptual framework for cross-cultural psychology (Berry et al., 1992). Figure 4 illustrates the system of variables that are employed in the ecocultural framework of cross-cultural psychology.

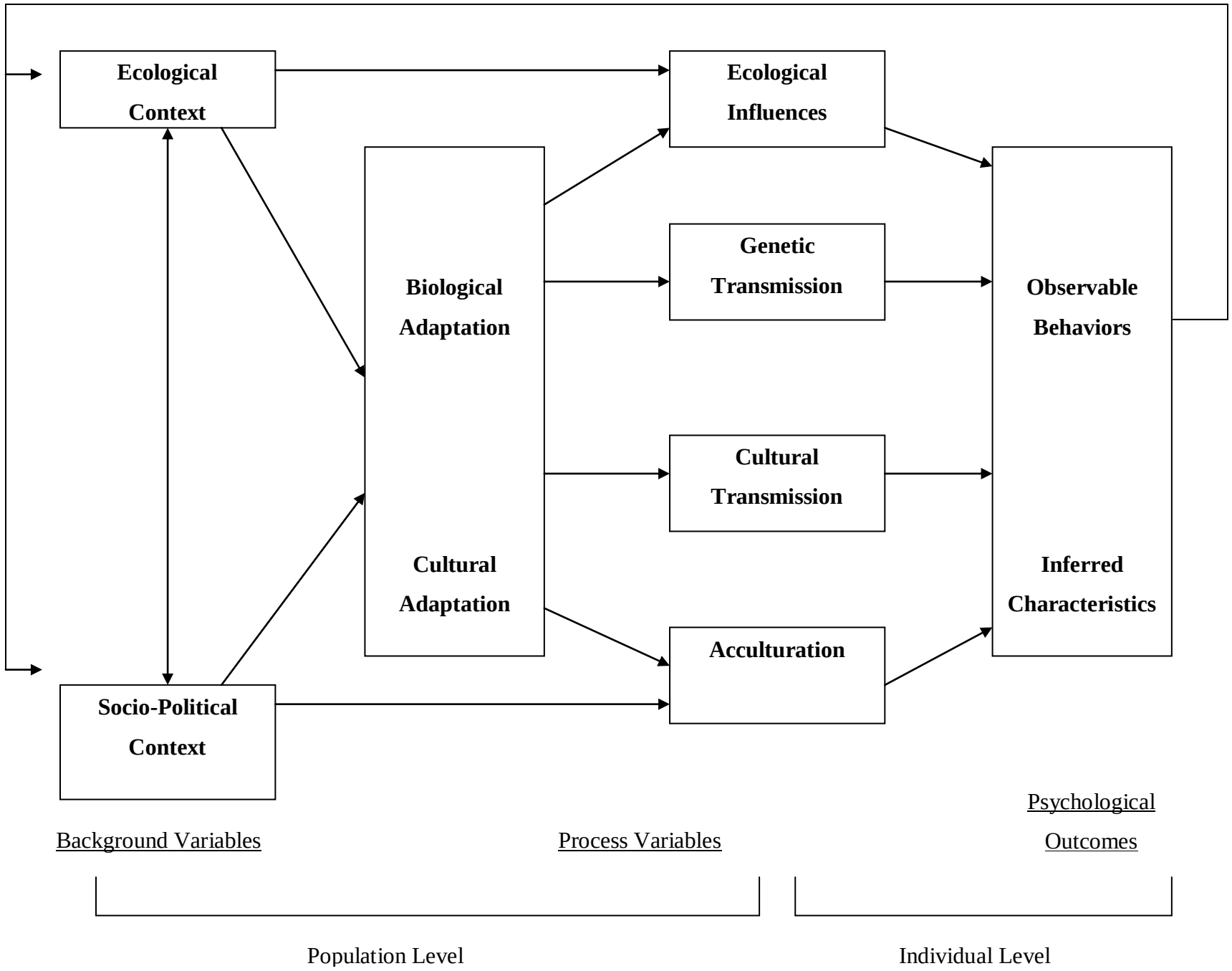

Figure 4: General conceptual framework of relationships among classes of variables employed in cross-cultural psychology (Berry et al., 1992).

At the far left of the figure are the two main classes: ecological context and socio-political context. At the far right are the psychological characteristics such as: traits, motives, abilities and attitudes, which result from the two transformative sets of variables that signify the influence or transmission from population variables to individuals. This conceptual model was designed to present the general relationships between classes of variables that can be used to explain the cross-cultural similarities and differences in human behavior (for a more detailed review see Berry et al., 1992).

Other researchers have studied cross-cultural psychology from the basis of the ecocultural conceptual framework. Studies that date back to the 1960's and 1970's, including the previously discussed works of Berry (1976) and Dawson (1967), are among those that put forth that ecology and culture are a source for psychological differentiation between cultural groups. Berry et al. (1986) studied two different groups in Africa. They compared the cognitive style of the African Pygmy (Blaka), hunters and gatherers, with a sample of individuals from an agricultural village within the same geographic region as the Pygmy. They discovered that there was a difference in cognitive style (assessed by way of an African embedded figures test) in the two African cultures, but only when differences in acculturation were considered as well. Therefore, they recognized that there is some interaction between cognitive style and acculturation.

John Ogbu also applies a cultural-ecological model in his cross-cultural psychology research (Ogbu, 1995). His work has been concentrated in the area of minority education from a cross-cultural perspective. Nevertheless, he too ascribes differences in intelligences (or cognitive performances) to the social or cultural adaptations characteristic to a given population. Ogbu asserts that children belonging to a given population are socialized to attain the cognitive

skills that are essential for the maintaining existence in that culture (Ogbu, 1994). Furthermore, Ogbu (2002) identifies a number of cultural amplifiers of intelligence, which he describes as those activities in an ecocultural niche that necessitate enhanced (or amplified) intellectual skills attainment. An ecocultural niche makes reference to the broad societal environment where cultural activities/tasks create cognitive problems for members of the population. For example, Ogbu identifies superior mathematical skills in children who grow up in cultures whose economy is rooted in commerce as opposed to farming. In this case, the cultural amplifier is commerce and the skill it augments is mathematics (as stated in Obgu, 2002). Overall, this discussion is provided to offer a general framework for how culture can potentially be a mitigating factor for the development and execution of cognitive skills for a given ethnic/cultural group.

The last concern within information design is being able to make sense of the information that has been perceived and interpreted (Rosson and Carroll, 2002). Often, users will try to make sense of information by making associations with what they already know about their task, and determining how it fits into the larger scheme of their desired goals/interests. When that does not work, users will consider alternate interpretations of the information and try to make sense of it that way. SBD suggests using consistency (i.e., of colors, vocabulary, shapes, layout), visual metaphor, information models and dynamic displays to facilitate making sense of the information.

While there are some obvious cultural issues that designers will have to consider (e.g., differences in spoken language or dialect), there are some not as obvious cultural issues as well. For example, in some countries the social norm is for both men and women to be tender, modest, and concerned with the quality of life (Hoftstede, 1997). So for them, it would be less

appropriate to use terminology such as "ABORT" or "KILL" (Shneiderman, 1992) to describe a function to exit or end a program. This example could serve for images and symbols as well.

Here again is an occasion for cultural awareness in design. According to Feurzeig (1997) an economically and educationally undeserved group of inner-city high school students in Boston, Massachusetts were capable of learning concepts related to complex Galilean relativity problems and genetics using educational computer programs just as well as high-school students from a more affluent background. However, the inner-city group (ethnicity of students was not provided) had difficulty transferring their knowledge of those concepts to written tests. It was determined that the underserved students lacked the literacy and communication skills necessary to reproduce the complex concepts they learned into written material. Therefore, meager reading comprehension skills may hinder user performance with text-centered interface design; designers should be conscious of that issue and use "descriptive" labels, titles, phrases, and instructions appropriately.

Another opportunity for cultural awareness for "making sense of the information" concerns visual metaphor. Metaphors are only valuable when they exploit the users' current knowledge about a task, process or social norm. Cultural differences unaccounted for in the design may result in implementation of inappropriate metaphors. For example, Aaron Marcus suggests that cultures that are high in uncertainty avoidance would be most comfortable or reassured with an interface that uses simple and easily discernable metaphors (http://www.amanda.com/resources/hfweb2000/AMA_CultDim.pdf). Uncertainty avoidance is one of five cultural dimensions that Geert Hofstede uncovered during an anthropological study of a global business organization. Uncertainty avoidance is defined as the degree to which individuals feel threatened in the midst of unknown or uncertain situations (Hofstede, 1997).

The last sub-stage in the design phase of SBD is "interaction design." Interaction design refers to the specification of mechanisms for gaining access to and manipulating task information (e.g., windows, icons, and menus). The ultimate goal of interaction design is to minimize the users' cognitive effort. In the discussion of interaction design, several antidotes for reducing cognitive effort are presented. One concern is to make action obvious to the user. In some cases direct manipulation (as in interaction style) can facilitate user action planning. In direct manipulation, the interface is constructed with objects and actions that map to real world objects and actions. For example, the user can grab, drag or stack a folder on the interface (Rosson and Carroll, 2002). The key here is to make interface interaction discernable by implementing analogies to the real world. Again, cultural awareness would dictate that designers develop "real world" semantic and physical analogies that are indicative of the culture that has shaped particular users. Gaps in analogy comprehension may produce performance problems.

Another component of this interaction design sub-stage concerns the execution of the action. This stage focuses on selection of input devices for a task. Input devices include a mouse, keyboard, button, joystick, trackball, and data glove. The discourse on execution of the action concerns selecting input devices and optimizing performance with them. One brief point about interaction through input devices is that the designer will have to be certain that the input devices support functions that are consistent with there cultural practices.

The final stage of the overall SBD is prototyping and evaluation. Prototypes are developed and tested to support the iterative portion of the SBD process. Prototypes are used to determine and refine user needs, explore design possibilities, perform participatory design, and/or explore open issues. It is in this stage where the data from the recorded focus groups will provide critical information for the development scenarios, thereby, the actual interface.

Usability evaluation is any analysis or empirical study of a prototype's ease-of-use (Rosson and Carroll, 2002) and usefulness (Hix and Hartson, 1993). Usability testing can be performed for formative or summative evaluation. At this stage in the SBD process, it may seem that the culturally based interventions would be unnecessary. Notably, evidence has been found that culture plays a role in usability evaluation as well. Vatrapu and Perez-Quinones (2006) report that Indian participants in a usability study using structured interviews found more usability problems and made more suggestions to an Indian interviewer than to a foreign (Anglo-American) interviewer. The authors were not able to determine if providing an individual that was sensitive to cultural (Indian) values and issues would be enough to diminish the gaps in the usability results. Nevertheless, the indication is that culture must be a consideration when recruiting usability facilitators and developing plans for usability sessions.

The disparity in computer access between majority Americans and ethnic minorities has been attributed to various causes. For this research "access" to computer technology is operationalized as having a computer interface that effectively facilitates user learning. Therefore, a computer interface that is cumbersome for a group of new user to learn would be considered a barrier to access for that group of individuals. From a human factors/macroergonomics perspective the problem of access can be conceptually viewed within a framework where (1) the external environment (including culture) impacts characteristics internal to an individual and (2) those internal characteristics should in turn inform the design of an appropriate technology. A part of the problem of access is related to the overall design and application of computer interface metaphors. Currently, the most pervasive interface metaphor – desktop metaphor– for computing presents some limitations. This metaphor assumes that individuals are familiar with an office environment. National reports suggest that more than one

third of Americans work in non-office environments. For that reason, there is a need to develop more socially valid interface metaphor designs, using a systematic process for acquiring those potential interface metaphors from various ethnic groups.

Purpose of Research

The purpose of this research was to explore various interface metaphor designs among ethnic minority groups of lower socio-economic status, and determine which combination of factors affects their computer performance. The goals of this research endeavor are given below with their associated hypotheses:

- Develop a culturally valid interface design methodology (which maintains social validity) for culturally divergent people/populations,
- Establish appropriate computer interface designs for the economically underserved,
- Specify any significant performance differences among the African-American group on specified interface designs,
    - Hypothesis # 1: Individuals from the African-American cultural group will perform better on the interface that was designed based on the ideas from their own cultural group verses Microsoft Word 2003.
- Determine if any relationships exist between individual differences (i.e., spatial ability, perceptual style, computer related attitudes and general self-efficacy), and user performance among the target African-American group, and
    - Hypothesis #2: There will be relationships between spatial ability, perceptual style, computer related attitudes, general self-efficacy, and the user's performance when performing specified computer tasks.

- Determine if there are any relationships (via a correlation study) between acculturation level and performance.
    - Hypothesis #3: There will be correlations between participants' acculturation level and performance.
- Identify any cultural aspects for good usability that should be considered when designing for the Latino population.

CHAPTER III. METHODOLOGY INTRODUCTION

This research project used mixed methods to achieve the research goals. More specifically, both qualitative and quantitative methods were used to obtain and assess data across all five studies designed to address the research goals and questions. Quantitative analyses are most traditional for engineering research. This endeavor also required the use of qualitative inquiry and analyses. Qualitative inquiry generally involves fieldwork where a researcher spends time in a particular setting. These studies typically produce large amounts of raw data that include detailed descriptions of the settings, people's activities and behaviors, quotations, personal diaries, written responses to questionnaires, organizational documents, etc. These data provide detailed insights into the setting of interest and any other observable human experience (Patton, 1990).

Moreover, both qualitative and quantitative approaches were integrated to effectively determine a process for engaging typically marginalized groups, interface metaphor preferences of African-Americans, and user performance with varying types of interface metaphors. The qualitative aspects of this study provided a basis for understanding how entry was obtained into the participants' community and for obtaining richer descriptions of user successes and challenges with the various interface designs.

Participants

The participants were selected using the criterion sampling technique of the purposeful sampling evaluation strategy (Patton, 1990). The rationale for purposeful sampling was to choose information-rich data sources whose study was of central interest to the research endeavor. Criterion sampling is one of many purposeful sampling techniques. In criterion

sampling all cases that meet a predetermined criterion are appropriate for review. The purpose of using criterion sampling was to obtain participation from individuals that most effectively represent the social and cultural groups designated in this research.

All Set I and Set II participants in this research (participants for Study 1, 2, 3, and 4) met the following criterion:

1. Working age young adults (men and women 18 to 30 years of age),
2. Novice computer users,
3. Individuals of lower socio-economic status, and
4. African-American who reside in Baltimore (East), Maryland.

Table 3 is a summary of participant involvement in the research.

Young working age individuals were the focus of this research, primarily, for the reason that they are at an age where they are soon entering the workforce or just entering the workforce. Likewise, 18 to 30 years of age is a commonly used age range for young adults in psychology and information technology research (Marquie & Huet, 2000; Marquie, Jourdan-Boddaert, & Huet, 2002; Westerman, Davies, Glendon, Stammers, & Matthews, 1998); therefore, the range of 18 to 30 years of age was adopted for implementation in this research endeavor. The aim of this research was to recruit young working age individuals that were novices (do not use computers as a part of their daily or even weekly lives at home, work, school, or for recreation).

Participant Screening

The researcher advertised with flyers, posters, and word of mouth to recruit throughout the East Baltimore communities. Individuals who were interested in participating were asked to call the researcher. The initial participant phone call was the primary mechanism for screening

those interested persons. The screening questions were used to determine the individuals' eligibility to participate in the study. The questions are pertained to:

- Ethnicity (Ethnic Identity),
- Area of Residence,
- Age,
- Computer Usage,
- Occupation,
- Household Income, and
- Contact Information.

The researcher used a telephone script with each participant. The questions used to screen the participants were embedded within the telephone script. The detailed telephone script can be found in Appendix A.

The research sessions were hosted in the meeting rooms of public libraries in East Baltimore. The researcher solicited the assistance of the library staff to screen for habitual drug and alcohol users; their knowledge of the surrounding community/environment was used to help avoid recruiting substance abusers and any miscreants. The library staff also served as a resource for determining specific locations in the East Baltimore communities to target for participant recruiting. Table 3 is a summary of all participant recruitment and activity for studies 1, 2, 3, and 4.

Table 3: Participant Summary

Study	Cultural Group	Participant Activity	Participant Set	# of Participants	Sampling Strategy
1	African-Americans	Preparation/Background Information for: Study 2 & Study 3	Set I	4*	Purposeful Sampling (with Criterion Sampling)
1	African-Americans	Preparation/Background Information for: Study 4	Set II	15**	Purposeful Sampling (with Criterion Sampling)
2	African-Americans	Focus Group	Set I	4*	Purposeful Sampling (with Criterion Sampling)
Pilot Test	African-Americans	Benchmark Task Description Pilot testing	N/A	3	Purposeful Sampling (with Criterion Sampling)
3	African-Americans	Interface Development Feedback	Set I	2*	Purposeful Sampling (with Criterion Sampling)
4	African-Americans	Interface Performance	Set II	15**	Purposeful Sampling (with Criterion Sampling)
Total # of Participants				22	

* = Same African-American participants across Studies 2 and 3

** = Same African-American participants as in Study 4

Additional Participant Characteristics and Behaviors

Balancing for Characteristics

When choosing individuals to form the focus group, the researcher's intent was to balance out various characteristics such as gender and occupation. The purpose for balancing across participant characteristics was to avoid having completely homogeneous groups of participants (e.g., all female waitresses). However, that goal was not completely attainable in the given participant recruiting situation.

Illiteracy

The researcher offered to read all written materials either to or with the participants if that would be more convenient for them. Participants asked clarification questions for the items that they were unsure about.

Participant Mortality

Participant mortality was a minor issue for study 3: Interface Implementation and Formative Evaluation, which was the study designed to perform a formative evaluation on the African-American Inspired Interface (AAII). The researcher's original intent was to administer a formal formative evaluation session with at least 3 of the original focus group members. After, the original focus group the researcher developed the design ideas into a function interface design. However, during the time between the original focus group and the complete development of the AAII, two of the four focus group members' contact information was no longer valid. Therefore, the remaining two participants did the formative evaluation of the AAII.

Participant Sharing

Since the participants were from the same communities, it was very important to address the issue of participant sharing. To eliminate (or at least minimize) the occurrences of

participant sharing, the researcher stressed the importance of the not sharing the details of the research with neighboring family and friends. The researcher highlighted this point during discussion of the informed consent.

Gaining Entry into the African-American Community

This section of the document was included to offer a description of the researcher's experience preparing to collect data outside of the university setting and inside of an economically underserved inner city. The description supplied is presented in first person, as is custom in naturalistic inquiry.

Gaining entry, or rather, getting by-in from the local community organizations and programs, was by far the most difficult aspect of my data collection. It was also a major factor in my ability to transition swiftly and smoothly between studies. My two most critical needs were to find a safe location to host my participants and to acquire some participants.

During the proposal stage of my dissertation research I found an advocate in East Baltimore, who spoke on my behalf to many of her local contacts. During this time she had secured a location for me to host my participants for my first and subsequent studies. By the time I worked through the proposal stage of my research and acquired all of the proper approvals and documentation to do research with human participants, the management of the local community that was to host my research left—and the opportunity that was previously secured for me left too.

With that in mind my advocate and I continued looking for local community centers, public libraries and other locations that would be willing to host my research. When I approached a potential opportunity, I submitted a summary of my research, a brief description about myself, and my IRB approved informed consent forms. In addition, I assured them that

the participants hosted would be paid for each hour they spent with me. I also offered to volunteer my time in support of their outreach programs.

Many of the individuals and organizations that I contacted were very supportive of me as an African-American young woman with such a "lofty" goal as completing a dissertation as part of obtaining a doctoral degree. However, while they were most interested in my study and pleased at my desire to work with inner city communities, they lacked the resources host my research or provide any substantial leads for my participant recruiting efforts. The most reoccurring challenges were (1) they did not have the space to lend or (2) their funding was running out and they did not know how long their doors would be open.

After months and months of following up with many contacts and local organizations, my advocate found another local community outreach center that was willing to assist me. This community center offered me the use of their classroom for my research sessions and allowed me to post recruiting flyers as well. The facility was well equipped for hosting participants for each of my studies and was also secured by a security guard and a "buzz-in" door system.

At this time I began to distribute my recruiting flyers widely and was able to organize the research sessions to complete the focus group of study two in December of 2005. Their was a five month period between the completion of study 2 (Implementation of the A.I.D. Methodology) and the need to return back to the community center in order to host participants in study 3(Interface Implementation and Formative Evaluation). During this time I was developing the interface that would be tested in studies 3 and 4(Testing African-Americans on the AAII and MSWord 2003). In April of 2006, I contacted the community center to find out what dates and times were available for me to use the classroom to complete study 3. At that time I was informed that the community center would no longer support my research endeavor. I

was told that their clients (who are East Baltimore residents) were being inundated with research projects and that they did not want to expose their clients to any more research. I asked if I could just use the classroom space if I assured them that none of their clients would be involved in the project; I was then told every resident in East Baltimore was a potential client to the center. Therefore, the answer to my question was "No."

Finally, in August of 2006 I found another local library of which I was originally unaware. I presented all of my information, and the branch manager welcomed my use of their meeting room space. The branch manager gave me the information of another local library that had meeting room space as well. I was able to complete the rest of my studies between these two library locations.

Study and Participant Activity Flow

Five different studies construct research activities for research project. Each study was not necessarily a stand-alone entity, in that a given study often provided an outcome(s) that were inputs for the following study. Particularly, studies 1(Psychosocial Characteristics Data), 2(Implementation of the A.I.D. Methodology), and 3(Interface Implementation and Formative Evaluation) provided inputs study 4(Testing African-Americans on the AAII and MSWord 2003). These research activities were categorized as studies they each had intricate methodologies to achieve its outcomes; describing these methodologies all as single study would have been awkward and potentially indecipherable. However, emergent study 5(SME Cognitive Walkthrough) was a stand-alone study that emerged during the course of this research project. Below is a brief discussion of each of the studies associated with this research. Figure 5 illustrates the flow of the studies as they provide inputs for the other studies. Table 4 summarizes the methodologies, participant activities and other relevant information.

Study 1: Psychosocial Characteristics Data

As noted previously, this research project consists of several studies. Each of the studies is linked together in an effort to better understand the effects of ethnicity and socio-economic status on the development of and user performance with various computer interface designs. Study one was designed to obtain information about each individual participant in the research project. This information provided an opportunity to acquire demographics data and various measures of individual difference: spatial ability, perceptual style, acculturation level, computer attitude and general self-efficacy. This information was used in Study four for inferential statistics. Therefore, study 1: Psychosocial Characteristics Data was input for study 4: Testing African-Americans on the AAII and MSWord 2003.

Study 2: Implementation of the A.I.D. Methodology

Study 2 was designed for the purpose of administering the A.I.D. model, in efforts to acquire innovative computer interface metaphor(s) and design from young African-Americans. These were Set I participants. The primary activity for study 2 was the focus group. The ideas for novel interface metaphor and the accompanying design were input to progress to study three. Thus, study 2: Implementation of the A.I.D. Methodology was input for study 3: Interface Implementation and Formative Evaluation.

Study 3: Interface Implementation and Formative Evaluation

The purpose of study 3 was to take the design ideas from study 2: Implementation of the A.I.D. Methodology and develop the AAII design. Once the researcher/interface designer developed the design into an actual computer interface, original members of the focus groups (of study 2) were given an opportunity to test the interfaces and provide feedback concerning any problems they may have encountered while performing the benchmark tasks. The participant suggestions

were incorporated into the design. Once this iteration of design was completed, the final design was used for the user performance evaluation in Study 4. Accordingly, study 3: Interface Implementation and Formative Evaluation was input for study 4: Testing African-Americans on the AAII and MSWord 2003.

Study 4: Testing African-Americans on the AAII and MSWord 2003

In Study four the Set II African-American participants performed several benchmark tasks. Special software recorded each participant's activity as he/she worked towards completing the benchmark tasks. The performance measures were used for various types of statistical analysis and qualitative analysis. Consequently, the outputs of study 4 were used for both quantitative and qualitative analysis. The results of those analyses were used for the purpose of triangulation.

Emergent Study 5: SME Cognitive Walkthrough

Study 5 is an emergent study, serving as a proxy for testing and evaluating the performance of Latinos on the AAII and MSWord 2003. In this study, subject matter experts (SMEs) with an expertise in Latino culture completed cognitive walkthroughs on both interfaces: the AAII and Microsoft Word 2003. Therefore, emergent study 5: SME Cognitive Walkthrough provided information that was used to augment the overall research discussion and further triangulation.

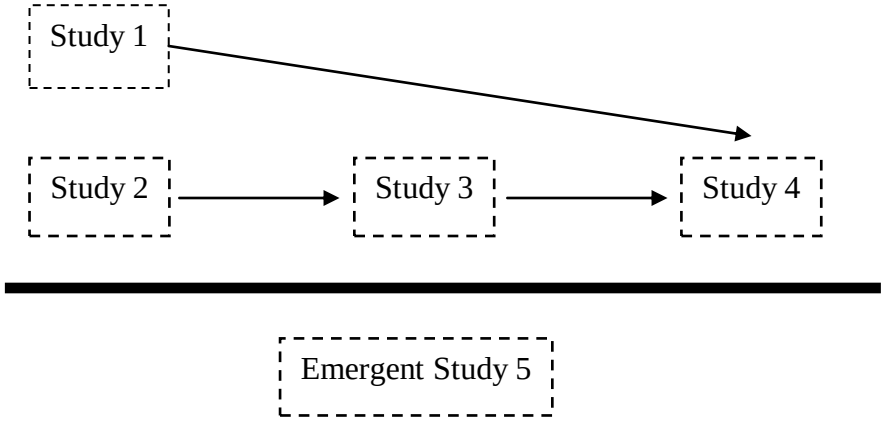

Figure 5: Study Input and Information Flow

Triangulation

Triangulation provides strength to the design of a study by utilizing a combination of evaluation methods (Campbell and Fiske, 1959). Making use of several kinds of research methods or data is a suitable way to achieve triangulation. Using a single method, generally, will not be adequate for determining multiple causal factors for a specific problem/phenomenon. The use of a single method is also likely to produce results that are confounded with error vulnerabilities associated with that specific method. In addition, triangulation, when used appropriately, can improve the validity and reliability of the evaluation of findings (Golafshani, 2003). Consequently, this research employs a mixed form, (i.e., qualitative and quantitative) of evaluation/analyses designed to provide a variety of data sources. It includes semi-structured interview questions, critical incident reports, content analysis, parametric statistics and non-parametric statistics; all of which were used for data triangulation. In triangulation the various types of data are considered together, in order to see how each set of data supports each other. Using triangulation will help the researcher to feel more confident that they understand the problem(s) presented.

Table 4: Methodology Summary and Activity Flow

Study	Activity	Type of Data	Instruments Used	Instrument Reliability	Data Obtained	Data Analysis Method
1	Participant completion of questionnaires and cognitive tests	Quantitative (all except demographics questionnaire)	Computer Attitude Scale	0.84	Computer Attitudes	Chronbach's Alpha; Regression prediction model (RPM)
			General Self-Efficacy Scale	0.76 to 0.90	General Self Efficacy Score	Chronbach's Alpha; RPM
			Kit of Factor-Referenced Cognitive Test		Spatial Ability test score	Chronbach's Alpha; RPM
			Group Embedded Figures Test	0.82	Perceptual Style test score	Chronbach's Alpha; RMP
			Multigroup Ethnic Identity Measure	0.71 to 0.90	Acculturation Survey Score	Used for data triangulation
			Demographics Questionnaire	----------	Demographic Information	----------
2	Participants attend focus groups	Qualitative	A.I.D. Methodology		Video recorded discussion of new metaphor ideas	Content Analysis
					Salient themes for interface design	Content Analysis
					Low-fidelity interface design	Content Analysis
2	Researcher Activity				Develop design scenario	

Table 4: Methodology Summary and Activity Flow (Continued)

Study	Activity	Type of Data	Instruments Used	Instrument Reliability	Data Obtained	Data Analysis Method
3	Researcher Activity	Develop African-American Inspired Interface design				
3	Participants participate in formative evaluation of AAII	Qualitative	Retrospective Think-A-Loud methodology & Post-Task Interview Questions		Feedback & design changes for the AAII	Content Analysis
4	Participant performance testing on both interfaces	Quantitative	Interface Designs		Performance Scores (# of Detours)	T-Tests, Chi-Square Analysis, RPM, & Correlation Analysis
4	Usability testing of interfaces with a new set of participants from a dominant culture	Qualitative	Retrospective Think-A-Loud methodology & Post-Task Interview Questions		Critical Incidents & Design Discussion	Content Analysis

CHAPTER IV. STUDY ONE: PSYCHOSOCIAL CHARACTERICS DATA

Design of Study

The purpose of study one was to collect various types of information about the participant to use in subsequent studies. More specifically, the goal was to use all of the collected data to develop a regression model, where scores on a general self-efficacy scale, a computer attitudes scale, spatial abilities tests, and the group embedded figures test were predictors for participant performance on various interface designs. Table 5, with its associated alphabet, is located throughout the document and provides an updated look at which studies have been completed and which studies remain; the grayed-out text indicates those studies which were completed.

Participants

Each participant was selected based on the criteria discussed in the Methodology Introduction section of this document. Sampling was achieved strategically within East Baltimore (this is a central city location) to obtain representation from the ethnic and socio-economic groups required for this project. The targeted locations for recruiting participants were community centers, libraries, grocery stores, churches, local Department of Social Services, W.I.C. program office, the public housing units and other neighboring homes in the East Baltimore communities. By design, public housing is provided to assist lower income individuals or families to obtain decent, safe and affordable housing (Baltimore City Public Housing Application, January 2005). The housing institution that supports Baltimore City is the Housing Authority of Baltimore City (HABC). This program is administered in accordance with the standards and regulations of the United States Department of Housing and Urban Development. The income standards for public housing eligibility for the city of Baltimore are:

- One person family: 23,250 dollars
- Two person family: 26,550 dollars
- Three person family: 29, 900 dollars
- Four person family: 33, 200 dollars
- Five person family: 35, 850 dollars
- Six person family: 38, 500 dollars
- Seven person family: 41, 150 dollars

Eight person family: 43, 800 dollars (Batimore City Public Housing Application, January 2005) These income standards were adopted for the purposes of this research. Participation did not require living in public housing; however, individuals must have represented one of the income levels enumerated above.

Instruments

Demographics Questionnaire

The demographics questionnaire asked for general and background information about the participant, in addition to information about their experience with computers. See Appendix C. This questionnaire provided information for a participant group profile.

Acculturation Survey

Each participant completed a questionnaire designed to determine his/her level of acculturation. Acculturation is process through which ethnic minorities engage in cultural traditions, practices, beliefs, values and assumptions of characteristic of the dominant society (Berry, 1980). Obtaining a measure of acculturation was valuable because it provided information about each participant's level of adaptation towards the mores of other cultures here in the United States. Individuals who have low acculturation are most a risk of being

disenfranchised in the development of computer interfaces, which are generally designed to accommodate mainstream American practices.

Acculturation, for the research, was assessed using Phinney's (1992) Multigroup Ethnic Identity Measure (MEIM), which appears in Appendix D. The MEIM is designed to gauge how individuals, regardless of their specific ethnic group (e.g., Asian-American, American Indian, and Anglo-American), view their ethnicity or their ethnic identity. The distinction between ethnicity and ethnic identity is grounded in the fact that, though there are many different ethnic groups represented, people differ in how they perceive their ethnicity. One's ethnicity is determined by the ethnic heritage of one's parents. Ethnic identity is a self-identified ethnic label that one uses (as stated in Phinney, 1992), which may or may not be different from an individual's ethnicity. More specifically, individuals may differ in how much they value their ethnicity and how much their behavior is influenced by it. Therefore, the MEIM is formulated to assess an individual's perceptions about their ethnic identity, to avoid confounding ethnicity with ethnic identity if in fact the two are different. For example, an individual's ethnicity could be Caucasian, but their ethnic identity is Irish-American; another person's ethnicity could be Black, but their ethnic identity is associated with Caribbean culture.

Participation in this research was based on self-selection; that self-selection was in terms of their self-identification with the African-American ethnic group. Consequently, the MEIM served as a measure of acculturation. This measure of acculturation shows how much each participant associates with his/her self-identified ethnic group and their orientation towards other cultural groups.

According to Phinney, there are several items that are common to numerous ethnic groups. These common elements: self-identification and ethnicity, ethnic behaviors and

practices, affirmation and belonging, and ethnic identity achievement; form the basis of the MEIM. Phinney notes that self-identification, which is defined as the ethnic label that an individual uses for himself/herself, as a member of an ethnic group is a prerequisite for ethnic identity.

The MEIM, in its original form, is comprised of 20 items that are measured by the way of a 4-point rating scale. Fourteen items measure three aspects of ethnic identity: ethnic behaviors or practices, positive ethnic attitudes and sense of belonging, and ethnic identity achievement (including both exploratory and resolution of identity issues). The six remaining items measure other-group orientation. The fourteen-item ethnic identity subscale's measure of reliability was 0.81 for high school students and 0.90 for college students. The six item other-group orientation scale reliability score was 0.71 for high school students and 0.74 for college students. A principal axis factor analysis revealed that there are two factors for the high school sample, which include ethnic identity (20% of the variance explained) and other-group orientation (9.1% of the variance explained). The same two factors were discovered for the college sample as well, where ethnic identity and other-group orientation accounted for 30.8% and 11.4% of the variance, respectively.

Spatial Abilities Tests

A number of studies have revealed that individuals with higher spatial abilities are better able to learn to perform interactive computer tasks (Davis and Bostrom,1992; Gomez et al. 1983; Westerman, 1997). The tests used to assess spatial abilities are from ETS's "Kit of Factor-Referenced Cognitive Tests" (Ekstrom, French, & Harman, 1976). In the Paper Folding Test, the individual has to mentally fold a piece of paper, imagine that a hole is punched through the folded paper, then determine what the paper would look like when it is unfolded; participants

select one of five alternative responses. As the participant progresses through the Paper Folding Test, the folding tasks get more complex; there are some instances were three non-symmetrical folds are required. In the Card Rotation Task the participant views a 2-dimensional target figure and determines which of the alternative figures are planar rotations of the original figure. The object is to respond as quickly and as accurately as possible. Finally, the Identical Pictures Test requires the participant to look at a target figure and determine which of five alternatives is identical to the original target. Again, the object here is to respond as accurately and quickly as possible.

Perceptual Style Test

Perceptual style will be measured using the Group Embedded Figures Test (Witkin et al., 1971). The Group Embedded Figures Test (GEFT) is a paper-and-pencil test that instructs the individual to find and trace the target object (target object is provided) within a larger object. The individual is given a series of these objects to trace. Once the completed test is scored, it can be determined if the individual is considered field-dependent of field-independent. Based on correlations between the 9-item First Section scores and the 9-item Second Section scores, a reliability calculation (via Spearman-Brown prophecy formula) of 0.82 was obtained for both males (N=80) and females (N=97). Witkin et al. (1971) reports a validity measure on the GEFT by the way of a combined measurement with the Embedded Figures Test (EFT) (Witkin et al., 1971) and the GERT. In one study of the EFT, the second and third sections of the EFT and the GEFT were interchanged across various trials. In simpler words the measured instrument was mixed with the EFT and the GEFT. Witkin et al. reports a validity coefficient for the combined measure as –0.82 (males) and –0.63 (females); the correlations are negative because the tests (the EFT and the GEFT) are scored in reverse fashion. Additionally, the GEFT (as it is correlated

with the EFT) is a nonverbal test and can be applied to various cultural groups that speak a diverse set of languages. Since the GEFT is void of any culturally relevant content, it can be applied in research involving individuals of divergent cultural groups (Witkin, Oltman, Raskin, & Karp, 2002).

Computer Attitudes Questionnaire

The Computer Attitude Scale by Popovich et al. (1987) is a 20 statement rating scale (Appendix E). The questionnaire instructs the participant to rate the statements that best describe their attitudes towards computers on a 5-point Likert-type scale (1=strongly disagree and 5=strong agree). The statements are representative of four interpretable factors: (1) negative reactions to computers, (2) positive reaction to computers, (3) computers and children and (4) reactions to computer related mechanisms. A principle factor analysis determined that the four factors account for 47.7% of the variance. This instrument has a reliability of 0.84.

General Self-Efficacy Scale

The final questionnaire was the general self-efficacy (GSE) scale (Jerusalem and Schwarzer, 1992). The GSE scale consists of ten items (See Appendix F). It was developed to assess general self-efficacy pertaining to an individual's ability to cope with daily hassles, and his/her ability to adapt encountering various stressful life events. This scale is a measure of global self-efficacy, is designed for adults (and adolescents 12 and older) and has a range of applications (http://userpage.fu-berlin.de/~health/selfscal.htm, last updated April 14, 2007).

The GSE scale was selected versus a computer self-efficacy scale for several reasons. The computer self-efficacy scale asks the responders about rather specific information concerning computing. For instance, Torkzadeh's et al. (1999) computer self-efficacy scale is divided into four sections/factors: beginning skills, advanced skills, file and software skills and

mainframe skills. It makes the assumption that computing is being represented by a "desktop" metaphor. Namely, it asks responders to rate their level of confidence concerning copying "files" to a disk, making selections from an on-screen "menu," and organizing and managing "files." Using this kind of computer self-efficacy scale would result in several limitations. First, the participants recruited for this research very little experience with computers; therefore, participants would not have the appropriate amount of experience/skills to know what "copying files to a disk" (or some other device) really means. This kind of situation would leave participants unable to respond to some or all of the statements listed in the questionnaire. Second, the terminology on a computer self-efficacy scale represents themes from the most pervasive computer interface metaphor—the desktop metaphor. Since one of the research goals was to uncover new and innovative interface metaphors, it would be inappropriate to expose the participants to the terminology on computer self-efficacy scale, because it would introduce potential interface metaphor biases.

Criterion validity for the GSE was assessed with correlational studies, where positive correlations were found with work satisfaction, favorable emotions, and dispositional optimism. Negative correlations were found with stress, burnout, health complaints, anxiety and depression. Reliability measures were taken from samples from 23 nations, including English-speaking countries. Cronbach's alpha reliability scores ranged from .76 to .90 on this one-dimensional scale; the majority of the scores were in the high .80s. The items from the GSE scale are rated on a 4-point scale: not true at all, hardly true, moderately true, and exactly are the anchor points on the scale.

Procedure

The researcher read the informed consent form to the participant and informed them of their rights as a research participant (see Appendix B); all participants signed and dated the informed consent. Each participant (i.e., Set I and Set II participants) in the research, regardless of the data collection stage in which they are participating, completed study one. In this study there were a total of six different questionnaires and tests administered.

After completing the informed consent form, each participant was given a demographics questionnaire, an acculturation survey, spatial abilities tests, a perceptual style test, and a computer related attitudes questionnaire and a general self-efficacy questionnaire. The order of the questionnaires and survey was administered to the participant using a partially balanced Latin-Square; the cognitive tests were administered using the Latin-Square ordering as well. The tests and questionnaires descriptions are listed later in this section of the document.

Study One Outcomes

The demographics questionnaire supplied background information about the individual participants, which was used to establish a profile of the targeted African-American group. The spatial abilities and the perceptual style tests both resulted in a single score for the dimension that it measures. The ratings for each statement on the computer attitudes, acculturation survey, and self-efficacy scales produced a single score for each participant also. Table 4 lists the type of analysis that was performed on the each measure collected in study 1: Psychosocial Characteristics Data.

Table 5A: Study Flow and Integration

Study	Type of Data	Data Obtained	Key Findings	Study Flow	Hypothesis #
STUDY 1	Quantitative	Computer Attitudes Score	Single Scores	→ STUDY 4	Hypothesis # 2
		General Self Efficacy Score			
		Spatial Abilities Test Scores			
		Perceptual Style Test Score			
		Acculturation Survey Score (ad-hoc qualitative analysis)	Single Score	→ STUDY 4	Hypothesis # 3
		Demographics Questionnaire			
STUDY 2	Qualitative	Video recorded discussion of new metaphor ideas		→ STUDY 3	
		Salient themes for interface design			
		Low-fidelity interface design of the AAII (Using novel interface metaphor)			

Table 5A: Study Flow and Integration, continued

Study	Type of Data	Data Obtained	Key Findings	Study Flow	Hypothesis #
STUDY 3	Qualitative	Low-fidelity design developed into testable interface (AAII)		→ STUDY 4	Hypothesis #2
		Suggestions for corrections and addition to the AAII		→ STUDY 4	Hypothesis #3
STUDY 4	Qualitative	Critical Incidents from AAII & MSWord 2003		QUALITATIVE & QUANTITATIVE Evaluation	Hypothesis #1
	Quantitative	Number of Detours (benchmark tasks)			
STUDY 5	Qualitative	Cognitive Walkthrough Data from Latino Culture SMEs		Stand-Alone	

CHAPTER V. STUDY TWO: Implementation of the A.I.D. Methodology

Study 2 was concerned with the administration of the acculturation interface design (A.I.D.) methodology as specified previously in this document. The goal of this study was to administer the A.I.D. methodology to economically underserved citizens, namely, African-Americans, and to determine from those individuals interface metaphors that would be most suitable for implementation into an interface design. A focus group was the mechanism for administering the A.I.D. methodology. The ultimate goal of the focus group was to attain themes for potential interface metaphors and a preliminary design for their interface.

Participants

Each participant was self-identified as a low-income African-American central city dweller and met each of the pre-set participant criteria discussion in the Methodology Introduction section of this document. Each participant signed the informed consent form at the beginning of the session. The appropriate informed consent form is in Appendix B. The focus group comprised four volunteer participants from Baltimore (East), MD. Participants were provided with refreshments for the duration of the focus group session and were compensated for their participation in the experiment.

There were a total of four African-Americans that participated in the focus group. There was one male and three females between the ages of 19 and 22 years old. Each of these participants was unemployed at the time of the focus group; the male in the group was completing G.E.D. classes.

Focus Group Moderator

Maintaining homogeneity in ethnicity of the focus group was most imperative. Keeping the ethnicity of the facilitator/moderator consistent with that of the group members has shown to

produce some benefits in usability studies (Vatrapu & Perez-Quinones, 2006). Therefore, the researcher (at that time, a 28 year-old African-American female) for this dissertation research was the moderator for the African-American focus group. A moderator acquired an assistant for the focus group session. The assistant was a 30 year-old African-American female. Her primary responsibility was to take notes for the participant as the focus group progressed and to help video record. The focus group sessions lasted approximately two-and-a-half hours.

The researcher on this project was the moderator for the African-American focus group. This 28 year-old African-American moderator was born and raised in the inner city of Baltimore, MD. She was educated in Baltimore City Public Schools and graduated from Morgan State University, also located within the city limits. In addition to her social and academic roots in the inner city of Baltimore, she also spent several weeks during the summer of 2004 assisting with a summer job program for high school students who live in East Baltimore. As an assistant to the program director she was able to spend time in discussions with the students, interacting with them while doing projects in the community and using computer technology.

The researcher/moderator's stance and interpretation of the participants' comments, suggestions and discussion was filtered by her personal experiences. In positivist methodology, truthfulness, i.e., validity, is maintained when the interpretation of the research is not biased by the scholar's personal or political values (Saukko, 2003). However, in naturalistic based studies it is inevitable that social and cultural biases are introduced; the very terminology that is used to convey the findings has a foundation in some socio-cultural environment (as stated in Saukko, 2003). Therefore, the researcher/moderator's experiences as a young African-American woman who was familiar with Baltimore inner city life is a factor in the interpretation of what is

occurring across the various methods of triangulation involved in this study and subsequent studies.

Procedure

Focus Group Description

While SBD was the foundation for the interface design that took place in this research, there were several innovations that have been integrated into the SBD design process. The first of these innovations was the application of participatory design into the analysis stage of the development process. The extensions to SBD's analysis phase were: (a) user photographs, (b) user theme selection, and (c) a user driven low-fidelity prototype. Figure 6 is an illustration of the field study design that took place in the analysis phase. Below is a more detailed description of the integrated analysis process.

A self-report technique, reported in the work by Johnson and Griffin (1998) was used to aid in determining the suitable themes that emerge from the daily living of the this group of young African-Americans. This particular self-report technique involves the use of photographs. The process of collecting and analyzing the data from the participant's pictures has origins in ethnography. Ethnography in its purest form often involves getting acquainted with a place, a group of people and/or a culture over an extended period of time: a month, a year or a lifetime. The goal of ethnography is to uncover the complexities and subtleties that lay at the foundation of what people think, say and do. Obtaining such data provides richer insight into the cultural patterns of various people and the implications for the design and innovation of new technologies (Bell, 2001).

Field Study

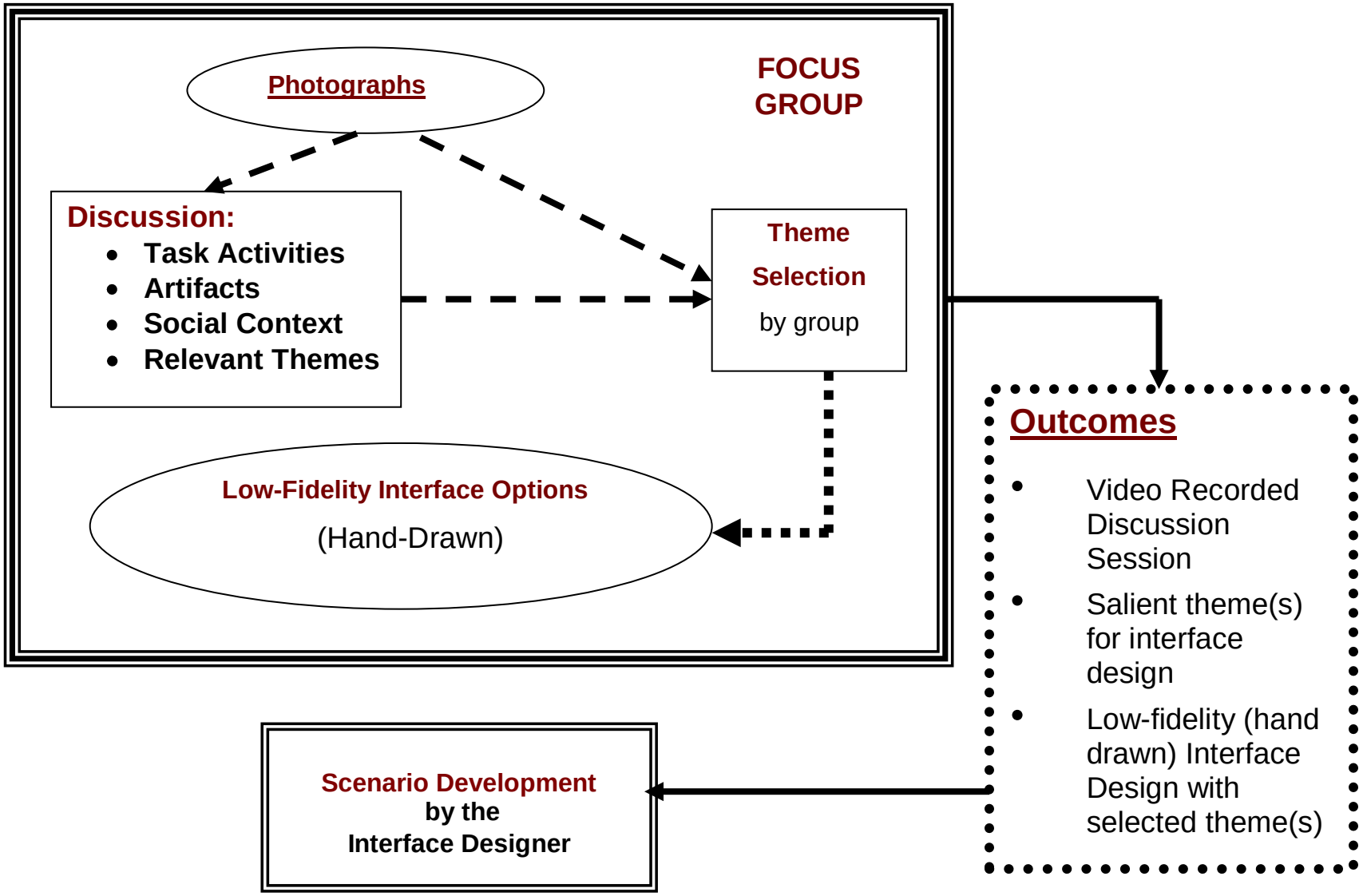

Figure 6: Field Study Information Model (adapted from Rosson and Carroll, 2002)

While traditional ethnography utilizes long periods of time to gather insights, design ethnography, as described by Bell (2001), transfers the focus from trying to create holistic models of entire cultures to formulating descriptions of specific social groups and practices. Design ethnography is a developing discipline, which is an amalgamation of theories practices and methodologies originating in anthropology, sociology, psychology, communications, among other areas. Enid Mumford (1985) pioneered the concepts behind design ethnography in her work on the ETHICS method. The ETHICS method is a information systems development methodology that actively engages participatory design to uncover user needs as a central focus. The objective of design ethnography lies in discovering the underlying tenets that drive people's thoughts and actions. However, design ethnography also differs from traditional ethnography in that it seeks to use less time to amass the necessary data to form descriptions of the specified social groups and practices. Using an abbreviated stint of time to determine specified cultural patterns create some methodological challenges for researchers (Bell, 2001).

Administration of Focus Groups

During the focus groups the PICTIVE (Muller, 1993) process, a participatory design technique used for interface design, served as a general framework, or rather, guiding principles for determining appropriate interface metaphor for a word processing task. PICTIVE, or Plastic Interface for Collaborative Technology Initiatives through Video Exploration, is a technique that utilizes low-tech design components with sophisticated video recording to provide design clarification and understanding for future software prototyping. In these PICTIVE sessions participants use brightly colored, durable and inexpensive plastic components to assemble, reassemble, arrange and rearrange interface mock-ups as a team in a game-like fashion. The ambition of the PICTIVE process is to facilitate a working partnership between designers and the

users of a software system. Completion of the PICTIVE sessions provides a concrete paper-and-pencil interface mock-up of what the software system looks like and how it will function.

The PICTIVE process includes six key attributes: (1) reciprocal education, (2) reciprocal preparation, (3) reciprocal validation, (4) checking in, (5) emergent designs, and (6) consensus decision-making. The process begins with a home assignment the participants prepare before the actual session starts. This assignment is designed to open up and create discussion concerning problem solutions for the group. In reciprocal education, each participant is responsible for explaining his/her perspective, skills, and personal stakes to the rest of the group. Reciprocal education can be achieved best if reciprocal preparation takes place. This preparation is generally the homework assignment that is completed before the session. The idea of reciprocal validation is to allow each individual to share his/her views while understanding and giving credence to the views of the other participants. Reciprocal validation does not advocate drawing the group to establish one worldview (or vocabulary), but rather mutual understanding of the points of view of others. Checking in is employed to assure that each individual in the group has equal opportunity to voice their opinions and perspectives; it is used to be certain that no one is ignored. Emergent designs concern the blending of ideas and perspectives to create a completely innovative design. Finally, consensus decision-making notes that decisions are made by consensus verses voting and potentially disenfranchising the minority (Muller, 1993).

Table 6 is a concise version of the tenets of the PICTIVE process that were applied in the focus group. The ultimate goal was to account for the ideas and contributions that each of the session participants had without causing any participants to be marginalized in any way.

Table 6: PICTIVE Process for Focus Group Sessions

I. **Home Assignment**: Used to create discussion about problem solutions for the group (Appendix G).	
II. Rules of Engagement	
Reciprocal Preparation	Completed home assignment. The home assignment was to take the photographs.
Reciprocal Education	Each person introduced himself or herself. Additionally, each person was given opportunities to share their views and opinions.
Reciprocal Validation	Each individual's views and opinions were given the same amount of credibility and respect. No one view was given precedence of another.
Checking In	The focus group facilitator(s) monitored the discussion so that no one's thoughts and ideas were ignored.
Emergent Designs	The focus group facilitator facilitated the blending of ideas and perspectives to create a suitable completely innovative design.
Consensus Decision-Making	The focus group facilitator also encouraged consensus verses voting to minimize potential disenfranchisement of any participant.

Focus Group Activity Flow

The focus group was administered using the PICTIVE principles. The basic flow and order of activities for the African-American focus group are listed below:

1. The researcher specified the task for implementation into a computer application. Participants were provided with an opportunity to reflect on the task being done by hand in a pre-focus group home assignment. Finally, participants were encouraged to photograph (Johnson and Griffin, 1998; Rosson and Carroll, 2002) the key elements associated with completing that task by hand.
2. The researcher facilitated a videotaped focus group with participants; the ultimate goal of the focus group was to uncover the salient design (interface metaphors) features for the interface. Here the participants had conversation about what they photographed and why.

They also had a more integrated conversation that uncovered a number of notable themes; this portion of the discussed was facilitated with probing questions.

3. The researcher performed a basic task analysis, artifact analysis, and theme analysis with the participants of the focus group. The emerging theme(s) were noted as interface metaphors that would be used in the design of the African-American Inspired Interface.
4. The participants were instructed to consider all of the themes, functions and tools that were discussed during the focus group and draw how they thought the interface should look, independently. The purpose here was to give each participant an opportunity to hand draw his or her own personal design. After each participant acquired his/her own design, the participants were charged with the task of coming to a consensus on one final hand drawn design.
5. The researcher used the focus group recording to do a content analysis on the discussion and to construct design scenarios to aid interface design development (This discussion appears in study 3).

Each participant was instructed to take photographs over the course of a week, with a disposable camera, of the things that they considered to be useful when performing a text-editing task by hand (pen-and-paper). Their home assignment supplied some examples of the kinds of things they might photograph: the tools they use, the environment that they are in (inside or outside), and/or other individuals that help them to perform the task. The pictures could have denoted the time of day they would perform the task, the sequence of activities performed to complete the task, or even what they were wearing while doing the task. The purpose of the pictures was to establish a mechanism for facilitating their recall of the task details once they arrived at the focus group session. The film was developed and labeled with a participant

number, which corresponded to the participant that took the pictures. The actual homework assignment given to each participant is provided in the Appendix G.

Moreover, the African-American cultural group participated in a video recorded focus group session designed to identify appropriate interface metaphors. In the focus group, the participants used their photographs to trigger their memory concerning the details of an editing task (by hand, not using a computer). After each participant had an opportunity to express there thoughts about what things were essential to the task of hand-writing a letter, the researcher/facilitator instructed them to lists out the common themes that emerged from all of the participants photographs. This discussion produced a list of themes, functions and tools that the research assistant mapped out on a chalkboard. It was these salient themes that became the hallmark of cultural significance that Bell (2001) speaks of when describing design ethnography.

Finally, each participant was asked to consider each of the all of the themes, functions and tools that were uncovered in during the focus group and hand draw how they thought the interface should look. This was an individual task; once each person was finished they each told the group about their design. Their final instruction as a focus group was to come to a consensus, taking into account all of the designs, and hand draw one final design. The participants drew their finalized design on a portable dry-erase board. This hand-drawn design was the foundation that the researcher/facilitator used to begin development of the African-American Inspired Interface.

Study 2 Outcomes

The final outcomes were (a) a video recorded discussion sessions, (b) salient themes for interface design, and (c) a hand drawn low-fidelity interface design incorporating the uncovered theme(s). The salient themes were: comfortability, writing location, and time of day. The most

prominent metaphor in the AAII was the participants' representation comfortability; this was the bedroom metaphor. Each of these outcomes was an input for study 3. A more in-depth discussion about the results and the use of the data is in Chapter VI: Interface Implementation and Formative Evaluation.

Table 5B: Study Flow and Integration

Study	Type of Data	Data Obtained	Key Findings	Study Flow	Hypothesis #
STUDY 1	Quantitative	Computer Attitudes Score	Single Scores	→ STUDY 4	Hypothesis # 2
		General Self Efficacy Score			
		Spatial Abilities Test Scores			
		Perceptual Style Test Score			
		Acculturation Survey Score (ad-hoc qualitative analysis)	Single Score	→ STUDY 4	Hypothesis # 3
		Demographics Questionnaire			
STUDY 2	Qualitative	Video recorded discussion of new metaphor ideas	Metaphors of comfortability, writing location, and time of day & Preliminary design for their interface	→ STUDY 3	
		Salient themes for interface design			
		Low-fidelity interface design of the AAII (Using novel interface metaphor)			

Table 5B: Study Flow and Integration, continued

Study	Type of Data	Data Obtained	Key Findings	Study Flow	Hypothesis #
STUDY 3	Qualitative	Low-fidelity design developed into testable interface (AAII)		→ STUDY 4	Hypothesis #2
		Suggestions for corrections and addition to the AAII		→ STUDY 4	Hypothesis #3
STUDY 4	Qualitative	Critical Incidents from AAII & MSWord 2003		QUALITATIVE & QUANTITATIVE Evaluation	Hypothesis #1
	Quantitative	Number of Detours (benchmark tasks)			
STUDY 5	Qualitative	Cognitive Walkthrough Data from Latino Culture SMEs		Stand-Alone	

CHAPTER VI. STUDY THREE: Interface Implementation and Formative Evaluation

The purpose of study three was to use the results of study two to design and to develop the interface according to the needs and expectations of the African-American focus group members (as representation of other African-Americans with similar attributes/characteristics). This study comprised two focal activities. The first of these activities was to draw on the outcomes of study 2: Implementation of the A.I.D. Methodology in order to implement the interface metaphors and design ideas into a testable operating computer interface, namely, the African-American Inspired Interface (AAII). Here the developed scenarios, focus group discussions, and the participant's low-fidelity designs were utilized in the development of the interface. The second activity was to test the original members of the African-American focus group on the interface designs. This evaluation were formative in nature; the goal was to be certain that the design and ideas discussed in the focus groups actually transferred into the design of the interface. The activities of this particular study are linked to the design and evaluation phases 2 and 3 of the original SBD process.

Participants for Formative Evaluation

There were originally four members in the focus group and the researcher's original intent was to administer a formative evaluation session with at least 3 of the original focus group members. However, during the time between the original focus group and the complete development of the AAII, two of the four focus group members' contact information was no longer valid. Therefore, the remaining two participants did the final formative evaluation of the AAII.

Instruments

There were a number of instruments involved in the development and implementation of the AAII. Table 7 is a listing of all of the significant themes, functions and tools that resulted from the focus group discussion and the subsequent content analysis. Design scenarios were another tool for interface development (See Appendix H). The final two instruments for the design were the low fidelity design and an extended version of Neale and Carroll's interface metaphor categorization (Table 8).

Table 7: Salient Themes, Functions, and Tools from Focus Group

Categorization of Units into: TOOLS, FUNCTIONS, and THEMES (by consensus items and the content analysis)		
TOOLS	FUNCTIONS	THEMES
Notebooks (little books and diary);(blue)	Option for "free-writing"	Comfortability--Bedroom (Physical comfort; ambiance)
Pens (black ink)	Edit (grammar, penmanship, phrasing)	Writing location—On the Bed or at the dining room table
Pencils	Preparation for mailing	Time of day—Day or Night
Radio (Music)	Sending the letter to its destination	
Legal Pad (yellow)	"Mother" is a function also	
Pictures	"Radio" is a function also	
Envelop	Television	
Stamp	Cat: An object that provides some comfort	
Money (for stamp and envelop)	Decorating/Arranging the "room" (work space)	
Mother (for assistance)		
Highlighters		
Container (to hold writing utensils)		
Paper (type not specified)		
Standard notebook paper (did not specify that it would need to be in a notebook)		
Table		
White-out		

Table 8: Examples of User Interface Metaphor (Neale and Carroll, 1997)--Extended

Context of Metaphor	Target Domain	Source Domain (Metaphor)	Exploits Knowledge of
Information Structures	Information browsing and searching	Storehouse / *House* / *Room*	Stores, rooms, malls, shelves, **bedrooms**, **dining rooms**
		Library	library catalogues, books, page turning, shelves, indexes
		Landscape	roads, junctions, signs, maps, mountains, lakes
		Space, conference, rooms, auditoriums, lobbies	navigation: shortcut, go to, travel between sites, links, movement
		Travel / Tourist activities	Exploring, guided tours, maps, indexes, asking questions
		Book / Dictionary	pages, bookmarks, tabs, indexes
		Personal Assistant: A person to give suggestions and help with computer user completing the task.	Person-to-Person Interaction
		Pressable Buttons	**Any objects with pressable buttons:** keyboards, telephones, cell phones, VCRs, DVD players, ATM machines, etc.
		Table	**Tables**
	Organizing task tools	**Container**	**Containers: cans, boxes, bottles**
	Organizing documents	Piles	physical piles of paper, categories
	Organizing and viewing information	Bags and Reviews (filters)	bags for hold items, viewers with different filtering capabilities, **envelop for holding paper/documents**
Multimedia	Presenting multimedia	*Television*, compact disks, *photographs*, film, **radio**	albums, photo holders, TV programs & channels, VCRs, CD tracks, **radio stations**
	Working with large video sources	Magnifying lens	Lens, changing resolution, changing viewing area, filters

Table 8: Examples of User Interface Metaphor (Neale and Carroll, 1997)—Extended, Continued

Context of Metaphor	Target Domain	Source Domain (Metaphor)	Exploits Knowledge of
Group Work	Shared work spaces, video conferencing, distance learning	Rooms, TVs, slides whiteboard, phone video	group interaction, meeting tools, chalkboard, phones, TV
Virtual Reality	Navigating	Flying hand / Floating guide / Lean-based	physical/spatial world, flying, moving objects
		Eyeball & Scene in hand / Flying vehicle control / Push-pull	Attributes in and movement of physical space, camera control, flying, moving objects

Interface Design Procedure

Interface Design

The items of cultural significance (i.e., interface metaphor themes) that emerged from study 2 (Implementation of the A.I.D. Methodology) were developed and implemented into an interface metaphor design—the AAII. The interface designer (primary researcher) used the themes and supporting information revealed in the focus groups session to develop design scenarios. The purpose of the scenarios was to provide further illumination pertaining to how different users (African-Americans who were not involved in the focus group) may steer through the same type of task. As Blomberg, Burrell, and Guest (2003) have asserted, identifying these differences facilitated the researcher's development of interface metaphor design solutions for the target user group. The scenarios served as an additional tool for the interface development; the scenarios are provided in Appendix H.

The researcher performed a content analysis on the video recorded focus group sessions with the four participants. A phenomenological perspective to content analysis was employed. Phenomenology is a philosophy that proposes that the phenomena of experience are fundamental

building blocks for the study of the nature of "being" and the study of knowledge (Dourish, 2001). As Patton (1990) highlights, phenomenological philosophy suggests that every individual has a unique set of experiences, which should be treated as truth. Hence, each participant's responses were considered as important; no relevant responses were discarded or ignored. This phenomenological perspective was utilized to complement the rules of engagements specified from the PICTIVE process being used in the two focus groups.

The focus group transcriptions were coded into referential units and thematic units (Krippendorff, 1980). Referential units are units that can be defined by particular persons, events, objects, countries, acts, or ideas to which an expression makes reference. Thematic units are "identified by their correspondence to a particular structural definition of the content of narratives, explanations, or interpretations (Krippendorff, 1980, p. 62)." The products of the content analysis are the themes, functions and tools listed in Table 6 of the previous instrument section.

The developed scenarios, focus group discussions, and the low-fidelity design were integrated to serve as an additional tool for the development of the AAII. The interface development cycle in Figure 7 is an illustration of the information and tools that were considered when making any necessary design decisions not specifically addressed in the focus group. The interface designer used Neale and Carroll's (1997) categorization of the interface metaphor as a foundation for organizing the new metaphors into a structure suitable for interface design. Moreover, the new metaphor ideas uncovered in the focus group were added into Neale and Carroll's interface metaphor categorization; this extension of their categorization provides a scheme for how the new metaphors relate to common and/or previously identified metaphors.

The extended version of their categorization structure is provided in Table 8; the new metaphor are listed in bolded text and the overlapping metaphor are italicized.

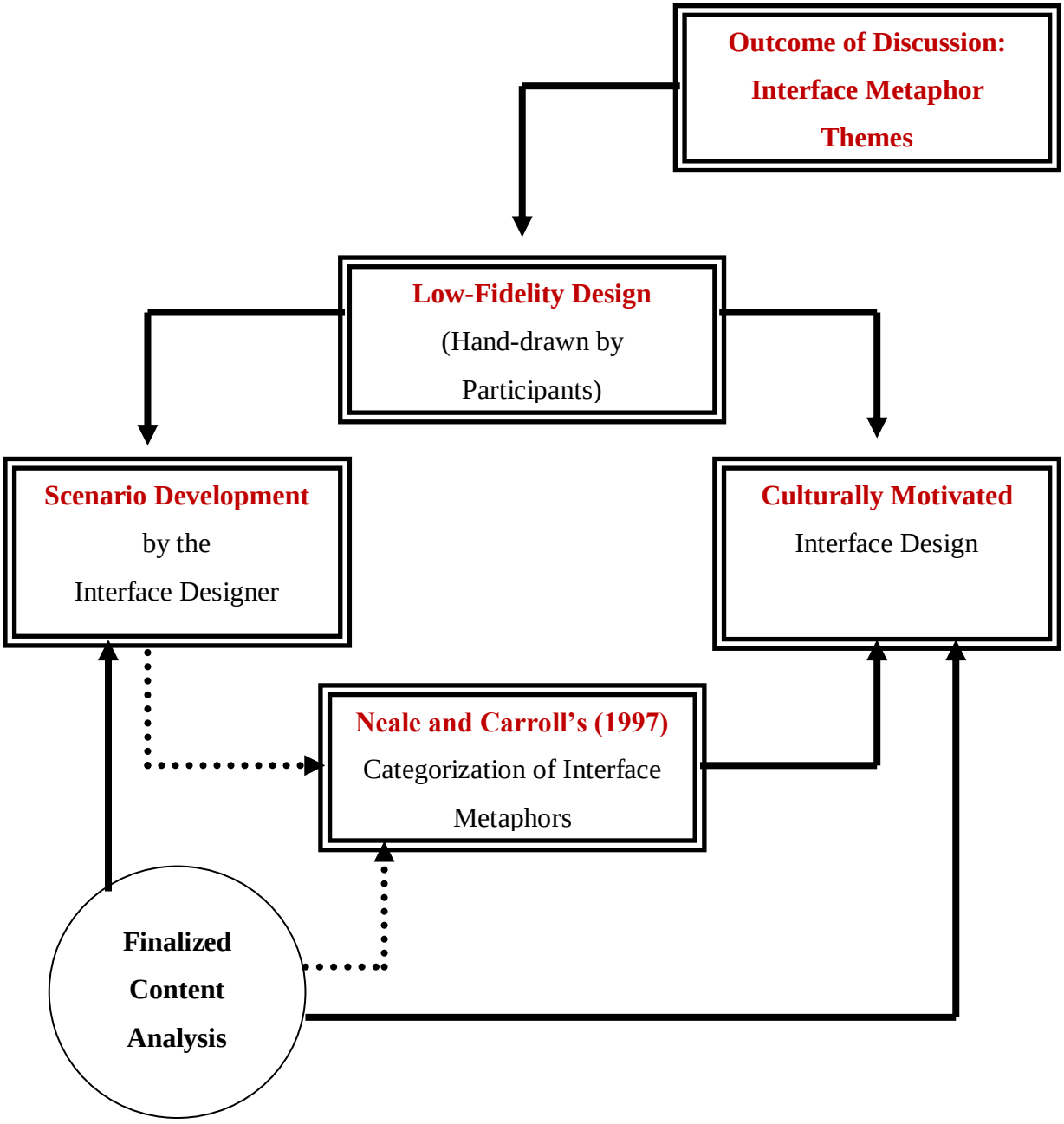

Figure 7: Interface Development Cycle

The interface development cycle shown in Figure 7 was administered as a way to systematically transfer the ideas from the focus group discussion into a functional/testable

interface design. Actually, the application of this development cycle provides a social constructivist perspective to determining an appropriate method for converting the design ideas/metaphor themes into an actual design. Social constructivism is a theory, which dates back to Piaget and Vygotsky, of how individuals come to "know" (Oldfather & West, 1999). Social constructivism stresses the importance of interactions with others, within a specific socio-cultural context, on an individual's cognitive development (learning). In social constructivism, learners engage in negotiation through conversation and dialogue (Jonassen, Peck, & Wilson, 1999). Using a social constructivist perspective for converting the design ideas into an actual design, gave the researcher/interface designer an occasion to observe (and become familiar with) the African-Americans sensibilities concerning the metaphor use and design. Having this experience, the researcher used her knowledge of the participants' understanding of the themes, functions and tools to make design decisions that were not actually articulated during the focus group session.

Interface Implementation

The framework of the design was taken directly from the participant's hand-drawn design. The actual interface was constructed using Macromedia's Dreamweaver™. It was here that the themes and metaphor of cultural significance and the details of the AAII's design came to fruition. The AAII was designed to support a number of tasks. Those tasks included the ability to change the design or color of the interfaces background, a built-in television and radio. Dreamweaver™ was able to provide support for all of the function (or at least a representation of the function) necessary for the design.

The interface designer constructed the framework of the design based on all of the archived information. Once the basic framework was in place, the interface designer performed

a “pre-formative” evaluation with two of the focus group participants. At this time the design was still quite rough; however, this appeared to be a good time to insure that the design details were on track with what they required and wanted. These participants walked through each of the options that were available. Upon their discussion of the options and functions they began to brainstorm and make suggestions to improve and streamline the design. The most essential changes made were (a) combining several options into one and/or (b) renaming the options presented on the screen. None of the thematic design aspects were changed. At the conclusion of this “pre-formative” evaluation, the designer immediately introduced the requested changes and continued working towards completing the design. Figure 8 is an illustration of the final version of the AAII in its most standard format; the boarders of the design begin to the left of “Screen Color” and ends to the right of “Final Draft.” In addition, Figures 9 and 10 are images that show the design features that accommodate the participants’ desire to have a “comfortable bedroom” environment for writing their letter.

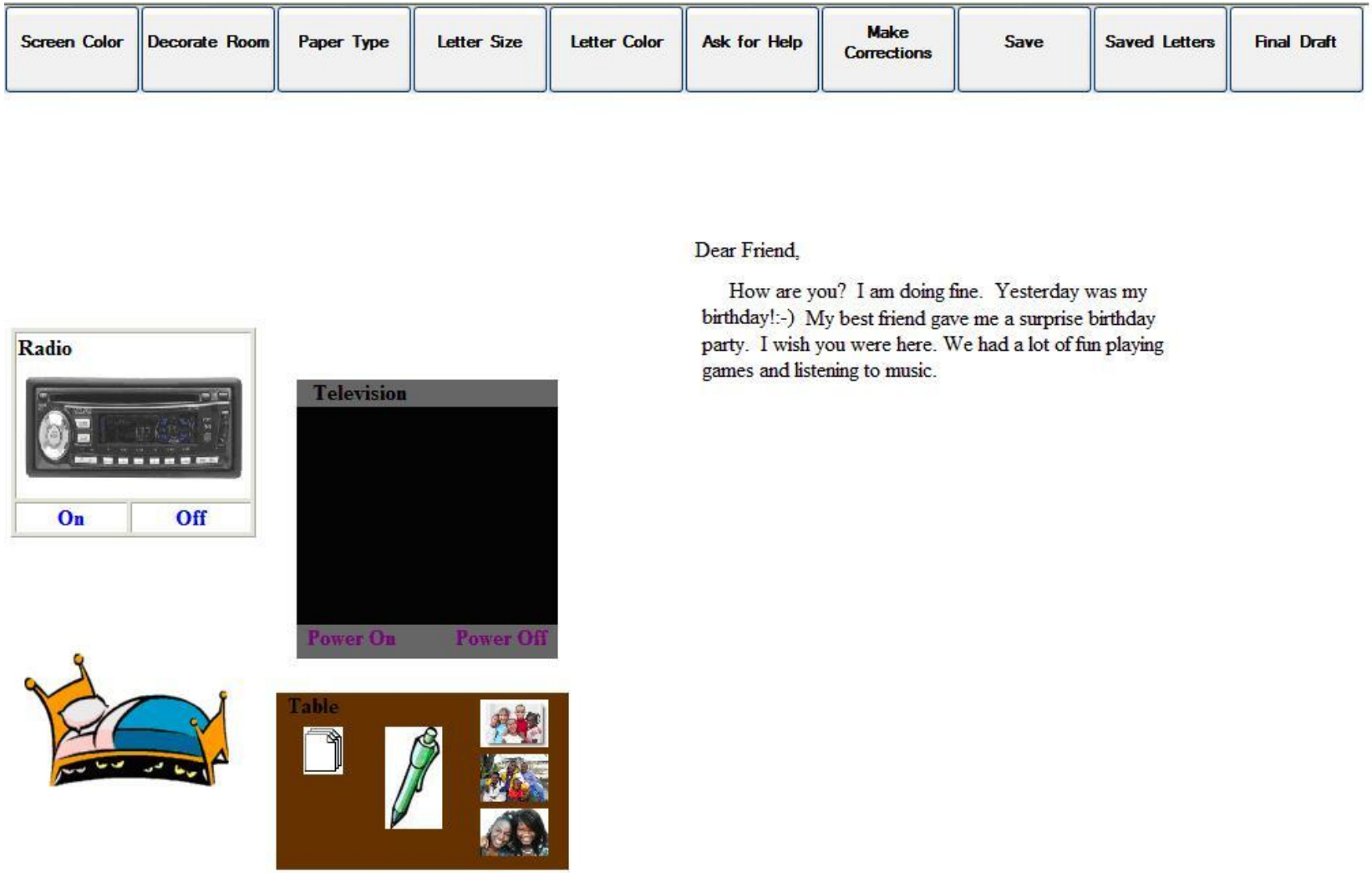

Figure 8: Finalized African-American Inspired Interface (AAII)

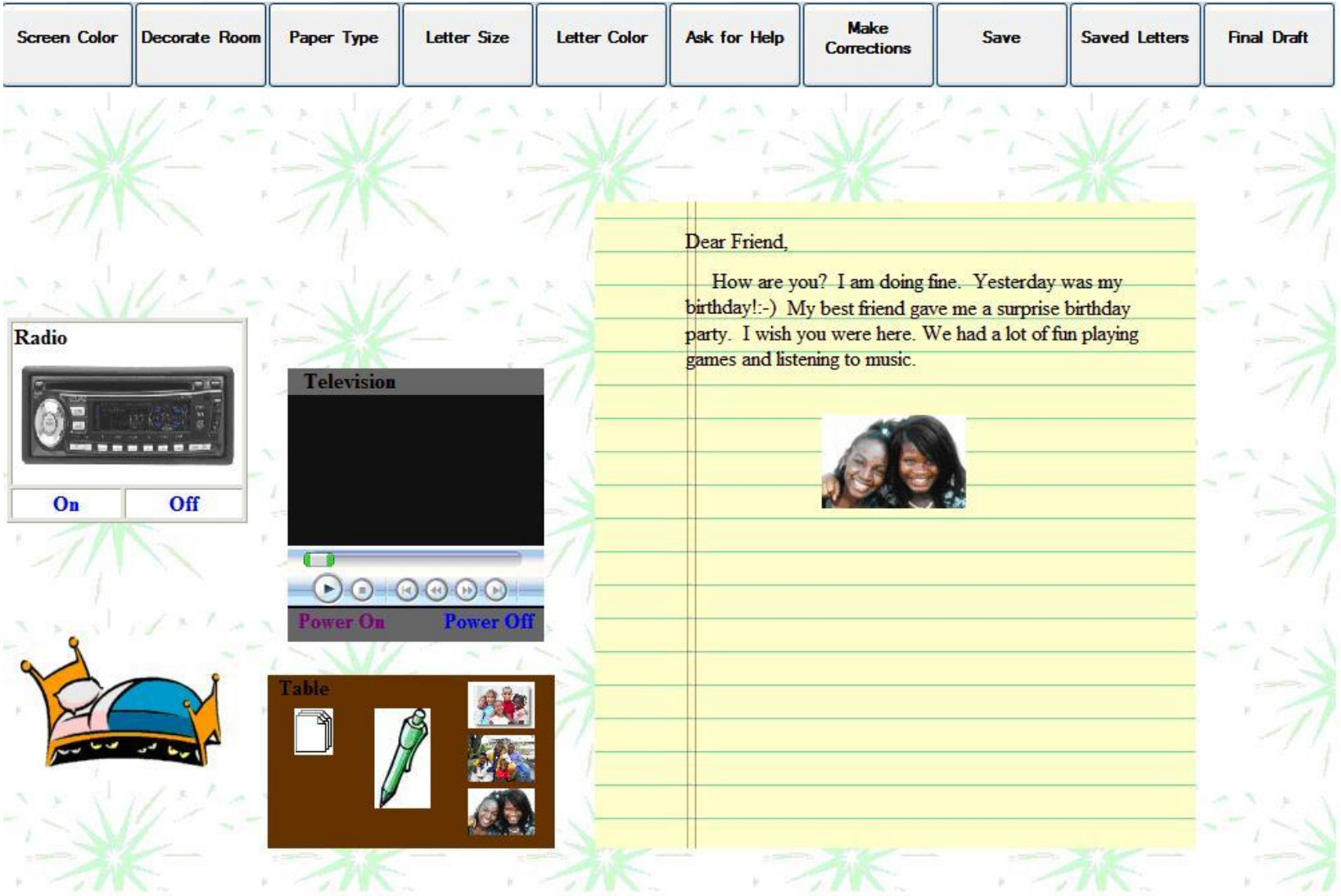

Figure 9: African-American Inspired Interface (AAII): Comfortable Bedroom

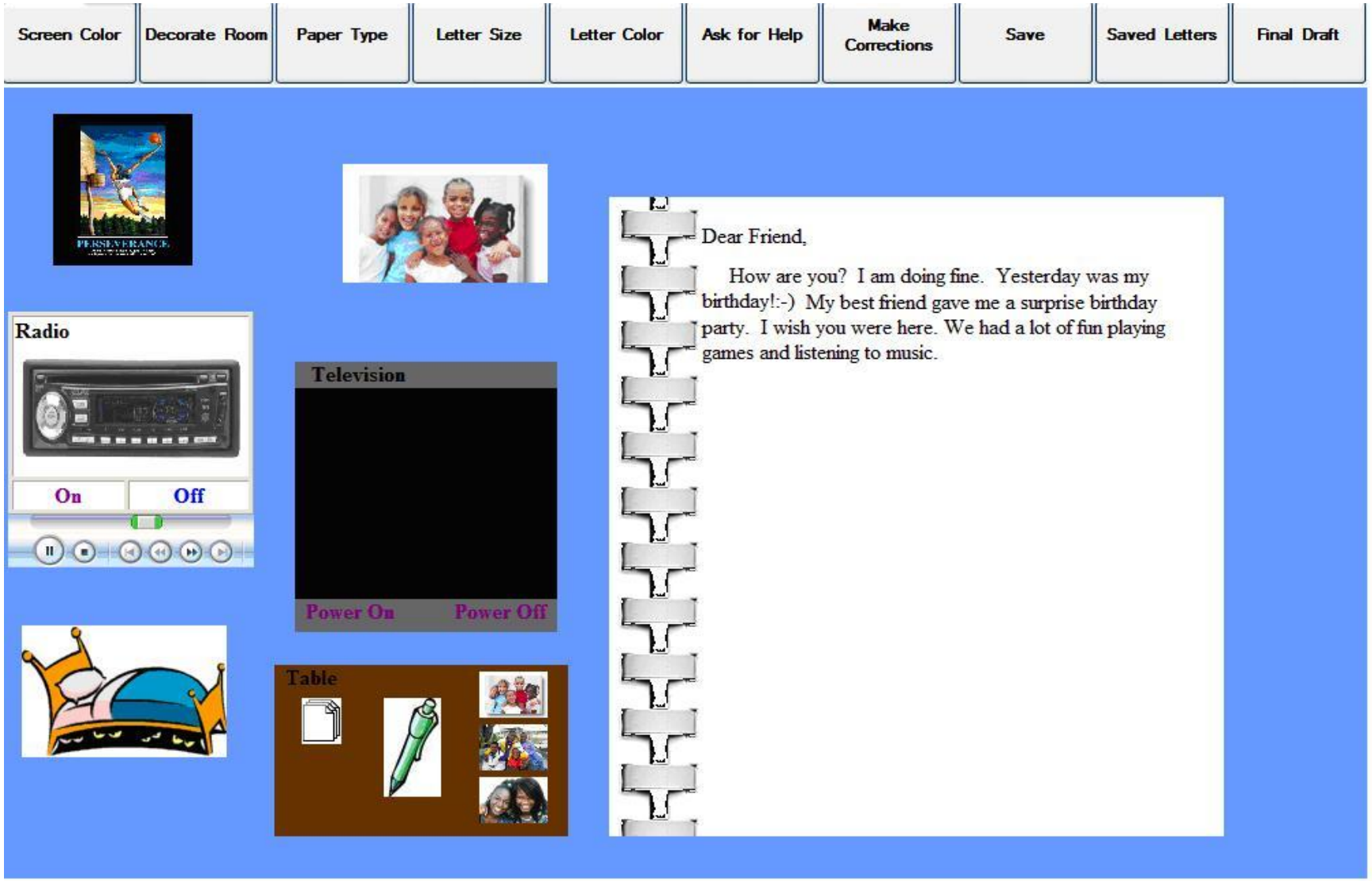

Figure 10: African-American Inspired Interface (AAII): Comfortable Bedroom II

Formative Evaluation

Participants

Two of the four African-Americans from the original focus groups participated in the final stage of the formative evaluation design iteration process; these participants were not different from those of the "pre-formative" evaluation. The original intention was to complete the final iterations with at least three of the original participants. In usability studies three to five persons are considered as optimal numbers for a given formative evaluation cycle (as stated in Hix and Hartson, 1993). Having at least three of the four original participants review the design and make the final changes would have helped to insure that each of the original design ideas/metaphors was applied most effectively. Participant mortality was the limiting factor in this case, but the two that participated were pleased with the design and the final alterations. Therefore, the interface design was iterated between the two participant evaluation sessions and the commencement of study 4: Testing African-Americans on the AAII and MSWord 2003.

Instruments for Formative Evaluation

The benchmark tasks for this study were derived from the focus group session in Study 2: Implementation of the A.I.D. Methodology. As the participants discussed (a) their thoughts about how they would perform a letter-writing task by hand and (b) various functions to include in the design of their novel interface, a number of tasks emerged. These tasks were things that the participants would want and need to be capable of achieving when writing a letter to a family member or a friend. The statements below represent the tasks that emerged. The benchmark tasks shown below are the refined version of the benchmark tasks; pilot testing with a new group of participants achieved this final version. Each benchmark task Appendix I shows how each individual task was presented to the participants.

- **Task 1 (ROOM):** Pretend that you are in your bedroom and you are getting ready to write a letter to your friend. Prepare the bedroom (screen) so that it is the environment that you would like to write in and it looks the way you want it to. Note: Please do not do anything to the actual letter on the right side of the screen.
- **Task 2 (PAPER):** Select the kind of paper you would like your letter to be on.
- **Task 3 (SIZE):** Find where you can change the size of a "letter" or a "word."
- **Task 4 (COLOR):** Find where you can change the color of a "letter" or a "word."
- **Task 5 (FIX):** Find where you can fix any mistakes that you may have found in your letter.
- **Task 6 (SAVE):** Imagine that you need to take a break from writing your letter to eat lunch or dinner. You have decided to put your letter away in a place where you can find it later. Find the place on this computer that will let you keep your letter until you are ready to finish it. Store your letter (where you would like to keep it). You can name your letter whatever you would like.
- **Task 8 (HELP):** You are writing your letter to your friend and you cannot figure out how to describe what you wore to the party in just a few words. Find the place on this computer that will give you some assistance.
- **Task 9 (PRINT):** You have just finished writing your letter on the computer and you want to get what you wrote on paper so that you can send it to your friend by postal mail. Find the place on this computer that will let you put what was written on the computer onto paper. Now complete this process.
- **Task 10 (EMAIL):** You have just finished writing your letter on the computer, and you want to send what you wrote to your friend. Find the place on this computer that will let

you send your letter to your friend through email. Next, send your letter to your friend through email.

Your email address should be: Yourname@email.com

Your Friend's email address is: David@email.com

- **Task 11 (PIC):** Put a picture (whatever picture you find) in your letter.
- **Task 12 (SAVEab):** Imagine that you took a break from writing a letter to your friend Karla. Before you took your break you stored your letter on the "table" on your computer. Part A: Find the place on this computer that will let you keep your letter until you are ready to finish it. Store your letter on the "table" with the name "Karla's Letter." Now, you have finished eating your lunch or dinner and you want to complete your letter to Karla. Part B: Find (the location of) your unfinished letter to Karla.

A tablet computer (tablet features components were not used), computer microphone, and Camtasia™ were used in the formative evaluation as well. Camtasia™ recorded all of their screen activity (i.e., mouseovers, mouse clicks, typing, etc.) as the participant proceeded with completing the task.

Procedure

Each participant was first reminded of the informed consent form (Appendix B) that they had read and signed in the focus group in the previous December. They were also granted an occasion to ask any questions they had pertaining to the informed consent. Once they reviewed that information, the research walked them through the script for the evaluation session (Appendix J).

The researcher presented a brief overview and stated, "Pretend that you are writing a letter to a friend. You have decided to use a computer to prepare your letter that you want to

send." The participants worked through all of the benchmark tasks. After the participant completed the benchmark task, the researcher played back the recording of their screen activity and asked the participant to perform a retrospective think-a-loud. In addendum to the retrospective think-a-loud, a post-task interview was conducted. Appendix J listed the all of the associated questions. It was this discussion that produced the suggestions and changes needed to make the design most representative of the participants' original intentions. There were only a few minor changes that needed to be made to satisfy the participant's request. Each of the suggestions were added in or removed from the AAII.

Study 3 Outcomes

The final outcome of study 3: Interface Implementation and Formative Evaluation was a finalized prototype for the AAII. This design was ready to for testing with a new group of African-American participants in study 4: Testing African-Americans on the AAII and MSWord 2003.

Table 5C: Study Flow and Integration

Study	Type of Data	Data Obtained	Key Findings	Study Flow	Hypothesis #
STUDY 1	Quantitative	Computer Attitudes Score	Single Scores	→ STUDY 4	Hypothesis # 2
		General Self Efficacy Score			
		Spatial Abilities Test Scores			
		Perceptual Style Test Score			
		Acculturation Survey Score (ad-hoc qualitative analysis)	Single Score	→ STUDY 4	Hypothesis # 3
		Demographics Questionnaire			
STUDY 2	Qualitative	Video recorded discussion of new metaphor ideas	Metaphors of comfortability, writing location, and time of day & Preliminary design for their interface	→ STUDY 3	
		Salient themes for interface design			
		Low-fidelity interface design of the AAII (Using novel interface metaphor)			

Table 5C: Study Flow and Integration, continued

Study	Type of Data	Data Obtained	Key Findings	Study Flow	Hypothesis #
STUDY 3	Qualitative	Low-fidelity design developed into testable interface (AAII)	Finalized prototype for the AAII	→ STUDY 4	Hypothesis #2
		Suggestions for corrections and addition to the AAII		→ STUDY 4	Hypothesis #3
STUDY 4	Qualitative	Critical Incidents from AAII & MSWord 2003		QUALITATIVE & QUANTITATIVE Evaluation	Hypothesis #1
	Quantitative	Number of Detours (benchmark tasks)			
STUDY 5	Qualitative	Cognitive Walkthrough Data from Latino Culture SMEs		Stand-Alone	

CHAPTER VII. STUDY FOUR: Testing African-Americans on the AAII and MSWord 2003

After the AAII was completed in study 3, two groups of African-Americans were tested on the AAII and Microsoft Word 2003. The purpose of this study was two-fold: (a) to obtain quantitative and qualitative data concerning young African-American's performance with the varying interface metaphor designs and (b) to assess the performance/individual differences and the performance/acculturation relationships. This study addressed research hypotheses 1, 2 and 3.

Participants

The original African-Americans in the focus group of Study 2 and formative evaluation of Study 3, were not apart the group of participants tested here in Study 4. Study four sample a new group of African-Americans that met the pre-determined participant criteria (i.e., African-American, low socio-economic status, urban-dwelling, and novice computer users). Of these novice computer users from Baltimore (a central city), 33% actually have access to a computer at home. The NTIA (2000) reported that 46.3% of households in central cities across the nation owned computers. Therefore, the computer ownership rate among the participants is actually lower than the national percentage of central city households that own computers. The researcher read through the informed consent form with each of the new participants, and each person signed and dated the form (See Appendix K). In addition, these participants completed all of the questionnaires and cognitive tests that are listed in Study 1: Psychosocial Characteristics Data.

Instruments

MSWord 2003 was presented in its most standard format. When the MSWord 2003 participants began only the "File, Edit, View, etc" menu selections and the standard toolbar were

present. The AAII was also presented in its most basic form. Figure 7 is a screen capture of the AAII in its most standard form. Below in Figure 11 is a screen capture of MSWord 2003, as it appeared when the participants initially began their tasks. A tablet computer, Camtasia™ and a computer microphone were used in this study as they were used in study 3: Testing African-Americans on the AAII and MSWord 2003.

Benchmark Tasks

The benchmark tasks for this study were identical to those that were used for the formative evaluation in study 3. The novel interface (AAII) was then designed to accommodate each of the tasks that emerged. MSWord 2003 also supports the majority of the pre-defined benchmark tasks. MSWord 2003 did not support Tasks 1 (ROOM), 2 (PAPER) and 12a and 12b (SAVEab). Appendix I displays how each individual task was presented to the participants.

Procedure

Once the participant arrived to the session, the researcher presented the informed consent sheet. After the researcher and the participant read through the informed consent form, the participant signed and dated it. The participants were then reminded that their movements on the screen and their voice would be recorded on the computer during and/or after they complete each benchmark task.

Next, the researcher provided a descriptive overview of what the participant would need to do during the research session. The detailed script and overview is provided in Appendix J. The participants were instructed to pretend that they were writing a letter to a friend, and that they have decided to use a computer to prepare their letter. They were told that they would be performing a number of tasks using a laptop computer and a specific computer design.

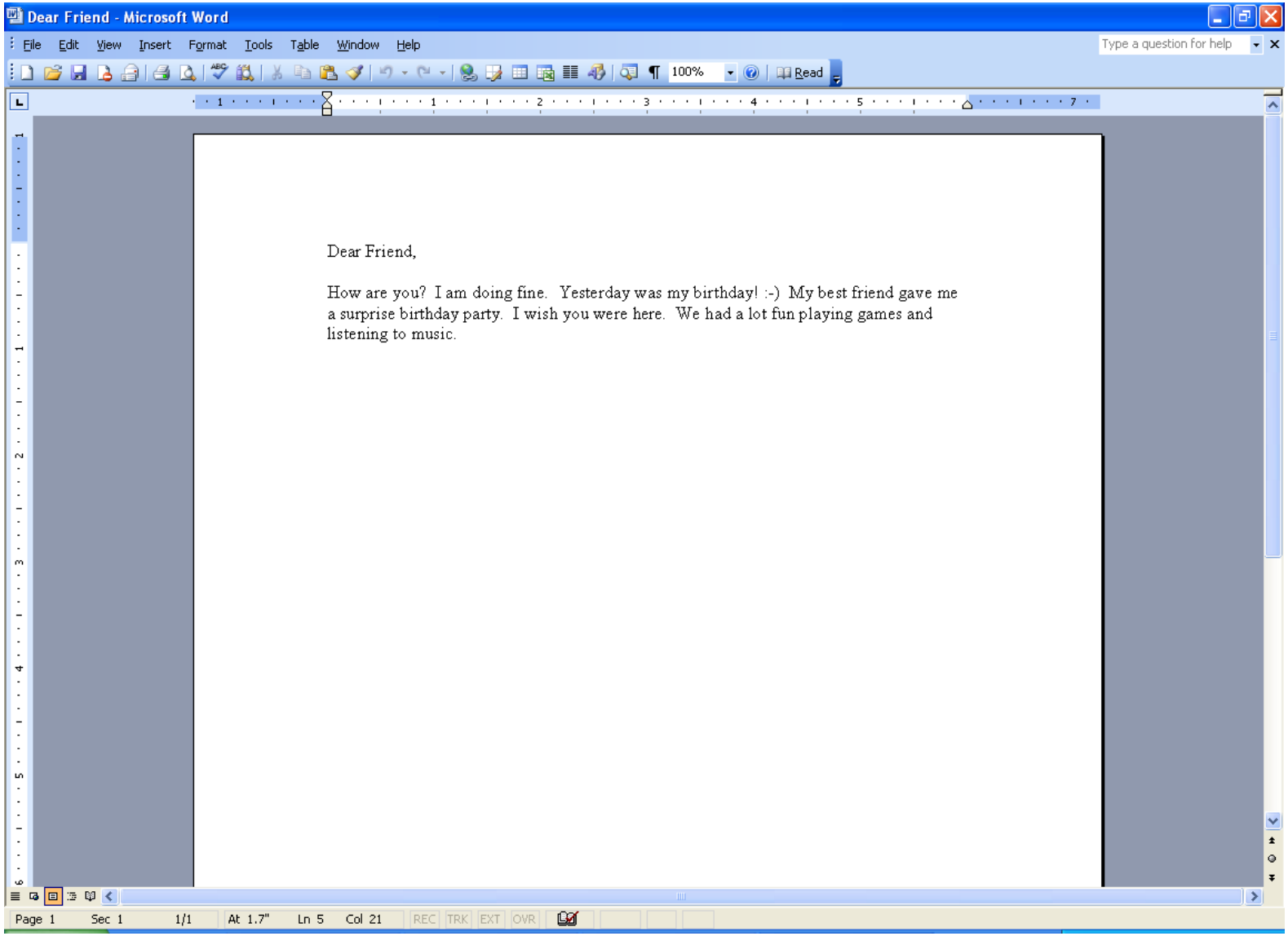

Figure 11: Microsoft Word 2003 in Standard Form

The participants were asked to complete the benchmark task, using an alternately assigned interface (MSWord 2003 or AAII). They were also encouraged to do their best to complete each task. Each task was read aloud to them; they also had a copy of the task in front of them. Each benchmark task was on a laminated card and the participants randomly selected one card (face down) at a time to complete. The AAII participants completed tasks 1 through 12; the MSWord 2003 participants completed tasks 3, 4, 5, 6, 8, 9, 10, and 11. The group of MSWord 2003 participants performed the subset of tasks that the interface design could support.

Participants were given a maximum of four minutes to complete each task with one of the two interface designs. Camtasia™ recorded all of their screen activity (i.e., mouseovers, mouse clicks, typing, etc.) as the participant proceeded with completing the task. As the participant worked to complete the task, the researcher tracked time using a stopwatch. The start time and the end time for task completion (if the task was completed) was recorded with Camtasia™. The beginning of the task was assessed at the first movement of the mouse across the screen; the task was considered complete once the participant stated that they were finished. After the participant completed the benchmark task or their four-minute allotment had expired, the researcher played back the recording of their screen activity and asked the participant to perform a retrospective think-a-loud. The retrospective think-a-loud method and verbal protocols were recorded with Camtasia™ as well.

Analyses

Qualitative Analyses

The verbal protocols supplied a rich set of commentaries pertaining to participants' thoughts about their experience with one of the two interfaces. These comments served as the foundation for identifying the positive and/or negative critical incidents (Flanagan, 1954) that

emerged. Therefore, these critical incidents were not constructed from researcher speculation, but were the result of direct participant comments (i.e., verbal protocols) about what they experienced with a given interface as they worked towards completing the task. The verbal protocols illuminating the critical incidence data were the primary source for uncovering the positive and negative themes that contributed to the participants' overall experience with each benchmark task.

Critical Incident Analysis

The critical incidents noted for this study were thoughts that were articulated by the participants. It was during the retrospective think-a-loud segments that each participant had the opportunity to explain his/her successes, failures, confusion, frustrations, and/or excitement concerning the interface designs.

Before any analysis was done on the reported critical incidents, the researcher reviewed each Camtasia™ recording and scripted out each critical incident. The researcher then organized the critical incidents by interface (i.e., AAII or MSWord 2003). Next, an expert interaction designer, who held a doctoral degree in Computer Science and specialized in Human-Computer Interaction, categorized all of the critical incidents. Her focal research is in computer mediated communication and affective computing. Her focus is in understanding peoples' behaviors and interactions when using different technological media. This expert was given a pair of critical incidents; one set was from participants who experienced MSWord 2003, and the other set was from those who used the AAII to do the benchmark tasks. The expert was then asked to assign each reported critical incident to one of three categories. Categorizing the critical incidents provided a listing of the types of critical incidents, whether positive or negative, that emerged as the participants talked through their experiences. The categories included: interface metaphor,

mental model and interaction, all of which are described as components of menu navigation within interfaces (Young Seok Lee, 2006). The expert was also provided with the list of pre-defined categories:

- Interface Metaphor: "Essential similarity conveyed visually through words and images, or through acoustic or tactile means",
- Mental Models: "Organization of data, functions, tasks, roles and people in group at work or play", and
- Design-driven Interaction: "The means by which users input changes to the system and the feedback supplied by system (as stated in Young Seok Lee, 2006, p. 308)."

Additional Critical Incidence Categorization

The primary researcher categorized the critical incidents further into various categories/themes in order to assess the critical incidents in a more precise and systematic manner. This categorization is provided in table 9 and is titled "Categorization: Level 3." The human-computer interaction expert, previously mentioned, provided the categorization of level 2 and level 2 (i.e., in table 9). In "Categorization: Level 3", the critical incidents were organized into broader theme that were most representative of the ideas that the participants expressed. More specifically, there are several themes amongst the positive and then the negative critical incidents that involve common ideas. For example, the positive critical incidents for the African-American Inspired Interface include: (a) Labels: Clarity of Wording, (b) Labels: Leading to correct mental models, and (c) Good/Useful Label: Verbal Metaphor. He primary researcher condensed these three critical incidence themes into one: Practical Labeling since each of those themes commonly denotes the use of labels that where practical for the participant. Thereby, the combined theme of Practical Labeling denotes any incident where a participant commented

about how good and/or appropriate labels (wording) facilitated the process of completing a given task.

Another example of common theme amongst reported critical incidents rests in the negative critical incidents for Microsoft Word 2003. The critical incidents themes: (a) Mental Model Mismatch: Based on labels and pictures, (b) Misunderstood a Label or Picture, and c) Could not find option: With words or pictures are all topics that result from "Inconsistency in Mental Models". Furthermore, the aggregated themes related to "Inconsistency in Mental Models" refer to any critical incident occurrence that could be associated as a mismatch between a participant's mental model of the interface's design structure and the mental model used to determine/design the actual interface's structure**.** Inconsistency in mental models implicates the existence of competing conceptual/metal models of the interface's design (Neale and Carroll, 1997). The first model is what is known in human-computer interaction (HCI) as the designer's conceptual model (or mental model). In the case of this research, the "designer's" conceptual model is actually a conceptual model that emerged from a focus group of Study 2: Implementation of the A.I.D. Methodology. This conceptual model was the framework that informed the design and development of the AAII. The second model is the user's or participants' mental model of the interface design. Furthermore, the degree to which a metaphor is applied in the "designer's" model and demonstrated in the actual interface design will directly structure the user's mental model (Neale and Carroll, 1997).

Table 9 shows each level of the critical incident categorization scheme and its relationship to the original parent categories: Interface Metaphor, Mental Model, and Design-Driven Interaction. The Level 1 categories represent the aforementioned parent categories. The Level 2 categories are the most refined description of the critical incidents that emerged during

the study, as they relate to the parent categories. These Level 2 categories provide the deepest insight as to where the strengths and weaknesses lay in the interface designs. More specifically, it answers the questions: What kind of mental model mismatch is it? or What kind of issue (i.e., interface metaphor, mental model, or design-driven interaction) did the critical incident actually represent? Finally, the Level 3 category represents a clustering of Level 2 critical incidents themes. For example, there are four different themes that involve the use of labeling (wording) in the interface design. Each of those themes shares a common thread; they each imply the use of practical wording for labels. Those themes were clustered into a single category, Practical Labeling to make the discussion easier to manage and comprehend.

In addition, all of the critical incidents themes reported and represented in table 9 were consistent with the User Action Framework's (Hartson et al., 1999) classification of usability issues. The User Action Framework (UAF) is a classification tool used to classify usability situations. Within this framework is an interaction cycle, which is comprised of: planning, translation, physical action and assessment. These four categories represent the areas where a user may encounter a success of a failure with an interface. The critical incidents themes reported in this research are relevant to both the planning and translation stages of the UAF. Both planning and translation stages involve the cognitive processes that the user need to make to establish a goal and specify an action sequence. Each of the critical incidents reported are consistent with the UAF classification of usability situations.

Table 9: Categorization of Critical Incident Theme

Categorization: Level 1	Categorization: Level 2	Categorization: Level 3
Interface Metaphor	Labels: Use of labels w/ visuals from toolbars Labels: Clarity of wording Labels: Leading to correct mental models Good/Useful Labels: Verbal metaphor	Practical Labeling
	Pictures: Leading to correct mental models	Pictures
	Pictures: Visual representation of metaphor or non-verbal metaphor	
	Accessibility: Clearly Visible; Not hidden	Accessibility
	Categorization of labels/selection: Structure	Categorization
	Misunderstood a Label or Picture	Misunderstanding
Mental Model	Mental Model Mismatch: Based on labels and pictures Could Not Find Option: With words or pictures Misunderstood a Label or Picture	Inconsistency in Mental Models
	Categorization of labels/selection: Structure	Categorization
Design-driven Interaction	Misjudged an Interaction	Misjudgment
	Unsure About How To Interact w/ Pop-up Box	Interaction Uncertainty

Results for AAII and MSWord 2003 Critical Incidents

There are considerations that should be made when reading through the qualitative analysis of the reported critical incidents. Be mindful that (1) there were not equal numbers of participants for each interface, and (2) for any given benchmark task a participant could have provided one or multiple critical incidents. Accordingly, in some cases the numbers of critical incidents are not balanced across benchmark tasks. The minimum to maximum range of critical incidents, across all benchmark tasks, reported by one participant was zero to four (0 – 4). Consequently, the range of raw frequency counts for the critical incidents was not highly variable for any of the benchmark tasks.

Positive and Negative Critical Incidents for the AAII and MSWord 2003. The majority of all positive critical incidents (44 out of 60) for the African-American Inspired Interface (AAII) involved "Practical Labeling". More specifically, 73% of the positive critical were attributed to the use of "Practical Labeling". Table 9 provides the thematic categorization scheme for the critical incident in this study. Figure 12 visually illustrates the relationship between all of the positive critical incidents for the AAII using a bar graph. The positive critical incident themes that are present in the "Practical Labeling" category for the AAII are (a) Labels: Clarity of wording (18/60= 30%), (b) Labels: Leading to correct mental models (8/60= 13%), and (c) Good/Useful Labels: Verbal metaphor (19/60= 30%). Other less salient, but not insignificant, critical incident themes are: Categorization of labels/selection: Structure (1/60= 2%), Pictures: Leading to correct mental (2/60= 3%), Pictures: Visual representation of the metaphor (5/60= 8%), and Accessibility: Clearly visible (7/60= 12%).

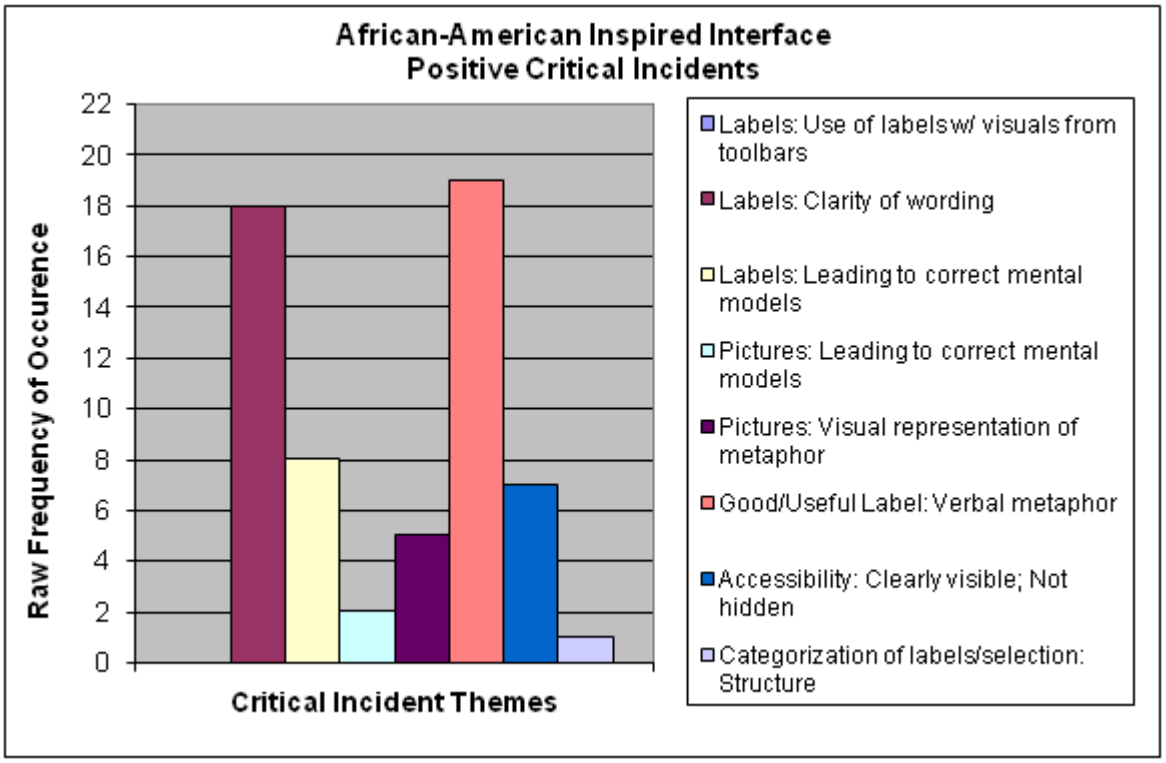

Figure 12: African-American Inspired Interface (AAII) Positive Critical Incidents

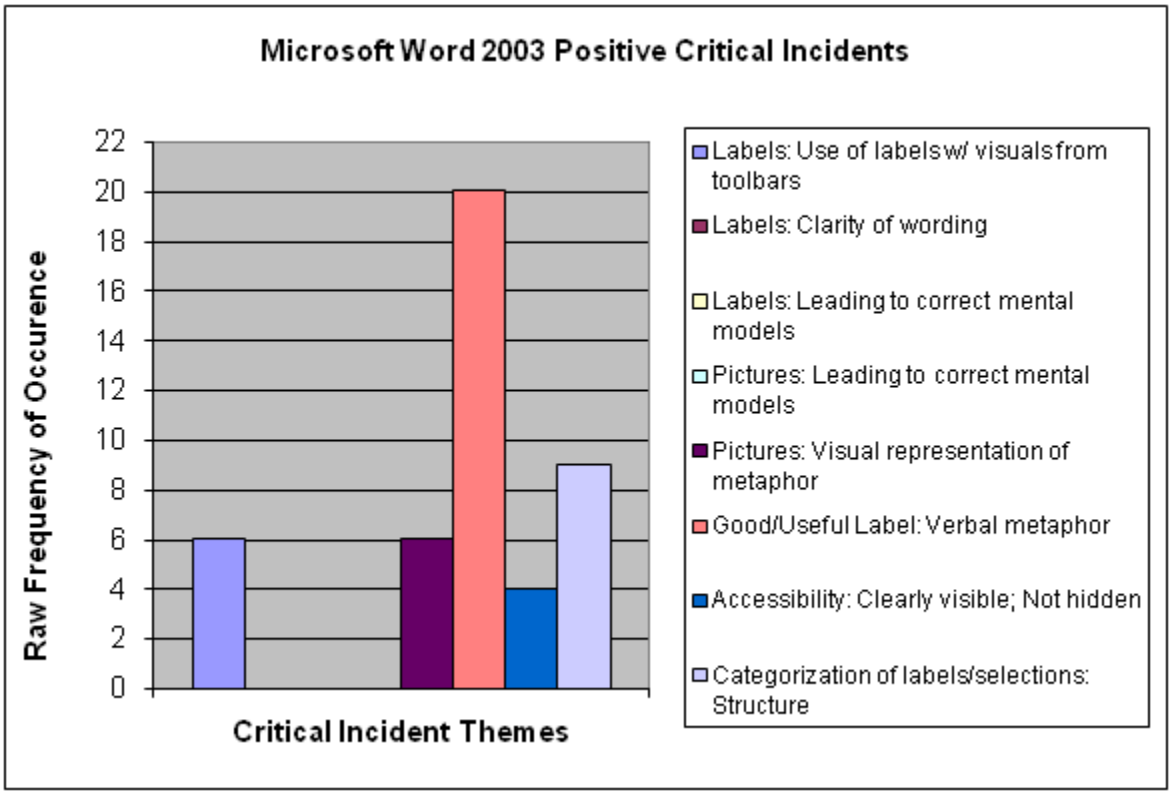

Figure 13: Microsoft Word 2003 (MSWord 2003) Positive Critical Incidents

"Practical Labeling" and Categorization of labels/selection:Structure are the largest contributors to the total number of positive critical incidents for MSWord 2003. Figure 13 uses a bar graph to illustrate the relationship between all of the positive critical incidents for the MSWord 2003. "Practical Labeling" makes up 58% (26/45) of the total number of positive critical incidents. The components of "Practical Labeling" represented here are: (a) Good/Useful Labels: Verbal Metaphor and (b) Labels: Use of labels with visuals from toolbar. The C.I. theme Good/Useful Labels: Verbal Metaphor alone makes up 44% (20/45) of the total positive critical incidents for MSWord 2003. The theme Labels: Use of labels with visuals from toolbar constitutes 13% (6/45) of the total number of positive C.I.s for MSWord. Furthermore, Categorization of labels/selection: Structure accounts for 20% (9/45) of the total positive critical incidents for Microsoft Word 2003. Other less salient, but not insignificant, critical incident themes are: Pictures: Visual representation of the metaphor and non-verbal metaphor (6/45=13 %), and Accessibility: Clearly visible (4/45= 9%).

"Inconsistency in Mental Models" accounts for 85% (22/26) of total negative critical incidents for the AAII. Figure 14 is a graph of all of the negative critical incidents. "Inconsistency in Mental Models" category contains three critical incidence themes: Mental Model Mismatch: Based on labels and pictures, Misunderstood a label or a picture, and Could not find option: with words or pictures. Mental Model Mismatch: Based on labels and pictures accounts for 58% (15/26), misunderstood a label or a picture represents 23% (6/26), and could not find option: with words or pictures accounts for 4% (1/26) of the total negative critical incidents for the AAII. Other less salient, but not insignificant, critical incident theme is misjudged an interaction (4/26= 15%).

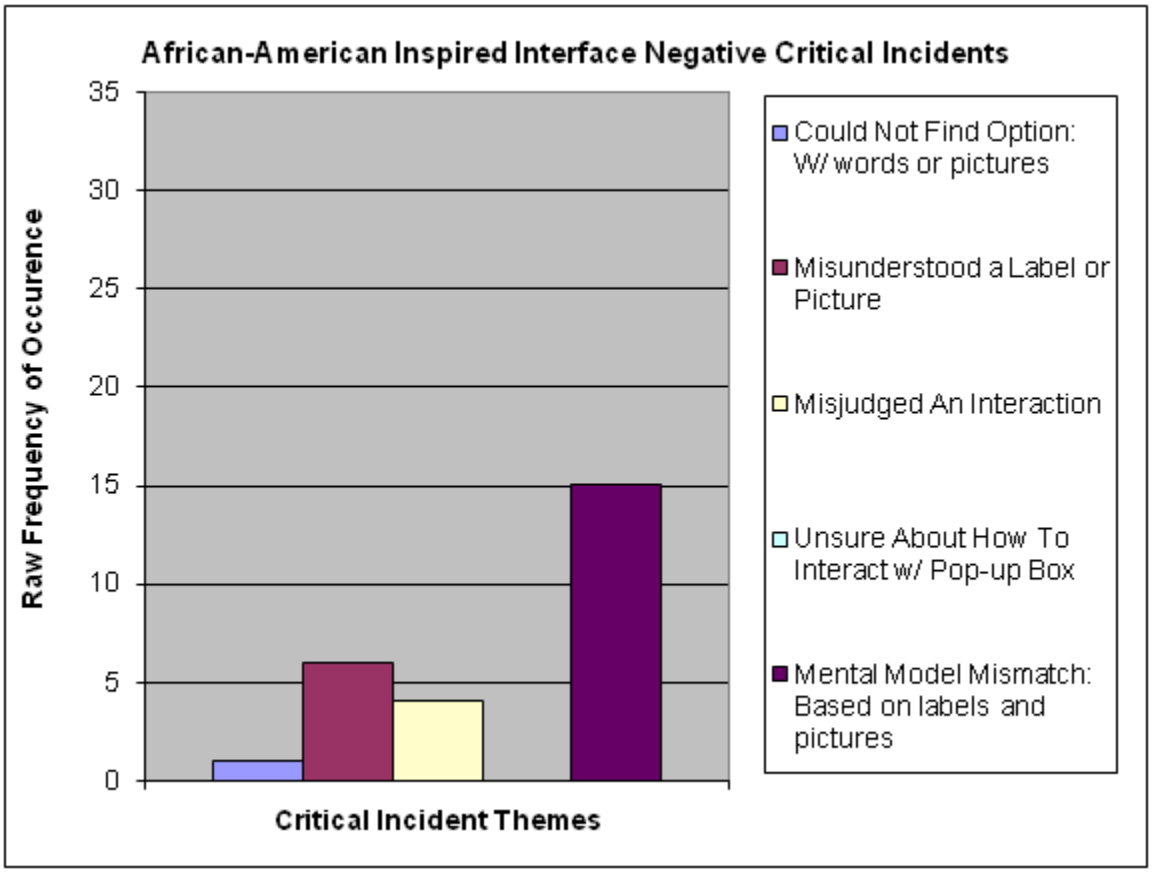

Figure 14: African-American Inspired Interface (AAII) Negative Critical Incidents

Ninety percent (54/60) of all the MSWord 2003 negative critical incidents were related to category "Inconsistency in Mental Models". The "mental model mismatch: based on labels and pictures" theme was the most frequently reported theme. Fifty-seven percent (34/60) of all the MSWord 2003 negative critical incidents were themed "mental model mismatch: based on labels and pictures". The additional two themes of the "Inconsistency in Mental Models" category, "misunderstood a label or a picture" and "could not find option: with words or pictures" represented 18% (11/60) and 15% (9/60), respectively, of the total negative critical incidents. Other less salient, but not insignificant, critical incident themes are: (a) misjudged an interaction (5/60= 8%) and (b) unsure about how to interact with pop-up box (1/60=2%). Figure 15 is a graph of all of the negative critical incidents for MSWord 2003.

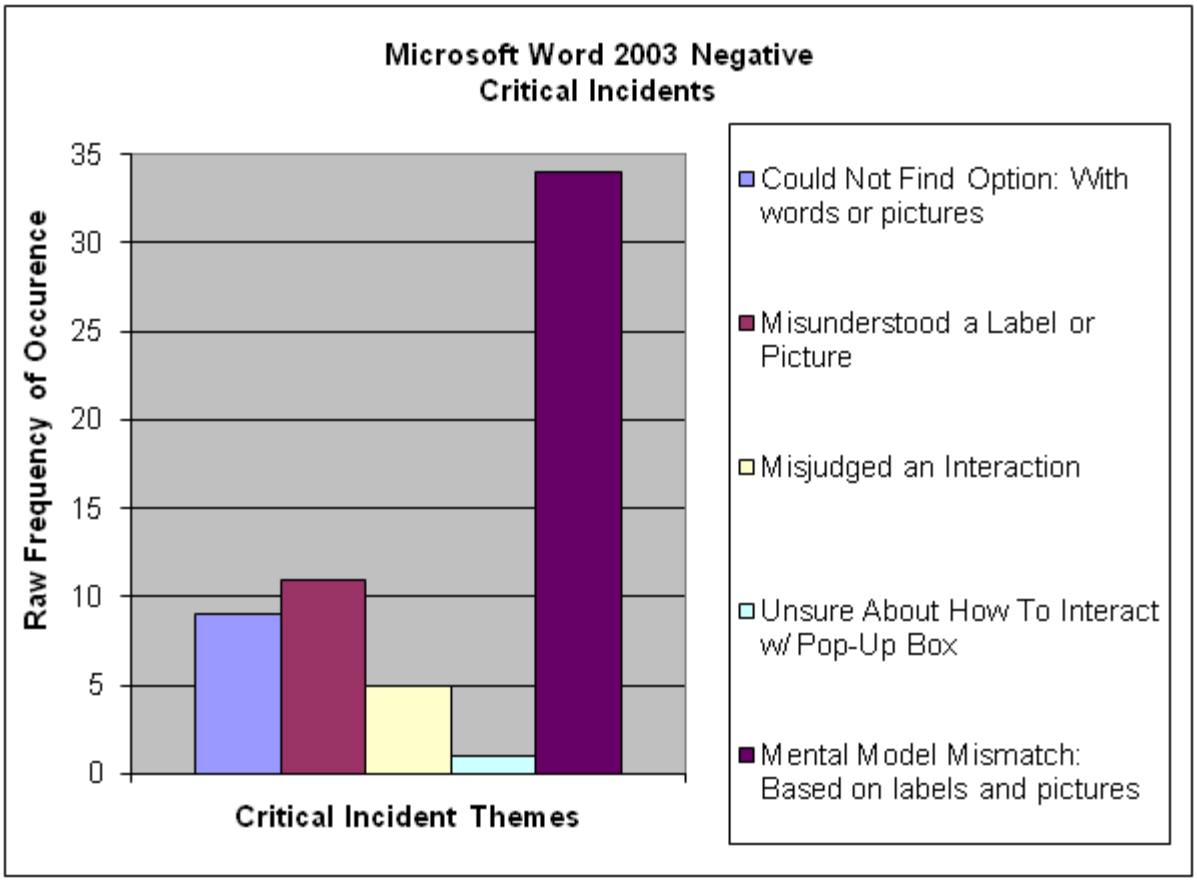

Figure 15: Microsoft Word 2003 (MSWord 2003) Negative Critical Incidents

Discussion of Positive and Negative Critical Incidents for AAII and MSWord 2003. The high occurrence of "Practical Labeling" comments (via critical incidents) shows that using familiar concepts for interface metaphor (labeling) supports positive experiences with the interface and facilitates novice users to execute tasks with less frustration and trial and error. Another important point to note is that the high occurrence of the single label: Clarity of Wording (18/60= 30%) suggests that the simplicity of the labels, i.e., the actual use of words, was a value-added portion of the design.

Good/Useful Labels: Verbal Metaphor is the most salient theme of the positive experiences that the novices (of African-American ethnicity) reported for both interface designs. In both the AAII and MSWord 2003, labels of some sort are immediately present at the top of

the screen once the application has been opened. It appears to be understood, even by the novice computers users sampled in this study, that the labels (the words) presented systematically at the top of the screen is, at least, one mechanism that will guide the user in completing any tasks they may encounter. This was directly observable during experimentation; the participants would immediately move the mouse to the word or pictures at the top of the screen. The novices in this study are correct, based on the previously mentioned observation, in thinking that the labels (words) are there to facilitate task completion. The labels are one way to help the user to know what can be done and where they need to go to achieve the goal. Since users have this expectation of the labels presented to them, it is essential to use word choices for labels that are appropriate for the users. It is in this that interface metaphor play a critical role. The verbal (words) metaphor used to produce the labels for the various options that the application has must be concepts that are familiar and applicable for the user group. Providing metaphor concepts which are understood and valued is a most critical cultural aspect to consider when a designer is endeavors to develop as inclusive design (Duncker, 2002).

The frequent occurrence of the "Good/Useful Label" theme across both interface designs provides evidence that labels are a significant part of the user's experience with the interface. The fact that the different participants consistently made a point to comment on the usefulness or clarity of the labels is an indication of its relative importance to the task completion. However, "Inconsistency in Mental Models" was the most pervasive categorization for the negative critical incidents for AAII and MSWord 2003. Inconsistency in mental models speaks to the existence of competing conceptual/metal models of the interface's design (Neale and Carroll, 1997). Moreover, the degree to which a metaphor is applied in the "designer's" model

and demonstrated in the actual interface design directly informs the structure of the user's mental model (Neale and Carroll, 1997).

The high occurrence of the "Inconsistency in Mental Models" related themes strongly implies that there are noteworthy problems with the interface metaphor(s) utilized in that particular design. When an individual is given a task to complete in a new or unfamiliar computing environment, they must rely on a currently formulated mental model of how the task should be structured. Their mental models are constructed based on things that they know from previous experiences (these experiences can be based in the context of a culture). When users' mental models are mismatched with the mental model used to design the steps of the task(s), users are put at risk for a negative (and potentially frustrating) experience while attempting to complete a task.

At this point, two things may occur are (1) the user will try to apply their preset model of how the task should be achieved or (2) the user will use the interface metaphor (verbal and/or pictorial) that are designed into the interface as cues for task completion. If the user follows their preset mental model, they may achieve the goal or realize, as a result of errors, that their mental structure of how the task should be completed is faulty. Considering the latter of the two scenarios, appropriate interface metaphors will augment the users' strategy for completing the task. If the interface metaphor are inappropriate—not sensible, not meaningful—the user will experience some uncertainty about how to proceed with the task. In addition, inappropriate interface metaphor might be the cause for the user to formulate an incorrect mental model and begin making errors during execution of the task. Either of these scenarios can produce adverse or negative experiences with the interface if the users/participants' mental models are incorrect or the metaphor designed into the interface were interpreted incorrectly.

Discussion Contrasting Microsoft Word 2003 and African-American Inspired Interface. The contrasts between the AAII and MSWord 2003 is discussed with the consideration that each participant, regardless of the interface that they used for this study, had exactly the same tasks to perform and the same amount of time for completion. The sole difference was the interface participants used to achieve the tasks. The focal characteristic(s) of the interfaces considered here are the (a) functions and (b) options, both of which are encased in the interface metaphor uniquely employed in the design of the individual interfaces.

Several considerations should be kept in mind while comparing the AAII and MSWord 2003. Microsoft Word 2003 is a fully developed interface, which supports a variety of tasks that extend beyond a letter writing and editing task. Therefore, its functions and options are much more diverse than the AAII, which solely supports a letter writing task. The comparison here is not apples with apples. Nevertheless, the experimental design implemented for these studies do provide a basis for comparing the interface metaphor used in each of the designs.

A number of questions were used to establish the premise for which the contrasting arguments for AAII and MSWord 2003. In this discussion the first question to answer is "Where do the differences in the interface lay?" The second question was "What are the commonalities among the two interfaces?" The third question is "Which design appears to serve the targeted African-American group most effectively based on the measures that have been acquired in this study?"

Labeling. Participants reported 45 (out of 60) incidents concerning "Practical Labeling" themes for the AAII, while participants reported 26 (out of 45) incidents of "Practical Labeling" for Microsoft Word 2003. Therefore, 75% of the total positive critical incidents for the AAII and 58% of the total positive critical incidents for MSWord 2003 are associated with "Practical Labeling" themes. In both Microsoft Word 2003 and the AAII, the majority of the positive

critical incidents were related to the benefits of utilizing practical/useful labels. The prominence of the good label (words) themes amongst the positive critical incidence is a clear indication that labeling, as a construct, is an essential aspect of the interface design for this 18 to 30 year old subset of urban dwelling African-Americans.

The AAII had more than 1.5 times the number of critical incidents that spoke to the practicality/effectiveness of the labeling. It is clear that the AAII prompted more positive comments about the labeling used on the interface than did Microsoft Word 2003. In their comments there was a sense of ease and familiarity when they discussed the labels used in the AAII. The participants used words such as: clear, good, simple, easy, etc. to describe the labels that they encountered in the AAII. In fact, 18 (out of 60) of the critical incidents were specifically themed as "Label: Clarity of wording". Notably, participants appeared to speak more freely, providing numerous comments, about their favorable thoughts towards the AAII's labeling convention. The AAII participants (as a group), through their critical incidents, showed that the most positive element that they experienced while completing the benchmark tasks were involved with "Practical Labeling." The remaining 25% of the positive critical incidents were related to themes such as: use of pictures (for navigating through available options), accessibility for options, and categorization of labels/selections.

MSWord 2003 produced positive critical incidents associated with "Practical Labeling" as well. The majority of the "Practical Labeling" critical incidents (20 out of 26) were specifically themed as "Good/Useful Label: Verbal metaphor." The participants stated that the labels helped them to complete the tasks, but there comments were commonly about using the words to eliminate other options. The MSWord 2003 participants did not share the AAII participants' opinion that the labels of the functions were clearly worded. As a matter of fact,

there were no positive critical incidents that were specifically themed "Label: Clarity of Wording." Considering that the participants (1) spoke of using to the label titles to eliminate the unlikely choices and (2) did not describe the labels as being clearly worded, it can be surmised that the labeling convention (and word choices) for MSWord 2003 was not initially comprehensible for these participants—in other words, the labels were not simple.

Yet, in the presence of relatively complicated labeling, a second positive theme emerged concerning labeling for the MSWord 2003 group: "Label: Use of labels with visuals from toolbar." This critical incident theme shows where labeling was more effective. Six of the 45 (13%) positive critical incidents for MSWord 2003 were about occasions where the labels associated with iconic toolbar options were helpful in determining the functions that the icons were attempting to predict. It appears that, for some, the labels describing the icons on the toolbar were quite useful. However, the fact that this theme surfaced at all is an indication that the illustrations on the icons alone were not necessarily effective for this African-American group. The fact that they needed the labels with the pictures is indication enough of that.

Mental Models. There were problems with "Inconsistency in Mental Models" in both the AAII and MSWord 2003. Both had similar percentages of "Inconsistency in Mental Models" critical incidents; this particular theme represented 90% (54/60) of the MSWord 2003 negative critical incidents and 85% (22/26) of the AAII negative critical incidents. While it is evident that the negative experiences encountered by the participants were overwhelmingly, and almost solely, attributed to inconsistencies with mental models, there still remains a distinctive gap between the actual numbers of these critical incidents that were reported for the two interfaces. This scenario embodies an example where 2 interfaces designed to support the same benchmark tasks are juxtaposed, and one discovers that one interface produced nearly 2.5 times the number

of negative mental model critical incidents than the other. It is apparent that the issues associated with incompatible mental models was a greater challenge with MSWord 2003 that with the AAII.

Results Comparing the AAII and MSWord 2003 for Each Benchmark Task

Comparing the interface metaphor(s) applied in the AAII design and MSWord 2003 across individual benchmarks is the basis for examining the effectiveness of the interface metaphors in more granulated detail. The computer interface metaphors used in both interfaces are numerous. Table 10 lists interface metaphor associations with the corresponding benchmark tasks and interface designs.

This comparison was made first by determining which of the Level 3 categories (Table 9) represented the majority of the reported critical incidents for a particular benchmark task and interface design. Once that category was determined, the next step was to determine which of the parent categories (Level 1 categories from Table 9) accounted for the majority of the previously identified Level 3 category critical incidents.

Table 10: Interfaces Metaphor(s) and Benchmark Tasks

Interface	Task	Related Function	Metaphor(s)
African-American Inspired Interface (AAII)	Task 3: Find where you can change the size of a "letter" or a "word."	Letter Size	• Alphabet Terminology
	Task 4: Find where you can change the color of a "letter" or a "word."	Letter Color	• Alphabet Terminology
	Task 5: Find where you can fix any mistakes that you may have found in your letter.	Make Corrections	• Handwritten letters • Fixing mistakes in a letter
	Task 6: Imagine that you need to take a break from writing your letter to eat lunch or dinner. You have decided to put your letter away in a place where you can find it later. Find the place on this computer that will let you keep your letter until you are ready to finish it. Store your letter (where you would like to keep it). You can name your letter whatever you would like.	Save	• Handwritten Letters • Storage • Storage Locations: • Diaries (private/person storage place), • Spiral Notebooks, • A drawer (where one would put clothing), • Fileboxes (Workplace), • Tables (that are a main piece of furniture in a room).
	Task 8: You are writing your letter to your friend and you cannot figure out how to describe what you wore to the party in just a few words. Find the place on this computer that will give you some assistance.	Ask for Help	• Asking for help from a real person (i.e., family member or friend)
	Task 9: You have just finished writing your letter on the computer and you want to get what you wrote on paper so that you can send it to your friend by postal mail. Find the place on this computer that will let you put what was written on the computer onto paper. Now complete this process.	Final Draft	• School terminology for a completed document • Printing, publishing • Physical Printers

Table 10: Interfaces Metaphor(s) and Benchmark Tasks, continued

Interface	Task	Related Function	Metaphor(s)
	Task 10: You have just finished writing your letter on the computer, and you want to send what you wrote to your friend. Find the place on this computer that will let you send your letter to your friend through email. Next, send your letter to your friend through email. Your email address should be: Yourname@email.com Your Friend's email address is: David@email.com	Final Draft	• School terminology for a completed document • Electronic mail • Postal Mail • White Envelops • Addressing Postal Mail
	Task 11: Put a picture (whatever picture you find) in your letter.	Picture (Picture image on Table)	• Pictures on a bedroom table
Microsoft Word 2003 (MSWord 2003)	Task 3: Find where you can change the size of a "letter" or a "word."	Format	• Set-ups and layouts • Fonts, typescripts, typeset, lettering, characters
	Task 4: Find where you can change the color of a "letter" or a "word."	Format	• Set-ups and layouts • Fonts, typescripts, typeset, lettering, characters
	Task 5: Find where you can fix any mistakes that you may have found in your letter.	Tools	• Utensils (things being used to assist in doing work) • Language Rules (Spelling and Grammar)
	Task 6: Imagine that you need to take a break from writing your letter to eat lunch or dinner. You have decided to put your letter away in a place where you can find it later. Find the place on this computer that will let you keep your letter until you are ready to finish it. Store your letter (where you would like to keep it). You can name your letter whatever you would like.	File	• Physical Files • Saving or Storing things • Computer Disks • Physical Folders • Folder Organization

Table 10: Interfaces Metaphor(s) and Benchmark Tasks, continued

Interface	Task	Related Function	Metaphor(s)
	Task 8: You are writing your letter to your friend and you cannot figure out how to describe what you wore to the party in just a few words. Find the place on this computer that will give you some assistance.	Help	• Request for help • Asking for help
	Task 9: You have just finished writing your letter on the computer and you want to get what you wrote on paper so that you can send it to your friend by postal mail. Find the place on this computer that will let you put what was written on the computer onto paper. Now complete this process.	File	• Physical Files • Printing, Publishing • Documents, text, papers, files, etc. • Physical Printers
	Task 10: You have just finished writing your letter on the computer, and you want to send what you wrote to your friend. Find the place on this computer that will let you send your letter to your friend through email. Next, send your letter to your friend through email. Your email address should be: Yourname@email.com Your Friend's email address is: David@email.com	File	• Physical Files • Mailing Letters • "Mail Recipient" or Mail Addressee • Image of Stamped Envelop (Postal Mail) • Copies of documents
	Task 11: Put a picture (whatever picture you find) in your letter.	Insert	• Adding things • Clip art: Cartoon-like pictures/images depicting different real-world scenarios • Physical Files

Task 3 (SIZE) : Find where you can change the size of a "letter" or a "word."

For task #3 participants who used the African-American inspired interface reported primarily positive critical incidents, where the majority, i.e., 100%, of those C.I.s were themed "Practical Labeling." In addition, the expert categorized 88% of those positive critical incidents about "Practical Labeling" as being "Interface Metaphor" C.I.s. For the same task, participants who used Microsoft Word 2003 reported primarily negative critical incidents, where the majority of those C.I.s were associated with "Inconsistency in Mental Models." One hundred percent of those C.I.s were categorized as being "Mental Model" C.I.s.

Therefore, the interface metaphor employed in the AAII design appears to better support task #3, which required the participant to locate the place on the interface where they can change the size of a letter or a word. Considering that 88% of the "Practical Labeling" C.I.s were identified as "Interface Metaphor" in nature, it appears that the AAII utilizes more effective interface metaphor for these African-American participants than did MS Word 2003 for the same task. Furthermore, the participants using MSWord 2003 reported a majority (83%) of negative C.I.s, 100% of which were further specified as problems that denote the interface design's departure from the participant's mental models of how the task should be completed.

For task #3 MSWord 2003 employs interface metaphor that would require the user to be familiar with terminology and concepts such as:

- Set-ups and layouts,
- Fonts, typescripts, typeset, lettering, and characters.

These metaphors appear to be problematic for this sample of inner city African-Americans. In particular, the term "font" was a not apart of their vocabulary. However, the alphabet terminology metaphor ("Letter Size") used in the AAII offered more effective label

nomenclature, and provided a more positive experience for the participants as they endeavored to complete the task. In this case it seems that the AAII design's use of the alphabet metaphor facilitated the participants' goal of completing the task, while MSWord 2003 interface metaphor was uncertain and cumbersome to them.

Task 4 (COLOR): Find where you can change the color of a "letter" or a "word."

The participants who performed the task #4 on the AAII reported all (100%) positive critical incidents and each were considered "Practical Labeling" C.I.s. In addition, each (100%) of these C.I.s were categorized as comments that concerned the design's interface metaphor. In contrast, 88% of all critical incidents discussed by MSWord 2003 participants were negative comments about "Inconsistency in Mental Models". Eighty-six percent of those negative comments were identified as problems with "Mental Models" concerning how to proceed in completing the task; this is an indication that the participants were having a hard time identifying clues from the interface to determine how to even begin the task.

For task #4 MSWord 2003 uses interface metaphor that would involve the user being familiar with terminology and concepts such as:

- Set-ups and layouts; and
- Fonts, typescripts, typeset, lettering, and characters.

As in task #3, the term "font" was an impediment to task completion for this group of African-Americans. However, the alphabet terminology metaphor ("Letter Color") used in the AAII appears to offer more effective label nomenclature, and provided a more positive experience for the participants as they worked towards completing the task.

Task 5 (FIX): Find where you can fix any mistakes that you may have found in your letter.

For task #5 the AAII users reported all (100%) positive critical incidents which were themed "Practical Labeling." Additionally, each of those critical incidents was identified as an "Interface Metaphor" C.I. The participants that used MSWord 2003 reported critical incidents that were distributed differently. Forty percent (40%) of the critical incidents noted for the MSWord 2003 were "Inconsistency in Mental Models." One hundred percent (100%) of those critical incidents were specifically attributed to "Mental Model" issues (vs. interface metaphor or interaction). Thirty-three percent (33%) of the overall critical incidents were positively themed "Practical Labeling" (100% of those critical incidents were categorized as being interface metaphor C.I.s). Another 20% of the overall critical incidents were positive critical incidents that were themed "Categorization of labels/selection: Structures." This final 20% of the critical incidents is different from the critical incidents that have been discussed thus far; this portion is different in that it represents positive "Mental Model" C.I.s. The "Categorization of labels/selection: Structures" theme characterizes critical incidents that describe the labels or the interface selections as being structured well. For example, this type of critical incident might concern a participant's statement that "it makes sense for both the 'Print' and 'Save' buttons to be under the 'File' menu."

The overall combination of critical incidents themes for MSWord 2003 (for task#5) was more difficult to assess. This case was harder to evaluate because just over 50% of the critical incidents indicate that the participants responded positively concerning the relevant aspects of the MSWord 2003 design, while the majority (40%) critical incidents for this task (and interface) are related to negative critical incidents denoting "Inconsistency in Mental Models." There was

almost an even split among the participant reported critical incidents as it relates to positive and negative reactions to the design.

Moreover, discussion of the interface metaphor used for both MSWord 2003 and the AAII may offer some insight into why there is a clear divide in reactions between the two interfaces for task #5. In the AAII the primary cue provided to facilitate the participant's task execution was a verbal interface metaphor that uses terminology drawing on a users' knowledge of: (1) handwritten letters and (2) fixing mistakes in a letter or another type of handwritten document. The label for this function was "Make Corrections." Since each of the critical incidents was positively related to "Practical Labeling" one can surmise that this metaphor was effective in communicating the achievable goals of this function.

For task #5 MSWord 2003 uses interface metaphors that would involve the user being familiar with terminology and concepts such as:

- Tools, Utensils (things that are used to assist in doing work)
- Language Rules (Spelling and Grammar)

Again, the goal of this task was: "Find where you can fix any mistakes that you may have found in your letter". In order to complete that task in MSWord 2003 the participant needed to go the menu label "Tools" which is listed within a row of other menu labels/options across the top of the screen. Examining the related critical incidents individually, the negative C.I.s for this interface/task indicates that the participants were confused as to why the "Spelling and Grammar" option was located under "Tools." They appear to know that they should be able to fix mistakes in there grammar and spelling, but had trouble locating that function. Some participants stated that "Spelling and Grammar" should have been located under "Format," others stated that it should have been located under "Edit" or "File." The discrepancy here is that

these participants had a different expectation as to where to locate a spelling and grammar type function. The function labeled "Tools" was not intuitive to them as they endeavored to complete the task.

On the other hand, there were positive "Practical Labeling" C.I.s for this task where participants reported that the "Spelling and Grammar" function's location was sensible and logical. For example, one related C.I. stated, "She was able to locate 'Spelling and Grammar' relatively easily from the 'Tools Menu'; these were good labels."

Noting the previous discussion, it is not completely conclusive if the one set of metaphors, of the two interface designs, is more suitable for this subset of African-Americans than the other. However, it is reasonable to state that the interface metaphor used in the AAII appears to communicate the achievable goals of it function.

Task 6 (SAVE): Find the place on this computer that will let you keep your letter until you are ready to finish it. Store your letter (where you would like to keep it). You can name your letter whatever you would like.

Sixty-eight percent (68%) of the C.I. reports by AAII participants were positive "Practical Labeling" in nature. Each of those C.I.s was categorized as an incident related to the "Interface Metaphor" appropriated in this particular interface design. Therefore, the majority of the comments made as the participants described there experiences suggest that the interface metaphor used in AAII design was successful, facilitating a positive experience for the participants as they worked towards completing task #6.

The C.I.s for MSWord 2003 were characterized differently. The C.I.s were mixed in that the majority C.I. theme was actually a tie between a positive theme (i.e., "Categorization of

Labels/Selection: Structure") and a negative theme (i.e., "Inconsistency in Mental Models"). Each theme, individually, represented 29% of the overall C.I.s reported for this task with the MSWord 2003. "Mental Model" was the parent category for each of the positive "Categorization of Labels/Selection: Structure" C.I.s. ; this is an indication that the MSWord 2003 interface design provided support for some participants' mental models associated with saving a letter/document. Conversely, an equal number of negative C.I.s (i.e., "Inconsistency in Mental Models") indicated the opposite of the positive "Categorization of Labels/Selection: Structure" C.I.s. One (out of 2 critical incidents) of these negative C.I.s was categorized as "Interface Metaphor" and the other was categorized as "Mental Model".

The "Practical Labeling" C.I.s from the AAII were the product of employing a number of interface metaphor for this task. The interface metaphors employed here were designed to tap into the participants' knowledge about:

- Handwritten Letters,
- Storage,
- Storage Locations,
- Diaries (private/person storage place),
- Spiral Notebooks,
- A drawer (where one would put clothing),
- File boxes (Workplace), and
- Tables (that are a main piece of furniture in a room).

The MSWord 2003 interface used interface metaphors to draw upon the participants' understanding of:

- Physical Files,

- Saving or Storing things,
- Computer Disks,
- Physical Folders, and
- Folder Organization.

The interface metaphors used in the AAII included a variety of concepts with their associated pictorial images. Generally, these metaphors were related to handwritten letters and the various places that handwritten letters can be stored. Storage locations were diaries, spiral notebooks, a bedroom drawer (where clothing items are kept), file boxes (workplace storage), and tables (furniture in a given room). The C.I. reports suggest that these concepts, with the associated images, are practical and/or reasonable ideas to facilitate the goal of saving a letter. The interface metaphors for MSWord 2003 are similar to the metaphors of the AAII in that they both utilize storage concepts. However, the storage concepts applied in MSWord 2003 are more technical and workplace-centered. These metaphors do not appear to be as clear/simple, in terms of learnability, as the AAII. For MSWord 2003 the participant needed to have a working knowledge of physical files/folders, folder organization and understanding of the function of a computer disk. These concepts do not appear to facilitate the goal of saving a letter (i.e., for this subgroup of African-Americans) as effectively as the metaphors used in the AAII.

Task 8 (HELP): Find the place on this computer that will give you some assistance.
Note: During testing, task #8 was ambiguous for a number of the participants across both interface designs. Some of the participants were initially confused about the goal of the task, as written above. The researcher provided addition clarification, and the participant was able to

move forward with the task. There may have been a flaw in task description. Task #8 is included in the qualitative analysis, but it is not included in the quantitative analyses that follow in a later section. Task #8 was left out of the quantitative analyses to avoid introducing bias into the analyses.

Eighty-eight percent of the C.I.s reported from the AAII participants were themed as "Practical Labeling." In addition, 86% of those C.I.s were categorized as being "Interface Metaphor" C.I.s. The participants using MSWord 2003 reported C.I.s where 70% were themed "Practical Labeling." Each (100%) of those C.I.s was further categorized as "Interface Metaphor" C.I.s as well. Both sets of C.I.s and their respective interfaces employ interface metaphors that provide positive experiences for the participants as they locate the option that will provide "Help." These are similar in outcome because they both used verbal metaphors that are related to a general and plainly stated request help. Furthermore, MSWord 2003's metaphor was associated with a request for help and actually asking for help. Similarly, the AAII's design used a metaphor related to asking for help from an actual person. Therefore, it is sensible that the reactions for both interfaces are similar and positive. Both MSWord 2003 and the AAII support the task #8 equally.

Task 9 (PRINT): Find the place on this computer that will let you put what was written on the computer onto paper. Now complete this process.

Here 47% of the C.I.s that resulted as participants used the AAII was themed as "Practical Labeling"; one hundred (100%) of those "Practical Labeling" C.I.s were categorized as being "Interface Metaphor" in origin. A representative number of those "Practical Labeling" incidents were more specifically labeled (Level 2 category in table 9) as "Label: Leading to

correct mental models" C.I.s. This is an indication that at least a subset of the participants recognized the "Final Draft" metaphor, and perceived that this would be where they could finalize their letter and perform activities such as printing. However, a similar percentage (40%) of the remaining critical incidents for this task (performed with the AAII) was themed "Inconsistency in Mental Models." Eighty-three percent (83%) of those "Inconsistency in Mental Models" C.I.s belonged to the "Mental Model" parent category. Considering these data, it is apparent that there is a split in the positive and negative responses to the "Final Draft" metaphor that was employed for this printing task with the AAII.

Interestingly enough a comparable pattern emerged among the C.I.s for the MSWord 2003 interface. Forty-two percent (42%) of the C.I.s were themed "Practical Labeling." All (100%) of those critical incidents were categorized as being positive "Interface Metaphor" C.I.s. Nonetheless, 42% of the remaining C.I.s was themed as "Inconsistency in Mental Models." Eighty percent (80%) of those "Inconsistency in Mental Models" were further classified specifically as "Mental Model" C.I.s.

The "Final Draft" interface metaphors (AAII) utilized to facilitate this task required the participant to have knowledge about:

- School terminology for a completed document,
- Printing,
- Publishing, and
- Physical Printers.

Meanwhile, MSWord 2003 used interface metaphors that were design to draw upon the participants' understanding concerning:

- Physical Files

- Printing, Publishing
- Documents, text, papers, files, etc and
- Physical Printers.

The participants clearly understood that this task was asking them to print (or publish) their letter, but some (just under half) of the critical incidents for both interfaces indicated that the participants did not perceive which option/function to select to begin the process of printing the letter. "Final Draft" is the real world concept that was used to help the participant to understand which option they should select to print the letter using the AAII. Both the "Final Draft" metaphor designed into the AAII and the "File" metaphor used in MSWord2003 did not match participants' expectations for executing this task. Thereby, large numbers of the negative critical incidents were akin to the parent theme of "Mental Models."

So again, there is a split between the negative and positive comments concerning this printing task. For this particular task, neither set of interface metaphors were infallible. There was ambiguity associated with both sets of interface metaphor; therefore, it seems that both sets of metaphors have faults. Nevertheless, since there were some participants for whom those metaphors were practical, it is possible that if both sets of metaphor undergo appropriate revision and/or amendments (independently) these sets of metaphors may be more effective for a larger set of African-Americans.

Task 10 (EMAIL): Find the place on this computer that will let you send your letter to your friend through email. Next, send your letter to your friend through email.

Your email address should be: Yourname@email.com

Your Friend's email address is: David@email.com

Participants using the AAII reported a majority of negative C.I,s for task #10. More specifically, 69% of the C.I.s was themed as "Inconsistency in Mental Models." Six of out 9 (67%) of those "Inconsistency in Mental Models" C.I.s were categorized as being specifically problems with "Mental Models" (verses interface metaphor or design-driven interaction). Participants using MSWord 2003 reported a majority (54%) of negative comments as well. These C.I.s were also themed as "Inconsistency in Mental Models"; eighty-three percent (83%) of those C.I.s were further categorized as being specifically "Mental Model" issues.

The overarching metaphor applied for this task in the AAII was "Final Draft". The metaphor and related metaphors employed in this interface required the participant to be familiar with real world concepts like:

- School terminology for a completed document,
- Electronic mail,
- Postal Mail,
- White Envelops, and
- Addressing Postal Mail.

MSWord 2003 used the "File" metaphor as an umbrella metaphor for the email function. The "File" and other related metaphors used here were designed to draw upon the user's knowledge of:

- Physical Files,
- Mailing Letters,
- "Mail Recipient" or Mail Addressee,
- Image of Stamped Envelop (Postal Mail), and
- Copies of documents.

Again, the "Final Draft" and the "File" metaphors were both ambiguous for the participants concerning where to start the process for sending their letter through e-mail. It was clear that they understood the concept and purpose of e-mailing, but some participants were not sure what they needed to select to begin the process. There were additional metaphors that were employed to supplement the task completion. For example, the AAII uses white envelops and addresses postal mail and MSWord 2003 uses "Mail Recipient" and an image of stamped envelop (postal mail). In several cases the supplementary metaphors were problematic also; however, the source of the most salient problems was related to initiating the emailing process for both interfaces.

The leading problem for the participants using the AAII appears to be that they did not, based on the visual cues (verbal and pictorial), perceive which of the options to select to begin the process of emailing the letter. Each of the nine "Inconsistency in Mental Model" critical incidents reported, for cases where the participant completed the task or not, spoke to the participants' initial confusion with where to start. Similarly, the MSWord 2003 participants commented that they had a difficult time determining what to select to begin emailing the letter as well. More specifically, some of the MSWord 2003 users mentioned that they had specific things that they were looking for to access the email option. For instance, participants were looking for:

- A globe to represent email/internet,
- An "email" button, and
- "Send a Copy" selection

in order to begin the process of emailing the letter.

Task 11 (PIC): Put a picture (whatever picture you find) in your letter.

Participants using the MSWord 2003 reported a majority of negative C.I.s for task #11. Forty-three percent (43% and 6/14) of the critical incidents commented on issues related to "Inconsistency in Mental Models." Eighty-three percent (83%) of those C.I.s had a parent category of "Mental Models". The majority (38%) of the C.I.s from the AAII was negative as well; these C.I.s were also themed as "Inconsistency in Mental Models." Eighty percent (80%) of those C.I.s were specifically identified as "Mental Model" issues. Notably, a second set of negative C.I.s have emerged from the AAII. A number of negative C.I.s categorized as "Misjudged An Interaction" were reported at a rate of 31%; one hundred percent (100%) of those C.I.s described negative aspects of related the interface metaphor. Another 31% of positive C.I.s were related to the "Effective Use of Pictures" theme. These positive C.I.s were largely related to interface metaphors. It seems important to consider all of these since they are so closely related in their rates of occurrence.

The focal metaphor for this task in the AAII was pictorial in implementation and was a "Picture." This was an image of a picture sitting on a "Table". The key concept that this pictorial metaphor was intended to convey was that of pictures on a bedroom table.

The overarching metaphor applied for this task in the MSWord 2003 was "Insert." The metaphor and related metaphors employed in this interface required the participant to be familiar with real world concepts like:

- Adding things,
- Clip art: Cartoon-like pictures/images depicting different real-world scenarios, and
- Physical Files.

Viewing the content of each MSWord 2003 critical incidents for task #11, provides a little more insight into the challenges that participates faced. While the "Insert" metaphor was the guiding metaphor for this task, there were other aspects of the task execution that presented challenges. For example, 3 out of 14 participants reported negative critical incidents for task #11 that were not at all related to the "Insert" metaphor. In fact, these participants recognized that "insert" was the selection, but were not able to figure out what was required to make the picture they selected appear on the letter. In more technical terms, these participants encountered a "Design-Driven Interaction" problem and thereby "Misjudged an Interaction" (Level 2 category). In addition, there were 2 (out of 14) positive critical incidents that reported "Practical Labeling" themes. So it is evident that the "Insert" metaphor was somewhat effective for this African-American group studied.

Interestingly the AAII had two categories of positive and negative critical incidents which appear to be conflicting. Thirty-eight percent (38%) of the critical incidents were negatively themed as "Inconsistency in Mental Models," while 31% of the critical incidents were positively themed as "Effective Use of Pictures." The process for placing a picture in the letter includes clicking on the one of the pictures shown on the table. So, it is clear that some participants had trouble determining (because of previously formed notions) what would allow them to place a picture in their letter; this description would represent the critical incidents that were themed as "Inconsistency in Mental Model." The question could be asked, "What was at the core of the discrepancy concerning the AAII's design and the participant's mental model?" Yet, another portion of participants reported positive experiences related to the "Effective Use of Pictures" on the table for completing the task.

In assessing this conflict more deeply, the purpose and use of interface metaphors were considered. In view of the fact that interface metaphors play a role in the development of the user's mental models, it is possible that (a) misunderstanding the meaning of the metaphor or (b) not recognizing the implementation of a metaphor may cause the user to formulate and apply a faulty mental model in the given interface environment. Upon this assertion, another question could be raised, "Were the negative critical incidences pointing to mismatches in mental models a product of not recognizing the implementation of the "Table" and "Picture" metaphors?" If so, could it be that the visual metaphor was appropriate, but rather just not salient enough?" In the AAII design, the "Table" which has "Pictures" on it is located at the bottom of the screen. It is possible that "Table" and "Picture" metaphor was a salient enough to be an initial option for selection among some of he African-American participants.

Quantitative Analyses

Hypothesis #1

Hypothesis #1: The African-Americans will perform significantly different on the AAII and MSWord 2003.

The first segment of the statistical analysis for study four will test Hypothesis # 1. The performance measures obtained in this study were first used for *t* tests. T-tests were used to determine if there were significant differences in the African-American's benchmark task performance on the AAII and MSWord 2003.

Dependent Measures. The primary unit of analysis for measuring performance was the number of detours made during benchmark task performance. However, the number of errors committed and the total number of keystrokes (i.e., mouse clicks) were recorded also. Errors are broadly defined as "any action that does not lead to progress in performing the desired task (Hix and Hartson, 1993, p.305)." The "error" measures were characterized in several ways during the initial stages of analyses. These additional re-characterizations of "errors" provided several different perspectives to consider these data. First, errors were viewed as the aforementioned definition. Second, errors were characterized as the number of times the user returns to a higher level of the menu structure to reposition themselves (Hix and Hartson, 1993; Ziefle and Bay, 2005). Third, errors were operationalized as the number of detour steps taken. The number of detour steps is defined as the "difference between the number of keystrokes actually effectuated and the number of keystrokes that were necessary to solve the task the shortest way possible (Ziefle and Bay, 2005, p.377)." The formula used to calculate the number of detours is provided below.

Equation 1

Detours = # of Keystrokes - # Keystrokes for Shortest Method (1)

The number of detours was chosen as the primary unit of analysis because unit that could be normalized and compared across both the MSWord 2003 and the AAII. (In this study the number of keystokes refers to mouse clicks, points and initiation of typing. The initiation of typing was considered as one keystroke.)

T-tests Results. T-tests were performed to determine significant differences in the number of detours made while participants worked to complete each benchmark task. T-tests were performed on benchmark tasks 3, 4, 5, 6, 9, 10, and 11. Tasks 1, 2, 12a and 12b were not included in the statistical analysis since these tasks were unique to the AAII. Task number eight (HELP) was eliminated from all statistical analysis because there several participants were initially confused about the actual goal of the task. Analyzing these data from task number eight would have potentially skewed the results by introducing confounding variables.

Table 11 lists the results of this statistical comparison. T-tests results revealed that the number of detours made (incorrect steps from the shortest path of task completion) with the AAII (M=0 .00) was significantly less than for MSWord 2003 (M=6.86) on benchmark task 3 (SIZE), $t($ 6) = -4.35, p= .005. The difference between the means was 6.86. The effect size d is approximately 3. The occurrence of detours in benchmark task 4 (COLOR), $t($ 6) = -6.69, p= .001, and task 5 (FIX), $t($ 6) = -3.54, p= .012, on the AAII (M=0.00 and M=0.00, respectively) were both significantly less than the detours made with MSWord 2003 (M=6.43 and M=2.86, respectively).

Each of the remaining comparisons was determined to have no statistically significant differences. Therefore, the AAII and MSWord 2003 could not be distinguished on the basis of the number of detour rate for benchmark task 6 (t = -0.92, df = 13, p = 0.375), task 9 (t = -0.90[a], df = 8.05[a], p = 0.395), task 10 (t = -1.26[a], df =7.95[a], p = 0.245) and task 11 (t = 0.848, df = 13, p = 0.412).

Chi-Square Analysis Results. The Fisher's exact test statistic was used to investigate whether there were differences in task completion rates between the AAII and MSWord 2003 across the benchmark tasks. The Fisher's exact test identifies benchmark tasks 3 (SIZE) and 4 (COLOR) as having significantly different task completion rates when considering both the AAII and MSWord 2003. Furthermore, in both benchmark tasks 3 and 4, significantly more participants completed the tasks using the AAII (Fisher's p-value = 0.026, N =15) than with MSWord 2003 (Fisher's p-value = 0.026, N =15). Participants using the AAII were more likely than expected to complete the tasks related to identifying the functions for changing the (1) text size and (2) text color. Phi, an indicator of the strength of the relationship between the two variables (completion rate and interface), was Φ = -0.645 for both benchmark tasks 3 and 4. Each of the remaining benchmark tasks did not show any significant differences when benchmark task completion rates were compared to interface type. Table 12 provides a listing of Fisher's exact test results for each benchmark task.

Table 11: Comparison of Number of Detours Made on Benchmark Tasks on the African-American Inspired Interface and MSWord 2003 (n= 8 AAII and n = 7 MSWord)

	M	SD	t	df	p
Task 3 (SIZE)			-4.350[a]	6.000[a]	.005*
AAII (Interface 1)	.000	.000			
MSWord 2003 (Interface 2)	6.857	4.170			
Task 4 (COLOR)			-6. 686[a]	6.000[a]	.001*
AAII (Interface 1)	.000	.000			
MSWord 2003 (Interface 2)	6.429	2.544			
Task 5 (FIX)			-3.540[a]	6.000[a]	.012*
AAII (Interface 1)	.000	.000			
MSWord 2003 (Interface 2)	2.857	2.135			
Task 6 (SAVE)			-.920	13	.375
AAII (Interface 1)	.1250	.354			
MSWord 2003 (Interface 2)	.3214	.472			
Task 9 (PRINT)			-.898[a]	8.048[a]	.395
AAII (Interface 1)	.225	.362			
MSWord 2003 (Interface 2)	.534	.813			
Task 10 (EMAIL)			-1.256[a]	7.954[a]	.245
AAII (Interface 1)	.4792	.804			
MSWord 2003 (Interface 2)	1.429	1.853			
TASK 11 (PIC)			.848	13	.412
AAII (Interface 1)	2.375	2.083			
MSWord 2003 (Interface 2)	1.486	1.959			

[a]The *t* and *df* were adjusted because variances were not equal.

* Significant at the 0.05 level

Table 12: Chi-Square Analysis of Benchmark Task Completion Rates Among the AAII and MSWord 2003 (N=15)

			Task Completion		
		n	Completed	Not Completed	Fisher's exact test *P*-value
Task 3 (SIZE)					.026*
	AAII	8	8	0	
	MSWord 2003	7	3	4	
Totals		15	11	4	
Task 4 (COLOR)					.026*
	AAII	8	8	0	
	MSWord 2003	7	3	4	
Totals		15	11	4	
Task 5 (FIX)					.467
	AAII	8	8	0	
	MSWord 2003	7	6	1	
Totals		15	14	1	
Task 6 (SAVE)					1.000
	AAII	8	7	1	
	MSWord 2003	7	7	0	
Totals		15	14	1	
Task 9 (PRINT)					.467
	AAII	8	8	0	
	MSWord 2003	7	6	1	
Totals		15	14	1	
Task 10 (EMAIL)					1.000
	AAII	8	7	1	
	MSWord 2003	7	6	1	
Totals		15	13	2	
TASK 11 (PIC)					1.000
	AAII	8	7	1	
	MSWord 2003	7	6	1	
Totals		15	13	2	

* Significant at the 0.05 level

Both the t-tests and the chi-square analysis provide complementary results. The t-tests revealed that participants made significantly more detours using MSWord 2003 than with the AAII for benchmark tasks 3 (SIZE), 4 (COLOR) and 5 (FIX). In addition to that, the chi-square

analysis shows that there were significantly different rates of completion between the AAII and MSWord 2003 for benchmark tasks 3 and 4. Significantly more participants successfully completed tasks 3 and 4 using the AAII than MSWord 2003. Considering these data, one can surmise that the design differences between the AAII and MSWord 2003 were significant enough to actually affect whether participants completed (or not) tasks 3 and 4 in the allotted amount of time.

Discussion: Integrated Qualitative and Quantitative Results

The purpose of integrating the results of both the qualitative and the quantitative methods of data collection is to present the richest possible discussion concerning participants' experiences using the two interfaces. The integrated discussion of the results serves as a means to achieve triangulation, "a validity procedure where researchers search for convergence among multiple and different sources of information to form themes or categories in a study (Creswell and Miller, 2000, p. 126)".

The qualitative and quantitative results complemented one another. The qualitative comparison between the AAII and MSWord 2003 for benchmark tasks 3 (SIZE) and 4 (COLOR) showed that the AAII participants reported that the interface metaphor (terminology) used in both tasks was effective because the function labels were stated in practical language. The effectiveness of the alphabet terminology metaphor of "Letter Size" and "Letter Color" was asserted, as each AAII critical incident reported was a positive affirmation that these labels were good. In this case, MSWord 2003 critical incidents are filled with challenges rooted in mismatches in mental models; these critical incidents centered on the participant's lack of familiarity with the concept of "Format" and/or "Font."

These qualitative results support the quantitative analyses findings. The t-tests show that the AAII participants made fewer errors (detours) on benchmark tasks #3 and #4 than did the MSWord 2003 participants. In addition, the Chi-Square analyses extended the findings to include not only significant differences in the number of detours made, but a significantly lower number of MSWord 2003 participants actually completed tasks 3 and 4 than did the AAII participants. As the foregoing discussion suggests, these three data sources support and confirm a single notion—the AAII better supports the African-American participant in identifying where to begin the process of changing the size of color of a letter or and word.

Discussion of benchmark task 5 (FIX) is quite different. In this instance the t-test revealed that the AAII participants made significantly fewer errors (detours) than did the MSWord 2003 participants. However, the Chi-Square test did not show that there was any significant difference in the number of tasks completed verses not completed. Interestingly, both of these ideas seem to appear in the qualitative data for benchmark task 5. The qualitative data presents the notion that (1) the AAII's "Make Corrections" function, with its accompanying metaphors (i.e., "handwritten letters" and "fixing mistakes"), was more intuitive and practical for the whole of its African-American participants than MSWord 2003's "Tools" function was for its participants, and (2) MSWord 2003's "Tools" function provided a level of clarity and understanding for some of its participants—enough so that the task completion rates between the two interfaces were not significantly different.

Namely, the AAII participants reported 100% positive critical incidents that spoke to the clarity and practicality of the "Make Corrections" function label. Participants described their experiences with MSWord 2003 with several opposing descriptions. Forty percent (40%) of the critical incidents noted for the MSWord 2003 were negatively themed "Inconsistency in Mental

Models." Thirty-three percent (33%) of the critical incidents were positively themed "Practical Labeling". Another 20% of the critical incidents were positive critical incidents that were themed "Categorization of labels/selection: Structures." Considering the quantitative data analyses, it makes sense that the overall distribution of themes is separated into similar-sized, yet opposing categorical themes. Further elucidation would affirm that some participants encountered a challenge with the "Tools" function, while the other participants thought that the "Tools" function made sense in its naming convention and in its menu structure. This would explain why the completion rates for this task, according to the Chi-Square analysis, were not significantly different for the two interfaces.

For tasks 6 (SAVE), 9 (PRINT), 10 (EMAIL), and 11 (PIC) statistical tests did not show any significant differences in (1) the number of detours made and (2) the number of tasks completed verses not completed between the two interfaces. Consequently, there is nothing novel to add to the former qualitative comparison of the AAII and MSWord 2003 for these benchmark tasks. Since there were no significant differences in the task error and completion rates, there is possibly an opportunity to further develop the present metaphor into culturally valid interface metaphor for the targeted African-American group. The interface and associated metaphors that have a stronger propensity for producing positive experiences with a particular interface (and the tasks they need to perform) should be further developed as options for increasing use and success among the targeted group users.

Hypothesis #2

Hypothesis #2: There will be relationships between spatial ability, perceptual style, computer related attitudes, general self-efficacy, and the user's performance when performing specified computer tasks. Multiple

regression was used to test this hypothesis. Here the performance measures and the previously identified constructs of individual difference were the input for the multiple regression models.

The second stage of the statistical analysis tested hypothesis #2. Each of the factors (i.e., perceptual style, spatial ability, computer attitudes, and general self-efficacy) previously identified were used as predictors of the model. The first equation determined if spatial abilities, perceptual style, computer attitudes and general self-efficacy could predict users' performance with respect to the number of detours made. This prediction model was developed using the performance data collected from participants of the African-American Inspired Interface and MSWord 2003. Another goal of this regression was to establish whether or not the user performance factors identified in previous human-computer interaction research are also predictors for the interfaces tested in this research (regardless of the ethnicity of the user). The hypothesized performance prediction equation based on Interface specified was:

Equation 2

$$\mathbf{Y1_{Error}} = \mathbf{b_0} + \mathbf{b_1}(\text{Spatial Ability}) + \mathbf{b_2}(\text{Perceptual Style}) + \mathbf{b_3}(\text{Computer Attitudes}) + \mathbf{b_4}(\text{General Self-Efficacy}) \quad (2)$$

The researcher used Cronbach's alpha to determine whether the scale items had reasonable internal consistency reliability. The alpha values for computer attitudes (.72) and general self-efficacy (.80) indicate good internal consistency.

Multiple regression was conducted to determine the best linear combination of spatial abilities, perceptual style (group embedded figures test), computer attitudes and general self-efficacy for predicting participant performance (total number of detours). Upon initial

investigation of the correlations between the predictor variables, it was discovered that general self-efficacy and spatial abilities were significantly correlated. Table 13 shows the relevant correlations.

Table 13: Correlations Between Computer Attitudes, General Self-Efficacy, and Spatial Abilities

		Computer Attitudes	General Self-Efficacy	Group Embedded Figures Test	Spatial Abilities (All Spatial Tests Totaled)
Computer Attitudes	Pearson Correlation	1			
	Sig. (2-tailed)				
	N	15			
General Self-Efficacy	Pearson Correlation	.335	1		
	Sig. (2-tailed)	.222			
	N	15	15		
Group Embedded Figures Test	Pearson Correlation	.186	.324	1	
	Sig. (2-tailed)	.506	.238		
	N	15	15	15	
Spatial Abilities (All Totaled)	Pearson Correlation	-.085	.567*	.458	1
	Sig. (2-tailed)	.763	.028	.086	
	N	15	15	15	15

* Correlation is significant at the 0.05 level (2-tailed)

To avoid problems with multicollinearity, several models were run to get an idea as to which set of predictors would be most appropriate. Therefore, a simultaneous regression was run using predictors computer attitudes, general self-efficacy, and group embedded figures test. While another simultaneous regression was run using predictor variables computer attitudes, group embedded figures test and spatial abilities. Upon reviewing the results for both models, it was determined that none of the predictors were significantly correlated to the dependent measure. This was the first indication that the predictors were not going to form a good prediction models.

Further investigation was done with predictors computer attitudes, spatial abilities, and group embedded figures test. General self-efficacy had and extremely low correlation with the dependent measure (.028). Backward regression (backward elimination method) was used to determine the most effective model. The final model was included predictors computer attitudes and the group embedded figures test. The model is shown below.

Equation 3

$$\mathbf{Y1_{Detour}} = \mathbf{-50.734} + \mathbf{.84}(\text{Computer Attitudes}) - \mathbf{1.57}(\text{Group Embedded Figures Test}) \quad (3)$$

The means, standard deviations and intercorrelations can be found in Table 14. This final combination of variables did not significantly predict participant performance, $F(2,12) = 3.90$, $p = .05$, with no variable significantly contributing to the prediction. The *R* squared adjusted value was .29.

Table 14: Means, Standard Deviations, and Intercorrelations for Participant Performance and Predictors Variables (N=15)

Variable	M	SD	Computer Attitudes	Group Embedded Figures Test
Participant Performance	13.40	11.80	.400	-.400
Predictor variables				
Computer Attitudes	85.13	6.91	--	.186
Group Embedded Figures Test	4.73	3.69	.186	--

*p < .05

The original predictor variables did not demonstrate any significant proficiency at predicting performance on the benchmark tasks. Each of the original predictor variables investigated here had been noted in human-computer interaction literature as predictors for user

performance with computers. It is evident that these predictors did not predict performance as expected. However, there are a number of potential model weakening factors that should be taken into account. First, the sample size (N=15) is a rather small sample size for fitting four predictors. Second, it is possible that a linear regression model is not most appropriate for this situation; there could have been a non-linear relationship between the dependent measure and the predictors. Third, it is also possible that the measures (some or all) used to assess spatial abilities, general self-efficacy, perceptual style, and computer attitudes were not valid for American-Americans. Consequently, more study needed to be performed to draw any useful conclusions.

Hypothesis #3

Hypothesis #3: There will be significant correlations between participant's acculturation level and performance.

The third stage of the statistical analysis was designed to test hypothesis #3. The acculturation scale was segmented into two groups: total ethnic identity and total other group orientation. To assess whether the fourteen total ethnic identity items and the six other group orientation items each formed reliable scales Cronbach's alpha was computed. Both the ethnic identity items (.77) and total other group orientation items (.73) indicated good internal consistency. A Pearson Product Moment correlation was used to determine if statistically significant correlations exist between participants' acculturation level and their performance (in total number of detours). No significant correlations surfaced in this quantitative analysis. The results of the correlation study are in Table 15.

Table 15: Participant Performance and Acculturation Correlation Matrix (N=15)

		Performance (Total # of Detours)	Total Ethnic Identity	Total Other Group Orientation
Performance (Total # of Detours)	Pearson Correlation	1		
	Sig. (2-tailed)			
Total Ethnic Identity	Pearson Correlation	.062	1	
	Sig. (2-tailed)	.828		
Total Other Group Orientation	Pearson Correlation	-.072	.579*	1
	Sig. (2-tailed)	.799	.024	

* Correlation is significant at the 0.05 level (2-tailed)

Ad-Hoc Qualitative Analysis on Acculturation and Critical Incident Reporting. Furthermore, an ad-hoc qualitative analysis was performed to determine if anything noteworthy relational patterns emerged concerning participant acculturation levels and they accompanying critical incidence reporting. The purpose in this qualitative analysis was to examine any potential

relationships between a participant's acculturation level (high, medium, or low) and the critical incidents (themes) that the participant offered.

This data analysis is best used as a supplement to the quantitative results and discussion previously provided here in study 4(Testing African-Americans on the AAII and MSWord 2003). The goal here was to highlight the number of positive and negative critical incident occurrences, and consider them with respect to participant acculturation levels. However, the noted critical incident occurrences do not necessarily represent each individual participant in that group. There were instances where a participant in the group did not report a comment/critical incident, and there were other instances where one participant reported two or three critical incidents.

The Multi-Ethnic Identity Measure (acculturation scale) includes two measurable constructs: total ethnic identity and other-group orientation. Participant total ethnic identity (TEI) and other-group orientation (OGO) scores were classified into three categories: high, medium and low. Table 16 displays the score segmentation. The maximum score, indication of a strong sense of identity in their ethnic group, for an individual's total ethnic identity score is 56. The maximum score, indication of positive attitudes towards other ethnic groups, for an individual's other-group orientation is 24.

Table 16: Participant Acculturation Categorization and Scores

	Low	Medium	High
TEI	<= 42	43 to 45	>= 46
OGO	<= 17	20 to 22	>= 23

For the MSWord 2003 group there were three (3) participants that were classified as low in other-group orientation, two (2) as medium, and two (2) as high (see Table 17). For the AAII

group there was one (1) participant that was classified as low in other-group orientation, three (3) as medium and four (4) as high.

Table 17: Participant Other-Group Orientation and Interface

	Low	Medium	High	Total
AAII	1	3	4	8
MSWord 2003	3	2	2	7

Integration with Quantitative Data. The t-tests showed significant differences in performance between the two interfaces for benchmark tasks 3 (SIZE), 4 (COLOR) and 5 (FIX); therefore, the discussion is focused on these tasks. These qualitative data were coded visually and assessed based upon the number of occurrences of critical incidents. Here the MSWord 2003 Low-Negative (i.e., low other-group orientation and negative critical incident) cell is more heavily populated with critical incidents than the Medium-Negative and High-Negative cells combined for tasks 3 and 4. Task 5 did not show any remarkable patterns of critical incident reporting associated with OGO scores. For the tasks 3, 4, and 5 AAII there were no negative critical incidents reported for the Low, Medium or High groups.

For the MSWord 2003 interface, it was apparent that the group characterized as being of low other-group orientation reported more occurrences of problems with task #3 and task #4 than the medium and high groups. Generally speaking, the high OGO group (with similar numbers of participants represented) reported less negative critical incidents concerning MSWord 2003 than the medium and low group.

The “low” group seemed, to have a more difficult time trying to locate the option for changing the (a) size and (b) color of a letter or a word. Both task 3 (SIZE) and 4 (COLOR) have the same first to steps. The low group participants could generally find the “Format” button,

which was the first step in locating the option for changing the size and color of text. It was the second step of the process, which required them to select "Font" that challenged these participants. Related individual examples of negative critical incidents from the low OGO group were:

- Task 3 (SIZE): The user went to the "Format" menu several times and did not see any keyword or phrase that would help her to change the size of a letter or a word.
- Task 3 (SIZE): She found the size by accident. She went to Format and clicked on Font just to see what it was and happened to find the Size numbers. She didn't know what FONT meant.
- Task 3 (SIZE): She thought that it could have been under "tools."
- Task 4 (COLOR): She could not find how to change the color of the text; she didn't know where (in what menu) it would be located.
- Task 4 (COLOR): She thought that it was in WordArt; she thought that the Word Art function would change the words to a different color.

These examples suggest that there were two issues for the low OGO group. First, participants did not know what the label "Font" meant. This was clearly not a word that was integrated into their functional vocabulary. Supporting evidence for this first issue is evident when considering the critical incident reports from the AAII. As stated previously, for tasks 3 (SIZE) and 4 (COLOR) participants reported all positive critical incidents for the AAII regardless of their OGO level. The key to the participants' success with tasks 3 (SIZE) and 4 (COLOR) was simply worded labels. Some the related critical incidents were:

- Task 3 (SIZE): The button labeled "Letter Size" is what helped her to complete the task.

- Task 3 (SIZE): The "Letter Size" button was clearly labeled. She was sure that she could change the size of a letter or a word with that button.
- Task 3 (SIZE): The "Letter Size" button was self-explanatory.
- Task 4 (COLOR): The button that said "Letter Color" was an obvious choice for her to complete the task.
- Task 4 (COLOR): The label "Letter Color" was clearly provided on the top row of buttons. [Participant] thinks that "Letter Color" is very simple and most people will know what that is.

The second issue was that there was a discrepancy as to which menu item would be the home of the function designed to change the size of text. The correct menu selection would have been "Format;" however, several participants in the low OGO group assumed the function (relevant to this particular task) would be located under a different menu option. Participant critical incidents stated:

- Task 3 (SIZE): She thought that it could have been under "tools."
- Task 4 (COLOR): She thought that it was in WordArt; she thought that the Word Art function would change the words to a different color. [WordArt is located under the "Insert" menu button.]

This particular issue suggests that the organization/categorization of the menu titles and the options inside of them may be mismatched with the users' expectations. Furthermore, the terminology and metaphors employed, whose purpose is to convey meaning to the user, may in some cases be counter-productive because the meaning that the user draws from that terminology or metaphor is different from what was originally intended by the designer. The mismatch in meanings can be ascertained by considering the content of the two negative critical incidents

given above. The correct menu selection for changing the size and color of any text was "Format." However, two participants expressed their confusion with tasks 3 and 4 by stating that they thought that they could achieve the task by selecting "Tools" and "Insert [for WordArt]," respectively.

What might this have to do with acculturation level? Could it be that the individuals of low other-group orientation were not as familiar with some of the "computer world's" mainstream concepts and terminologies represented in MSWord 2003? It is certainly possible for a member of an ethnic minority, who resides in an underserved urban neighborhood to be somewhat disconnected from some developing computer technologies. Ethnic minorities (e.g., African-Americans) who are economically underserved have shown that they are less likely to have computers at home (NTIA, 2000). Furthermore, individuals who live in underserved neighborhoods attend primary and secondary schools that have not achieved effective integration of computers (with relevant computer software) into their academic curriculums (S. Roberts, personal communication, March 7, 2008). Resource-rich schools generally have better and more frequent opportunities for its ethnic minority students, as well as the general student body, to become well versed in computer vocabulary, applications and functionality. The latter set of students has more exposure to mainstream computer technologies, and thereby garner more opportunities to adapt (culturally and socially) to any novel vocabulary, ideas or concepts that exist in those computer technologies.

The second half of the discussion pertains to the TEI aspects of the MEIM. The breakdown of the participant TEI level and the critical incidents reports are listed in Table 18. The integrated discussion here focuses on tasks 3 (SIZE), 4 (COLOR), and 5 (FIX) since those resulted in statistically significant t-tests. For the AAII there were only reports of positive

critical incidents for tasks 3, 4, and 5. For the MSWord 2003 interface tasks 3 and 5 do not show any salient patterns of critical incident reporting as it relates to TEI scores. However, the critical incidents reported for task 4 loaded heavily on the Low-Negative and Medium-Negative cells of the visual data representation. After considering the contents of the critical incidents, it appeared the more densely populated Negative-Low and Negative-Medium cells may have been because participants identified more "potential", but incorrect, options to change the color of text in the MSWord 2003 interface. For example, some participants thought that they could change the color of the text with (a) WordArt, and (b) Ink Annotations.

Terminology usage presented a challenge for the low and medium level TEI participants. A heavy cognitive load (Sweller, 1988) is one possible explanation for the participants' difficulty with task 4 (locating the option to change the color of the text) in MSWord 2003. One salient effect of a heavy cognitive load is error (Sweller, 1988). He (Sweller, 1988; Sweller et al., 1998) characterizes cognitive load as referent to the load on working memory while reasoning, thinking and problem solving. A heavy cognitive load is a result of a person having to process a large amount of information using the limited capacity of working memory. While engaged with task 4, the participants perceived the possibility of several options to change color of the text. Given the various representations that the participants perceived, they may have needed to allocate their working memory capacity towards: (a) translating those "potential" options (i.e., labels/terminology and images), (b) remembering which label titles were possibly relevant while scrolling through different menus, and (c) comparing label titles to make a selection by the process of elimination. Those "potential" options presented on the MSWord 2003 interface were the most likely culprits of the participants' confusion and the resulting errors. The data

available does not provide any identifiable illumination of any relationships between TEI acculturation levels and critical incident reporting.

Table 18: Participant Total Ethnic Identity and Interface

	Low	Medium	High	Total
AAII	2	4	2	8
MSWord 2003	3	2	2	7

Study 4 Outcomes

The primary outcome of study 4 (Testing African-Americans on the AAII and MSWord 2003) was an integration discussion concerning the interface metaphor presented in the AAII and MSWord 2003. The integration of the quantitative and qualitative data provided a good opportunity for data triangulation. In addition, it provided some useful ideas concerning cultural aspects for usability.

Cultural Aspects for Usability Attributes

The participants' benchmark task discussions were also examined to determine if any novel usability attributes emerged from this group of African-Americans. Commonly assessed usability attributes include: learnability, efficiency, memorability, errors, and satisfaction (Nielsen, 1993). Nielsen (1993) describes these usability attributes as:

- Learnability: The system should be easy to learn so that the user can rapidly start getting some work done with the system,
- Efficiency: The system should be efficient to use, so that once the user has learned the system, a high level of productivity is possible,

- Memorability: The system should be easy to remember, so that the causal user is able to return to the system after some period of not having used it, without having to learn everything all over again,
- Errors: The system should have a low error rate, so that users make few errors during the use of the system; if they do make errors, they should be able to easily recover from them. Further, catastrophic errors must not occur, and
- Satisfaction: The system should be pleasant to use, so that users are subjectively satisfied when using it; they like it.

Learnability and errors were the attributes that this research project was designed to assess. Both learnability and errors are discussed in terms of their relationship with each design's interface metaphors. What was discovered from studying learnability with the African-American users? First, a design consideration for augmenting learnability among African-Americans is to consider the "culture" (at a relatively low level) of the user group, and let the users' common language and perceptions about the way they do their work be a primary guide for the interface's design. This is particularly related to the formation and implementation of metaphor(s) used in efforts to provide a mechanism for understanding, especially for the new users. This usability consideration is not notably novel; however, the nuance is the notion of "relatively low-level" cultural considerations driving the implementation of (a) terminologies and (b) relevant verbal and pictorial metaphors. These considerations provide further specification of general usability components.

Second, there are several cultural aspects for good usability aspects among the African-American group. The aforementioned design consideration commences as a result of reviewing the African-American participants' comments concerning the ease and difficulty of the various

benchmark tasks. During the post-task interviews, the African-American participants had an opportunity to rate each task on a scale of one (easy) to ten (hard). These participants characterized the "easy" tasks with a number of descriptors. The attribute that was most salient among the "easy" tasks concerned the use of labels. When asked the question "Was there anything about this computer [interface] design that helped you to complete this task?", the response was often concerning the clarity of the labels titles. In these discussions participants commented on the simplicity of the terminology used on the buttons or menu selections. For instance, the participant may comment on the label "Format" in MSWord 2003 or the "Make Corrections" button in the African-American Inspired Interface (AAII). There some cases were the participants recognized the deeper meaning of the labels titles that were represented metaphorically. For example, some participants understood that "Final Draft" in the AAII was used to convey that it was the option where they could finalize their work and print or email the letter. A few others recognized that a "File" in MSWord would be something that they could save and kept until later. Even when the terminology used on the labels was somewhat ambiguous, the participants still mentioned that the labels were the cue(s) they used to complete the benchmark tasks. Moreover, participants' comments indicate that the labels were key in making the task easy; the participants almost always made reference to the verbal labels on the menu selections or on the buttons.

The attribute that was most salient among the "hard" tasks concerned options being hidden. A popular phrase for the "hard" tasks was "I couldn't figure out where to go to…" Further discussion with the participant would often reveal that some option(s) appeared to be hidden. The root to the problem of hidden options was consistently related to the use of unclear or ambiguous terminology. One very common example of the use of ambiguous terminology is

MSWord 2003's use of "Font." Participants could generally recognize that they needed to go to the "Format" to change the color or size of a letter or a word in their document; however, the participants would get stuck after selecting "Format." The next step would be to select "Font", but many of the participants did not understand what "font" meant. A second problem with the use of terminology is rooted in the misinterpretation of metaphors. For example, there were occasions where the participant stated that certain function should have been located under different menu titles. For example, a participant trying to correct his/her spelling and grammar may look under the "Edit" menu in MSWord 2003. However, the participant may be frustrated when they go to the "Edit" function (with a mental model that leads them to think that "Edit" would be the place to make any corrections in their document) and can not find a "Spelling and Grammar" option.

Several theoretical concepts provide further support for the resulting cultural aspects for usability among the African-American group. The participants had the most trouble when the terminology, with its accompanying metaphors, was largely ambiguous. In these instances the participants' mental models were not applicable to the interface design. Don Norman (1983) discusses the importance of designing systems and instructional materials that facilitate users' construction of coherent and usable mental models as a duty for designers.

In addition, Norman's (1983) claim works in tandem with the philosophy of Cognitive Load Theory (Sweller, 1988). Traditionally, Cognitive Load Theory (CLT) has previously been applied specifically to the design of instruction. Three primary components comprise the core of CLT: intrinsic cognitive load, extraneous cognitive load and germane cognitive load. Intrinsic cognitive load is the load on working memory that results from the inherent nature of the material to be learned; the intrinsic cognitive load can not be altered with instructional

interventions. Extraneous cognitive load is the unnecessary use of working memory capacity that results from the poorly designed instructional materials; instructional interventions can alter extraneous cognitive load. Germane cognitive load refers to the productive use of working memory capacity which leads to the construction of schemas (Sweller et al., 1998). Moreover, the goal of CLT is to design instructional materials that reduce extraneous cognitive load and increase germane cognitive load. Considering the similar ideals of good usability in interface design and instructional design, the most rudimentary components of CLT can be applied to computer interface metaphor design as well. In order to achieve good usability, extraneous load would be reduced by designing in culturally appropriate interface metaphor into the interface. In turn, germane cognitive load would increase and result in schema construction (learning).

Other Considerations

Additional Methods of Human-Computer Interaction Performance Measurement

User performance with computer systems/interfaces are often assessed using HCI models such as GOMS (Goals, Operators, Methods, and Selection rules) and KLM (Keystroke Level Model). The GOMS model predicts user performance (method for accomplishing the task and the time to complete the task) by describing the user's information processing in terms of their goals, operators, methods and selection rules, and assigning predefined, expert time values to the models' sequenced operators. KLM, a simplified version of GOMS, predicts only task completion time, given a method for completion — it does not predict a method as GOMS does (Card, Moran, and Newell, 1983). These engineering models have matured into being widely used for the purposes of predicting: skilled-performance time, (2) method-learning time, and (3) likelihood of memory errors all before a computer system is bought, designed or re-designed (John, 1995). The general purpose of using these models is to predict the efficiency of a

computer interface design, considering the cognitive processes a user would employ to complete a particular task. These predictions are then used to justify the purchase, design or redesign of a computer system (John, 1995; Holleis et al., 2007).

While HCI researchers and practitioners use GOMS/KLM extensively in their scholarly discussions of a variety of emerging application domains (Holleis et al., 2007), the use of GOMS/KLM predictions is a premature endeavor for this particular research project. One goal of this research project was to develop the AAII with enough depth to determine whether the novel interface metaphor designs actually provide a viable basis for developing the interface into a more comprehensive word processing tool— a tool that is designed to achieve more than a single goal of writing a letter to a family member of a friend. It should first be established that interface metaphors are a critical design component when designing for an economically and technologically underserved ethnic minority group. Once there is empirical evidence to support the claim that interface metaphor selection and use play a significant role in user performance (and potentially satisfaction) among the ethnic minority group, then the AAII can be further developed into a tool that will support more word processing goals.

Given the scope and objectives of this research endeavor, comparing the GOMS or KLM predictions of the benchmark task times for Microsoft Word 2003 and the AAII would not provide substantive data/information. If the task predictions times for one of the systems are better than the other, it will not presently add value to the research goals of this project sense the two interfaces do not provide the same level of support for various word processing tasks. It would be more logical to perform this level of analysis in subsequent research activities.

Table 5D: Study Flow and Integration

Study	Type of Data	Data Obtained	Key Findings	Study Flow	Hypothesis #
STUDY 1	Quantitative	Computer Attitudes Score	Single Scores	→ STUDY 4	Hypothesis # 2
		General Self Efficacy Score			
		Spatial Abilities Test Scores			
		Perceptual Style Test Score			
		Acculturation Survey Score (ad-hoc qualitative analysis)	Single Score	→ STUDY 4	Hypothesis # 3
		Demographics Questionnaire			
STUDY 2	Qualitative	Video recorded discussion of new metaphor ideas	Metaphors of comfortability, writing location, and time of day & Preliminary design for their interface	→ STUDY 3	
		Salient themes for interface design			
		Low-fidelity interface design of the AAII (Using novel interface metaphor)			

Table 5D: Study Flow and Integration, continued

Study	Type of Data	Data Obtained	Key Findings	Study Flow	Hypothesis #
STUDY 3	Qualitative	Low-fidelity design developed into testable interface (AAII)	Finalized prototype for the AAII	→ STUDY 4	Hypothesis #2
		Suggestions for corrections and addition to the AAII		→ STUDY 4	Hypothesis #3
STUDY 4	Qualitative	Critical Incidents from AAII & MSWord 2003	Strength and Weaknesses of both Interface Metaphor Designs	QUALITATIVE & QUANTITATIVE Evaluation	Hypothesis #1
	Quantitative	Number of Detours (benchmark tasks)	T-test: Tasks 3, 4, & 5 significantly different on AAII & MSWord 2003		
STUDY 5	Qualitative	Cognitive Walkthrough Data from Latino Culture SMEs		Stand-Alone	

CHAPTER VIII. EMERGENT STUDY FIVE: SME COGNITIVE WALKTHROUGH

Introduction and Rationale

Study 5 was an emergent study, serving as a proxy for having actual Latino participants involved in each of the previously described studies. This study was included in this research project as a means of obtaining the Latino perspective on the two interface designs: AAII and MSWord 2003. Removing the Latino participants from the overall studies resulted in only having one novel and ethnically motivated interface design. Consequently, the AAII was employed in conjunction with MSWord 2003 for study 4 (Testing African-Americans on the AAII and MSWord 2003). The comparison between the two interfaces was based on their differences in interface metaphor selection and application.

The goal for selecting and alternative study was to maintain as much of the original research intent as possible. Based on the fact the Latino participants could not be successfully recruited, the researcher decided to implore the assistance of subject matter experts (SMEs) whose expertise is in inner-city Latino culture. These SMEs were asked to act as representatives of the target users (Latinos) and complete cognitive walkthroughs on the interfaces: the African-American inspired interface and Microsoft Word 2003. Doing cognitive walkthroughs with the SMEs was a way to collect information pertaining to the strengths and weaknesses of the designs, and to present those findings on behalf of the originally targeted Latino group with a usability inspection method.

Nevertheless, there are limitations to utilizing cognitive walkthroughs as an evaluation method. The cognitive walkthrough cannot be used alone for usability problem identification; it must be used with other evaluation methods. The cognitive walkthrough is also described as having low consistency across evaluators in comparison to usability testing (as reported in

Smith-Jackson, 2005). Therefore, the cognitive walkthrough designed for this dissertation only provides some insight into potential problems for Latino users. These results were not intended to be formally compared with the usability study with the African-American group; only the high level ideas, issues, concepts and metaphors are discussed in relation to each other.

Moreover, the cognitive walkthrough is a technique created for evaluating the design of a computer interface. This technique is designed to pay special attention to one aspect of usability --how well the interface supports exploratory learning (Wharton et al., 1994) –learnability (Spencer, 2000). This type of evaluation is typically done at the beginning stages of the design process to provide feedback and input for further design iterations. Cognitive walkthroughs assess each step of a single task (or a number of tasks) in an effort to expose design flaws that may impede users' exploratory learning with a given computer interface. One goal of the cognitive walkthrough is to elucidate mismatches between users' and designers' conceptualization of the task, unsuitable word choices for menu titles, button labels, and insufficient feedback concerning the consequences of users' actions (Wharton et al., 1994). Furthermore, the method allows designers to take on the user's perspective and identify any potential problems that the user may encounter during interaction with the computer interface (Smith-Jackson, 2005). Therefore, this evaluation methodology very precisely aims to address those critical questions pertaining to Latinos and their use of the AAII and the more mainstream MSWord 2003.

Methodology

The SME cognitive walkthroughs were completed in two separate sessions. There was one SME per session and each experienced one interface type. Each SME chose the location of their session; therefore, one session took place at an elementary school and the other took place

at the SME's home. The research first presented the SMEs with the informed consent form (see Appendix L). After reading and signing the consent forms the cognitive walkthroughs began.

SME Participants

The researcher recruited two SMEs that were capable of providing comments and design suggestions from the Latino perspective. Each SME recruited had a history of working with Latinos whose demographic attributes mirror those of the African-Americans that participated in studies one, two, three and four. As a result, the SMEs were asked to offer perspectives of 18 to 30 year-old Latinos, who (1) live in East Baltimore, (2) are of low socio-economic status, and (3) are novice computer users. The SME biographies are in Appendix M.

Procedure

The researcher facilitated the cognitive walkthroughs and followed a predetermined cognitive walkthrough script with the SMEs. This script supplied the SME with more detailed information about cognitive walkthroughs, its process and its outcomes. It also provided insight into why they were selected and what the researcher needed them to do. The full script can be found in Appendix N.

The usability evaluation used for this particular study was a streamlined version of Wharton's original design of the cognitive walkthrough (Spencer, 2000). In There are four relevant components of Spencer's implementation of the cognitive walkthrough. Those components and their sub-components are listed below.

1. Define inputs to the walkthrough
    a. Identification of users
    b. Sample tasks for evaluation
    c. Action sequences for completing the tasks

    d. Description of implementation of interface

2. Convene the walkthrough
    a. Describe the goals of the walkthrough
    b. Describe what will be done during the cognitive walkthrough
    c. Describe what will not be done during the walkthrough
    d. Explicitly defuse defensiveness
    e. Post ground rules in a visible place
    f. Assign roles
    g. Appeal for submission to leadership
3. Walkthrough action sequences for each task
    a. Tell a credible story for these two questions:
        i. Will the user know what to do at this step?
        ii. If the user does the right thing, will they know that they did the right, and are making progress towards their goal?
    b. Maintain control of the CW, enforce the ground rules
4. Record critical information
    a. Possible learnability problems
    b. Design ideas
    c. Design gaps
    d. Problems in the Task Analysis

Generally, cognitive walkthroughs are administered in small groups of experts. So component #2 is where the experts learn about their rules for interaction during the walkthrough and what role they will play during the actual walkthrough session. For the purpose of this

study, there was only one expert for each session. Thereby, the only assignment for the SME was to provide comments that would represent the perspective of Latino users. The researcher recorded each session, so it was unnecessary for the SME or the researcher to hand-write any notes during the session. All relevant notes were transcribed after the session.

Results of the Cognitive Walkthroughs with Latino Culture SMEs

The SMEs helped to uncover any potential learnability issues with the AAII and MSWord 2003 by answering a few questions as they walkthrough each step of each of the benchmark tasks. The sequence of actions for the benchmark tasks are in Appendix O. The essential questions were: (1) Will the user know what to do at this step? and (2) If the user does the right thing, will they know that they did the right, and are making progress towards their goal? As those questions were answered and discussed, learnability problems and corrective design ideas were also presented. Below are the key points that emerged from the sessions.

Results for MSWord 2003

Overall, the most salient learnability issues that surfaced were pertaining to use of ineffective terminology and inappropriate verbal and/or visual metaphor. Tasks 3, 5, 6, 8, 9, 10 and 11 were assessed in this cognitive walkthrough. Throughout the discourse about these tasks, there were a number of key findings as it relates to the target Latino population. Among those key findings were a list of the benchmark tasks that may potentially produce learnability challenges, a list of problematic labels/terminology, and a list of effective labels/terminology. All of the problematic labels/terminology are components of the learnability challenges present in the benchmark tasks. The benchmark tasks and the associated learnability issues are recorded in Table 19. Note that the issues mentioned below are not guaranteed to make the task

impossible to complete, but rather, these are issues may potential impede easy progress through the task.

Table 19: MSWord 2003 Potential Learnability Issues for Latinos

Benchmark Task	Learnability Issues	SME Explanation
Task 3 (SIZE)	Ineffective Terminology: "Format"	"Format" is not a common word and does not translate into Spanish.
Task 4 (COLOR)	No record	No record
Task 5 (FIX)	Inappropriate Metaphor: "Tools"	Latinos may not know that they can find "Spelling and Grammar" under "Tools".
Task 6 (SAVE)	Inappropriate Metaphor: "File" and "Disk"	If the Latino is not familiar with an office environment, he/she will not know that you can save things in files. Therefore, they would not know to go to the "File" menu selection to find a "Save" type function. Even though there is a picture of a disk next to the "Save" option (in the "File" drop-down), if the user does not have a physical floppy disk in front of them, he/she still may not know that the picture of the disk means "Save." Also the user may not know what a disk is from the beginning.
Task 8 (HELP)	Ineffective Terminology: "Microsoft Office Word Help"	The user my not be able to distinguish well the available options from the drop down list. The labels are not obvious in their function/purpose.
Task 9 (PRINT)	Inappropriate Metaphor: "File"	The user would not intuitively to go "File" to find "Print".
Task 10 (EMAIL)	No learnability issues reported	N/A
Task 11 (PIC)	Accessibility of the Function: "Picture"	The user would look to the [standard] toolbar first to see if he/she would be able to find a way to put a picture in the letter. They probably wouldn't go to the word menu for that.

Despite that fact that there were some potential learnability challenges with metaphor and terminology usage, there remains some positive and useful aspects to the MSWord 2003 design

for the target Latino population. The SME pointed out the labels/terminology that would be effective for the Latinos. Those words include:

- Style,
- Size,
- Color,
- Underline,
- Save,
- My Documents,
- Help,
- Search For,
- Go,
- Print,
- Ok ("Ok" is a very common expression among Latinos),
- Email,
- To,
- Send a Copy,
- Insert, and
- Picture.

Results for the AAII

The reoccurring learnability issues were related to use of inappropriate verbal and/or visual metaphor. For the purpose of discussing these results with those of MSWord 2003, only tasks 3, 5, 6, 8, 9, 10 and 11 were regarded here. The key findings from this discussion are highlighted in table 20 entitled "AAII Potential Learnability Issues for Latinos".

Table 20: AAII Potential Learnability Issues for Latinos

Benchmark Task	Learnability Issues	SME Explanation
Task 3 (SIZE)	No learnability issues	N/A
Task 4 (COLOR)	No learnability issues (Action Sequence #1) Inappropriate Metaphor: "Pen" (Action Sequence #2)	"Pen" graphic would not be intuitive to the Latinos for picking the color of the text. The "pen" would denote writing something. People would identify the "pen" with composing the letter (beginning the letter).
Task 5 (FIX)	No learnability issues	N/A
Task 6 (SAVE)	No learnability issues	N/A
Task 8 (HELP)	No learnability issues	N/A
Task 9 (PRINT)	Inappropriate Metaphor: "Final Draft"	"Final Draft" may not be a commonly used expression amongst Latinos.
Task 10 (EMAIL)	Inappropriate Metaphor: "Final Draft"	"Final Draft" may not be a commonly used expression amongst Latinos.
Task 11 (PIC)	Inappropriate Metaphor: "Table"	In the Latino culture the "table"—la mesa is most important for food and meals. You would see bread, butter, salad, coffee, etc. "La Mesa" is very important. Their meals are very important. Table in Latin America does not translate into "Work" table. Maybe this should be the "desk" verses it being the table.

There was one other potential metaphor challenge associated with the "Save" task (task 6). In the AAII, a person can select from several locations to save his/her document. One of those locations is a "drawer" (i.e., drawer where you store clothing). The SME stated that the "drawer" may not be a place where someone saves their letter. Moreover, the SME did identify some effective labels and terminology that are already applied in the design as function labels or direction within the interface:

- Letter Size,
- Letter Color,
- Make Corrections,

- Save,
- Name Your Letter,
- Ask for Help,
- Print,
- Yes, and
- Send Mail.

All of the noted potential learnability issues were most insightful and useful. However, the discussion about the "table" ("la mesa") metaphor in the AAII was a classic example of poor transferability of concepts between cultural groups. The SME communicated the point that in Latino culture the "table"—"la mesa" is for food and meals. On "la mesa" one would possibly see bread, butter, salad, coffee, etc. "La Mesa" is traditionally very significant in Latino culture; their meals are important. The African-American participants who conceptualized the overall interface design intended for the "table" to be perceived as a place where you do work. "Table" in Latin America does not translate into "work" table and may be a source of confusion for Latino use.

Cultural Aspects for Usability Considerations for Latino Users

The SMEs' recommendations for design changes were the focal source of identifying any cultural aspects for good usability in relation to the Latino group. The majority of the SME's cultural design considerations that are common to both interfaces are recommendations that would facilitate a reduction in Sweller's (1988) cognitive load. Design considerations for both interfaces are juxtaposed in Table 21.

Table 21: Cultural Aspects for Good Usability Consideration for Latinos in MSWord 2003 and the AAII

SME Discussion for MSWord 2003	SME Discussion for AAII
Use demonstrations to facilitate user understanding of the function labels. (e.g., The label heading for "Font" should show the word "font" written with different lettering styles.)	Use demonstrations to facilitate user understanding of the function labels. (e.g., The label heading for "Font" should show the word "font" written with different lettering styles.)
Use metaphor that are socially familiar to Latino culture and language	Use metaphor that are socially familiar to Latino culture and language
Use simple and concise function labels	Use simple and concise function labels
Make frequently used functions more salient and accessible (e.g., those functions should have there own labels at the top of the screen.)	Make frequently used functions more salient and accessible (e.g., those functions should have there own labels at the top of the screen.)
Make use of pictures and symbols with the words for labels.	Make use of pictures and symbols with the words for labels (e.g., the picture of a question mark on the button with the label).
Make use of colorful displays	Use clearly discernable pictures/graphics
	Minimize the amount of reading
	Incorporate appropriate cultural values into the interface design (e.g., From a cultural perspective it is most appropriate to have a Latino person show up inside the "Ask for Help" pop-up box. Culturally, Latino people value family, people and personal interaction with others. Having the lady in there smiling makes it look interactive.)
	Use effective meaningful pictures

While the cognitive walkthrough evaluation method is primarily concerned with identifying potential learnability issues and recommendations for design changes, the SMEs also made several points about what design aspects would work well. One of the design benefits was apparent while one SME walked through task 8 (HELP) with the AAII. The SME commented on the welcoming appearance of the smiling woman of color when the user selects the "Ask for Help" function. The SME stated that Latino people are extremely family-centered and they value personal interaction with others. Chong and Baez (2005) also describe Latinos as valuing collectivism and "simpatía." They consider Latinos collectivist because Latinos value the

personal satisfaction and self-assurance they garner by being in the company of other people. "Simpatía" speaks of the qualities one uses to foster pleasant social interactions (as stated in Chong and Baez, 2005). "Simpatía" does not exactly translate into an English word, but is the catalyst for relationship development among family and friends. In Latino families, relationships gain strength through "simpatía", and aunts and uncles often become confidants, mentors and advisors as children mature into adulthood. The smiling woman of color that appears as the user asks a question embodies both Latino cultural values. This is an example of including cultural elements in interface design.

Table 5E: Study Flow and Integration

Study	Type of Data	Data Obtained	Key Findings	Study Flow	Hypothesis #
STUDY 1	Quantitative	Computer Attitudes Score	Single Scores	→ STUDY 4	Hypothesis # 2
		General Self Efficacy Score			
		Spatial Abilities Test Scores			
		Perceptual Style Test Score			
		Acculturation Survey Score (ad-hoc qualitative analysis)	Single Score	→ STUDY 4	Hypothesis # 3
		Demographics Questionnaire			
STUDY 2	Qualitative	Video recorded discussion of new metaphor ideas	Metaphors of comfortability, writing location, and time of day & Preliminary design for their interface	→ STUDY 3	
		Salient themes for interface design			
		Low-fidelity interface design of the AAII (Using novel interface metaphor)			

Table 5E: Study Flow and Integration, continued

Study	Type of Data	Data Obtained	Key Findings	Study Flow	Hypothesis #
STUDY 3	Qualitative	Low-fidelity design developed into testable interface (AAII)	Finalized prototype for the AAII	→ STUDY 4	Hypothesis #2
		Suggestions for corrections and addition to the AAII		→ STUDY 4	Hypothesis #3
STUDY 4	Qualitative	Critical Incidents from AAII & MSWord 2003	Strength and Weaknesses of both Interface Metaphor Designs	QUALITATIVE & QUANTITATIVE Evaluation	Hypothesis #1
	Quantitative	Number of Detours (benchmark tasks)	T-test: Tasks 3, 4, & 5 significantly different on AAII & MSWord 2003		
STUDY 5	Qualitative	Cognitive Walkthrough Data from Latino Culture SMEs	Cultural Aspects for Usability Considerations	Stand-Alone	

CHAPTER IX. OVERALL DISCUSSION

This research endeavor explored the relationships between culture and computer interface metaphor design. Together, these studies provided an opportunity to (1) develop and administer an interface design process, (2) identify interface design preferences of African-Americans and (3) determine the African-Americans' level of performance with the African-American Inspired Interface (AAII) and MSWord 2003; determine areas of strengths and weakness of the AAII and MSWord 2003 for the Latino group as well.

Studies Two and Three: Implementation of the A.I.D. Methodology and Interface Implementation and Formative Evaluation

The experimental design and implementation structure of studies two and three offered a more ecologically-valid method for designing for various cultures and discovering design characteristics that make computing simpler and more user-centered. With the A.I.D. methodology the participants were able to inform the design of the AAII with ideas and concepts that were already integrated into their daily living. The resulting interface design, the AAII, employed a composite metaphor. The integration of the home/bedroom interface metaphor with the writing task was most innovative and quite unique. The AAII design features provided its users with an environment of personal comfort (and optional entertainment). The background design of the AAII gives the user an opportunity to customize their "writing space" to be an environment where they are most inspired for their writing task.

Participatory design was the key factor in the conceptualization and design of the AAII. Consequently, the AAII design, in its final form, embodied several African-American cultural elements. These cultural traits/values include sharing one's life with family and close relationships (Hecht et al., 2003), and African-American preferred learning styles (Belgrave and

Allison, 2006). African-Americans are known to be inclined towards collectivism (Hofstede, 1997) in their behavior and communication styles. Hecht et al. (2003) reports that African-Americans develop closer and deeper relationship with friends and/or family than European Americans do. Interconnectedness, interrelatedness, sharing and interdependence characterize the depth of those relationships. These relationships often demonstrate a greater level of intimate communication cross all areas of life (as stated in Hecht et al., 2003). These cultural values are most successfully integrated into the "Ask for Help" function in the AAII. The participants who conceptualized and designed the AAII agreed to include a matured African-American woman (a mother figure) as a part of the "Ask for Help" function. The participants felt that they would be more comfortable asking a mother-like figure for help with writing their letter to a family member of friend. This example is a demonstration of their value for sharing and interdependence.

A second cultural element that appears with the AAII is a preferred learning style for African-Americans. African-Americans are most akin to relational learning styles, while European Americans are more analytical in their learning approach (Belgrave and Allison, 2006). An analytical learning style is associated with an elemental way of organizing information, and defines the learner as being stimulus centered, field independent and reflective (in his/her information processing). Conversely, relational learners are holistic in their information processing. This holistic learning comprises three information processing constructs: self-centeredness, field dependence, and spontaneity (as stated in Belgrave and Allison, 2006). In self-centeredness, learners process information by orienting towards social and personal cues present in the learning environment; these learners are inclined to focus on the personal aspects of the learning environment, rather than on the objects in that environment.

Field dependence refers to the inclination to perceive and process components of information holistically (Belgrave and Allison, 2006). Self-centeredness and field dependence are both embodied in the AAII design. The participants thought that is was important have an interface design that given them the option of personalizing their work/writing space with items and ideas that are typical of their daily lives in the home environment. The AAII design enables the user to select items to decorate the room and different types of paper to write their letter on. In addition, their partiality towards having their work/task embedded in a personalized "home" environment is a clear indication of field dependence.

The final point about the cultural elements in the AAII is relevant to the incorporation of the radio and television in the design. During the focus group the participants talked about needing the radio and/or television to be a distraction to aid their focus. As odd as that may sound, the participants were communicating the need for a high stimulus environment. As Belgrave and Allison (2006) discuss cognition, learning and language for African-Americans, they talk about how verve and rhythm influence learning style. Verve describes an improvisational style that uses rhythmic and creative expression. Verve emerges from the high stimulus environments of African-American homes and neighborhoods. African-American living has been described as comprising a lot of variability and physical intensity.

Rhythm, consistent repetition of elements in speech, music, art and everyday living, is conveyed through various activities of daily living. Both verve and rhythm have showed to enhance learning among African-American children (as stated in Belgrave and Allison, 2006). More specifically, the relevant study revealed that African-American children had a higher preference for task variety and physical stimulation.

Studies Four and Five: Testing African-Americans on the AAII and MSWord 2003 and SME Cognitive Walkthrough

The experimental design implemented for study four provided a basis for comparing the interface metaphors used in both the AAII and MSWord 2003 designs. The qualitative and the quantitative data revealed that the most salient point of concern for designing culturally appropriate interfaces is to simplify the metaphoric (verbal and pictorial) representations of labels. Frohlich (1997) would have identified this simplification of the labels as a means for cognitive directness, a principle for interactions that advocates for "least cognitive effort", employing familiar terminology in conjunction with coherent real-world metaphor. The function/option labels were both the source of positive and negative critical incidents. The African-American participants performed better on benchmark tasks 3, 4 and 5 when using the AAII versus MSWord 2003. It was most clear that the metaphoric use of terminology was problematic for these users. Consequently, the unfamiliar terminology and concepts were a source of the participants' mental model breakdowns (Neale and Carroll, 1997).

To achieve more culturally inclusive interface designs, designers must be able to identify culturally valid interface metaphor to utilize in a particular design. Culturally appropriate metaphor usage aids the user as they retrieve appropriate schemas to apply any to novel computer applications. Accurately applying schemas from long-term memory will provide a reduction in overall cognitive load and reduce the possibility for user error (Sweller et al., 1998).

Cognitive Load Theory (Sweller et al., 1998) (CLT), as a framework for discussing the participants' experience with unfamiliar computer interface designs, provides further insight into the cognitive processes that are affected when there is ambiguity designed into the interface. The qualitative data (and some of the quantitative data) obtained from the African-Americans and the

Latino culture subject-matter-experts suggested that some of the metaphoric representations were inappropriate for the participants. Culturally inappropriate interface metaphors add a burden to the ethnic minorities' performance, particularly with MSWord 2003. All interface designs should be considered in relationship to the cognitive load that they invoke upon the users. As users work toward achieving their goals, they utilize mental models (schemas within long-term memory) to help them navigate through a novel design (Neale and Carroll, 1997). When the design does not match the users' expectation, he/she will have to perform more cognitive processes with the limited working memory capacity. Here the extraneous cognitive load is a cause for user error during performance; the intersection of CLT and interface usability rests here. The extraneous cognitive load impedes learnability and increases the error rate. The high extraneous cognitive load is a result of inappropriate interface design aspects. A good design would promote germane cognitive load which directs the individual to schema development (learning) (Sweller et al., 1998).

Nevertheless, there were notable interface metaphors that worked well. Various aspects of both the qualitative data and the quantitative data offered illumination of the successful components of the interface metaphor designs. For example, the African-Americans performed well with the function labels that used an "alphabet" metaphor. From a qualitative perspective the African-Americans performed better on the AAII, as a result of the simplicity of the terminology incorporated into the design. SMEs of study five reported that simple terminology would work favorably for the Latino group also. However, there were some cultural differences found amongst the ethnic groups as it related to the interface metaphor used. For example, the "table" metaphor in the AAII, which represented a place where the user could find tools and options for writing a letter, was inappropriate for the Latino group because table ("la mesa") has

different cultural significance for Latinos. For the Latino group "la mesa" is primarily associated with eating meals.

Acculturation

Ethnic minorities whose acculturation level is characterized as low in other-group orientation and who reside in underserved communities may not get the same opportunities to become adept with computer technologies. These individuals will more than likely have divergent expectations concerning ideas and concepts of the computer applications; they have not had enough exposure to the computer application's novelties and may have a more difficult time trying to draw meaning from the terminology and metaphors derived from mainstream culture. Therefore, ethnic minorities in underserved communities do not have the same level of "accessibility" to the computer applications. Accessibility is defined in two distinct ways. The first definition would be related to an individual's access to the computer hardware and software. The second (and most relevant) definition of "accessibility" is related to the computer software's capacity to address the culturally induced needs of the user (Smith-Jackson and Williges, 2001).

CHAPTER X. CONCLUSIONS

Does culture influence the preference of and performance with computer interface metaphor among ethnic minorities of low socio-economic status? The simplest answer is "Yes." Culture played an active and noteworthy role in the process, preference and performance stages of this research. In conclusion, this research endeavor produced several outcomes, which may be used immediately. The first outcome is the A.I.D. methodology for developing interface metaphors for culturally divergent groups. The A.I.D. methodology serves as a mechanism to engage generally marginalized groups in the interface design process and to produce interface designs that reflect a greater level cultural competence. Second, the research offers interface designers further insight into useful interface metaphors that appeal to African-Americans and Latinos, and the interface metaphors that do not augment learnability and reduce errors.

It must be noted that the researcher's experiences as a young African-American woman (who was familiar with Baltimore inner city life) is a factor in the interpretation of what is occurring across the various methods of triangulation involved in these studies. The researched applied a systematic experimental design where researcher bias would not contaminate the data used for statistical analyses. Conversely, the interpretation of the qualitative data, by its very nature, is filtered through the researcher's personal sensibilities.

The African-American participants performed significantly better on task 3 and 4 using the AAII; the remaining tasks did not show any statistical significant differences in performance between the AAII and MSWord 2003. However, it was apparent through the qualitative reports that AAII produced less negative critical incidents and resulted in more positive critical incidents in comparison to MSWord 2003.

In brief, the use of inappropriate labels and/or pictures provided a catalyst for negative experiences with the computer interfaces. These negative experiences cause frustration, and in some cases the participant could not complete the task in a timely manner. The risk of employing inappropriate interface metaphor and thereby challenging the user's mental model with the metaphoric design components includes: (1) decreased productivity, (2) increased occurrence of usability problems with the interface, and potentially (3) increased frustration, and (4) overall dissatisfaction with the interface. Points one and two were directly observable as a result of these empirical studies. Points three and four are not actively supported by the result discussed in this document; however, they can certainly be a by-product of decreased productivity and poor usability. It is important to take note of these issues and provide appropriate interventions, since they have the propensity to create barriers to access for typically marginalized populations.

So what might this mean for human factors engineers and human-computer interaction designers? The focal takeaway is that accounting for culture's affect on interface metaphor design is the duty of interaction researchers and designers. Researchers and designers must consider the cognitive load that interface design imposes on a user (especially a novice user). Even though Cognitive Load Theory (CLT) is typically applied to instruction design, its basic components and underlying philosophy is applicable for achieving good learnability within an interface design. As in CLT, interface designers must endeavor to remove all extraneous information and thereby reduce the overall cognitive load of the user. The goal is to reduce the amount of cognitive processing that is not devoted to schema construction (learning). The application of augmented interface design methodologies, such as the A.I.D. methodology, can

lead researchers and designers in the elicitation of culturally valid interface metaphors that are meaningful to typically marginalized groups.

A myriad of cultures comprise our global society. One might ask the question "Is it feasible, or even sensible, for interaction designers to develop computer interface metaphors for every identifiable culturally divergent group?" Clearly, it is not feasible to develop a different version of an interface design for each group. On the other hand, it is feasible for designers to be cognizant of applications that include a broad array of user groups, and integrate known interface metaphor solutions that provide cultural value for multiple groups. For example, the "Ask for Help" function in the AAII contains elements of cultural significance for both Latino group and the African-American group. It is most critical to incorporate this type of scholarly inquiry into the philosophies about designing for broadly diverse groups of people. Maintaining an effective level of cultural competence in design will create the foundation for achieve inclusive design.

Implications for Future Research

Addressing the research questions of this dissertation work has produced as a list of new questions for further research development. The widespread implications the role of culture in computer interface metaphor design is almost boundless when considering the rapid penetration of computing (and Internet) technologies into the everyday lives of citizens of the globe. This dissertation research should be extended to examine the following issues:

- Each metaphor represented in the tasks for the AAII and MSWord 2003 needs to be studied individually. This dissertation research only assessed these metaphors at a peripheral level. Participants would need to have an opportunity to discuss and rework any faulty interface metaphors.

- The metaphors previously mentioned should also be studied and compared with a larger sample of participants ranging in their cultural background.
- Another study should be designed to more skillful study the performance and critical incidents reporting in its relationship to acculturation (total ethnic identity and other-group orientation). This study should be designed to directly include a line of inquiry pertaining to the relationship between an individual's level of acculturation and their proficiency with mainstream computer terminologies such as Microsoft products. The acculturation questions would need to be more narrowly focused on the ethnic minority member's level of adaptation to and ownership of the majority population cultural mores that are being represented in the computer application.

There are a number of other opportunities for research that are related to the implications of this dissertation work. Further study may include: (1) methods for designing culturally appropriate interface designs for electronic government applications, (2) comparisons of cultural appropriateness between MSWord 2003 and the newly released MSWord 2007, (3) culturally informed icon-driven interface designs, and (4) educational computer interfaces for ethnic minorities.

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APPENDIX A: TELEPHONE SCRIPT

1. Are you calling to participate in Kayenda Johnson's research?
   Thanks so much for your interest! I have a few questions that I need to ask you.

What is your name?: _____

Phone Number:_____

2. How did you here about this project? Did you receive a flyer?
3. Are you African-American ?
4. Do you live in East Baltimore? Which area?
5. Are you between the 18 to 30 years of age?
6. What is your occupation?
7. Do you ever use a (personal) computer? How often have you used computers?
8. I have a question about your household income. How many people are in your household?

# of Persons in Household	1	2	3	4	5	6	7	8 or more
HOUSEHOLD INCOME	$23,250 or less	$26,550 or less	$29,900 or less	$33,200 or less	$35,850 or less	$38,500 or less	$41,150 or less	$43,800 or less
	Over $23,250	Over $26,550	Over $29,900	Over $33,200	Over $35,850	Over $38,500	Over $41,150	Over $43,800

YES: Well, you MEET the requirements to participate in this research. Which day are you available?

If not, What times are you available on those days: LIST THE TIMES HERE…
Give a brief description about what things the participants will have to do.

Meeting Place: XXXXXXXXX or XXXXXXXXXX

Directions: (Ask for their address if necessary)

Please remember that you will be paid for participating in this research.

I will call/contact you to remind you of our appointment (2 days before or appointment) and give you any additional details. The session will start off with discussion about the research that you are going to participate in. You will also have an opportunity to review what the research will involve (and determine if you want to continue with the research). There will be five to nine of people there as participants.

*The 1st session will be mostly concerned with introducing you to the project and getting some background information from you.
*The 2nd session will be more interactive. My goal is for this to be a fun activity!

Do you have any questions?

I'm am glad that you will be participating. I look forward to meeting you. If you have any questions please feel free to call me @ XXX-XXX-XXXX.
Can I verify your telephone number? Is there a good time to call you?

No: Unfortunately, you do not meet the requirements for participation. Explain why.

APPENDIX B: INFORMED CONSENT FORM

Title of Project: Ethnicity and Socio-Economic Status: Factors for Computer Interface Design
Principal Investigator: Kayenda T. Johnson
IRB #: 05-494

PURPOSE OF PROJECT

You are invited to participate in a research project designed to develop computer interface designs that accommodate the interface metaphor preferences of ethnic minorities (i.e., Hispanic-Americans or African-Americans). There will be a total of 16 to 20 Hispanic-Americans and African-Americans recruited for participation in the three studies discussed below. The purpose of this project is engage members of ethnic minorities in the process of developing culturally valid interface metaphor.

INFORMATION

First, you will be asked to complete a number of questionnaires and paper-and-pencil cognitive tests. The questionnaires will be comprised of a demographics questionnaire, an acculturation survey, a general self-efficacy questionnaire and a computer attitudes questionnaire. In addition, you will be asked to take a spatial abilities test and a perceptual style test. The responses that you provided during your participation in this study may be audio recorded. The approximate time to complete this study is 1.5 hours.

Second, you will participate in a focus group where the purpose is to develop new ideas for computer interface design. Before the focus group you will be asked to use a disposable camera (that the researcher will provide) to take pictures of the things you would use to perform a writing task. You will use those pictures during the focus groups to initiate discussion about new computer interface designs. In the focus group session you and 7 to 9 other individuals will discuss their ideas with the focus group leader. At the end of the focus group you will help to design a simple model of the interface based on the group's ideas. The responses that you provided during your participation in this study will be video recorded. The approximate time to complete this study is 2 to 2.5 hours.

Third, you will be asked to participate in a formative evaluation session designed to present an opportunity for you to provide feedback and voice your concerns about the interface design after it is implemented into a real computer interface. The responses that you provided during your participation in this study may be audio and/or video recorded. The approximate time to complete this study is 45 minutes to 1 hour.

RISKS

There are no physical or emotional risks associated with this research project. However, you may find that some of the questions or tasks associated with these studies may be difficult to answer and may result in frustration.

BENEFITS

Your participation will provide the data required to help the researcher enrich the body of knowledge in the field of Human-Computer Interaction.

At the end of this session, you will be provided with a copy of this form. At the bottom of this form, you will find contact information that can be used to contact the principal investigator after the research has been completed in order to receive information about the results.

CONFIDENTIALITY

The information gained in this research project will be kept strictly confidential. At no time will the researcher release the results of the study to anyone other than individuals working on the project without your written consent.

You will be identified only by a 3-digit participant code. All written, audio and video recorded data will be stored securely in a locked file case in the primary researcher's office. Only the primary researcher and designated research staff will have access to the data for the purpose of research discussions and publications. No reference will be made in oral or written reports that could link you to the data, nor will you ever be identified as a participant in the project. All audio and video data records will be erased shortly after the completion of this research.

COMPENSATION

Your compensation will include being paid $7.50 for each hour that you spend participating in this research project.

FREEDOM TO WITHDRAW

You are free to withdraw from this study at any time without penalty. In addition, during the course of this study, you are free not to answer any questions that you choose not to.

APPROVAL

It is very important that you keep the activities and information discussed during your sessions confidential, since others will be participating in this research.

QUESTIONS

If you have questions or do not understand the information on this form, please feel free to ask those questions or voice your concerns now.

PARTICIPANT'S PERMISSION

I have read and understood the Informed Consent and conditions of this project. I have had all of my questions answered. I agree to abide by rules of this project.

I hereby acknowledge the information and requests stated above and give my voluntary consent for participation in this project. Nevertheless, I understand that I may withdraw at any time without penalty.

Please place your initials next to the appropriate statement of consent.

_____ I **consent** to be audio and video taped as a part of my participation in these studies.

_____ I **do not consent** to be audio and video taped as a part of my participation in these studies.

Signature _____

Date _____ **Phone Number** _____

CONTACT

If you have questions at any time about the project or the procedures, you may contact the principal investigator, Kayenda T. Johnson at kajohns5@vt.edu. Additional contact information will be made available once on site of study.

If you feel you have not been treated according to the descriptions in this form, or your rights as a participant have been violated during the course of this project, you may contact the Chair of the Institutional Review Board Research Division at Virginia Tech, Dr. David M. Moore, at 540-231-4991.

Directions: Please complete the following items about you background.
Age:

Gender: Male or Female

Marital Status:
Single/Never been married Single/Divorced Married/Separated Married

Ethnic-Background
1. Ethnicity: African-American or Hispanic-American

2. Country of Your Birth:

If you were not born in the United States, at what age did you arrive in the United States:

3. Country of Mother's Birth:

4. Country of Father's Birth:

5. What language(s) do you speak?

6. Language spoken most often?

7. Language spoken at home?

Current Residence and Income
1. Years of Residence in the United States
    a. 0 to 1 year
    b. 2 to 5 years
    c. 6 to 10 years
    d. More than 10 years

2. Which neighborhood in East Baltimore do you live?

3. Are you currently employed? What is your occupation?

4. Are you are a student? What are you studying? What school do you attend?

5. Please circle the income description that applies to you. First, locate the column with the number of persons in your household. Second, in the same column, circle the income description that applies to you.

# of Persons in Household	1	2	3	4	5	6	7	8 or more
Household Income	$23,250 or less	$26,550 or less	$29,900 or less	$33,200 or less	$35,850 or less	$38,500 or less	$41,150 or less	$43,800 or less
	Over $23,250	Over $26,550	Over $29,900	Over $33,200	Over $35,850	Over $38,500	Over $41,150	Over $43,800

Education

1. What is the last level of education you have completed?

a. Middle School
b. Some High School
c. High School
d. Some College
e. College
f. Post College
g. Trade School
h. Technical School
i. Other: _____

Computer Experience and Use

1. How often do you use a personal computer?

a. Never
b. Once or Twice a Year
c. Once or Twice a Month
d. A Few Times a Week
e. Daily

Please circle all that apply:

2. Where do you use a personal computer(s)?

a. I do not use a computer
b. Home
c. Work
d. Library
e. School
f. Community Center
g. Other: _____

Please circle all that apply:

3. What do you use a computer for?
    a. Writing letters, notes and/or messages
    b. Calculating numbers
    c. Email
    d. Surfing the Web
    e. Instant Messaging
    f. Watching Videos
    g. Computer Games
    h. Online Games with others
    i. Getting information from the Web
    j. Other: _____
    k. I do not use computers

4. What types of technologies do you use? For example, cell phones, DVD players, VCRs, televisions, microwaves, walkie-talkies etc.

Please list the various technologies that you use below:

APPENDIX D: MEIM (English)

MEIM (English)

In this country, people come from a lot of different cultures and there are many different words to describe the different backgrounds or ethnic groups that people come from. Some examples of the names of ethnic groups are Mexican-American, Hispanic, Black, Asian-American, American Indian, Anglo-American, and White. Every person is born into an ethnic group, or sometimes two groups, but people differ on how important their ethnicity is to them, how they feel about it, and how much their behavior is affected by it. These questions are about your ethnicity or your ethnic group and how you feel about it or react to it.

Please fill in:

In terms of ethnic group, I consider myself to be _____

Use the numbers given below to indicate how much you agree or disagree with each statement.

Statement	Response (Place an X in the box that matches your answer).			
	STRONGLY DISAGREE	SOMEWHAT DISAGREE	SOMEWHAT AGREE	STRONGLY AGREE
	1	2	3	4
1. I have spent time trying to find out more about my own ethnic group, such as its history, traditions, and customs.				
2. I am active in organizations or social groups that include mostly members of my own ethnic group.				
3. I have a clear sense of my ethnic background and what it means for me.				
4. I like meeting and getting to know people from ethnic groups other than my own.				
5. I think a lot about how my life will be affected by my ethnic group membership.				
6. I am happy that I am a member of the group I belong to.				
7. I sometimes feel it would be better if different ethnic groups didn't try to mix together.				

8. I am not very clear about the role of my ethnicity in my life.				
9. I often spend time with people from ethnic groups other than my own.				
10. I really have not spent much time trying to learn more about the culture and history of my ethnic group.				
11. I have a strong sense of belonging to my own ethnic group.				
12. I understand pretty well what my ethnic group membership means to me, in terms of how to relate to my own group and other groups.				
13. In order to learn more about my ethnic background, I have often talked to other people about my ethnic group.				
14. I have a lot of pride in my ethnic group and its accomplishments.				
15. I don't try to become friends with people from other ethnic groups.				
16. I participate in cultural practices of my own group, such as special food, music, or customs.				
17. I am involved in activities with people from other ethnic groups.				
18. I feel a strong attachment towards my own ethnic group.				
19. I enjoy being around people from ethnic groups other than my own.				
20. I feel good about my cultural or ethnic background.				

Write in the number that gives the best answer to each question.

21. My ethnicity is

_____

(1) Asian, Asian American, or Oriental

(2) Black or African American
(3) Hispanic or Latino
(4) White, Caucasian, European, not Hispanic
(5) American Indian
(6) Mixed; parents are from two different groups
(7) Other (write in): _____

22. My father's ethnicity is (use numbers above)
_____
23. My mother's ethnicity is (use numbers above)
_____

APPENDIX E: COMPUTER ATTITUDES QUESTIONAIRE

Computer Attitudes Questionnaire

Directions: Please read the statements that are labeled 1, 2, 3, 4, and 5.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

In the space provided write the number that matches the following statements.

_____ I would prefer to type a paper on a word processor than on a typewriter.

_____ Whenever I use something that is computerized, I am afraid I will break it.

_____ I like to keep up with technological advances.

_____ I know that I will not understand how to use computers.

_____ Using a computer is too time consuming.

_____ I feel that having a computer at work would help me with my job.

_____ I prefer not to learn how to use a computer.

_____ I would like to own, or I do own a computer.

_____ I like to play video games.

_____ I feel that the use of computers in schools will help children to learn mathematics.

_____ I prefer to use an automatic-teller for most of my banking.

_____ If I had children, I would not buy them computerized toys.

_____ I have had bad experiences with computers.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

_____ I would prefer to order items in a store through a computer than wait for a store clerk.

_____ I feel that the use of computers in schools will negatively affect children's reading and writing abilities.

_____ I do not like using computers because I cannot see how the work is being done.

_____ I would prefer to go to a store that uses computerized price-scanners than go where the clerks enter each price into the cash register.

_____ I do not feel I have control over what I do when I use a computer.

_____ I think computers and other technological advances have helped to improve our lives.

_____ I do not like to program computerized items such as VCRs and microwaves.

APPENDIX F: GENERAL SELF-EFFICACY SCALE

Directions: Please read the phrases that are labeled 1, 2, 3, and 4.

1 = Not at all true **2** = Hardly true **3** = Moderately true **4** = Exactly true

In the space provided write the number that matches the following statements.

_____ I can always manage to solve difficult problems if I try hard enough.

_____ If someone opposes me, I can find the means and ways to get what I want.

_____ It is easy for me to stick to my aims and accomplish my goals.

_____ I am confident that I could deal efficiently with unexpected events.

_____ Thanks to my resourcefulness, I know how to handle unforeseen situations.

_____ I can solve most problems if I invest the necessary effort.

_____ I can remain calm when facing difficulties because I can rely on my coping abilities.

_____ When I am confronted with a problem, I can usually find several solutions.

_____ If I am in trouble, I can usually think of a solution.

_____ I can usually handle whatever comes my way.

APPENDIX G: PARTICIPANT HOME ASSIGNMENT

Directions: Please read the following paragraph and following the instructions given.

Scenario:

Imagine that you need to send a message to a family member. Right now this family member does not have a cell phone or a house phone. Therefore, the only way you can communicate with this person is by a hand-written note or letter. Think about all of the things that would to be useful to you when writing your note or letter.

Assignment:

Your assignment is to use a disposable camera to take photographs of the things that you consider to be useful when writing a note/letter by hand (pen-and-paper). These could be pictures of:

1. What you would write with,
2. What you would write on,
3. The environment that you are in (inside or outside),
4. Other people that help you to write the note/letter,
5. Time of day you perform the task,
6. The sequence of activities performed to complete the task,
7. What you are wearing while they as they do the task, etc.

Those are just examples of what you could photograph. *Feel free to take pictures of* ***ANYTHING*** *that you think is important when you are writing a note or letter.*

The purpose of the pictures would be to facilitate your recall of the task details once you get into the focus group session. **Remember your thoughts and opinions are valued and are very important for this research project.** There are NO wrong ideas or thoughts.

Call me if you have questions:

Kayenda Johnson
XXX-XXX-XXXX

APPENDIX H: DESIGN SCENARIOS

Scenario 1:

Shawntay's cousin and best friend moved from Baltimore, MD to Philadelphia, Pennsylvania nearly two months ago. Shawntay lives in Baltimore, which is approximately 120 miles from Philadelphia. Shawntay misses her cousin greatly and has so many things to tell her. Since Shawntay's family does not have a car to visit her cousin, Shawntay's mother suggested that she write her a letter so that she can tell her cousin what has been happening in Baltimore. Just one month ago Shawntay gave birth to her first child; so Shawntay decided that after she feed the baby and rocked him to sleep, she would begin her letter. Once the baby was sleep, she went to her bedroom and put on some relaxing clothes and turned on some music. Then she began to write her letter and tell her cousin about how the baby was growing nicely and the new things he had been doing over the last month. She also told her cousin that the baby usually takes 2 hours naps….as soon as she wrote that sentence, she could hear her son beginning to wake up for his next bottle. She gets up and tends to the baby. As soon as she got the opportunity she went back to writing her letter. She added a few more paragraphs and asked her mother if there is anything else she forgot to tell her cousin in the letter; Shawntay doesn't want to leave anything out. Shawntay wants to include some pictures of the baby in the letter.

Scenario 2:

James is currently finishing up his preparation for taking his GED test two weeks from now. He has done very well in his GED classes so far and is expecting to begin looking for job. His wants to apply for a position as a delivery person for United Parcel Services (UPS). He does not have Internet access at his home to access the UPS application online; however, he has the address for requesting an application to be sent to his home. He wants to start writing his application request letter tonight. Before James starts his letter he goes to his bedroom and puts on some shorts and a t-shirt. For extra privacy he shuts and locks himself in his bedroom; he feels more comfortable writing when there are no distractions.

APPENDIX I: BENCHMARK TASKS FOR STUDIES 3 & 4

Task 1: Pretend that you are in your bedroom and you are getting ready to write a letter to your friend.

Prepare the bedroom (screen) so that it is the environment that you would like to write in and it looks the way you want it to.

Note: Please do not do anything to the actual letter on the right side of the screen.

Task 2: Select the kind of paper you would like your letter to be on.

Task 3: Find where you can change the size of a "letter" or a "word."

Task 4: Find where you can change the color of a "letter" or a "word."

Task 5: Find where you can fix any mistakes that you may have found in your letter.

Task 6: Imagine that you need to take a break from writing your letter to eat lunch or dinner. You have decided to put your letter away in a place where you can find it later.

Find the place on this computer that will let you keep your letter until you are ready to finish it. Store your letter (where you would like to keep it). *You can name your letter whatever you would like.*

Task 8: You are writing your letter to your friend and you cannot figure out how to describe what you wore to the party in just a few words.

Find the place on this computer that will give you some assistance.

Task 9: You have just finished writing your letter on the computer and you want to get what you wrote on paper so that you can send it to your friend by postal mail.

Find the place on this computer that will let you put what was written on the computer onto paper.

Now complete this process.

Task 10: You have just finished writing your letter on the computer, and you want to send what you wrote to your friend.

Find the place on this computer that will let you send your letter to your friend through email. Next, send your letter to your friend through email.

Your email address should be: Yourname@email.com
Your Friend's email address is: David@email.com

Task 11: Put a picture (whatever picture you find) in your letter.

Task 12: Imagine that you took a break from writing a letter to your friend Karla. Before you took your break you stored your letter on the "table" on your computer.

Part A: Find the place on this computer that will let you keep your letter until you are ready to finish it. Store your letter on the "table" with the name "Karla's Letter."

Now, you have finished eating your lunch or dinner and you want to complete your letter to Karla.

Part B: Find (the location of) your unfinished letter to Karla.

APPENDIX J: RESEARCH SESSION SCRIPT FOR STUDIES 3 & 4

Preparation for Administering the Benchmark Tasks

I. **Present the informed consent sheet.** The tasks that you will do task today will be recorded on the computer. Your face will not be video recorded; however, your movements/selections on the computer screen and your voice will be recorded.

II. **Overview:**
Pretend that you are writing a letter to a friend. You have decided to use a computer to prepare your letter that you want to send.

I will ask you to do a number of tasks using a laptop computer.

Please Note: This is not a test of your ability to type or even writing letters, but these tasks are designed to determine how "usable" this particular computer design is for you as it relates to writing a letter. So again this is not a test about your personal abilities, but rather it is a test to see how well this computer design works for you.

Again, I will ask you to do a number of tasks using this computer design. I will give you one task at a time. I will read the task to you aloud (you will have a copy of it in front of you also).

I will ask you, "Are you ready to begin?" If you are ready and do not have any other questions, I will start the recorder and ask you to begin doing the task.

After you have completed the task, I will replay the movements/selections that you made on the screen. While we looking at the instant replay, I will ask you to tell me what you were thinking as you were making your selections on the screen. Your comments will be audio recorded. Do you have any questions?

PLEASE do your best to complete each task.

When you are done with the task please say, "I am finished."

Now, please take 1 minute to look over the entire screen. Please do not make any selections; just take this time to look it over.

Okay. Are you ready to begin??? Remember to tell me when you are finished.

Questions for Retrospective Think-A-Loud

This is the procedure for each of the 10 to 12 tasks. Cycle through this until each task has been done.

I. Please describe what you were thinking while doing this task. Before you begin describing the task, (1) think about what goal you were trying to complete and (2) the steps you took to complete the goal. So say out aloud exactly what you were thinking about and what actions you were taking to complete your goal.

II. I will read the task to you in just a moment. While we are looking at the recording together, feel free to make any comments you would like about the task (For example, "this was easy," "this was difficult," "I didn't understand what this meant," " this reminded me of" etc. No comment is or will be viewed as wrong or silly. Your opinion is very important.

III. Read the task.

IV. Would you say that this was an "Easy" or "Hard?"

V. On a scale of 1 to 10 (1 being "Easy" and 10 being "Hard"), how would you rate this task?

VI. Were you able to complete the task?

VII. Considering the goal of this particular task….did the steps you needed to take to complete the goal make sense to you? *(Were these steps what you would have expected for completing this task?)*

If "Yes," go to VII. *Positive* CRITICAL INCIDENTS section
If "No," go to VIII. *Negative* CRITICAL INCIDENTS section

VIII. *Positive* CRITICAL INCIDENTS
   a. Was there anything about this computer design that helped you to complete this task?
   b. PROBING QUESTIONS….

IX. *Negative* CRITICAL INCIDENTS
   a. Where did the problem begin?
   b. Describe to me what was happening while you were having the problem.
   c. Considering the goal of this particular task….did the steps you needed to take to complete the goal make sense to you? *(Were these steps what you would have expected for completing this task?)*
   d. Were you able to complete the task?
      i. If "Yes," were did the problem end? What happened that allowed you to get beyond the problem?

X. What (if anything) would you change/add to make this task easier to complete?

XI. While you were doing this task, were you reminded of any previous experience?

XII. Is there anything else that you think is important to say about this particular task?

APPENDIX K: INFORM CONSENT FORM

INFORM CONSENT FORM

Title of Project: Ethnicity and Socio-Economic Status: Factors for Computer Interface Design
Principal Investigator: Kayenda T. Johnson
IRB #: 05-494

PURPOSE OF PROJECT

You are invited to participate in a research project designed to develop computer interface designs that accommodate the interface metaphor preferences of ethnic minorities (i.e., Hispanic-Americans or African-Americans). A total of 80 Hispanic-Americans and African-Americans will be recruited to participate in these studies. The purpose of this project is engage members of ethnic minorities in the process of developing culturally valid interface metaphor.

INFORMATION

First, you will be asked to complete a number of questionnaires and paper-and-pencil cognitive tests. The questionnaires will be comprised of a demographics questionnaire, an acculturation survey, a general self-efficacy questionnaire and a computer attitudes questionnaire. In addition, you will be asked to take a spatial abilities test and a perceptual style test. The responses that you provided during your participation in this study may be audio recorded. The approximate time to complete this study is 1.5 hours.

Second, you will be asked to perform a text-editing task using one of two computer interface designs and to provide your thoughts and concerns about the interface that you used. The responses that you provided during your participation in this study will be audio and/or video recorded. The approximate time to complete this study is 1 hour.

RISKS

There are no physical or emotional risks associated with this research project. However, you may find that some of the questions or tasks associated with this study may be difficult to answer and may result in frustration.

BENEFITS

Your participation will provide the data required to help the researcher enrich the body of knowledge in the field of Human-Computer Interaction.

At the end of this session, you will be provided with a copy of this form. At the bottom of this form, you will find contact information that can be used to contact the principal investigator after the research has been completed in order to receive information about the results.

CONFIDENTIALITY

The information gained in this research project will be kept strictly confidential. At no time will the researcher release the results of the study to anyone other than individuals working on the project without your written consent.

You will be identified only by a 3-digit participant code. All written, audio and video recorded data will be stored securely in a locked file case in the primary researcher's office. Only the primary researcher and designated research staff will have access to the data for the purpose of research discussions and publications. No reference will be made in oral or written reports that could link you to the data, nor will you ever be identified as a participant in the project. All audio and video data records will be erased shortly after the completion of this research.

COMPENSATION

Your compensation will include being paid $7.50 for each hour that you spend participating in this research project.

FREEDOM TO WITHDRAW

You are free to withdraw from this study at any time without penalty. In addition, during the course of this study, you are free not to answer any questions that you choose not to.

APPROVAL

It is very important that you keep the activities and information discussed during your sessions confidential, since others will be participating in this research.

QUESTIONS

If you have questions or do not understand the information on this form, please feel free to ask those questions or voice your concerns now.

PARTICIPANT'S PERMISSION

I have read and understood the Informed Consent and conditions of this project. I have had all of my questions answered. I agree to abide by rules of this project.

I hereby acknowledge the information and requests stated above and give my voluntary consent for participation in this project. Nevertheless, I understand that I may withdraw at any time without penalty.

Please place your initials next to the appropriate statement of consent.

_____ I **consent** to be audio and video taped as a part of my participation in these studies.

_____ I **do not consent** to be audio and video taped as a part of my participation in these studies.

Signature _____

Date _____ Phone Number _____

CONTACT

If you have questions at any time about the project or the procedures, you may contact the principal investigator, Kayenda T. Johnson at kajohns5@vt.edu.

If you feel you have not been treated according to the descriptions in this form, or your rights as a participant have been violated during the course of this project, you may contact the Chair of the Institutional Review Board Research Division at Virginia Tech, Dr. David M. Moore, at 540-231-4991.

APPENDIX L: INFORM CONSENT FORM

INFORM CONSENT FORM

Title of Project: Ethnicity and Socio-Economic Status: Factors for Computer Interface Design
Principal Investigator: Kayenda T. Johnson
IRB #: 05-494

PURPOSE OF PROJECT

You are invited to participate in a research project designed to develop computer interface designs that accommodate the interface metaphor preferences of ethnic minorities (i.e., Hispanic-Americans/Latinos and African-Americans). The purpose of this project is engage members of ethnic minorities in the process of developing culturally valid interface metaphor. A total of 4 to 6 Subject Matter Experts (SMEs) will be recruited to participate in this portion of this research project.

INFORMATION

You have been recruited to participate as a Subject Matter Expert (SME) in this study. You are considered an expert based on your personal interaction with Hispanic-Americans on a frequent basis. Today, you will be asked to use your knowledge of Hispanics/Latinos who are 18 to 30 years old, novice computer users, of lower socio-economic status and urban dwellers.

First, you will be given an opportunity to introduce yourself to the other participants in this research session. Following the group introductions, you will be given an overview of the goals of this session, as well as a set of directions and guidelines for today's session.

The purpose of this study is to provide an alternate way of acquiring the Hispanic-American perspective concerning both an African-American inspired computer interface design and the more widely used Microsoft Word. You will be asked to walk through a number of editing tasks, using one of the two computer interface designs. You will work in groups of 2 to 3 SMEs and will walk through the pre-scripted list of steps for accurately completing each of the editing tasks. In your groups you will sit in front of the designated computer design and execute each of the steps to complete the task. At that time you will answer several questions related to the sensibility of the sequence of steps (using your knowledge of the Hispanic populations that they serve) needed to execute the task successfully.

RISKS

There are no physical or emotional risks associated with this research project. However, you may find that some of the questions or tasks associated with this study may be difficult to answer and may result in frustration.

BENEFITS

Your participation will provide the data required to help the researcher enrich the body of knowledge in the field of Human-Computer Interaction.

At the end of this session, you will be provided with a copy of this form. At the bottom of this form, you will find contact information that can be used to contact the principal investigator after the research has been completed in order to receive information about the results.

CONFIDENTIALITY

The information gained in this research project will be kept strictly confidential. At no time will the researcher release the results of the study to anyone other than individuals working on the project without your written consent. You will be identified only by a 3-digit participant code. All written, audio and video recorded data will be stored securely in a locked file case in the primary researcher's office. Only the primary researcher and designated research staff will have access to the data for the purpose of research discussions and publications. No reference will be made in oral or written reports that could link you to the data, nor will you ever be identified as a participant in the project. All audio and video data records will be erased shortly after the completion of this research.

COMPENSATION

Your compensation will include being paid $7.50 for each hour that you spend participating in this research project.

FREEDOM TO WITHDRAW

You are free to withdraw from this study at any time without penalty. In addition, during the course of this study, you are free not to answer any questions that you choose not to.

APPROVAL

It is very important that you keep the activities and information discussed during your sessions confidential, since others will be participating in this research.

QUESTIONS

If you have questions or do not understand the information on this form, please feel free to ask those questions or voice your concerns now.

PARTICIPANT'S PERMISSION

I have read and understood the Informed Consent and conditions of this project. I have had all of my questions answered. I agree to abide by rules of this project.

I hereby acknowledge the information and requests stated above and give my voluntary consent for participation in this project. Nevertheless, I understand that I may withdraw at any time without penalty.

Please place your initials next to the appropriate statement of consent.

_____ I **consent** to be audio and video taped as a part of my participation in these studies.
_____ I **do not consent** to be audio and video taped as a part of my participation in these studies.

Signature_____

Date _____ Phone Number _____

CONTACT

If you have questions at any time about the project or the procedures, you may contact the principal investigator, Kayenda T. Johnson at kajohns5@vt.edu. If you feel you have not been treated according to the descriptions in this form, or your rights as a participant have been violated during the course of this project, you may contact the Chair of the Institutional Review Board Research Division at Virginia Tech, Dr. David M. Moore, at 540-231-4991.

APPENDIX M: COGNITIVE WALKTHROUGH EXPERTS

Cognitive Walkthrough Interface: Microsoft Word 2003

Subject Matter Expert (1) Biography: Latinos in East Baltimore

Subject matter expert number one completed a Masters and PhD in Latino Studies. The SME is fluent in Spanish and has traveled extensively to Latin American countries. The SME works with young Latinos in the area of community outreach.

Cognitive Walkthrough Interface: African-American Inspired Interface

Subject Matter Expert (2) Biography: Latinos in East Baltimore

SME number two has a Masters degree in Spanish and Latin American. SME number two has traveled extensively throughout Latin America from countries Bolivia, Peru, Venezuela, El Salvador, Chile, Ecuador, Mexico etc. The SME is fluent in Spanish and volunteers with Latino/immigrant serving community centers local to the target community. This SME mentors several Latinos that live in the East Baltimore area and provides translation services for them on a weekly basis.

APPENDIX N: COGNITIVE WALKTHROUGH SCRIPT

Convene the Walkthrough:

Cognitive Walkthrough is a technique created for evaluating the design of a computer interface. This technique is designed to pay special attention to one aspect of usability --how well the interface supports exploratory learning (Wharton et al., 1994) –learnability (Spencer, 2000). This type of evaluation is typically done at the beginning stages of the design process to provide feedback and input for the design further design iterations. Cognitive walkthroughs assess each step of a single task (or a number of tasks), in an effort to expose design flaws the will impede the users' exploratory learning with a given computer interface. One goal of the cognitive walkthrough is to elucidate mismatches between users' and designers' conceptualization of the task, unsuitable word choices for menu titles and buttons labels, and insufficient feedback concerning the consequences of the users' actions (Wharton et al., 1994). Furthermore, it is used for the designers to take on the user's perspective and identify any potential problems that the user may run into during interaction with the computer interface (Smith-Jackson, 2005).

So these are the types of things that I would like for you to do today. Smith-Jackson (2005) notes that good cognitive walkthrough method evaluators are individuals that have the ability to identify with the preexisting mental models and schemes the users will employ while exploration of product takes place. Furthermore, evaluators of this sort are able to reason hypothetically and explore the product from the users' perspective. I have recruited you because each of you has a level of expertise as it relates to the Latino community here in Southeast Baltimore. So today I would like for you to lend me your knowledge of Latinos who match the following description:

- Ages 18 to 30 years of age
- Novice computer users
- Low socio-economic status
- Resident of Southeast Baltimore
- English or Spanish speaking

Throughout this entire session, I would like for you to represent this group (to the best of your knowledge and ability) as it relates to the computer design that I will present to you today. So as we are walking through the assessment today I would like for you to have two questions in the back of your minds:

What must the user know prior to performing the task?

What should the user learn while performing the task? (Wharton et al., 1994)

- We will be collecting (taking note of) four types of information today:
- User knowledge requirements (Wharton et al., 1994),
- Potential Learnability problems (Spencer, 2000),
- Notes about side issues and design changes (Wharton et al., 1994), and
- Credible success stories for each step of the task--which includes assumptions about the user population (Wharton, et al., 1994).

I know that this may seem like a lot of information, but don't stress it is my job to keep everything moving smoothly for our session; what is most important to me is your expertise of this population of Latinos.

Directions for the walkthrough: (***Step by step***)

In the cognitive walkthrough the reviewers evaluate a proposed interface design in the context of one or more specific user tasks. I will provide you with several pieces of information to serve as inputs for this cognitive walkthrough. That information will include: a detailed design description of the interface, a task scenario, description of the user population and the context of use, and the sequence of actions needed for the successful completion each tasks to be evaluated. (Usability Inspection Methods)

During the walkthrough process the SME considered:

The credible stories are constructed by asking two questions:

- Will the user know what to do at this step?
- If the user does the right thing, will they know that they did the right, and are making progress towards their goal (Spencer, 2000)?

At this step I will describe the action sequence

All of this will be recorded in Camtasia.

Cognitive Walkthrough Preparatory Phase

I. The Walkthrough: Preparatory Phase

a. Users: The user class includes Latinos ages 18 to 30 years of age, who are current residents of Baltimore, Maryland (more specifically Southeast Baltimore). The members of user class are characterized as being individuals of low socio-economic status who are novice computer user; the user class may use computers on occasions to access the internet for recreation or email, but are not savvy with word processing software products. For example, Microsoft Word…These individuals may or may not be his/her first language. Their levels of education may vary tremendously. These individuals do not know how to manipulate documents, and text for writing a letter.

b. Tasks: The tasks are pre-defined by the original usability with the AA group in Southeast Baltimore. Tasks from the original study were selected for review in the cognitive walkthrough based on their propensity to present usability challenges. For example, the "help" task was not selected for review because it was not an issue in either interface.

c. Action Sequence: Will be provided

d. Interface (AA): This interface design was inspired by a group of African-Americans from the same community as the Latino user population described as the "users" for the cognitive walkthrough. The demographic characteristics/attributes are identical: 18 to 30 years of age, novice computer users, residents of Southeast Baltimore, low socio-economic status.

The interface is designed to be a word processing tool. The interface can be presented on a laptop or desktop computer. The user will interact with the interface using the mouse and the keys on the keyboard. This is presented in its standard format.

Interface (MS Word 2003): This interface is the word processing application which is a part of Microsoft Office. This interface can be presented in a laptop or a desktop computer. The user will interact with the interface using the mouse and the keys on the keyboard. The user will interact with the keyboard. The interface is presented at its most standard format: (Explain what standard looks like).

What will we get from the cognitive walkthrough?

The agenda for the cognitive walkthrough is as follows.

1. Define inputs to the walkthrough
    a. Identification of users
    b. Sample tasks for evaluation
    c. Action sequences for completing the tasks
    d. Description of implementation of interface
2. Convene the walkthrough
    a. Describe the goals of the walkthrough
    b. Describe what will be done during the CW
    c. Describe what will not be done during the walkthrough
    d. Explicitly defuse defensiveness
    e. Post ground rules in a visible place
    f. Assign roles
    g. Appeal for submission to leadership
3. Walkthrough action sequences for each task
    a. Tell a credible story for these two questions:
        i. Will the user know what to do at this step?
        ii. If the user does the right thing, will they know that they did the right, and are making progress towards their goal?
    b. Maintain control of the CW, enforce the ground rules
4. Record critical information
    a. Possible learnability problems
    b. Design ideas
    c. Design gaps
    d. Problems in the Task Analysis

APPENDIX O: SEQUENCE OF ACTIONS

Sequence of Actions

African-American Inspired Interface

TASK 1: Prepare the screen so that it is the environment that you would like to write in and it looks the way you want it to. *Please do not do anything to the actual letter on the right side of the screen.*

Action Sequence A:

1. Click once on the "Screen Color" button (at the top of the screen).
    a. Computer Interface: Pop-up box will appear where the user can change the color or theme of the screen background.
2. Click once on the words (of the colors) or the picture (or words) of the background you would select for the background.
    a. Computer Interface: The background should reflect the selection that was made.

Action Sequence B:

1. Click once on the "Decorate Room" button (at the top of the screen).
    a. Computer Interface: Pop-up box will appear where the user can choose from three items to decorate the room.
2. Click once on the picture (or words) of the item you would like to use as decoration.

    a. Computer Interface: The item selected should be on the left side of the screen.

Action Sequence C:

1. Click once on the word "On" under the picture of the radio.
    a. Computer Interface: A "play" arrow will appear under the radio "on" and "off".
2. Click once on the "play" arrow.
    a. Computer Interface: The song will begin to play (you will hear it).

Action Sequence D:

1. Click once on the word "Power On" at the bottom of the television.
    a. Computer Interface: A "play" arrow will appear above the "Power On" and "Power Off".
2. Click once on the "play" arrow.

Computer Interface: The t.v. will begin to play (you will hear and see it).

TASK 2: Select the kind of paper you would like your letter to be on.
Action Sequence #1….

1. Click once on the "Paper Type" button (at the top of the screen).
    a. Computer Interface: Pop-up message box will appear.

2. Click once on the desired paper type (paper background) with the mouse.
    a. Computer Interface: New paper type (background) will appear behind your letter.

TASK 3: Find where you can change the SIZE of a "letter" or "word".

1. Click once on the "Letter Size" button (at the top of the screen).
    a. Computer Interface: Pop-up message box will appear with a list of various sizes that can be selected.

TASK 4: Find where you can change the COLOR of a "letter" or "word".
Action Sequence #1…

1. Click once on the "Letter Color" button (at the top of the screen).
    1. Computer Interface: Pop-up message box will appear with a list of various colors that can be selected.

Action Sequence #2…

1. Click once on the picture of the pen on the table.
    a. Computer Interface: Pop-up message box will appear with a list of various colors that can be selected.

TASK 5: Find where you can fix any mistakes that you may have found in your letter.

1. Click once on the "Make Corrections" button (at the top of the screen).
    a. Computer Interface: Pop-up message box with a list of topics to correct.

TASK 6: Find the place on this computer that will let you keep your letter until you are ready to finish it. Store your letter (where you would like to keep it). *You can name your letter whatever you would like.*

1. Click once on the "Save" button (at the top of the screen).
    a. Computer Interface: Pop-up message box will appear where the user should type in the name of the letter and select where they would like to store the letter.
2. Type in the name of the letter.
    a. Computer Interface: The typed in name will appear in the white space next to "Name Your Letter."
3. Click once on the place where you would like the letter to be saved.
    a. Computer Interface: Pop-up message box will appear stating where the letter was saved.

TASK 8: Find the place on this computer that will give you some assistance.

1. Click once on the "Ask for Help" button (at the top of the screen).
    a. Computer Interface: Pop-up message box with the question: What is your question?

TASK 9: Find the place on this computer that will let you put what was written on the computer onto paper. Now complete the process.

1. Click once on the "Final Draft" button (at the top of the screen).
    a. Computer Interface: Pop-up message box will appear where the user is asked, "Are you ready to 'Print' or 'Email' your letter?"
2. Click once on the word "YES".
    a. Computer Interface: Pop-up message box will appear where the user is where the user can select a 'Print' button or an 'Email' button.
3. Click once on the button with a picture of the printer on it.
    a. Computer Interface: Pop-up message box will appear where the user can select if they would like to print the letter only or print the letter with the "wallpaper" and type in the number of copies they want to print.
4. Type in the number of copies into the "Print Letter Only" section.
    a. Computer Interface: Interface will not change; it will simply show the number of copies that was typed in.
5. Click once on the "Print" button in the "Print Letter Only" section.
    a. Computer Interface: Print pop-up will disappear.

TASK 10: Find the place on this computer that will let you send your letter to your friend through email. Next, send your letter to your friend through email.

Your email address should be: Yourname@email.com
Your Friend's email address is: David@email.com

1. Click once on the "Final Draft" button (at the top of the screen).
    a. Computer Interface: Pop-up message box will appear where the user is asked, "Are you ready to 'Print' or 'Email' your letter?"
2. Click once on the word "YES".
    a. Computer Interface: Pop-up message box will appear where the user is where the user can select a 'Print' button or an 'Email' button.
3. Click once on the button with a picture of the "e-mail" envelop on it.
    a. Computer Interface: Pop-up message box will appear with a white envelop, where the user can type in their email address and their friend's email address.
4. Type in the user's email address in the white space next to the word "From."
    a. Computer Interface: Interface will not change; it will simply show the email address that was typed in next to "From".
5. Type in the friend's email address in the white space next to the word "To."
    a. Computer Interface: Interface will not change; it will simply show the email addresses that were typed in next to "From" and "To".
6. Click once on "Send Mail."
    a. Computer Interface: Pop-up message box will appear telling the user that the mail was sent.

TASK 11: Put a picture (whatever picture you find) in your letter.

1. Go to the table (on the screen) with the mouse.
    a. Computer Interface: Mouse Indicator (arrow, hand, or highlight) will be over the table.
2. Click once on the desired picture with the mouse.
    a. Computer Interface: Pop-up message box
3. Use the mouse to select "On Your Paper."
    a. Computer Interface: Picture will show up on the letter

TASK 12a: Find the place on this computer that will let you keep your letter until you are ready to finish it. Store your letter on the "table" and name it "Karla's Letter."

1. Click once on the "Save" button (at the top of the screen).
    a. Computer Interface: Pop-up message box will appear where the user should type in the name of the letter and select where they would like to store the letter.
2. Type in "Karla's Letter".
    a. Computer Interface: The typed in name will appear in the white space next to "Karla's Letter."
3. Click once on the picture of the "Table" shown among the other places where the letter can be saved.
    a. Computer Interface: Pop-up message box will appear stating that the letter was saved on the "Table"
    b. Computer Interface: A white sheet of paper with black lines on it will show up on the table.

TASK 12b: Find (the location of) your unfinished letter to Karla.
Action Sequence #1….

1. Click once on the sheet of white paper (with black lines) on the table.
    a. Computer Interface: Pop-up message box will appear where the user can select from their previously saved letters.
2. Click on the down arrow.
    a. Computer Interface: A list of the names of saved letters will appear.
3. Click once "Karla's Letter"
    a. Computer Interface: Karla's Letter will be highlighted in the selection box.

Action Sequence #2….

1. Click once on the "Saved Letters" button at the top of the screen.
    a. Computer Interface: Pop-up message box will appear where the user can select from the places where letters could have been saved.
2. Click on the word "Table".
    a. Computer Interface: Pop-up message box will appear where the user can select from a list of the names of letters on the table.
3. Click on the down arrow.
    a. Computer Interface: A list of the names of saved letters will appear.

4. Click once “Karla’s Letter.”
    a. Computer Interface: Karla’s Letter will be highlighted in the selection box.

Sequence of Actions

Microsoft Word 2003 Interface

TASK 3: Find where you can change the SIZE of a "letter" or "word".

1. Click once on the word "Format" (at the top of the screen).
    a. Computer Interface: A menu will appear under the word "Format."
2. Scroll down to "Font" and click once.
    a. Computer Interface: Pop-up box will appear that shows the various things that can be adjusted of change.
3. Go to the section of the box that says "Size."
    a. Computer Interface: Inside of the "size" section the user change the size of a letter or word by typing the number into the black space or scrolling down to the number desired

TASK 4: Find where you can change the COLOR of a "letter" or "word".

1. Click once on the word "Format" (at the top of the screen).
    a. Computer Interface: A menu will appear under the word "Format."
2. Scroll down to "Font" and click once.
    a. Computer Interface: Pop-up box will appear that shows the various things that can be adjusted of change.
3. Go to the section of the box that says "Font color."
    a. Computer Interface: Inside of the "Font color" section the user change the color of a letter or word.
4. Click once on the down arrow to the right of the word "automatic"
    a. Computer Interface: Inside of the "Font color" section the user can click (select) any of the color in the dropdown box to change the color of a letter or word.

TASK 5: Find where you can fix any mistakes that you may have found in your letter.

1. Click once on the word "Tools" (at the top of the screen).
    i. Computer Interface: A pop-up menu will appear below the word "Tools."
2. Scroll down and point to "Spelling and Grammer…"
    ii. Computer Interface: "Spelling and Grammer…" will be highlighted.

TASK 6: Find the place on this computer that will let you keep your letter until you are ready to finish it. Store your letter (where you would like to keep it). *You can name your letter whatever you would like.*

Action Sequence #1:

1. Click once on the "disk" icon on the toolbar (at the top of the screen).
    a. Computer Interface: Pop-up box will appear that shows the user where they can save their letter and also provides a space to type in the name of their letter.

2. Type in the name of the letter.
    a. Computer Interface: The typed in name will appear in the white space next to "File Name."
3. Click once on the place where you would like the letter to be saved.
    a. Computer Interface: The contents in the large window will show (or change to show) what is currently saved in that location.
4. Click once on the "save" button.
    a. Computer Interface: The very top (left side) of the Microsoft interface will show the name of the letter.

Action Sequence #2:

Click once on the word "File" (at the top of the screen).

Computer Interface: A menu will appear under the word "File"

Scroll down to "Save As" and click once.

Computer Interface: Pop-up box will appear that shows the user where they can save their letter and also provides a space to type in the name of their letter.

Type in the name of the letter.

Computer Interface: The typed in name will appear in the white space next to "File Name."

Click once on the place where you would like the letter to be saved.

Computer Interface: The contents in the large window will show (or change to show) what is currently saved in that location.

Click once on the "save" button.

Computer Interface: The very top (left side) of the Microsoft interface will show the name of the letter.

TASK 8: Find the place on this computer that will give you some assistance.

Action Sequence #1….

1. Click once on the "Help" button (at the top of the screen).
    a. Computer Interface: Pop-up menu box with will appear below the word "Help."
2. Scroll down to "Microsoft Office Word Help" and click once.
    a. Computer Interface: A pop-up box will appear to the right of the screen entitled "Word Help."
3. Type help topic into the "search for" box.
    a. Computer Interface: Topic will be shown in the box.

Action Sequence #2…

1. Type in help topic in the box at the top right hand corner of the screen (in the box it says: Type a question for help)
    a. Computer Interface: Topic/Question will be shown in the box.

TASK 9: Find the place on this computer that will let you put what was written on the computer onto paper. Now complete the process.

Action Sequence #1….

1. Click once on the word "File."

a. Computer Interface: A menu will appear under the word “File.”
2. Scroll down to and click once on the double down arrow.
    a. The “File” menu will expand downwards to uncover options will show.
3. Click once on the words “Print.”
    a. Computer Interface: A pop-up box will appear.
4. Type in the number of printed copies that is needed.
    a. Computer Interface: The typed in number will appear.
5. Click once on the “Print” button.
    a. Computer Interface: A pop-up message will disappear.

Action Sequence #2….

1. Click once on “printer” icon on the toolbar (at the top of the screen).
    a. Computer Interface: A pop-up box will appear.
2. Type in the number of printed copies that is needed.
    a. Computer Interface: The typed in number will appear.
3. Click once on the “Print” button.
    a. Computer Interface: A pop-up message will disappear.

TASK 10: Find the place on this computer that will let you send your letter to your friend through email. Next, send your letter to your friend through email.

Your email address should be: Yourname@email.com
Your Friend’s email address is: David@email.com

Action Sequence #1:

1. Click once on the “email” icon on the toolbar (it is the icon with an envelop on it).
    a. Computer Interface: A somewhat large email tool bar will appear towards the top of the screen.
2. Type “David@email.com” to the right of the word “To.”
    a. Computer Interface: The typed in email address will be shown next to the word “To.”
3. Click once on the words “Send a Copy.”
    a. Computer Interface: A pop-up message will appear asking for the user’s name. (the task is over here)

Action Sequence #2….

1. Click once on the word “File.”
    a. Computer Interface: A menu will appear under the word “File.”
2. Scroll down to and click once on the double down arrow.
    a. The “File” menu will expand downwards to uncover options will show.
3. Point to the words “Send To.”
    a. Computer Interface: A menu will appear to the right of the words “Send To.”
4. Click once on the words “Mail Recipient.”

a. A somewhat large email tool bar will appear towards the top of the screen.

5. Type "David@email.com" to the right of the word "To."
    a. Computer Interface: The typed in email address will be shown next to the word "To."
6. Click once on the words "Send a Copy."
    a. Computer Interface: A pop-up message will appear asking for the user's name. (the task is over here)

TASK 11: Put a picture (whatever picture you find) in your letter

Action Sequence #1…..

1. Click once on the word "Insert" (at the top of the screen).
    a. Computer Interface: A menu will appear under the word "Insert."
2. Scroll down and point to "Picture".
    a. Computer Interface: Pop-up menu will appear to the right of the word "Picture" that shows the methods for inserting a picture into the letter.
3. Click once on the words "From File."
    a. Computer Interface: A pop-up box will appear where the user can select a picture from a file by name or by clicking on the picture folder.
4. Locate the picture you want to insert.
    a. Computer Interface: Inside the picture folder are pictures that can be selected. Pictures can also be found by filename.
5. Double-click the picture you want to insert.
    a. Computer Interface: The selected picture will be in the letter.

Action Sequence #2….

1. Click once on the word "Insert" (at the top of the screen).
    a. Computer Interface: A menu will appear under the word "Insert."
2. Scroll down and point to "Picture".
    i. Computer Interface: Pop-up menu will appear to the right of the word "Picture" that shows the methods for inserting a picture into the letter.
3. Click once on the words "Clip Art".
    a. Computer Interface: A pop-up box will appear to the right of the screen entitled "Clip Art."
4. Type in a topic/subject for a picture search and click on "Go".
    a. Computer Interface: A set of related pictures will show up in the lower part of the pop-up box.
5. Double-click the picture you want to insert.
    a. Computer Interface: The selected picture will be in the letter.

APPENDIX P: COPYRIGHT PERMISSSIONS

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===== Original Message From Adam Hirschberg <ahirschberg@cambridge.org> =====
September 12, 2005

Re: Cross-Cultural Psychology 1ed
John W. Berry, Ype H. Poortinga, Marshall H., Segall, Pierre R. Dasen
Figure 1-3: General conceptual framework of relationships among classes of variables employed to cross-cultural psychology

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Sincerely,
Adam

Adam Hirschberg
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New York, NY 10011-4211

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Copyright Permission 2:

24 February 2005 Our Ref: HG/smc/Feb.2005.bk584

Mr Kayenda Johnson
Kajohns5@vt.edu

Dear Mr Johnson

HANDBOOK OF HUMAN-COMPUTER INTERACTION, 1997, ISBN 0444818626, Pages 441-462, Helander et al (eds), 1 Table only

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