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Should We Integrate?: A User Evaluation of
Web and Desktop Integration Strategies

by

K. Johanna Segerström. B.A. (Hon)

A thesis submitted to
the Faculty of Graduate Studies and Research
in partial fulfillment of the
requirements for the degree of
Masters of Arts

Department of Psychology

Carleton University
Ottawa, Ontario
May 11, 1999

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Faculty of Graduate Studies and Research
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"Should We Integrate? A User Evaluation of Web and Desktop Integration Strategies"

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in Partial fulfillment of the requirements for

the degree of Master of Arts


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May, 1999
Abstract

This study examined whether the web and the desktop should integrate and what methods of integration should be implemented. Two approaches, a web and desktop integrated approach and a web and desktop independent approach, were evaluated and compared for ease of use, preference and as a function of computer and web experience of users. These approaches incorporated five integrated and independent methods for storing and manipulating files, which were compared for preference, value and in terms of users' computer and web experience. The main findings of this study revealed that there were significant differences between expert and intermediate users. While both groups rated the independent approach easier to use, they differed in preference for the approaches and methods. Expert users preferred the independent approach overall and the independent method for file manipulation style. Intermediate users, in contrast, preferred the integrated methods for file storage and access. A conceptual model theory has been put forth to explain the differences in preference between the two user groups.
Acknowledgements

I would like to express my sincere thanks and appreciation to several individuals who have helped me in the process of completing this study.

I would like to thank my faculty advisor, Dr. Jo Wood, for her sound guidance and useful feedback throughout this project. I am also thankful to Dr. Dick Dillon for his helpful advice and practical insight during this project and over the last few years. I would like to thank my external advisor and friend, Coralie Lalonde. Despite her busy schedule, she guided me through this entire process. I am very grateful to her for her comprehensive and endless feedback, continuous encouragement and unwavering commitment. I am also truly appreciative of everything that she has taught me both academically and personally.

I would like to extend many thanks to all my friends, particularly to Christine, Yvonne, and Jennifer for their friendship and their wonderful support during this project. I am very lucky to have friends like them. I would also like to thank Darlene for her support. Since she was doing her thesis at the same time I was, it was a great comfort to experience and share the ups and downs of the thesis experience with her.

I am thankful to my family. I would like to thank my dad for encouraging me to pursue my goals and always believing in me. I am grateful to my mom because although she passed away a few years ago. I have always sensed her loving and unconditional support. I would also like to thank my brother, Per, for his support, which was often expressed by his many humorous and uplifting emails. I would also like to thank Reggie, the Berglunds, Kerstin for all their support and min Farmor who passed away a few months ago. I am truly blessed with such a wonderful family.

Finally, to my partner, Ray, who has continued to encourage me, stand by me patiently and always made me laugh when I was feeling blue. I give very special thanks to him. Your love and support is greatly appreciated.
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Should We Integrate?: A User Evaluation of Web and Desktop Integration Strategies

There is a growing trend towards the integration of the World Wide Web and the desktop user interface environment. This trend is strongly supported by many, in particular by various computer analysts and software and internet industry leaders. Differences of opinions, however, have been expressed among these supporters as to how integration should be implemented. There are also others who think that the desktop and the web should continue to stay completely independent. Although there are various opinions on integration, very little research has been conducted with actual web and desktop users to determine whether the web and the desktop should integrate and what methods of integration should be implemented. The purpose of this study was to explore whether web and desktop activities should become more integrated by examining how current users react to integration and to evaluate specific methods of integration.

Introduction to the Desktop

Since its original development in the 1970’s, the popularity of the personal computer (PC) has increased dramatically. It is estimated that there are approximately 115 million PC users in the United States or 44 percent of the total US population are using a PC (US Census Bureau, October 1993). In contrast, only 18 percent of the population were PC users in 1984. This growth is primarily due to the accessibility of the PC to the average user. The main reasons for this accessibility have been the PC’s decreased cost and the increasing ease of use of the graphical user interface design (GUI), first introduced by Xerox and then followed by Apple in 1984 and Microsoft a few years later.

The GUI was truly revolutionary. Unlike the command lines on earlier computers, the GUI increased the ease of use of the computer by providing users with a desktop metaphor and a visual representation of their computer environment. This GUI has remained consistent over the
last fifteen years and has stayed relatively the same across various operating systems, allowing users to easily apply their computer skills to new operating environments.

The incorporation of the desktop metaphor into the GUI has allowed users to apply their paper-based filing management practices to computer-based systems. The purpose of a metaphor is to ease the learning of a system or an application by providing a mapping of a domain with which users are familiar (Gentner & Nielsen. 1996; Marcus. 1995). As a metaphor for document processing activities, the screen is viewed as a desk surface and windows as paper documents. Files and folders are represented as icons and can be moved around the desktop with a mouse or other pointing device. These files can also be added or removed from folders and the folders are then placed on the desktop or in a hierarchical filing system as a way for users to organize information.

The GUI has provided users with a visual or graphical representation of the computer environment, rather than a textual one found on earlier computers. This graphical representation facilitated performance by no longer requiring users to memorize and manually enter commands, reducing the training and the technical skills that were once necessary to use a computer. It enabled users to partition the screen into separate areas called windows with each window representing a different task. It also allowed users to select and activate an operation from a list of options by a single and then a double click of a mouse or other pointing device.

Introduction to the Web

Like the desktop, the World Wide Web (WWW) has become very popular with an exponential growth in the last few years. There are approximately 70 million web users in the United States, a growth of over 1.6 million users since January of 1998 ("How many on-line?". August 1998). This growth can be attributed to the availability of the web to the average user.
The reasons for this availability are primarily the web's low subscription cost and the introduction of the graphical web browser, first made available with the Mosaic browser in 1993 and then followed with Netscape Navigator and later with Microsoft's Internet Explorer.

The graphical web browser represented an important departure from the traditional character-based network protocols by providing users with easy to understand metaphors and searching and browsing utilities in a graphical format. Information on the web can be accessed using any operating system because of its platform independent structure, enabling users to become proficient at using the web irrespective of computer type.

The web is a large information space for which a number of metaphors exist. These metaphors facilitate web browsing and searching through concepts and terminology with which users are familiar. The main metaphor is a general exploration or travel metaphor. Since the web is a very open ended environment, users are free to explore and this exploration is done through hyperlinks. A hyperlink is connected to another hyperlink, which is associated with a file. Users can click on a hyperlink to view a site and continue to do so for each hyperlink of interest. They can type in a web address to a specific site location and go back and forth between sites they have previously visited by clicking the go, back and forward icons found on the web browser's tool bar.

The other three common metaphors used on the web are the book, television and highway metaphors (Card. Robertson & York. 1996; Nielsen. May 1997; Sullivan. 1997: Tomoharu. Hosomi & Miyashita, 1997). The book metaphor is illustrated through files on the web, which are referred to as web pages and these web pages can be stored under bookmarks. Traffic and congestion are terms derived from the information highway metaphor and these terms refer to the number of people using the web. If there is a lot of traffic, access to web sites may be slow or
even stopped. Channels are components from the television metaphor. They appear as icons on many search engines and they allow users to subscribe to news and entertainment delivery websites. The information from these channels can be updated, depending on when users want to read the news, and viewed from the desktop if they are activated as the desktop's screen saver.

The introduction of the graphical web browser has provided users with greater ease by which to access web content. Through the graphical web browser, the web presents the user with a number of search engines, which allow users to search for information by typing in a word or a phrase. They are then presented with a list of hyperlinks and by mousing over and single clicking on a desired hyperlink, they are able to select and view the web page of their choice. These web pages can then be stored under the bookmarks menu in the web browser for convenient access to frequently used web pages.

Although the web has quickly become known for its simple and uniform style, multiple variations of hyperlink activation have recently been found on the web. For instance, users can mouse over a hyperlink and its colour will change or become highlighted, while other hyperlinks do not change at all when moused over. If a more recent browser is used, users may be presented with a rollover user interface, which displays a preview of the next web page upon the selection of a hyperlink (DiVittorio, 1998).

Web and Desktop Integration

Until recently, the web and the desktop have been two separate entities, but now the two are integrating and the implementation of integration is occurring very quickly. Software and internet companies are already working toward creating this new breed of desktop computers, which is expected to replace many of the traditional ones by the end of 2000 (Forrester Research, 1996). Apple has plans to include integration into its new operating system and Netscape’s
upcoming web browser has been referred to as "the browser that is the desktop" (Halfhill. July 1997, p. 66). Microsoft appears to be going further than both Apple and Netscape since it has already released its latest web and desktop integrated operating system called Windows 98 and its integrated Internet Explorer called the Active Desktop.

Should the Web and the Desktop Integrate?

Although companies are moving forward with integration, it remains a largely unexplored research area. To date, there is very strong support from many software analysts and industry representatives, but no empirical studies have been conducted with actual web and desktop users to indicate a user preference for integration. Due to this lack of research, the discussions on integration appear fairly one-sided. The majority of the computer and industry reports and reviews identify the potentials of integration, but few address the possible adverse effects. These reports may also be misleading since the reasons for integration are not adequately justified. For example, it is often reported that integration will change the way people will use their computers or it will make computing easier and more effective, but it is rarely explained how this will be accomplished (Karpinski. July 1997; Seidman & Haight. February 1997. "True Web Integration". February 1997).

There appear to be three main reasons for integration. The first reason has to do with the web's popularity as a function of its ease of use and the second reason has to do with the web's importance. The third reason has to do with a replacement of the desktop metaphor and interface for a more appropriate web metaphor and easier to use web interface.

The first and second reasons for integration have to do with the way the web is rapidly becoming one of the main ways in which people are using their computers (Bergal. 1997: Parks & Edmonds. 1997: Rickard. 1995). It is a rich information source and information on almost any
topic of interest is available on the web. Product advertisements, news updates, hotel listings and stock quotes are only a few of the topics that can be found on various web sites. Moreover, since web sites can be easily and inexpensively modified, they are regularly updated to provide users with recent information. These web sites can also be viewed by people all over the world and accessed from any location and at any time, enabling individuals to communicate and exchange information worldwide.

This popularity and importance of the web can be evidenced by the increasing trend towards network connectivity. In large and medium size corporations, 94 percent of desktop computers currently have network access, providing employees with direct web access (Halffhill, July 1997). Most of these companies also have intranets, which are internal company networks, allowing for even quicker web access. This fast access will also become available on a different type of computer from the PC called the network computer (NC). Unlike the PC, the NC will not have a local hard drive but will store both local and remote resources on a central server, enabling users to remotely access their applications and files.

Due to this popularity and importance, many people believe that the web is quickly becoming a necessary information tool (Sanders, 1996). This deemed necessity has led proponents of integration to propose that the web should have a more integral role in personal computing (Fernandes, 1997; Forrester Research, 1996: "True Web Integration". February 1997). There are, however, those who are not in agreement with this proposal and have started to question if the web is as popular and important as it is believed (Berghal, 1997; Sanders, 1996).

There are numerous surveys that track broad web trends and statistics. These statistics suggest that the web is a widely used medium but the data may be misleading. Most of the surveys typically report the total number of on-line subscribers, which is currently documented
to be 147 million worldwide ("How many on-line?". August 1998). Due to this sheer volume of
on-line users, it is believed that web activities are an essential part of computing. However, this
claim can be challenged since other aspects of web use, such as the regularity of use and the
reasons for web use, are rarely examined. That is, although people have access to the web, they
may be using the web relatively infrequently and primarily for recreational purposes. Therefore,
more detailed research is needed to investigate web use to establish its importance and to verify
whether the assumptions currently being made about the web are indeed accurate.

There are practical issues that could prevent the web from ever becoming a standard
information tool as well. Bandwidth and server availability are two such issues. Web users are
often unable to access the information they want in the time they need due to web traffic or
because web pages are temporarily or permanently unavailable on a server. Due to these
limitations, the web may be perceived as unreliable despite its richness of information and thus
prevent users from fully adopting it as a necessary information source.

The third reason for integration has to do with the web replacement of the desktop as a
result of the desktop's inappropriate metaphor and complex GUI. The desktop has been the basic
metaphor for most graphical computer interfaces, but advocates of integration believe it is no
longer sufficient as a result of the development of network access (Card, Robertson & York.
1997). Users are no longer just at their desktops, but are now exploring a global information
space as well on their computers, which means that exploration tasks are not accurately reflected
in the desktop metaphor. The web metaphors, in contrast, may be more closely attuned to these
tasks and the web exploration metaphor has specifically been proposed for these tasks. This
metaphor has also been suggested for desktop file activities since local data may soon be
transferred from the hard drive to a network server. This transfer of information storage will require users to access their personalized workspaces and applications remotely, making the exploration metaphor appropriate for desktop tasks (Gentner, Ludolph & Ryan. 1997: Gentner & Nelson. 1996).

There are also those who think the desktop paradigm should continue to be the norm for computer systems as a way to manage information (Nardi & Barreau. 1997). They believe that users will continue to spend time and effort in desktop filing practices, despite the advances in network developments. The only difference is that file management will include both local and remote resources. One study examined the way users managed their files on their computers and discovered that the desktop was a very good basis for the organization of information (Barreau & Nardi. 1995). Users reported moving files near the trash can as a reminder to delete the files and putting documents in the middle of the desktop as a reminder to attend to them. In addition, users also preferred to browse through a list of files to find a document, rather than use text-based find mechanisms. The researchers hypothesized that this preference was due to a greater sense of control felt by the users over their environment. That is, users actively searched for a file since the searching was done in their own personal workspace.

Furthermore, some opponents of integration do not think the web metaphor can effectively be applied to the desktop because of the significant differences between the web and desktop metaphors (Shubin & Perkins. 1998). For instance, desktop users begin with a goal in mind and each task has a beginning and an end. In contrast, web users usually begin with a goal in mind, but that goal often changes as other information of interest is presented. Web users may spend no more than a few minutes at any given site before they are ready to move to another site, while desktop users are generally "in" an application and spend a relatively long period of time
in each application (Badshah. 1996: Nielsen. February 1997). Web users browse and search for information, while desktop users create and edit the information. Finally, desktop users use a multiple window paradigm, but a single page paradigm is typically used on the web (Bayer. 1998). Due to these differences, it is believed that the web metaphor will cause conflict with the conceptual metaphor that users have already developed on the desktop. This conflict will lead to confusion and thus hinder users from effectively performing desktop tasks.

Although the desktop interface has been effective in personal computing, proponents of integration believe that it has an overabundance of features. Because of the extent to which features are available, users only use a small portion of the desktop and application functionality (Gentner. Ludolph & Ryan. 1997: Halfhill. July 1997). Furthermore, other integration advocates think that the desktop interface is too hard for an average user to master (Forrester Research. 1996: Nielsen. May 1996). They have theorized that traditional desktop basics, such as file naming structures, hierarchical lists and mouse use are too complex to use (Halfhill. July 1997). In a usability study of Microsoft’s Windows 3.1 user interface, it was found that both novice and experienced users had difficulties with the management of the hierarchical file system and overlapping windows (Sullivan. 1996). For instance, beginners had the most trouble when they minimized a window because they considered the window gone if it was obscured by another window. Users also had difficulties using the mouse and the main problem was the action of double clicking to open a file. As a result, they often failed to see the information in the document when they were required to double click a file to open it.

Due to these usability problems, integration advocates believe that the web user interface should replace the desktop interface since the use of hyperlinks and the web style is easy to use (Forrester Research. 1996: Seidman & Haight. February 1997: “True Web Integration”. February
They purport that new users will easily be able to learn how to use the hyperlinks for the navigation of the web and the web style for the viewing of web pages. Average and expert users will also find the web interface easy to use because they will simply have to apply their web skills onto the desktop environment (Halfhill. July 1997: Seidman & Haight. February 1997).

But despite the claims of ease of use, there is no evidence to support that users find the web interface easy to use. There is even research to suggest that the use of hyperlinks for navigation is a major obstacle for effective browsing activities (DiVittorio. 1998). Users often become lost and can not find the information they want using hyperlinks. This difficulty with hyperlinks could imply that the web interface might not necessarily be an effective replacement to the desktop interface.

In addition, the assertion that the desktop interface is becoming increasingly difficult to use may be unwarranted. In one study, McCracken and Tinoo (1996) found that the GUI for Windows 95 was easy to understand and use. A comparison study of two Windows operating systems revealed that the Windows 95 user interface far exceeded the Windows 3.1 interface in the areas of satisfaction, productivity, ease of learning and ease of use ("Windows*3.1 versus Windows*95". November 1994). These findings could suggest that although users experienced some problems with the desktop interface as evidenced in Sullivan's usability study of Windows 3.1, many of the problems may have been rectified as a result of the GUI improvements made in Windows 95. Due to these improvements, the desktop may have become an even easier user interface to use, which could suggest that the desktop is still an effective metaphor for users to use on their computers.

There are also some opponents of integration who do not think the web interface is fully mature and, therefore, should not replace the desktop (Dysart. 1998: Perkins. 1998). Currently,
the web is varied in its interface. There are few conventions and standards that have been established on the web. For instance, while some web sites use the typical blue for hyperlinks to web pages that have yet to be seen by a user, other sites use black or red hyperlinks. Moreover, the web interface will not only probably continue to vary but it will also likely change. Web technology has rapidly been advancing and, as a result of these advancements, the web is being used for more than just an information browsing tool (Henderson. 1996: Instone. 1996: Shum. 1997). Users will likely start using the web for applications and without the use of the browser as an intermediary (Fellenz. Parkinnen & Shubin. 1998). As a consequence, the current static hyperlink and browser interface will possibly disappear and new interfaces for the web will emerge. Thus, until the web interface is standardized and formalized, the desktop interface may be a better interface to use for computers.

How Should the Web and the Desktop Integrate?

As with the debate over whether the web and the desktop should integrate, there are also arguments and uncertainties as to how integration should be implemented, if desired. For instance, many computer reports indicate that the web will absorb the desktop environment or web access will become a seamless part of the desktop but it is unclear as to how this will be accomplished (Forrester Research. 1996: "True Web Integration." February 1997).

The methods of integration also appear to vary significantly across products and platforms as well. For instance, Netscape will expand the web browser into a full-screen desktop and eliminate the traditional menus, buttons and icons. Microsoft, in contrast, will continue to have the web browser as a separate entity on the desktop (Halfhill. July 1997). While Microsoft will provide users with a single explorer for the access of web and personal resources, Netscape and Apple may go one step further and use the single approach both for the access and for the
storage of information. Currently, most operating systems, such as Windows, store personal resources on a hard drive and remote information on a network server but Netscape and Apple have plans to make files location independent (Fernandes. 1997: Halalh. July 1997). Apple plans to preserve both local and remote information on a server and Netscape will gather information and replicate it onto a server. As these plans proceed, it is ambiguous as to whether Apple and Netscape will be developing web integrated desktops or network computers. Although they assert their products to be web and desktop integrated, location independence implies that these computers will not have a permanent local storage. If some web integrated desktops will indeed store local resources on a server, it is not apparent how the web integrated desktop computer will differ from the network computer. It is also not clear as to whether the user interface strategy will be consistent across all web integrated desktops if some will store local resources remotely and others will store them locally.

Moreover, there will be additional variation on integrated products since integration may not be accomplished in a single product release. That is, the number of software releases and the extent of integration have yet to be determined. For example, some analysts predict full integration will involve a more tightly coupling of the web and the desktop, while others suggest a more dramatic step, such as a complete web takeover of the desktop to the point where all vestiges of the desktop will be eradicated (Fernandes. 1997: Karpinski. July 1997).

The terminology used to describe integration also seems to vary across products. Terms such as web integration, webified desktop, active desktop, internet desktop, webtops, webPC’s and desktop web, are commonly used. Since it is not clear whether these terms have the same meaning, integration may be implemented quite differently across products. Furthermore, even the term, web and desktop integration, is ambiguous. The term implies a mutual influence
between the desktop and the web and yet there seems to be a greater focus in computer reports
and reviews of the web’s influence on the desktop. As an example, one report indicated that the
desktop will look and behave like the web and that the navigation of the hard drive will be like
surfing the web ("I.E. vs. Communicator", 1997). But despite the heavy web influence, there
seems to be a desktop influence on the web as well and the reason why the desktop influence is
less emphasized is not apparent.

Although there appears to be significant variation in how integration will be
implemented, there are five popular integration methods found on web and desktop integrated
products. Most of these methods can be found on Microsoft’s integrated Internet Explorer 4.0
and Windows 98. They include a single integrated explorer, a web-based storage strategy for
personal files, a desktop-based storage strategy for web pages, a web style for the desktop and a
web style as a single style for the explorer.

The first proposed method of integration is the use of a single integrated explorer, shown
in Figure 1 and Figure 2. Traditionally, Microsoft has had two explorers, shown in Figure 3 and
Figure 4. There has been the Windows Explorer for personal file management and the Internet
Explorer for web browsing activities. With the integrated approach, only one explorer is used for
the access of both local and remote information.

Figure 1. Single explorer before activation
Figure 2. Single explorer after activation. Note that personal resources are on the left, while a web page is displayed on the right with its address shown above.

Figure 3. Two explorers (Internet Explorer and Windows Explorer) before activation.

Figure 4. Two explorers (Internet Explorer and Windows Explorer) after activation. Note that a web site is displayed in the Internet Explorer and personal resources are in the Windows Explorer.

By presenting web and personal resources through one utility, integration advocates believe users will only have to learn one method of information access, making access easier and more convenient (Seidman & Haight, February 1997; Stewart, October 1997; Zelnick, 1997). According to Microsoft, users find that searching and using data on the web requires them to have a different set of tools and methods than finding and using information on their computers.
making their learning curve higher and training longer ("True Web Integration," February 1997). Therefore, users will find the one explorer easier to use since they will only have to learn and use one way to access information. Advocates believe that the single explorer will also be more convenient because information can be accessed from one location, as opposed to two in the traditional method, and access to resources will be faster since there will be fewer steps to retrieve the information.

It can be argued, however, that since the original development of the web and the desktop interfaces, users have already learned how to use two explorers. By presenting them with one explorer, users would be required to learn a new method of information access. This new method could perhaps conflict with familiar methods, making the new way harder for users to learn and use. There is also no evidence to suggest that users prefer to have different information types in one explorer. In other words, they may prefer personal files in one location and web content in another.

A second proposed method of integration is the use of a web-based storage strategy for personal files, shown in Figure 5. Currently, personal files and desktop applications are accessed from the desktop and the Windows Explorer, as shown in Figure 6. But with the integrated approach, personal files and desktop applications can be accessed from areas where web pages are generally stored. By using a web-based storage strategy for personal files, users would be able to store a word document under the bookmark (or favorites) menu in the web browser together with frequently used web pages.
A third proposed method of integration is the use of a desktop-based storage strategy for web pages, which is different from the other proposed web-based methods because this method is applying a desktop-based strategy for web pages (see Figure 7). Currently, web pages are stored as bookmarks in the web browser or as links on the browser’s tool bar, shown in Figure 8. With the integrated approach, web pages can be accessed from the desktop computer where personal files and folders are typically stored. By using a desktop-based storage strategy for web pages, users would be able to view a web page by accessing it from the desktop.
Advocates of integration believe that these two methods of integration will be more convenient to use since remote and local information can be accessed in the same location. An example of this convenience would be if users chose to store on-line recipes together with their own recipes in one folder (Seidman & Haight, February 1997; Stewart, October 1997; Zelnick, 1997). Although these strategies may be convenient in some cases, they may not be in other cases depending on the type of information users create and collect. That is, users may never need to store a personal file with web pages. Moreover, despite the advantage of integrating personal files and web pages into one area, these strategies may be disadvantageous in some situations because users may get confused if different information types are combined into one area.
The fourth proposed method of integration is the use of a web style for the selection and activation of desktop file manipulation. Currently, the desktop style is used for file manipulation tasks. Users select a file or folder with a single click of the mouse and activate it with a double click. This style is used for the opening of files, the renaming of files and the multiple selection of files. With the integrated approach, users would select a file or folder with a mouse over and activate it with a single click.

Proponents of integration believe that the web style is easy to use and would be much easier to use than the desktop style since the desktop style is difficult to use. Sullivan (1996) found both new and average users had some difficulty with the action of double clicking to open a file or an application. The web style, in contrast, is thought to be easy to use. Advocates believe that new users will find it easy to learn how to use and average and experienced users will find it easy to use since they are already familiar with this style based on their experiences with the web (Halfhill. July 1997: Seidman & Haight. February 1997).

In contrast, opponents of integration believe that users may resist adopting this style despite its ease of use since they are already familiar with the desktop style ("IE vs Communicator". 1997: Jeffries. 1996). This preference for a familiar style is illustrated in a usability study of Internet Explorer 4.0 ("Internet Success Stories". 1997). The findings revealed that users could open applications more easily with the web style but they had trouble selecting an application without opening it. That is, they found the single click of the web style easy to use for the opening of files but confusing to use for the selection of files since they were used to using a single click rather than just a mouse over to select a file. When they experienced difficulties, users consistently reverted to the desktop style.
The web style may also not be readily adopted because it is not just the selection and opening of files and folders that users would have to learn or relearn. The renaming and multiple selection of files and folders are different in the two styles. For example, users would have to learn to mouse over to select and right mouse click to rename a file with the new style. This relearning may become cumbersome since users already know how to left mouse click and re-click on the selected title or left mouse click to select and right mouse click to rename a file using desktop style (Blackwell. November 1997: Finnie & Methvin. 1998).

The fifth proposed method of integration is the use of a single style for the integrated explorer. Currently, there are two ways to select and activate a file or an icon depending on whether the Windows Explorer or the Internet Explorer is used. The desktop style is used on the desktop and the Window Explorer and the web style is used on the Internet Explorer. In the integrated explorer, the web style is the suggested style for all operations (Forrester Research. 1996: Halfhill. July 1997: Market Bulletin. Summer 1997).

Advocates of integration have proposed this style as the common style for the single explorer to promote its consistency across the desktop and the explorers. Users would be able to use the same style for both web pages and personal files and folders (Seidman & Haight. February 1997: “True Web integration”. February 1997). In a survey to evaluate Microsoft’s Active Desktop, PC Magazine found that although users disliked the web domination of their desktop computer, they did like the homogenized interface found across the explorers and the desktop (Yael-Li. December 1997).

Despite this appreciation, it can be argued that this style is not consistent since there are multiple variations of this style as implemented on different web sites. For example, a hyperlink on the web could change colour or become highlighted upon mouse over of a web page. It could
also remain unchanged on other web pages. Therefore, the web style may not be an appropriate style to use when arguing for consistency. The desktop style, in contrast, has remained consistent since the original conception of the GUI and has stayed relatively consistent across many operating systems.

Present Study

This study was conducted to explore whether web and desktop activities should become more integrated by examining how current web and desktop users react to integration and to evaluate five specific methods of integration.

Two approaches, a web and desktop integrated approach and a web and desktop independent approach, were evaluated and compared for ease of use and preference. These approaches incorporated five methods of integration and independence, which were also evaluated and compared for preference. That is, five comparisons were made between each of the web and desktop integrated methods and web and desktop independent methods. The first comparison evaluated the explorer strategy. It compared a single integrated explorer versus two explorers (the Windows Explorer and the Internet Explorer). The second comparison evaluated the personal file storage strategy. It compared the capability of storing personal files on both the desktop computer and in the web browser versus the capability of storing personal files on the desktop computer only. The third comparison evaluated the web page storage strategy. It compared the capability of storing web pages in both the web browser and on the desktop computer versus the capability of storing web pages in the web browser only. The fourth comparison evaluated the file manipulation style strategy. It compared a web mouse over to select and single click to activate style for the desktop versus a desktop single click to select and double click to activate style for the desktop. This comparison was done for opening, renaming
and multiple selection of files. The fifth comparison evaluated the explorer style strategy. It compared a web style for the integrated explorer versus a web style for the Internet Explorer and a desktop style for the Windows Explorer. The value of each of the web and desktop integrated methods were also assessed to determine the extent to which the integrated methods were valued. Finally, a posthoc comparison was made to determine if there was a difference in ease of use and preference in the two approaches, and differences in preference and value of the five methods, as a function of users' computer and web experience.
Method

Participants

Thirty-two 49.100 students were recruited to participate in this study and received one credit for participating. Participation was voluntary and confidentiality was assured. Participants were required to have used Windows 95 and the web for at least a year. The reason for this recruitment requirement was to avoid computer and web inexperience with task performance since participants were required to perform windows-based and web-based tasks and no training was going to be provided. The recruitment questionnaire is provided in Appendix A.

Material

Equipment

Two identical Intel MMX pentium computers with 128 Megabytes of RAM were used. Both computers had the same 21" Sony Multiscan 20 se monitors. Both had identical gray desktop backgrounds with the screen resolution set at 800 by 600 pixels. Identical keyboards and Logitech mice were present. Both computers had an internet connection. The Windows 98 operating system was installed on both computers. The computers had identical files, folders and applications on the desktop and on the hard drive.

Five differences between the two computers were present. The first difference was that the integrated computer used a single integrated explorer on the desktop, while the independent computer had both the Windows Explorer and the Internet Explorer on the desktop. The purpose of this difference was to evaluate the explorer strategy by making a comparison between the single explorer for the access of both web and personal resources versus two explorers (the Windows Explorer for the access of personal files and the Internet Explorer for the access of web pages). The second difference was that the integrated computer had personal files in the web
browser together with web pages, while the independent computer had only web pages in the
web browser. The purpose of this difference was to evaluate the personal file storage strategy by
making a comparison between the storage of personal files on both the desktop computer and in
the web browser and the storage of personal files on the desktop computer only. The third
difference was that the integrated computer had web pages on the desktop computer together
with personal files, while the independent computer only had personal files on the desktop
computer. The purpose of this difference was to evaluate the web page storage strategy by
making a comparison between the storage of web pages in both the web browser and on the
desktop computer and the storage of web pages in the web browser only. The fourth difference
was that the integrated computer had the web style (mouse over to select and single click to
activate) activated on the desktop, while the independent computer used the desktop style (single
click to select and double click to activate) on the desktop. The purpose of this difference was to
evaluate the file manipulation style strategy by making comparing the two styles. This difference
applied to the opening of files, the renaming of files and the multiple selection of files. The fifth
difference was that the integrated computer had the web style for the single explorer, while the
independent computer had the desktop style for the Windows Explorer and the web style for the
Windows Explorer. The purpose of this difference was to evaluate the explorer style strategy by
making a comparison between a single web style for the explorer and two separate styles, a web
style for the Internet Explorer and a desktop style for the Windows Explorer.

Location and setup

Testing was conducted at the CURE lab at Carleton University. Two computers were
positioned next to each other on a table. In front of the table, there were two chairs next to each
other. One was for the participant and the other was for the experimenter. A video camera was
mounted onto a bookshelf behind the participant to record the testing session. The lab setup is shown in Figure 9.

![Diagram showing lab setup with computer stations, participant's chair, experimenter's chair, and video camera.]

Figure 9. Setup

Procedure

Upon arrival at the testing session, participants were asked to sign an informed consent form, provided in Appendix B. They were then asked to fill out a computer and web experience questionnaire to determine their computer and web experience level (see Appendix C). In this questionnaire, the participants were asked eight questions. Four of the questions covered computer experience and four covered web experience. The method used to assess computer experience was based on 4 dimensions: familiarity with operating system functions, familiarity with application types, number of operating systems known and a subjective level of computer experience. The method used to assess web experience was based on four dimensions: hours of use, proficiency with web browsing, familiarity with web development and a subjective level of web experience. Each question required the participants to choose one of the three statements
which best describe them. Each of the statements was associated with a number (6, 0, -6). After the completion of the questions, a total score from the eight computer and web statements was obtained to determine an experience rating for each participant. If they scored between 17 and 48, they were classified as an expert computer and web user. If they scored between 16 and -16, they were classified as an intermediate computer and web user. If they scored between -17 and -48, they were classified as a novice computer and web user. None of the participants were novice users, as expected because novice users had been screened from the study during the recruitment process. There were six expert users and twenty-six intermediate users.

After the completion of these questions, the participants were given a brief introduction to web and desktop integration and general instructions as to how the experiment would proceed (see Appendix D). The participants were told that they would be performing a set of tasks on each of the two approaches, followed by some questions about their experiences while doing the tasks. The participants were also assured that the purpose of the experiment was to evaluate the different design ideas and not to test their abilities to perform tasks. This assurance was important to reduce participants' nervousness about performing the tasks. They were asked to talk aloud throughout the experiment and were given an example of how talking aloud should be done. The purpose of talking out loud was to capture any impressions and reactions that the participants might have and to see what differences they noticed between the two approaches as they were performing the tasks.

Following this, permission to videotape the session was requested. A video release form, provided in Appendix E, was given to each participant to sign. The experimenter explained to the participants that the sole purpose of recording the testing session was to allow the experimenter to capture any information that might have been missed during the data collection. Participants
were assured that the videotape would only be used by the experimenter and that their names would not be associated with the video.

The data collection process, provided in Appendix F, consisted of three sections. These sections are summarized in Table 1.

Table 1

<table>
<thead>
<tr>
<th>Section</th>
<th>Type of activity</th>
<th>Type of question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section 1</td>
<td>Integrated and independent approach tasks</td>
<td>Individual ease of use rating for integrated and independent approaches</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Preference rating for integrated versus independent approaches</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Identification of differences between the two approaches</td>
</tr>
<tr>
<td>Section 2</td>
<td>Demonstrations of integrated and independent methods</td>
<td>Preference rating for each integrated versus independent methods</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Second preference rating for integrated versus independent approaches</td>
</tr>
<tr>
<td>Section 3</td>
<td>Demonstration of integrated methods</td>
<td>Value rating of integrated methods</td>
</tr>
</tbody>
</table>

In the first section, participants were asked to perform two parallel sets of tasks on each of the two approaches under investigation. The purpose of these tasks was to provide the
participants with the opportunity to explore the web and desktop integrated and independent approaches. The tasks had been selected to illustrate the differences between the two approaches. The order of presentation of these tasks was double-counterbalanced. That is, sixteen of the participants got the integrated tasks first and then the independent tasks, while the other sixteen participants received the independent tasks first and then the integrated tasks. Of the first sixteen participants, eight performed the integrated tasks on the first computer, while the other eight performed the integrated tasks on the second computer. Similarly, of the other sixteen participants, eight performed the independent tasks on the first computer, while the other eight performed the independent tasks on the second computer.

After participants completed one set of twelve tasks using one approach, they were asked to rate the ease of use of the approach and the reason for their rating. They then performed the next set of twelve tasks on the other approach and were asked to rate the ease of use of that approach. Following the two sets of tasks, they were asked to compare the two approaches for preference. The purpose of this question was to determine their preference between the two approaches before any explanations and illustrations of the differences between the two approaches were given. Participants were also asked what they thought the main differences were between the two approaches. The purpose of this question was to see what differences they noticed before the differences between the approaches were illustrated in the next section of the study.

In the second section, the experimenter showed the five methods of integration or independence and then asked the participants to compare each method for preference and to discuss the reasons for their preference. The order of presentation of these methods was counterbalanced. The participants were always either presented with the integrated method first
or with the independent method first. The order of presentation of the methods was consistent
with the order of presentation of the tasks. That is, if the participants were presented with the
integrated tasks first, they would later be shown the integrated methods first in each of the five
comparisons and if the participants were presented with the independent tasks first, they were
shown the independent methods first in each of the five comparisons. The purpose of this order
of presentation was to maintain consistency in order to prevent the participants from getting
confused as to which approach was which. The participant would know that one approach was
consistently presented first and the other approach was consistently presented second.

In the third section, an explanation of the integrated and independent methods was provided by
the experimenter. Participants were asked to compare the web and desktop integrated and the
web and desktop independent methods for preference and to discuss the reason for their
preference. The purpose of these questions was to determine if there was a difference in the two
preference ratings once participants has see the differences between the two approaches. Finally,
the participants were asked to assess the value for each of the integrated methods.

After the completion of the value ratings, the participants were debriefed about the
purpose of the experiment and thanked for their willingness to participate in the study (see
Appendix G).
Results

Thirty-two (6 expert, 26 intermediate) participants were included in this study. All participants had used both Windows 95 and the web for at least a year. None of the participants had used Windows 98 or Internet Explorer 4.0.

Quantitative analyses were conducted on the following data: the ease of use ratings of the integrated and independent approaches, the preference ratings between the two approaches, the preference ratings between the integrated and independent methods and the value ratings of the integrated methods. Qualitative analyses were also conducted on the differences between the two approaches observed by participants before the differences were shown and on the participants’ comments concerning the reasons for their ease of use ratings, preference ratings and values ratings. These comments are given in Appendix H.

Ease of Use between the Two Approaches

Two 9-point likert scales were used to determine the ease of use of the two approaches (1 = very difficult, 5 = neutral and 9 = very easy.) To determine the ease of use of the two approaches as a function of computer and web experience, a mixed 2 X 2 Analysis of Variance was conducted with the approach type (independent and integrated approach) as a within-subjects independent variable and user type (intermediate and expert) as a between subjects independent variable. The Levene’s test for homogeneity of variance was not significant. The ANOVA analysis yielded only a main effect for approach type. The independent approach (M = 7.72, SD = 1.44) was rated as statistically significantly easier to use than the integrated approach (M = 6.59, SD = 1.86). F(1, 30) = 15.13, p < .01, η² = .34. The main effect for user type was not significant. F < 1. No significant difference between intermediate users (M = 7.06, SD = 1.53) and expert users (M = 7.47, SD = 1.35) were found F(1, 30) < 1. The
interaction was also not significant. $F(1.30) < 1$.

Preference between the Two Approaches

A 9-point likert scale was used to determine user preference between the two approaches ($1 =$ much prefer integrated approach. $5 =$ no preference and $9 =$ much prefer independent approach). This scale was given twice, before and after the differences between the two approaches were explained. Thus, shifts in preference after the two approaches were demonstrated could be examined, as well as differences due to computer and web experience. A mixed 2 X 2 Analysis of Variance with the approach (pre and post demonstration) as a within-subjects independent variable and user type (intermediate and expert) as a between-subjects independent variable was conducted. The Levene’s test for homogeneity of variance was not violated. Only the main effect for user type was statistically significant $F(1.30) = 10.93$. $p < .01$. $\eta^2 = .27$. There was a significant difference between the expert users ($M = 7.50$, $SD = 2.44$) and intermediate users ($M = 4.42$, $SD = 2.50$). The main effect for the pre/post effect was not significant. $F(1.30) = 1.47$. $\eta^2 = .05$. The interaction was also not significant. $F(1.30) < 1$.

To determine whether there was a preference for one of the approaches in either of the two user groups, single sample t-tests were conducted for each group in which the null hypothesis was that there was no preference ($\mu = 5$). Experts users had a statistically significant preference for the independent approach ($M = 7.50$, $SD = 2.44$). $t = 4.18$. $p < .01$. The intermediate users did not have a statistically significant preference for either approach ($M = 4.42$, $SD = 2.50$). $t = -1.26$. $p > .05$.

Preference between the Integrated and the Independent Methods

9-point likert scales were used to determine the preference between each of the integrated and independent methods ($1 =$ much prefer integrated method. $5 =$ no preference and $9 =$ much
prefer independent method). To determine the preference between these integrated and independent methods as a function of computer and web experience, a mixed factorial analysis of variance with user type (intermediate and expert) as a between-subjects independent variable was conducted. The within-subjects variable consisted of the methods. The Levene's test for homogeneity of variance was not violated. The multivariate approach to the mixed design was used for the within-subject effects. No statistical difference was found for the interaction. $F < 1$. $\eta^2 = .017$. A statistical difference was found for the user groups $F(1.30) = 10.61$. $p < .01$. $\eta^2 = .26$. There was a statistically significant difference between the expert group ($M = 6.63$, $SD = 2.58$) and intermediate group ($M = 4.37$, $SD = 2.46$). There was an overall significant difference among the different methods. $F(7.24) = 3.98$. $p < .01$. $\eta^2 = .53$.

Table 2 shows the mean preference for each method. Lower scores are associated with greater preference for the integrated methods. Paired comparisons, using the Bonferroni correction, showed that the file manipulation style strategy (overall for opening, renaming and multiple selection of files), as well as the style for the multiple selection of files and the renaming of files were significantly different in preference than the web page storage strategy. No other pairwise were found.
Table 2

Mean and standard error of the integrated and independent methods

(1 = much prefer integrated method, 5 = no preference, 9 = much prefer independent method)

<table>
<thead>
<tr>
<th>Method</th>
<th>M</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>File manipulation style strategy</td>
<td>6.43</td>
<td>.53</td>
</tr>
<tr>
<td>Style for opening files</td>
<td>6.04</td>
<td>.63</td>
</tr>
<tr>
<td>Style for renaming files</td>
<td>6.46</td>
<td>.50</td>
</tr>
<tr>
<td>Style for the multiple selection of files</td>
<td>6.08</td>
<td>.45</td>
</tr>
<tr>
<td>Explorer style strategy</td>
<td>5.44</td>
<td>.54</td>
</tr>
<tr>
<td>Explorer strategy</td>
<td>4.90</td>
<td>.62</td>
</tr>
<tr>
<td>Personal file storage strategy</td>
<td>4.75</td>
<td>.58</td>
</tr>
<tr>
<td>Web page storage strategy</td>
<td>3.91</td>
<td>.45</td>
</tr>
</tbody>
</table>

To determine whether there were significant preferences among the integrated and independent methods, single sample t-tests were conducted for each user group. The null hypothesis was that there was no preference (μ=5). The intermediate users had three mean preferences significantly less than 5, indicating a preference for the integrated methods. These methods were the web page storage strategy, the personal file storage strategy and the explorer strategy. They had no statistically significant preferences for the independent methods. In contrast, the expert users had no statistically significant preferences for the integrated methods.
However, they significantly preferred the independent methods. These methods were the file manipulation style strategy, including the renaming of files and the multiple selection of files.

The differences between the expert users and intermediate users can be seen in Figure 2. Table 3 and Table 4 shows the results of these single sample t-tests for the user groups.

![Graph showing preference ratings](image)

**Figure 10.** Mean preference rating by user group and methods. (1 = prefer integrated method, 5 = no preference, 9 = prefer independent method). Note that while the expert users preferred the independent method for file manipulation, the intermediate users had no preference. Also, while the intermediate users preferred the integrated methods for storage and access, the expert users did not have a preference.
Table 3

T-tests for the expert users

<table>
<thead>
<tr>
<th>Method</th>
<th>M</th>
<th>(SD)</th>
<th>t (df)</th>
</tr>
</thead>
<tbody>
<tr>
<td>File manipulation style strategy</td>
<td>7.43</td>
<td>2.51</td>
<td>2.59* (6)</td>
</tr>
<tr>
<td>Style for opening files</td>
<td>7.00</td>
<td>2.65</td>
<td>1.52 (6)</td>
</tr>
<tr>
<td>Style for renaming files</td>
<td>7.57</td>
<td>1.40</td>
<td>4.87* (6)</td>
</tr>
<tr>
<td>Style for the multiple selection of files</td>
<td>7.29</td>
<td>1.70</td>
<td>2.56* (6)</td>
</tr>
<tr>
<td>Explorer style strategy</td>
<td>6.71</td>
<td>2.98</td>
<td>1.52 (6)</td>
</tr>
<tr>
<td>Explorer strategy</td>
<td>6.00</td>
<td>3.21</td>
<td>.82 (6)</td>
</tr>
<tr>
<td>Personal file storage strategy</td>
<td>5.86</td>
<td>3.24</td>
<td>.51 (6)</td>
</tr>
<tr>
<td>Web page storage strategy</td>
<td>5.14</td>
<td>3.03</td>
<td>.13 (6)</td>
</tr>
</tbody>
</table>
Table 4

T-tests for the intermediate users

<table>
<thead>
<tr>
<th>Method</th>
<th>M</th>
<th>(SD)</th>
<th>t (df)</th>
</tr>
</thead>
<tbody>
<tr>
<td>File manipulation style strategy</td>
<td>5.44</td>
<td>2.45</td>
<td>.90 (24)</td>
</tr>
<tr>
<td>Style for opening files</td>
<td>5.08</td>
<td>3.01</td>
<td>.13 (24)</td>
</tr>
<tr>
<td>Style for renaming files</td>
<td>5.28</td>
<td>2.52</td>
<td>.55 (24)</td>
</tr>
<tr>
<td>Style for the multiple selection of files</td>
<td>4.88</td>
<td>2.17</td>
<td>-.28 (24)</td>
</tr>
<tr>
<td>Explorer style strategy</td>
<td>4.16</td>
<td>2.38</td>
<td>-1.77 (24)</td>
</tr>
<tr>
<td>Explorer strategy</td>
<td>3.80</td>
<td>2.80</td>
<td>-2.14* (24)</td>
</tr>
<tr>
<td>Personal file storage strategy</td>
<td>3.64</td>
<td>2.53</td>
<td>-2.69* (24)</td>
</tr>
<tr>
<td>Web page storage strategy</td>
<td>2.68</td>
<td>1.80</td>
<td>6.46* (24)</td>
</tr>
</tbody>
</table>

Value of the Integrated Methods

5-point likert scales were used to determine the value for the integrated methods
(1 = not at all valuable, 3 = fairly valuable and 5 = very valuable). A mixed factorial analysis of
variance was performed with the two user groups as a between-subjects variable and the
individual value ratings as a within-subjects variable. The Box test for multivariate homogeneity
of variance was not violated. The multivariate test of the interaction was not statistically
significant F(4, 27) = 1.43. $\eta^2 = .18$. The difference in user groups also failed to reach statistical
significance, F(1, 30) = 2.92. $\eta^2 = .09$. The difference between the expert users
($M = 2.63, SD = 1.24$) and the intermediate users ($M = 3.42, SD = 1.05$) was not significant.
There was a statistically significant difference among the different methods. \( F(4, 27) = 6.12, p < .01. \eta^2 = .48. \) Table 5 shows the mean values for the integrated method. Paired comparisons, using the Bonferroni correction, showed that the web style strategy was less valued than both the web page storage strategy and the explorer style strategy. No other pairwise differences were found.

Table 5

Means and standard error of the integrated methods

<table>
<thead>
<tr>
<th>Method</th>
<th>M</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>File manipulation style strategy</td>
<td>2.33</td>
<td>.29</td>
</tr>
<tr>
<td>Explorer style strategy</td>
<td>3.08</td>
<td>.27</td>
</tr>
<tr>
<td>Explorer strategy</td>
<td>2.94</td>
<td>.32</td>
</tr>
<tr>
<td>Personal file storage strategy</td>
<td>3.03</td>
<td>.28</td>
</tr>
<tr>
<td>Web page storage strategy</td>
<td>3.75</td>
<td>.26</td>
</tr>
</tbody>
</table>

Differences Observed by the Participants

Participants were asked what they thought the main differences were between the two approaches. The purpose was to see what differences they noticed before the differences between the approaches were pointed out to them. Since the difference between the single explorer and the two explorers had already been shown to the participants prior to the start of the experiment as an example of a difference between the two approaches, the differences that could have been possibly identified by the participants are displayed in Table 6. along with the number of
participants who noticed these differences.

Table 6

Differences observed by participants

<table>
<thead>
<tr>
<th>Potential Differences</th>
<th># of Participants (N = 32)</th>
<th>% of Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>File manipulation style strategy</td>
<td>9</td>
<td>28 %</td>
</tr>
<tr>
<td>Hyperlinks</td>
<td>5</td>
<td>16 %</td>
</tr>
<tr>
<td>Style for renaming files</td>
<td>4</td>
<td>13 %</td>
</tr>
<tr>
<td>Style for multiple selection of files</td>
<td>0</td>
<td>0 %</td>
</tr>
<tr>
<td>Explorer style strategy</td>
<td>1</td>
<td>.03 %</td>
</tr>
<tr>
<td>Web page storage strategy</td>
<td>3</td>
<td>9 %</td>
</tr>
<tr>
<td>Personal file storage strategy</td>
<td>2</td>
<td>6 %</td>
</tr>
</tbody>
</table>

Most differences between the two approaches were noticed by only a small percentage of the participants. On average, a participant noticed one of the seven differences between the two approaches. The three main differences that participants discovered were file manipulation style strategy (N = 9) the use of hyperlinks (N = 5) and the style for the renaming of files (N = 4).

To assess whether there were differences between the expert and intermediate users in the number of differences observed, a single sample t-test was conducted. A statistically significant difference was found between the intermediate users (M = .54, SD = .10) and the expert users (M = 1.43, SD = .08). F(1, 30) = 4.25, p < .05. η² = .16, such that expert users noticed more differences between the two approaches than intermediate users.
Comments Given by the Participants

Participants made a number of comments about the ease of use, preference and value for the independent and integrated approaches and their respective methods. The main reasons are listed below for both the approaches and their methods. All the specific comments are listed from table 1 to table 15 in Appendix H.

Support for the independent approach

**Familiarity.** Twenty-five of the thirty-two participants (N = 6 expert users, N = 19 intermediate users) stated that they found the independent approach easier to use because it was familiar to them. Also, fifteen participants (N = 6 expert users, N = 11 intermediate users) stated their preference for the independent approach was due to familiarity.

**Integration concerns.** Participants raised concerns about integration. Seven participants (N = 2 expert users, N = 5 intermediate users) were concerned about the security and corruption of files if the files were to be integrated with web pages. Five participants (N = 2 expert users, N = 3 intermediate users) were worried about increased cost and increased use of the web. Three participants (N = 3 intermediate users) were concerned about busy phone lines as a result of increased web use.

**Independence of the web and the desktop.** Seven participants (N = 5 expert users, N = 2 intermediate users) indicated that the web and desktop did not belong together. They expressed the view that independence between explorers and independence between personal files and web sites should be kept. Five participants (N = 4 expert users, N = 1 intermediate user) preferred to use the independent approach since they were more easily able to differentiate between information that belonged to them and the information that belonged to the web.
Support for the integrated approach

Willingness to use. Thirteen participants (N = 13 intermediate users) indicated that they would use the integrated approach if they were given the opportunity to use it.

Integration of the web and the desktop. Ten participants (N = 10 intermediate users) indicated that the integration would be an advantage for easier access to web pages and personal files.

Support for the independent methods

Like the independent approach, the independent methods were also preferred for familiarity, but there are a few other reasons that the independent methods were preferred.

Increased speed of the desktop style. Twenty-one participants (N = 6 expert users, N = 15 intermediate users) indicated a preference for the desktop style because of its increased speed for file manipulation. They cited that the selection of a file with a click was faster than having to wait until the file was selected with the mouse over during the opening, renaming and multiple selection of files.

Increased ease of use of the desktop style. Twenty-three participants (N = 6 expert users, N = 17 intermediate users) found the desktop style to be easier to use than the web style primarily because they were familiar with it and because of the difficulties they experienced with the web style.

Avoid cluttering of the web and the desktop. Six participants (N = 4 expert users, N = 2 intermediate users) cited that cluttering of the desktop and the web browser would become a problem with the personal file and web page storage strategies. Since participants would have the ability to store not only personal files but also web sites on the computer, they thought that this storage might increase and create a messy looking desktop and bookmarks area of the web
browser bookmark list.

**Separate styles.** Seven participants \((N = 3\) expert users, \(N = 4\) intermediate users) stated that web pages and personal files should have separate styles since they have separate functions and web style was not appropriate for personal files.

**Support for the integrated methods**

Like the integrated approach, the integrated methods were also preferred for increased accessibility to information. There are, however, a few other reasons for the preference and value of the integrated methods.

**Increased convenience and speed of a single location area.** Twelve participants \((N = 12\) intermediate users) indicated an increased preference for the single explorer because of the ability to access both web sites and personal information from a single location. Eight of these participants \((N = 8\) intermediate users) said that this single location not only provided convenience, it also enabled them to use the web and manage files simultaneously and access files and web sites in a more immediate, easier and more efficient manner. Six participants \((N = 6\) intermediate users) said that the single explorer was useful because it no longer required them to switch between two explorers.

**Increased speed and ease of the web style.** Seven participants \((N = 7\) intermediate users) preferred and valued the web style because of its increased speed with a single click for the activation of a file and five participants \((N = 5\) intermediate users) liked the speed of a single click for the renaming and multiple selection of files. Six participants \((N = 6\) intermediate users) preferred the web style because of its increased ease of use. They only have to single click to activate a file as opposed to using two clicks with the desktop style. They did mention that they often experienced difficulty with the double click when attempting to open a file.
Consistency. Five participants ($N = 5$ intermediate users) found the web style useful for its consistency when using the single explorer. Two of them ($N = 2$ intermediate users) stated it would prevent them from having to consciously think about what style to use, making it impossible to use the wrong style.

Performance Behaviors.

While the participants were performing the computer and web related tasks, a number of performance behaviors were observed.

**Desktop style problems.** Three participants ($N = 3$ intermediate users) experienced difficulties renaming files and eight participants ($N = 8$ intermediate users) had difficulties with selecting multiple files with the desktop style. Six participants ($N = 6$ intermediate users) did not know how to rename and multiple select files. Seven participants ($N = 7$ intermediate users) experienced difficulties with the double click to open files. This would typically happen if the double click was not performed fast enough. Five participants ($N = 5$ intermediate users) had never used the second mouse button for desktop operations.

**Web style problems.** Twenty-eight participants ($N = 5$ expert users, $N = 23$ intermediate users) experienced difficulties with the web style during task performance. They opened a file when the intention was only to select a file.

**Double clicking on the web.** Six participants ($N = 2$ expert users, $N = 4$ intermediate users) were found double clicking on various web sites.

**Obtaining wrong files.** Twelve participants ($N = 12$ intermediate users) appeared to have difficulties with differentiating between a Word document icon and an Internet Explorer web page and as a result, they got confused and mistakenly accessed the wrong files.
Discussion

The web and the desktop have recently began to integrate but there is very little research to support whether they should integrate and how integration should become available. This study was conducted to examine whether the desktop and the web should become more integrated by exploring how users react to web and desktop integration and to evaluate specific methods of integration.

User Reaction to Web and Desktop Integration

Two approaches, the web and desktop integrated approach and the web and desktop independent approach were evaluated and compared for overall ease of use and preference. They were also evaluated in relation to the amount of computer and web experience of users.

Overall, both intermediate and expert users found the independent approach to be easier to use than the integrated approach. The main reason that was cited for this increased ease of use was familiarity with the currently used system. Other research has also shown that familiarity is an important factor in determining which interface people will choose or prefer to use. In one study, users preferred the interface with which they were most familiar despite performing better on another less familiar interface (Kissel, 1995). In another study, users indicated a greater willingness to use an interface similar to the one with which they were most familiar (Wogalter & Frei, 1990).

Although users found the independent approach to be easier to use overall, there were differences in preference between the two user groups for this approach. While there was no significant preference for intermediate users, expert users preferred the independent approach over the integrated approach. This difference in preference was likely related to the degree of familiarity. Expert users, by definition, were more experienced in using the independent
approach and were, therefore, more familiar with this approach. As they performed the independent tasks, it was evident that these users had a very good understanding of the way the independent approach was structured and functioned. These users did not experience difficulties performing tasks using the independent approach.

Intermediate users had no preference between the integrated and independent approaches and this lack of preference could be attributed to the fact that they were less familiar and proficient at using the independent approach. This lessened familiarity was evidenced in two ways. First, some of them indicated that the two approaches appeared very similar to them. This was confirmed when they did not notice many differences between the two approaches following task performance. Second, many of them had difficulties with the independent approach. Specifically, they had problems with opening files, renaming files and the multiple selection of files. Intermediate users would often experience difficulty opening a file by double clicking on a file icon because they would not double click fast enough for the action to take effect, a finding supported in other research (Sullivan, 1996). Some users did not know how to rename and multiple select files, despite having used the Windows interface for at least a year. These difficulties suggest that intermediate users were not as experienced or familiar with the independent approach as expert users.

Researchers have indicated that there are significant distinctions in knowledge acquisition of system functioning between user types and these distinctions are reflected in their development of a conceptual model of a system (Dillon, 1987; Gillan, Fogas, Aberasturi & Richards, 1995; Hanish, Kramer, Hulin & Schumacher, 1988). Differences in the development of a conceptual model may be related to the ease of use and preference for an approach. Expert users, through more experience, have developed a better conceptual model of the independent
approach. Since the integrated approach differs from the conceptual model of the independent approach, expert users found the integrated approach more difficult to use and hence were more resistant to using it and preferred the independent approach.

Intermediate users, with less experience with the independent approach, would have a less developed conceptual model for this approach, as evidenced by their task performance difficulties and their difficulties distinguishing the differences between the two approaches. Because these users had some exposure to the independent approach, they would have a more developed conceptual model of the independent approach than of the integrated approach, a user interface style with which they were unfamiliar before the study. Therefore, the independent approach would be considered easier to use than the integrated approach. Because these users still experienced difficulties with the independent approach, many believed that the new approach may provide solutions to these difficulties and therefore were more willing to use the integrated approach if given the opportunity. However, with their limited exposure to the integrated approach, these users may not have been exposed enough to appreciate the long-term difficulties with this new approach. Thus, despite finding the independent approach easier to use, these users did not specifically prefer one approach over the other.

In addition to a lack of familiarity, another concern with integration, particularly for expert users, is that these users view the web and the desktop as separate entities. These users want a distinction made between what is theirs, as in personal files, and what belongs to others, as in web pages. Typically users access the web to obtain information while they use their desktop to create information. In addition, the web is a public forum of information and the desktop is a private workspace in which the user has control over the access to information. Thus, the metaphors used to describe the web and the desktop appear appropriate. Because of
these differences between the purpose of the web and the desktop. Expert users would prefer to keep these two entities separate.

Some intermediate users, however, view the integration of the web and the desktop as an advantage because it allows them easier access to web pages and to personal files by not restricting how these pages or files are accessed. Expert users do not object to these restrictions because it allows them to keep the web and the desktop separate. These differences between intermediate and expert users may be explained again by the differences in the development of their conceptual models. Expert users had a more developed conceptual model of the web, the desktop, and the distinction between these two entities. Intermediate users, with a less developed conceptual model, experienced more difficulty understanding the differences as evidenced by their confusion when asked to differentiate between local and remote information during task performance. In addition, many intermediate users were unfamiliar with the term ‘desktop’ when used in a task description. If these users experienced difficulty understanding the conceptual distinction between the web and the desktop, they would be unlikely to appreciate any advantage to limiting the access to web pages and personal files by restricting the methods by which these sources of information are accessed.

Some users were concerned about security and file corruption caused by the integration between the web and the desktop. Users were concerned that personal files could be more easily corrupted through their closer association with the web. They were also concerned that the access and distribution of personal files, such as proprietary documents, could unknowingly become available for public use through integration. In addition, there was some concern that hackers would be able to more easily access personal files on their computers if these files were combined with web pages. These security concerns have been identified as an issue not only for
integration but also for the web in general. In one study, eighty percent of users were very concerned about security issues regarding privacy, confidentiality and proof of identity on the web (GVU's WWW Users Surveys. October 1998). Furthermore, this concern may actually increase, especially when viruses from the web interact with personal files such as in the case of the recent Melissa virus ("Net gains and Net losses". April 1999). When users opened an attached document of an email they received through the internet that seemed to be from an acquaintance, the virus was activated and harvested users' first 50 email addresses stored in their directories and then forwarded the infected message to each of the 50 people.

Given their security concerns about the web, an advantage of the independent approach is that it allows users greater control over how and when they choose to access the web by making a better distinction between these two entities. This gives the user the power to decide when it is worth the security risk to access the web and to take appropriate security precautions when they do access the web. Because the integrated approach reduces the distinction between personal files and web pages, users felt that this approach posed a greater security concern.

Similarly, because of the difficulty in distinguishing between personal files and web pages, some users were concerned that the integrated approach may result in an undesired increase use of the web and this was particularly true of users who pay for their connection time. Users were concerned that they would accidentally access the web by mistakenly selecting web pages that they thought were locally stored files, resulting in increased costs.

**User Evaluation of Web and Desktop Integration Methods**

The web and desktop integrated and independent approaches incorporated five methods, which were also evaluated and compared for preference. The first comparison was made between a single integrated explorer versus two explorers (the Windows Explorer and the Internet
Explorer). The second comparison was made between web page storage strategies, comparing the capability of storing web pages in both the web browser and on the desktop computer versus the capability of storing web pages in the web browser only. The third comparison was made between personal file storage strategies, comparing the capability of storing personal files on both the desktop computer and in the web browser versus the capability of storing personal files on the desktop computer only. The fourth comparison was made between a web mouse over to select and single click to activate style for the desktop versus a desktop single click to select and double click to activate style for the desktop. This comparison was further evaluated for the opening of files, the renaming of files and the multiple selection of files. The fifth comparison was made between a single web style for the integrated explorer versus a web style for the Internet Explorer and a desktop style for the Windows Explorer. The integrated methods were also rated for their value. Finally, the preference and value of these methods were evaluated as a function of users' computer and web experience.

There were only a few significant preferences found when comparing the five integrated and independent methods overall. A greater preference for the integrated web page storage strategy was found over the integrated file manipulation style strategy. That is, users liked the integrated method of storing web pages both in the web browser and on their desktop computer over the independent method of only being able to store web pages in a web browser. But while they liked the integrated method for web page storage, they did not like the integrated method for file manipulation style strategy. That is, they preferred the independent desktop single click to select and double click to activate style, particularly for the renaming of files and multiple selection of files, over the web mouse over to select and single click to activate style. Also, when asked how valuable the integrated methods were, the web style received quite a low value rating
compared to the integrated storage and access methods.

When making comparisons between each of the integrated and independent methods for the two user groups, considerable differences were found between intermediate and expert users. Overall, expert users preferred the independent desktop style, particularly for the renaming of files and for the multiple selection of files. That is, expert users preferred the independent desktop style method over the integrated web style. Expert users had no preferences for the other integrated or independent methods. Intermediate users preferred the integrated web page and personal file storage strategies and the integrated explorer and had no preference for the other integrated or independent methods. That is, intermediate users preferred being able to store web pages and personal files in both the web browser and on the desktop over being able to store web pages in the web browser only and personal files on the desktop only. They also preferred storing and accessing both web pages and personal files in a single integrated explorer over storing and accessing personal files in the Windows Explorer and storing and accessing web pages in the Internet Explorer. Neither expert nor intermediate users had a preference between a single web style for the integrated explorer versus a web style for the Internet Explorer and a desktop style for the Windows Explorer.

Thus, what really appeals to intermediate users about the integrated approach is the combined access and storage of information. They would like to be able to store web pages and personal files in their web browser and on the desktop and access these files from an integrated explorer. They do not have a preference for whether a web style or a desktop style is used for desktop operations. In contrast, what really appeals to expert users about the independent approach is that the desktop style is used for desktop operations. They would like to be able to single click to select and double click to activate files. Expert users do not have a preference for
the way that personal files and web pages are stored and accessed.

**Access and storage methods.** Intermediate users preferred the web page storage strategy and the personal file storage strategy because of increased convenience and ease of accessibility. These reasons have been cited as advantages to the integration between the web and the desktop by many of the integration advocates (Seidman & Haight, February 1997; Stewart, October 1997; Zelnick, 1997). The web page storage and personal file storage strategies provided these users with convenience by allowing them to access both web pages and personal files in the same location. For example, a doctor’s bookmarked URLs for medical journals could be stored together with personal medical research files in a single folder, or the personal medical research files can be accessed with the bookmarked URLs for medical journals from the browser.

Intermediate users also preferred the integrated explorer because it increased the ease and speed with which resources could be accessed since it required fewer steps to switch between file types than using two explorers. That is, users would not have to repeatedly open and close the Internet Explorer and the Windows Explorer to simultaneously retrieve a personal file and a web page.

Despite the desire to integrate, intermediate users experienced substantial difficulty in differentiating between web pages and personal files when they were stored together, either in the explorer or on the desktop. As a consequence, intermediate users got confused when they were asked to access similarly named personal files and web pages and often obtained the wrong file. For instance, if these users were asked to indicate the number of stored web pages on Shakespeare, they often included the personal files related to Shakespeare as well. When they were asked to retrieve an online recipe in a single folder, which was stored with personal files related to recipes, many of them retrieved a personal file instead of the stored web page. This would suggest that although intermediate users like the integration of personal files and web
pages together, they have difficulties differentiating between them. These users did not experience difficulties with the same tasks performed using the independent approach.

The finding that intermediate users preferred the integrated access and storage methods, yet experienced difficulties performing tasks with these methods may again be explained by their less developed conceptual model of the independent approach. These users were not familiar enough with the independent approach to know that web pages and files could be accessed simultaneously through multiple windows and that they were not required to open and close applications to switch between files. Intermediate users, during task performance, would access these files sequentially. Thus, the ability to access files and web pages from the same location may be viewed as a major advantage. Similarly, because of their less developed conceptual model of the independent approach, intermediate users seemed to rely on application cues to determine the distinction between web pages and files rather than a more developed understanding of the differences between web pages and files. That is, these users understood that when they were in a web browser, they were accessing web pages and when they were on their desktop they were accessing files. The removal of these cues in the integrated approach may have caused these users to experience difficulty making this distinction since their primary distinction cues were no longer available. Hence, they require alternative distinction cues in the integrated model.

While intermediate users preferred these integrated storage and access methods, expert users had no preference between the integrated and independent methods. This lack of preference was primarily because of familiarity with the use of the two explorers and the desire to maintain web pages and personal files as separate entities. Expert users were also concerned with the cluttering of the desktop and the web browser through the storage of personal files in the web
browser and web pages on the desktop, creating a very unorganized looking desktop and web browser. Although they did not experience difficulty during task performance with the integrated approach, they also saw no advantage to using integrated storage and access methods since they could access personal files and web pages by keeping both the Internet Explorer and the Windows Explorer activated with the use of multiple windows.

As previously suggested, expert users have a strong mental model of independence between the web and the desktop. They are familiar with maintaining the web independent from the desktop through their previous use of two explorers and through the independent methods of storing information. This would suggest that expert users would prefer the independent methods of access and storage, however these users did not have a specific preference for either the integrated or independent methods. The reason may be because the mental model they have established with the independent methods can be maintained with these integrated methods. That is, with the integrated methods, users do not have to store web pages on their desktop or access personal files in their web browser, nor do they have to access their personal files and web pages from within the same explorer. They could continue to perform tasks according to their current conceptual model of the web and the desktop as separate entities.

**File manipulation style method.** Expert users preferred the independent desktop style over the integrated web style and the two main reasons for this preference was the increased speed and ease of use of the desktop style. This advantage was found for overall file manipulation and in particular, for the renaming of files and the multiple selection of files.

The desktop style was considered to be faster than the web style. With the web style of selecting files, users reported a short delay during the mouse over before a file was actually selected and an even longer delay when multiple files were selected. The web style for renaming
files was also considered to be longer because it required more steps. When using the web style, users had to mouse over to select a file, click the right mouse button and select the rename menu option and then type in the file's new name. When using the desktop style, users only had to single click the file to select it and then type in the new name. This supports the position of integration opponents that the file manipulation strategy of the web would be difficult for users (Blackwell, November 1998; Finnie & Methuin, 1998) and may even suggest that the web style is not effective for file manipulation operations. In other words, since users do not rename other people's web pages, the use of the web style to rename a personal file is not as effective as the desktop style, which was specifically created for file manipulation tasks.

Because of their extensive familiarity with the desktop style, expert users considered it to be easier to use than the web style. This contradicts the assumptions being made by several integration advocates that the web style is easy to use and confirms the assumptions being made by integration opponents that the desktop style is easier as a function of its familiarity (Halflin. July 1997: “IE vs Communicator”, 1997; Jeffries, 1996: Seidman & Haight. February 1997).

As a result of their familiarity, expert users were very proficient at using the desktop style for desktop operations. In fact, these users would often mistakenly use this style on the web by double clicking on various web pages rather than using the web's single click style. This transference of desktop behavior onto the web may be a common occurrence. For example, on the Toronto Dominion Bank web site, users would double click on the Yes button on the bill payment confirmation screen (“Double Clicking Bill Payments”. November 1998). As a consequence, payments were being processed more than once, resulting in stern warnings from the bank to their customers to stop their double clicking behavior. These users were also mistakenly using the desktop style on the web.
When expert users employed the desktop style on the web, this behavior is known as a transfer conflict. Conflicts occur when there is a negative transfer of knowledge from one system to another that prevents users from performing effectively on the second system. In the field of human-computer interaction, there is substantial evidence to indicate that negative transfer conflicts are a serious problem for users (Karat, Boyes, Weisgerber & Schafer 1986; Pollock, 1988; Polson & Kieras. 1985; Scholtz & Wiedenbeck. 1992; Tetzlaff. 1987; Ziegler, Hoppe, Fahrtich, 1986). Another transfer conflict would commonly occur when users were performing desktop tasks using the integrated approach. Users would use the desktop style to select a file by clicking its icon, an action that would result in the opening of the file. Based on their experience with the desktop style, users expected to select the file and were surprised when the file would open on the action of a single click. Other research has found the same problem where users could open an application without difficulty but had trouble selecting it since they were used to using the desktop single click style not to select but rather to activate an application (“Internet Success Stories”. 1997).

Given expert users’ strong conceptual model of the desktop style and the difficulties they experienced with transfer conflicts when interacting with the web style, it is not surprising that the independent method of file manipulation was preferred over the integrated method. The findings of other research showing that Internet Explorer users revert back to using the desktop style when given the opportunity to use either style (“Internet Explorer 4.0”. 1997) may apply to expert users.

Intermediate users did not have a preference between the integrated and independent methods of file manipulation. This lack of preference was partially attributed to the speed and ease of use of the web style. Intermediate users thought that the activation of files was faster
using the web style because it required a single click as oppose to a double click using the desktop style. In addition, the web style single click was considered to be easier to use because it did not require the timing accuracy of the desktop double click style. That is, users experienced difficulty activating files using a double click because they would not double click fast enough to activate the file, confirming research conducted by Sullivan (1996).

The lack of preference between the integrated and independent methods of file manipulation was also attributed to the speed and ease of use of the desktop style. Like expert users, intermediate users also experienced transfer conflicts between the familiar desktop style and the web style. They also reported the same speed concerns about the web style such as the increased number of steps required to rename a file and the delays experienced when mousing over to select a file.

These findings contradict the assumptions made by integration advocates that the web style would be easier to use for intermediate users to use (Halfhill. July 1997: Seidman & Haight. February 1997). Because intermediate users were less familiar with the desktop style, they were more likely to experience difficulties with this style than expert users. They also experienced the same difficulties as expert users with the web style. As a result of their difficulties with both styles, these users did not have a preference between the two styles.

Neither expert nor intermediate users had a preference between a single web style for the explorer versus a web style for the Internet Explorer and a desktop style for the Windows Explorer. Some participants cited consistency as an advantage for the single style, confirming predictions made by integration advocates about this strategy (Seidman & Haight. February 1997: “True Web integration”. February 1997). Several participants also indicated that two separate styles were needed since web pages and personal files had separate functions. The web
style was also in some cases considered to be ineffective and inappropriate for personal files. For instance, when a user accidentally clicked on a web page, the user can easily stop the process of going to the page by selecting the stop button in their browser. With a personal file, a user cannot as easily stop an accidental activation because they would have to wait for the file to open and then close it. Also, several users found that the web style was inappropriate since it applied hyperlinks to personal files. Since hyperlinks were associated with remote access, they were deemed inappropriate to use for personal files since personal files are typically locally accessed.

Future Research

This study raises a number of further concerns about the integration of the web and the desktop that should be examined in order to draw conclusions about whether integration should occur and about how integration should be implemented.

Extended exposure. This study presented users with the integrated approach for the first time and only for a short period of time. Hence, they were comparing a familiar approach to an unfamiliar approach. The results clearly indicated that familiarity has a strong influence on preference for an approach and this raises the issue about the extent of the impact of familiarity on preference. This study has proposed a conceptual model to explain the differences between users and this conceptual model was based on familiarity. It was suggested that users, with more experience and familiarity, had developed a better conceptual model of an approach and since a less familiar approach differed from the conceptual model of the familiar approach, users would prefer the one they were familiar with. This could suggest that had users been familiar with the integrated approach, they might have preferred it over the independent approach.

In future research, users should have the opportunity to learn and use the integrated approach for an extended period of time before comparisons and evaluation of the two
approaches are made. For example, users should be required to use the integrated approach for at least a two week period giving them the opportunity to become familiar with the integrated approach as well allowing them to use the integrated approach within the context of their own computer needs. This will determine whether there is a preference to integrate once users are familiar with the integrated approach. This preference can then be compared to the one in this study to determine if there was a change in preference as result of familiarity and how temporary the preference for a familiar approach is.

While it would be useful to examine users after a two week period, it would also be worthwhile to give users the option of integration to see whether users will use it and what methods of integration they like. This could reveal that users do not change their opinions, no matter how much exposure they are given to the integrated approach. That is, if they do not prefer it immediately, they may continually revert back to the familiar approach as found in the study of the Internet Explorer 4.0 where users were given the choice of using either the web style or the desktop style and they consistently chose the desktop style (“Internet Success Stories”. 1997).

Alternatively, it would be useful to conduct an evaluation of the reasons for the preference for integration with users that are currently using the integrated approach on Windows 98. These results could be compared with users who are using the independent approach on this platform.

**Web importance and frequency of use.** Several integration advocates have suggested that the web is rapidly becoming a necessary resource and, therefore, the web should play a more important role in personal computing (Fernandes. 1997; Forrester Research. 1996; “True Web Integration”. February 1997). Although the web’s importance and frequency of use was not
directly examined in this study, there was little support in the results for the impact of web importance and frequency of use on the preference for integration. While there is research emerging to indicate that the web is a highly frequently used resource (GVU’s Tenth WWW User Survey, October 1998), there are no studies to examine the frequency of web use in relation to integration. Therefore, it would be worthwhile to further investigate how the importance and frequency of use of the web plays a role in user preference to integrate.

Future research could evaluate the frequency of web use in relation to a preference for integration by comparing users with low frequency of web use and those with high frequency of web use to determine whether there is a difference in preference as a function of web use. It may be interesting to examine whether the amount of web use could predict a preference for integration. That is, there may be a positive relationship between frequency of web use and a preference to integrate. It may also be useful to assess users’ thoughts on the importance of the web and compare importance ratings with a preference for integration.

Novice users. Novice users were intentionally not used in this study and, thus, it is unknown whether the integrated approach will be easier to use and preferred by novice users. The results of this study, comparing expert users to intermediate users, suggest that the strength of the development of a conceptual model for the independent approach will effect preference for integration and integration methods. New users may find it easier to use since not only will they not be biased by any previous experience with the independent approach but also because it uses a single approach for both web and desktop-related activities. That is, it uses a single style for file manipulation and single method for personal file and web page access and storage, possibly requiring a simpler conceptual model.
In future research, two possible studies could be conducted with new users. In the first study, new users could be trained on both the integrated and independent approaches to compare the preference and ease of use of the two approaches. In another study, novice users could be given the integrated approach without training in order to evaluate the discoverability, ease of learning and ease of use of the integrated approach. This study should also examine the type of conceptual model that novice users will develop with the integrated approach.

**Modem users.** Only users with direct web access were studied in this research and, hence, it is unknown as to whether the integrated approach will be easier to use or preferred by those users who access the web through a modem. Since the access to the web can be a more challenging task for those who have to dial up, integration may not be useful to them. They usually have to pay for their time and may often wait to access the web if the server is too busy to handle their connection. On the other hand, integration may be seen as an advantage because they may like using a single style or method for file access and storage. They may also not experience the difficulties that the users in this study had with distinguishing between local and remote information. That is, unless they are already on-line browsing the web, these users will be prompted to establish a connection if they mistakenly accessed a web page. This prompting will provide a cue to users as to what information belongs to the web and what belongs to their computer.

In a future study, a comparison of the two approaches should make to determine the ease of use and the preference for integration of modem users, as well as perhaps the type of conceptual model these users have. It may be that because the modem is used as a mechanism to separate local and remote information, these users have a strong mental model for independence. These preferences should be compared to the results of this study to see if there is difference in
ease of use and preference between users with direct web access and those who access the web via a modem. It would also be of value to examine whether the conceptual models differ between direct web access users and those with modems.

Objective performance measures. This study primarily used subjective measures to compare and evaluate the ease of use and preference for the integrated and independent approaches and methods. However, studies have shown that users can perform well and not like a system, or like a system and still not perform well (Bailey. 1993; Grudin & MacLean. 1984; Kissel. 1995). These differences could suggest that objective measures should be used to compare and evaluate the two approaches as well. That is, although users rated the independent approach easier, they may actually perform better using the integrated approach.

In future research, the two approaches could be compared and evaluated with the use of task time and task accuracy to determine which of the two approaches would provide users with the best task performance. This could reveal that if users performed desktop and web-based related activities faster and with fewer errors using the integrated approach, integration may make computing easier and more effective as suggested by many integration advocates (Karpiniski. July 1997; Seidman & Haight. February 1997. "True Web Integration". February 1997).

Conclusion

There were three reasons specified by integration advocates for the web and desktop integration and they include the popularity of the web, the importance of the web as a resource tool and the replacement of the desktop metaphor and interface for the more appropriate web metaphor and easier to use web interface. The results of this study do not support the first two reasons for integration as specified by integration advocates (Bergal. 1997; Parks & Edmonds.
When comparing the two approaches, participants did not discuss the popularity of the web and the importance of the web as primary reasons for integrating the web with the desktop. In fact, users were more concerned about the possible security and cost ramifications of integration based on the increased popularity and importance of the web. This issue should be further examined in future research.

An analysis of support for the third reason for integration is more complex. Integration advocates suggest that the desktop metaphor is inappropriate for the increased network access environment (Card, Robertson & York, 1996; Gentner & Nelson, 1996; Tomoharu, Hosomi & Miyashita, 1997; Halfhill. February 1997). However, expert users want to maintain a distinction between the web and the desktop, considering them to be separate entities based on the separate activities being performed. These users also preferred the desktop metaphor for desktop activities and experienced transfer conflicts when performing activities using a web approach. Therefore, for these users, applying the web metaphor to the desktop may be inappropriate. Intermediate users seemed to have a less developed conceptual model of either metaphor, with little evidence suggesting the appropriateness or inappropriateness of either metaphor.

Integration advocates also suggest that the web metaphor is easier to use based on difficulties experienced by users with the desktop interface (Gentner, Ludolph & Ryan, 1997; Halfhill. July 1997) and the ease of use of the web interface (Forrester Research, 1996; Seidman & Haight, February 1997: "True Web Integration". February 1997). The results of this study indicate that overall, users find the desktop interface to be easier to use. Intermediate users did experience difficulties with the desktop interface while performing tasks however both expert and intermediate users experienced difficulties using the web interface. Integration advocates suggest that an integrated interface will be easier for intermediate and expert users to learn
because they are already familiar with the web interface strategy (Halfhill. July 1997: Seidman & Haight. February 1997). The results of this study indicate that, in fact, this familiarity resulted in greater difficulty in learning the integrated strategy because of transfer conflicts.

The main and most important finding in this evaluation was the substantial differences between the two users groups. Intermediate users had no overall preference between the two approaches, but preferred the integrated methods to file storage and access and had no preference for the file manipulation style methods. In contrast, expert users preferred the independent approach overall, as well as the independent method for file manipulation style and had no preference for the storage and access methods. A conceptual model theory has been put forth to explain the differences between the two user groups based on their differences in familiarity with the desktop and the web.

The support for web and desktop integration and its methods is not particular strong, which could suggest that integration is not recommended. However, because the primary concerns about integration is based on familiarity, further research is needed to assess the impact of familiarity on the preference for integration before determining whether integration should occur and what methods should be employed. It may be that an integrated model is preferred once users become familiar with the model and are able to assess its relative merits without the influence of familiarity. There is a tendency for users to initially project a negative reaction to the unfamiliar, however without venturing into the unfamiliar, progress would never be made. If product designers had allowed familiarity to completely dominate their designs, the move from the command line to a graphical windows based interface would have never happened. However, product designers should also ensure that the justifications for designs are based on research with intended users, rather than unjustified assumptions about the future.
References


Appendix A

Recruitment Questionnaire

Participant's name: ________________

Date and time of session: ___________

(Hello. My name is Johanna Segerstrom. I am conducting a study on web and desktop integration and you have signed up to participate in this study. Before we set up a date and time, I would like to ask you a few questions about your computer and web use).

1. How long have you been using Windows 95?

2. How long have you been using the web?

3. Have you used either Internet Explorer 4.0 or Windows 98?
   a.) Yes
   b.) No

Now let's decide on a date and time that we can schedule the session. For the session, you will be using a computer, so please bring any necessary eyewear.

The session will be in the Social Science Research Building at Carleton University.

Provide directions.
Provide the number 520-6628 if rescheduling is necessary.
Appendix B

Informed Consent Form

Guideline
The purpose of an informed consent is to ensure that you understand the purpose of the study and the nature of your involvement. The informed consent must provide sufficient information such that you have the opportunity to determine whether you wish to participate in the study.

Present Study: A user evaluation of web and desktop integration strategies.

Research Personnel: The following people are involved in this research study and may be contacted at any time. Johanna Segerstrom (Principal Investigator. 520-6628) and Dr. Jo Wood (Faculty Advisor, Department of Psychology. 520-6626). Should you have any ethical concerns about this study, please contact Dr. Mary Gick (Chair, Department of Psychology Ethics Committee. 520-2664) or Dr. Kim Matheson (Chair, Department of Psychology. 520-2648).

Purpose: The purpose of this study is to examine whether or not web and desktop activities should become more integrated by exploring how user react to integration and to evaluate specific methods of integration.

Task Requirements: You will be asked to perform two sets of computer tasks using two different approaches. An example of a task might be to find a particular file on the computer. The objective of these tasks is for you to gain familiarity with the two approaches. You will be asked to talk aloud as you complete each task so that I can record any impressions that you might have. You will then be asked a series of questions about your experiences using the two approaches. Before the session begins, you will be asked to sign a video consent form. The sole purpose of recording the session is to allow me to capture any information that may have been missed during the data collection. Only I will use the videotape and your name will not be associated with the video.

Duration and Locale:
The session will last 1 hour. Testing will be held at Carleton University in the Social Science Research Building, room 314.

Potential Risk/Discomfort: There are no potential physical or mental risks or discomfort in this study.

Anonymity/Confidentiality: The data collected in this experiment is confidential. Your name will not be associated with the data.

Right to Withdraw: You have the right to withdraw from the session at any time.

Signatures:
I have read the above description of the study and understand the conditions of my participation. My signature indicates that I agree to participate in the study.

Date: ____________________________
Participant’s Name: ____________________________________________

Participant’s Signature: __________________________________________

Researcher’s Signature: __________________________________________
Appendix C

Computer and Web Experience Questionnaire

For the following categories, please circle the statement that best describe you.

Computer questions:

Familiarity with operating system functions:
a.) I have an in-depth knowledge of most of the functions of the operating system (ex. control panel, printer settings, system properties, display settings, accessibility options, sound settings, etc).
b.) I have some familiarity with many of the functions of the operating system (ex. control panel, printer settings, system properties, display settings, accessibility options, sound settings, etc).
c.) I am not familiar with any of the functions that are related to the operating system (ex. control panel, printer settings, system properties, display settings, accessibility options, sound settings, etc).

Application type:
Please indicate how familiar you are with the following application types.

<table>
<thead>
<tr>
<th>Application type</th>
<th>Very</th>
<th>Some</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word processing applications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graphics applications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statistical applications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Database applications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spreadsheet applications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multimedia/Authoring applications</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Knowledge of operating systems:
a.) I know how to use 2 or more operating systems.
b.) I know how to use 2 operating systems.
c.) I know how to use 1 operating system.

Computer experience:
a.) I consider myself an expert computer user.
b.) I consider myself an intermediate computer user.
c.) I consider myself a novice computer user.
Web questions:

Hours of web use:
a.) I use the web for more than fifteen hours a week.
b.) I use the web between five and fifteen hours a week.
c.) I use the web less than five hours a week.

Web development:
 a.) I am very familiar with creating web sites and uploading them onto a server.
b.) I have some familiarity with creating web sites and uploading them onto a server.
c.) I am not familiar with creating web sites and uploading them onto a server.

The use of search engines:
 a.) I am very skilled at using a search engine to find information on the web.
b.) I am relatively skilled at using a search engine to find information on the web.
c.) I often have difficulties at using a search engine to find information on the web.

Web experience:
 a.) I consider myself an expert web user.
b.) I consider myself an intermediate web user.
c.) I consider myself a novice web user.
Appendix D

Test Protocol

Introduction

Date: ____________

Participant #: ____________

Counterbalance order #: ____________

As you probably know the web has been very popular in the last few years and because of this popularity some people believe the web and information stored on your desktop computer should be integrated. Others think that the two should stay separate.

To explore these issues, I will get you to do some tasks using two approaches. One of the approaches is the web and desktop integrated and the other is the web and desktop independent. I will then ask you specific questions and get your opinions on different approaches and some specific differences between the approaches.

I will use Microsoft’s Windows*98 program to explore these ideas but this study is not an evaluation of Windows*98. I will use some aspects of Windows*98 to illustrate particular design ideas.

I would like to get your permission to videotape this session.

• **(Point to camera)** As you can see, there is a video camera located behind you. **(Point to microphone)** Attached to the camera is this microphone that is sitting on the desk. The camera is focused on the computer screen itself and not on you **(Show camera focus of attention)**.

• The reason that I want to videotape the session is solely for the purposes of capturing what you are saying during the session and what you are referring to on the screen. I will be trying to capture as much as I can in my notes during the session but I may miss something you say or do and would like to be able to go back to the tape as a backup.

• The videotapes will only be used by me and your name will not be associated with the video. Do you have any objections to having this session videotaped? **(Sign permission to videotape consent)**
Part 1: Exploration Tasks

First, I’ll give you two series of tasks to do, followed by some questions about your experiences while doing the tasks. An example of a task might be to go to a particular web page. First you will do the tasks on this computer that uses the web and desktop integrated approach (point to first option in counterbalancing) and you will do similar tasks on this computer (point to second option in counterbalancing) that uses the web and desktop independent approach.

There are a number of differences between the two approaches and I’d like to tell you about one of the main differences. On this computer your Windows Explorer and your Internet Explorer are combined into one explorer (point to shortcut on desktop). On this computer, you have a Windows Explorer and an Internet Explorer (point to shortcuts on desktop).

The purpose of the tasks is not to test you but to give you an opportunity to explore and gain familiarity with the different approaches. While you are doing the tasks, I’d like you to let me know of any comments that you have. I want you to speak aloud and tell me everything you are thinking (demonstrate thinking out loud).

Do you have any questions before we begin?
Integrated Tasks  *(The options (integrated or independent) are presented in counterbalanced order. A cue card with the task wording will be presented for each task.)*

1. Using your **Single Explorer**, find the file called **Draft History Essay**.

2. Select the **Draft History Essay** file. Open it to verify that it is the final draft.

3. Close the file and make a copy of the file and put it into the folder called **Final Essays**.

4. Select the **Draft History Essay** file. Change the name to **Final History Essay**.

5. Staying in the **Single Explorer**, go to the top story for this week at the **Microsoft** web site at [www.microsoft.com](http://www.microsoft.com).

6. The **Carleton University** web site has been saved as one of your **favorites** in the menu bar. Find Professor Dillon's phone number on the Carleton site under **People**.

7. Your **Application letter** to Carleton has been saved as one of your **favorites** as well. *(favorites are bookmarks for Netscape users)*. Go to this letter.

8. Staying in the **Single Explorer**, go to the **Literature Folder** and find out how many web sites you have as resources for your research on Shakespeare?

9. Your **June, July and August** bank statements and your **Personal Banking** folder are on your desktop. Select the three files using the control key and move them into the Personal Banking folder.

10. Select the **August** file. Open it.

11. Close the August file and rename it **September**.

12. Go to the **Sybarus** web site. It has been saved on your desktop.
**Integrated Questions**

1.) Using this scale from 1 to 9, how easy or difficult was it to perform these tasks?  
(Show cue card with scale and explain the scale. Explain how to use the two ends of the scale and what neutral means.)

<table>
<thead>
<tr>
<th>Very Difficult</th>
<th>Neutral</th>
<th>Very Easy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

Would you explain your thinking?

**Independent Tasks** *(The options (integrated or independent) are presented in counterbalanced order. A cue card with the task wording will be presented for each task.)*

1. Using your **Windows Explorer**, find the file called **Vancouver Trip Report**.

2. Select the **Vancouver Trip Report**. Open it to verify that it is the right report.

3. Close the file and make a copy of the file and put it into your folder called **American Trip Reports**.

4. Select the **Vancouver Trip Report**. Change the name to **Washington Trip Report**.

5. Using your **Internet Explorer**, find out if a company called **Intrasoft** has job opportunities in the Human Factors department. The address is **www.intrasoft.ca**.

6. The **IBM** web site has been saved as one of your **favorites** in the menu bar. Find out the name of one of their products.

7. Your **letter to Mary** has been saved on your desktop. Go to this letter.

8. Using your **Windows Explorer**, how many files do you have in your **Psychology** folder?

9. You have 3 new recipe files on your desktop. Select the three files using the control key and move them into the Recipes folder.

10. Select the file called **Pie**. Open it.

11. Close the file and change the name of the file to **Cherry Pie**.

Independent Questions

1.) Using this scale from 1 to 9, how easy or difficult was it to perform these tasks? *(Show cue card with scale)*

<table>
<thead>
<tr>
<th>Very Difficult</th>
<th>Neutral</th>
<th>Very Easy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

Would you explain your thinking?

Comparison Questions

1. Using this scale from 1 to 9, which approach do you prefer? *(Show cue card with scale and explain the scale. Tell how to use the two ends of the scale.)*

<table>
<thead>
<tr>
<th>Much prefer first approach</th>
<th>No preference</th>
<th>Much prefer second approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

Would you explain your thinking?

2. I have shown you two approaches for performing similar tasks *(point to the two computers)*. What do you see as the main differences between these two approaches?

**Part 2: Demonstration of Methods**

Now, I’d like to demonstrate some specific methods using the integrated design and independent approaches. I want to get your feedback on what you prefer.

**Demos** *(In each demo there are two approaches (integrated and independent). The order of presentation of the approaches is counterbalanced. Half the participants will always be presented approach 1 first and half will always be presented approach 2 first.)*

1. In the integrated approach, while on the desktop to select something, you mouse over to select it and single click to open it. In the independent approach, while on the desktop to select something you single click to select it and double click to open it.

- Mouse over to select and single click to open
- Single click to select and double click to open
Using this scale from 1 to 9, which method do you prefer? (Show cue card with scale)

<table>
<thead>
<tr>
<th>Much prefer mouse over to select &amp; single click to open</th>
<th>No preference</th>
<th>Much prefer single click to select &amp; double click to open</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Would you explain your thinking?

2. In the integrated approach to rename something, you mouse over to select it, right mouse click to select rename. In the independent approach, you left mouse to select and click on the selected title to rename or you left mouse click to select it, right mouse click and select rename.

- Mouse over to select and right mouse click to rename
- Left mouse click to select and click on the selected title to rename or left mouse click to select and right mouse click to rename

Using this scale from 1 to 9, which method do you prefer? (Show cue card with scale)

<table>
<thead>
<tr>
<th>Much prefer mouse over to select &amp; right mouse to rename</th>
<th>No preference</th>
<th>Much prefer left mouse click to select &amp; click on the selected title or left mouse click to select &amp; right mouse to rename</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Would you explain your thinking?
3. In the integrated approach to multiple select several items, you mouse over or single click on the items and hold down the control key. In the independent approach to select several items, you single click the items and hold down the control key.

Using this scale from 1 to 9, which method do you prefer? *(Show cue card with scale)*

<table>
<thead>
<tr>
<th>Much prefer mouse over items or single click &amp; hold down control key</th>
<th>No preference</th>
<th>Much prefer single click items &amp; hold down control key</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Would you explain your thinking?

4. In the integrated approach, you use the mouse over/single click style and in the independent approach, you use the single click/double click style.

- Mouse over/single click style
- Single click/ double click style

Using this scale from 1 to 9, which method do you prefer? *(Show cue card with scale)*

<table>
<thead>
<tr>
<th>Much prefer mouse over single click style</th>
<th>No preference</th>
<th>Much prefer single click double click style</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Would you explain your thinking?

5. In the integrated approach, you have one explorer for accessing both personal files and web sites. In the independent approach, you have two explorers, one for personal files and another for web sites.

- One explorer for accessing both personal files and web sites
- Two explorers: One for accessing personal files and one for web sites
Using this scale from 1 to 9, which method do you prefer? *(Show cue card with scale)*

<table>
<thead>
<tr>
<th>Much prefer one explorer</th>
<th>No preference</th>
<th>Much prefer two explorers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>6</td>
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<td>7</td>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

Would you explain your thinking?

6. While in the integrated explorer, you use the mouse over/single click style when accessing both web pages and personal files. While in the independent explorers, you use mouse over/single click style when accessing web pages and single click/double click style when accessing personal files.

- Mouse over/single click style for both web pages and personal files in the explorer
- Mouse over/single click for web pages in the Internet Explorer
- Single click/double click for personal files in the Windows Explorer

Using this scale from 1 to 9, which method do you prefer? *(Show cue card with scale)*

<table>
<thead>
<tr>
<th>Much prefer mouse over/ single click style for both web pages &amp; personal files</th>
<th>No preference</th>
<th>Much prefer mouse over/ single click style for web pages &amp; single click/double click for personal files</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

Would you explain your thinking?
7. In the integrated approach, web pages are stored in the web browser and on the desktop computer. Personal files are stored on the desktop computer and in the web browser. In the independent approach, web pages are stored in the web browser and personal files are stored on the desktop computer.

- Web pages are stored on/in
  - Web browser
  - Desktop computer
- Personal files and folders are stored on/in
  - Desktop computer
  - Web browser

- Web pages are stored on/in
  - Web browser
- Personal files and folders are stored on/in
  - Desktop computer

a. Using this scale from 1 to 9, which method do you prefer for storing web pages? (*Show cue card with scale*)

<table>
<thead>
<tr>
<th>Much prefer web pages in web browser and on desktop computer</th>
<th>No preference</th>
<th>Much prefer web pages in web browser</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Would you explain your thinking?

b. Using this scale from 1 to 9, which method do you prefer for storing personal files? (*Show cue card with scale*)

<table>
<thead>
<tr>
<th>Much prefer personal files on desktop computer and in web browser</th>
<th>No preference</th>
<th>Much prefer personal files on desktop computer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Would you explain your thinking?
Part 3: General Questions

Questions

1. Some people think that the web and the desktop should be integrated. Other people think that the web and desktop should be independent. *(The approach that is presented first is counterbalanced according to the counterbalancing strategy in part 2).*

Using this scale from 1 to 9, which do you prefer? *(Show cue card with scale)*

<table>
<thead>
<tr>
<th>Much prefer web and desktop integrated</th>
<th>No preference</th>
<th>Much prefer web and desktop independent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

Would you explain your thinking?

Considering your own situation, which of the following characteristics of web and desktop integration would you find valuable? *(This is not comparing the approaches as you did before, but rather rate how valuable each of the web and desktop integration methods is.)*

1.1 In the integrated approach, while on the desktop to select something, you mouse over to select it and single click to open it.

- Mouse over/single click style for the desktop

Using this scale from 1 to 5, how valuable do you find this method? *(Show cue card with scale)*

<table>
<thead>
<tr>
<th>Not at all Valuable</th>
<th>Fairly valuable</th>
<th>Very valuable</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

Mouse over/single click style for the desktop

1.2 While in the integrated explorer, you use mouse over/single click style when accessing both web pages and personal files.

- Mouse over/single style for accessing both web pages and personal files in the explorer
Using this scale from 1 to 5, how valuable do you find this method? *(Show cue card with scale)*

<table>
<thead>
<tr>
<th>Mouse over/single click style for both web pages and personal files in the explorer</th>
<th>Not at all valuable</th>
<th>Fairly valuable</th>
<th>Very valuable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

1.3 In the integrated approach, you have one explorer for accessing both personal files and web sites.

- One explorer for accessing personal files and web sites

Using this scale from 1 to 5, how valuable do you find this method? *(Show cue card with scale)*

<table>
<thead>
<tr>
<th>Single explorer for accessing personal files and web sites</th>
<th>Not at all valuable</th>
<th>Fairly valuable</th>
<th>Very valuable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

1.4 In the integrated approach, personal files are stored on both the desktop computer and in the web browser.

- Personal files are stored on/in
  - Desktop computer
  - Web browser

<table>
<thead>
<tr>
<th>Personal files are stored on the desktop computer and in the web browser</th>
<th>Not at all valuable</th>
<th>Fairly valuable</th>
<th>Very valuable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
1.5 In the integrated approach, web pages are stored in both the web browser and on the desktop computer.

Web pages are stored on/in
- Web browser
- Desktop computer

Using this scale from 1 to 5, how valuable do you find this method? *(Show cue card with scale)*

<table>
<thead>
<tr>
<th>Not at all valuable</th>
<th>Fairly valuable</th>
<th>Very valuable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web pages are stored in web browser and on desktop computer</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

2. Are there any other comments on the integrated approach and the independent approach?
Appendix E

Video Release Form

I agree to have my participation in this study videotaped for the purpose of data collection. I understand that only the experimenter will have access to the videotape and that my identity will not be associated with the data collected.

Date: ________________

Participant #: __________

Participant’s Name: ________________________________

Participant’s Signature: ____________________________

Researcher’s Signature: ____________________________
Appendix F

Data Collection Form

Part 1: Exploration Tasks

Integrated Question
Ease of use rating: __________
Would you explain your thinking?

Independent Questions
Ease of use rating: __________
Would you explain your thinking?

Comparison Questions
Preference rating: __________
Would you explain your thinking?

Differences between the two options:

Part 2: Demonstration of Methods

Style Question
Preference rating: __________
Would you explain your thinking?

Renaming Question
Preference rating: __________
Would you explain your thinking?

Multiple Selection Question
Preference rating: __________
Would you explain your thinking?

File Manipulation Strategy Question (overall for opening, renaming and mult. selection)
Preference rating: __________
Would you explain your thinking?

Explorer Question
Preference rating: __________
Would you explain your thinking?

Explorer Style Question
Preference rating: __________
Would you explain your thinking?
Desktop-based Strategy Question
Preference rating: _________
Would you explain your thinking?

Web-based Strategy Question
Preference rating: _________
Would you explain your thinking?

Part 3: General Questions

Integration/Independent Question
Preference rating: _________
Would you explain your thinking?

Value Questions
Style Question
Preference rating: _________
Would you explain your thinking?

Style for Explorer Question
Preference rating: _________
Would you explain your thinking?

Explorer Question
Preference rating: _________
Would you explain your thinking?

Desktop-based Strategy Question
Preference rating: _________
Would you explain your thinking?

Web-based Strategy Question
Preference rating: _________
Would you explain your thinking?

2. Are there any other comments on the integrated design and the independent designs?
Appendix G

Debriefing Form

Because of the increasing popularity of the web and the complexity of the desktop, many people believe that the web and the desktop should become more integrated. Others believe that the desktop should continue to be the metaphor used for personal computing and the web should not have a stronger influence than it already has. To date, corporate representatives and industry leaders have expressed these opinions, but very little research has been conducted with actual web and desktop users. The purpose of this study was to explore whether or not web and desktop activities should become more integrated and to evaluate specific methods of integration.

You were first provided with an opportunity to become familiar with the two approaches through a series of tasks that were selected to illustrate the differences between these two approaches.

One approach included the web and the desktop as integrated, while the other approach maintained desktop and web independence. Following an evaluation of these two approaches, you were then shown a number of specific integration methods for evaluation. The goal of the study was to obtain user reaction as to whether or not web and desktop activities should be more integrated and if so, to what extent.

Thank you very much for participating in this study. If you have any questions about any aspects of this study, please contact Johanna Segerstrom at 520-6628 or Professor Jo Wood at 520-6626.
Appendix H

Summary of Participants Specific Comments

Ease of use results of the two approaches

Table 1. Comments on the difficulty/ease of use of the two approaches

<table>
<thead>
<tr>
<th>Difficulty/ease of use of the integrated approach</th>
<th>Difficulty/ease of use of the independent approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Easy access to web since do not need to open a browser (5 participants)</td>
<td>• Easier because of familiarity with independent approach (25 participants)</td>
</tr>
<tr>
<td>• Slightly more difficult because of lack of familiarity (8 participants)</td>
<td>• Hard/do not want to change habits/way of doing it now (5 participants)</td>
</tr>
<tr>
<td>• Easy because of the similarity between the two approaches (4 participants)</td>
<td>• Easier because knew what was mine and what was the web stuff (4 participants)</td>
</tr>
<tr>
<td>• Harder/confusing because it is confusing with two together (3 participants)</td>
<td>• Easier to maneuver when separate (2 participants)</td>
</tr>
</tbody>
</table>

Preference results of the two approaches

Table 2. Comments on the preference for the two approaches

<table>
<thead>
<tr>
<th>Preference for integrated approach</th>
<th>Preference for independent approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Could get used to integration because it is a matter of getting used to it (13 participants)</td>
<td>• Familiarity with independent approach (15 participants)</td>
</tr>
<tr>
<td>• Web pages and personal files can be retrieved anywhere on the computer and without a web browser (10 participants)</td>
<td>• Web and local desktop are not the same (4 participants)</td>
</tr>
<tr>
<td>• Makes sense since the web will be used more (2 participants)</td>
<td>• They do not belong together (6 participants)</td>
</tr>
<tr>
<td></td>
<td>• Prefer/like traditional/standard method (1 participant)</td>
</tr>
<tr>
<td></td>
<td>• Know/understand what is mine and what is web (1 participant)</td>
</tr>
<tr>
<td></td>
<td>• Integration is not needed (1 participant)</td>
</tr>
</tbody>
</table>
Preference results of the two approaches

Table 2. Comments on the preference for the two approaches (continued)

<table>
<thead>
<tr>
<th>Preference for integrated approach</th>
<th>Preference for independent approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Purpose is to make the web as common as the computer (1 participant)</td>
<td>• Security concerns: access to files and hackers can get to personal files when filed with web pages (4 participants)</td>
</tr>
<tr>
<td>• Preference depends on how much the computer and the web are used. If used a lot, integration is good. (1 participant)</td>
<td>• Pay for web time, do not need to pay to see files (3 participants)</td>
</tr>
<tr>
<td></td>
<td>• Phones lines tied up, if internet is always there (3 participants)</td>
</tr>
<tr>
<td></td>
<td>• Personal files can get corrupted if they are integrated (3 participants)</td>
</tr>
<tr>
<td></td>
<td>• Concerned that the web would be used more and that is not necessary (2 participants)</td>
</tr>
<tr>
<td></td>
<td>• Purpose is to make things easier and faster, but it is not (3 participants)</td>
</tr>
<tr>
<td></td>
<td>• Limited to only using Internet Explorer as the web browser (2 participants)</td>
</tr>
<tr>
<td></td>
<td>• Whole computer should not be the web (1 participant)</td>
</tr>
<tr>
<td></td>
<td>• Two are not the same and should not pretend it is (1 participant)</td>
</tr>
</tbody>
</table>
Preference and value of the integrated and independent methods

Table 3. Comments about the preference for the explorer(s)

<table>
<thead>
<tr>
<th>Preference for single explorer</th>
<th>Preference for two explorers</th>
</tr>
</thead>
<tbody>
<tr>
<td>• All in one area (12 participants)</td>
<td>• More familiar with 2 explorers (8 participants)</td>
</tr>
<tr>
<td>• Easier/convenient/faster (8 participants)</td>
<td>• Two should stay separate (4 participants)</td>
</tr>
<tr>
<td>• Do not have switch between two explorers (6 participants)</td>
<td>• Can access the other web browser or explorer through taskbar/other windows (3 participants)</td>
</tr>
<tr>
<td>• Easier because do not have to open web browser (5 participants)</td>
<td>• Too jammed into one screen (2 participants)</td>
</tr>
<tr>
<td>• Could do two things are once (2 participants) Ex. Browse/download and work on a paper.</td>
<td>• For web, want as a whole and separate window (2 participants)</td>
</tr>
<tr>
<td>• Do not have to open/close applications minimize/maximize (3 participants)</td>
<td>• Know where to go (2 participants)</td>
</tr>
<tr>
<td>• Could be handy to have a single explorer but still have to retrieve web in the single explorer (i.e. is not automatically there) (1 participant)</td>
<td>• Do not use the two at the same time (2 participants)</td>
</tr>
</tbody>
</table>

Table 4. Comments on the value of the single explorer

<table>
<thead>
<tr>
<th>Value for single explorer</th>
<th>No value for single explorer</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Easier/convenient in one place (8 participants)</td>
<td>• Web pages and local files should not be the same (3 participants)</td>
</tr>
<tr>
<td>• Saves time (4 participants)</td>
<td>• Go to one or the other. know what to look for (2 participants)</td>
</tr>
<tr>
<td>• Open only one and less steps involved (2 participants)</td>
<td>• Easy to use two explorers at the same time (1 participant)</td>
</tr>
<tr>
<td>• Could be good for novice participants (ex. parents) since it is all in one place</td>
<td></td>
</tr>
<tr>
<td>(1 participant)</td>
<td></td>
</tr>
</tbody>
</table>
Table 5. Comments about the preference for desktop-based storage strategy

<table>
<thead>
<tr>
<th>Preference for integrated personal file storage strategy</th>
<th>Preference for independent personal files storage strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Store anywhere on computer (9 participants)</td>
<td>• Confusing if together (6 participants)</td>
</tr>
<tr>
<td>• Do not have to open the browser (5 participants)</td>
<td>• Not difficult to open favorites to get web pages (2 participants)</td>
</tr>
<tr>
<td>• Faster/Easier to access stuff anywhere on computer (10 participants)</td>
<td>• Two should be separate (1 participant)</td>
</tr>
<tr>
<td>• Convenient/access to frequently-used web pages on the computer (5 participants)</td>
<td></td>
</tr>
</tbody>
</table>

Table 6. Comments on the value of the desktop-based storage strategy

<table>
<thead>
<tr>
<th>Value for integrated personal file storage strategy</th>
<th>No value for integrated personal file storage strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Convenient, if use certain files a lot (3 participants)</td>
<td>• Favorites could get cluttered/messy (6 participants)</td>
</tr>
<tr>
<td>• Accessible (3 participants)</td>
<td>• Do not need personal files in web (3 participants)</td>
</tr>
<tr>
<td>• Easier/faster to get stuff (2 participants)</td>
<td>• Causes confusion between the two (3 participants)</td>
</tr>
<tr>
<td></td>
<td>• Icon differentiation is not sufficient (2 participants)</td>
</tr>
<tr>
<td></td>
<td>• Could go to desktop easily (1 participant)</td>
</tr>
</tbody>
</table>

Table 7. Comments about the preference for web-based storage strategy

<table>
<thead>
<tr>
<th>Preference for integrated web page storage strategy</th>
<th>Preference for independent web page storage strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Store anywhere on computer (5 participants)</td>
<td>• Web browser should not have anything to do with personal files (5 participants)</td>
</tr>
<tr>
<td>• Faster/Easier to access stuff anywhere on computer (6 participants)</td>
<td>• Confusing if two together (5 participants)</td>
</tr>
<tr>
<td>• So many steps to get a file otherwise. (1 participant)</td>
<td>• Sufficient on the desktop (4 participants)</td>
</tr>
<tr>
<td>• Easier to find a file (1 participant)</td>
<td>• Could mistakenly get a personal file instead of web page in the browser (3 participants)</td>
</tr>
</tbody>
</table>

Table 8. Comments on the value of the web-based storage strategy

<table>
<thead>
<tr>
<th>Value for integrated web page storage strategy</th>
<th>No value for integrated web page storage strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Convenient when researching, can go well-used sites on the desktop, instead of always opening and closing the two explorers (16 participants)</td>
<td>• Desktop gets too cluttered (6 participants)</td>
</tr>
<tr>
<td>• Faster/easier for access of web sites (8 participants)</td>
<td>• Could go to web browser easily (3 participants)</td>
</tr>
<tr>
<td>• Can put similar things together (i.e., all travel stuff: documents and web sites) (1 participant)</td>
<td>• Web and local files should not be the same, they could be confused (3 participants)</td>
</tr>
<tr>
<td>• Have important web stuff on desktop (1 participant)</td>
<td>• Not saving time to put on computer (1 participant)</td>
</tr>
<tr>
<td></td>
<td>• Do not need web pages on computer (1 participant)</td>
</tr>
</tbody>
</table>
Table 9. Comments on the preference for opening style

<table>
<thead>
<tr>
<th>Preference for web style</th>
<th>Preference for desktop style</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Save time with one click (7 participants)</td>
<td>• Easier because annoying to accidentally open files with web style (28 participants)</td>
</tr>
<tr>
<td>• Easier with one click (6 participants)</td>
<td>• Familiar with it (23 participants)</td>
</tr>
<tr>
<td>• Easier on the finger (2 participants)</td>
<td>• Faster to open with one click. Do not want to wait for selection (21 participants)</td>
</tr>
<tr>
<td>• If could adjust the speed, would like it better (3 participants)</td>
<td>• With mouse over, can not see the rest of the selected title (3 participants)</td>
</tr>
<tr>
<td>• Easier since one does not just select it but also want to open it (2 participants)</td>
<td>• Act of double click is a more of an effort but it is a definite selection and definite choice (2 participants)</td>
</tr>
<tr>
<td></td>
<td>• More control (2 participants)</td>
</tr>
<tr>
<td></td>
<td>• Confusing to switch to a new way (2 participants)</td>
</tr>
<tr>
<td></td>
<td>• No need/want to change (2 participants)</td>
</tr>
<tr>
<td></td>
<td>• Only one more click (1 participant)</td>
</tr>
<tr>
<td></td>
<td>• Easy to double click (1 participant)</td>
</tr>
<tr>
<td></td>
<td>• Mouse over is irritating to use if rebuilding a computer (1 participant)</td>
</tr>
<tr>
<td></td>
<td>• Faster when compiling (1 participant)</td>
</tr>
</tbody>
</table>

Table 10. Comments about the value of the web style

<table>
<thead>
<tr>
<th>Value for web style</th>
<th>No value for web style</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Easier/faster to click once (5 participants)</td>
<td>• Annoying to accidentally open it (10 participants)</td>
</tr>
<tr>
<td>• Trouble with double click since it does not always open (6 participants)</td>
<td>• Familiarity of desktop (7 participants)</td>
</tr>
<tr>
<td>• Valuable, if speed can be adjusted (3 participants)</td>
<td>• Causes confusion without selection (2 participants)</td>
</tr>
<tr>
<td>• Useful for novice participants (3 participants)</td>
<td>• Faster to click (2 participant)</td>
</tr>
<tr>
<td>• Eventually have to change according to Microsoft (1 participant)</td>
<td>• Could get used to it but there is already one way that works (1 participant)</td>
</tr>
<tr>
<td>• For open only. not selection (1 participant)</td>
<td>• Probably the mouse over would take longer to learn (1 participant)</td>
</tr>
<tr>
<td></td>
<td>• Have to get used to new way (1 participant)</td>
</tr>
</tbody>
</table>
Table 11. Comments on the preference for renaming style

<table>
<thead>
<tr>
<th>Preference for web style for renaming of files</th>
<th>Preference for desktop style for renaming of files</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Faster (5 participants)</td>
<td>• Easier/convenient with few clicks (4 participants)</td>
</tr>
<tr>
<td>• Two choices (4 participants)</td>
<td>• Rarely type it in (3 participants)</td>
</tr>
<tr>
<td>• Familiarity (4 participants)</td>
<td></td>
</tr>
<tr>
<td>• Confusing not to be able to type in (1 participant)</td>
<td></td>
</tr>
</tbody>
</table>

Table 12. Comments about the preference for the multiple selection style

<table>
<thead>
<tr>
<th>Preference for web style for the multiple selection of files</th>
<th>Preference for desktop style for the multiple selection of files</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Two choices (5 participants)</td>
<td>• Faster to click and instead of waiting (5 participants)</td>
</tr>
<tr>
<td>• Saves time from clicking (3 participants)</td>
<td>• With mouse over, could accidentally select ones (4 participants)</td>
</tr>
<tr>
<td>• Easier to mouse over several things (2 participants)</td>
<td>• Familiarity (4 participants)</td>
</tr>
<tr>
<td></td>
<td>• Easier with several files (1 participant)</td>
</tr>
</tbody>
</table>

Table 13. Comments on the preference for the overall style

<table>
<thead>
<tr>
<th>Preference for web file manipulation style strategy</th>
<th>Preference for desktop manipulation style strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Saves time/easier (5 participants)</td>
<td>• Faster to click, instead of waiting (6 participants)</td>
</tr>
<tr>
<td>• Click to select is a waste of time (5 participants)</td>
<td>• Prefer more steps than accidentally opening things (4 participants)</td>
</tr>
<tr>
<td>• Problem with double click because it does not always open (4 participants)</td>
<td>• Familiarity (4 participants)</td>
</tr>
<tr>
<td>• Had a hard time learning to double click, so mouse over is easier (1 participant)</td>
<td>• It is the same as on the Mac (2 participants)</td>
</tr>
<tr>
<td>• More clear, know it is open with one click (1 participant)</td>
<td>• Easier and clearer to click (2 participants)</td>
</tr>
</tbody>
</table>
Table 14. Comments on the preference for the single style for explorer

<table>
<thead>
<tr>
<th>Preference for integrated explorer style strategy (web style for explorer)</th>
<th>Preference for independent explorers style strategy (web style for IE and desktop style for WI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Convenient to have same for both (5 participants)</td>
<td>• Should not be the same since the two are not the same (7 participants)</td>
</tr>
<tr>
<td>• Easier, do not have to think which one you are using (2 participants)</td>
<td>• Used to hyperlinks going somewhere but files stay locally (3 participants)</td>
</tr>
<tr>
<td>• Quicker/easier, click once (2 participants)</td>
<td>• With web pages, it is fine because do not have to rename/multiple select them (2 participants)</td>
</tr>
<tr>
<td>• One style is useful for novice participants (like parents) (3 participants)</td>
<td>• Not same as web because web links are not always the same (1 participant)</td>
</tr>
<tr>
<td>• See underline and know to mouse over for both (1 participant)</td>
<td></td>
</tr>
</tbody>
</table>

Table 15. Comments about the value for the single style for explorer

<table>
<thead>
<tr>
<th>Value for integrated explorer style strategy (web style for explorer)</th>
<th>No value for integrated explorer style strategy (web style for explorer)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Consistency on the computer as a whole (4 participants)</td>
<td>• The two are different (7 participants)</td>
</tr>
<tr>
<td>• Easier/faster to have one (4 participants)</td>
<td>• Regular files should double click. With personal files, want to commit before opening it. With web pages, download can be stopped (5 participants)</td>
</tr>
<tr>
<td>• See hyperlinks for both, know to mouse over/single click (1 participant)</td>
<td></td>
</tr>
</tbody>
</table>