The Perseus hypermedia environment: Enhancing access to Classical Greek culture
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This paper is based on work completed during my Ph.D. research on the Enabling and Disabling Affects of a Hypermedia System on Information Seeking. As such this paper is but a very thin slice of a much larger project.

I will first provide a thumbnail overview of hypermedia systems and the current version of the Perseus database. I will then briefly present the rhetoric of the advocates and the critics of the use of hypermedia systems in education. Next, I will describe the context in which I conducted the research and the methodology used. The bulk of the paper examines the users, the tasks they were performing and the tools provided by Perseus. The paper concludes with implications for researchers, hypermedia developers and educators.

What is a Hypermedia System

The concept of hypertext is not new and people have been experimenting with such systems for well over 40 years. The two fundamental concepts shared by all hypermedia systems are those of links and nodes.

A node is a fragment of information. A node might contain text, graphics, sound or video. Ideally a node contains a single discrete idea (Conklin, 1987). A textual node might vary in size from a single sentence to a paragraph or even a page. Often hypermedia authors attempt to ensure that a node is smaller than a single computer screen so that it can be viewed in entirety.

A link is a relationship or connection between these discrete nodes. Users of the hypermedia system use these links to move from one node to another nodes.

Systems containing interlinked nodes of information are not new with two common examples being short encyclopedia articles linked with "see also" references or the interlinking citations of scientific communication. What is new with hypermedia is the computational nature of the system and this has only recently been possible with the increasing power of computers. However, hypermedia has become a buzzword of the late 80's and Horton (1990) writes: "In one sense, hypertext does not exist, the term being merely a catchword for a grab-bag of various features, none of them unique to hypertext and few of them found in any particular system." (Horton, 1990, p. 290).

Perseus

The Perseus Project

The Perseus project is an experiment in many different domains. First it is an experiment in the collection and dissemination of a vast amount of information about ancient Greek Culture. It is also an experiment in new forms of electronic publication and media—the principal initiator of Perseus considers his role to be that of a senior editor. Perseus is also a test bed in the domain of Human Computer Interaction with it being one of
the largest hypermedia databases in any single domain. The driving hypothesis behind the project is that the available information environment or infrastructure limits the questions a scholar can ask within a given domain. In the same way that the development of printing made it possible for more people to read and study the bible, it is hoped that Perseus will open primary classical materials to scrutiny by a wider audience. Thus the overarching goal of the Perseus environment is to empower scholars to be able to ask a wide variety of questions related to ancient Greek culture by providing them with a powerful information environment. The power in this environment derives both from the quantities of information it contains and also the tools which it provides for working with this information. The Perseus developers are committed to creating a very open ended information environment. Thus instead of Perseus attempting to be a comprehensive exposition on Greek culture it is more of a collection of information fragments and supporting tools which can be used in many different ways. The Perseus materials are also open ended because they will continue to be useful well after the project has finished. For this reason all data has been archived in a format which allows it to be ported to more powerful computational environments as they develop. Perseus is headquartered at Harvard University and major funding has been provided by the Annenberg/CPB Project, with additional funding from Apple Computers, the National Endowment for the Arts, and others. With the end of the initial funding cycle in 1993 it is hoped that Perseus will become a self funding project and significant progress has been made towards this with the marketing of Perseus 1.0 by Yale University Press in April 1992. Perseus Materials Perseus 1.0 consists of a CD-ROM disk and an optional LaserDisk. These materials are accessed using HyperCard on a Macintosh computer with at least 2 megabytes of memory. Currently the Perseus CD-ROM contains over 50 volumes of Greek literature including English translations, and over 5,000 colour images and textual descriptions of about 1,500 objects including sculpture, coins, vases and buildings. Perseus also contains an historical overview of 5th Century Greece, a classical encyclopedia, many site plans, an atlas and bibliography. Future versions of Perseus will include a larger quantity of materials with Perseus 3.0 containing more than 3 million words of Greek literature and associated translations, representing two-thirds of the existent literature from Homer to the death of Alexander the Great (Crane, 1992). It is anticipated that about 20,000 colour images will also be included. While the massive content of Perseus is a significant resource in itself, Perseus provides a number of tools to help work with this mass of information. Below is a brief description of the Perseus data base. A more complete description can be found in Mylonas (1992). Content Gateway Figure 1 shows the Perseus gateway which provides access to the resources within Perseus. Equally important the Gateway is the home base to which
the user can return at any time by clicking on gateway icon on the navigator.

Figure 1: Perseus gateway showing the different resources of Perseus.

Primary texts
Perseus contains approximately 50 works by the following 10 ancient Greek authors: Aeschylus, Apollodorus, Herodotus, Hesiod, Homer, Pausanias, Pindar, Pluarch, Sophocles and Thucydides. English translations and some commentaries and notes are also available. Providing access to these works within a single environment is in itself is a significant advantage to the Greek scholar but Perseus also contains the following philological tools for working with these texts: a morphological analyser, a Greek-English lexicon, a English-Greek word list and a compound verb list. The morphological analyser provides a morphological analysis of most Greek words in these texts (see Figure 2). To use the morphological analyser the user highlights a Greek word and then clicks the analyse button and this results in a list of the possible roots or lemmas for the word and the different forms of the word. From this list it is possible to examine the lexical entry for any lemma or its usage by any author.

Figure 2: Primary text card showing the morphological analysis of the first Greek word on the second line and the lexical entry for that word.

Archaeological Objects
Currently Perseus contains information on vases, sculpture, coins, buildings and sites. For each object Perseus provides a catalog card which include basic details of the object, for example, location, period, potter, style, type etc. Figure 3 shows a catalog card from the pottery stack. The catalog card provides access to more extensive information on the object and links to related objects. The catalog card also provides access to colour images of the object and many of the vases in Perseus have up to 100 colour images providing a very detailed visual representation of the object.

Figure 3: Pottery catalog card and one of the 30 images of this Kylix.

The sites and buildings catalog cards are also linked to line drawings and plans. Figure 4 shows a site plan containing image arrows which when clicked display a photograph from that location and that direction. Clicking a building on the site plan gives access to either a detailed plan of the building or a textual description of the building.

Figure 4: Part of the site plan of the Acropolis showing the Parthenon. The darkened image button just above the pointer has been clicked and the resulting colour image is shown. The colour image has been dithered before printing.

Historical Overview
The Historical Overview contains approximately 320 kilobytes or 160 pages of text providing an overview of the major events in 5th century B.C. Greek history. This overview contains 520 explicit links, shown as underlined
text, to other parts of the database which can be accessed by a mouse click. Figure 5 shows part of the Historical Overview related to hero cults.

Figure 5: Card from the Historical Overview showing three explicit links from the underlined phrase "hero cults".

Encyclopedia
The encyclopedia contains approximately 300 articles on regions, architecture, art, bibliographies, and musical instruments. Figure 6 shows the encyclopedia article for Kylix. The encyclopedia also contains over 3000 articles derived from the Loeb editions of the indexes to the Apollodorus and Herodotus.

Figure 6: Encyclopedia article for "Kylix" showing "see also" links, a linked illustration and credits.

Atlas and Bibliography
The Atlas contains a number of maps of the Mediterranean, mainland Greece and the Greek islands (see Figure 7). Perseus also contains an extensive bibliography of sources used in the compilation of Perseus and further sources for information.

Figure 7: Portion of a map with several sites plotted. The map is much larger than the displayed window and can be scrolled using the hand in the rectangle at the top right of the screen.

Search and Identification Tools
Perseus contains many indexes organised along different dimensions. These indexes provide access to the objects using traditional access points. For example, Figure 8 shows an architecture index ordered by site with alternative indexes ordered by type, period and date.

Figure 8: Site ordering of the architecture index. Alternative indexes can be selected from the menu at the right of the screen.

Perseus also contains a number of stacks which can be used to search for objects or information. The English Word Search stack will search for any English word in either the whole or part of Perseus and return a list of hits to the user. Figure 9 shows the Object Keyword Search stack which allows the user to select keywords from a list and search under these. The HyperCard find command also allows users to do very rapid searches within a single HyperCard stack.

Figure 9: Keyword Search stack showing the list of hits found after doing a search on "vases" and "divinities" matching the keyword "Dionysos".

Navigation Tools
Once information is identified the user must display it. Using the metaphor of travel this is generally called navigation. Figure 10 shows the Perseus navigator palette which provides single click access to information about the current stack, help, the "paths", gateway, return to last location, and the previous and the next card in the current stack.
Figure 10: The navigator palette showing the following icons: information, help, paths, gateway, return to last location and the previous and the next card in the current location.

Within each stack common actions are available as buttons displayed on the card. For example, every catalog card contains a "description" button which when clicked displays the description for that object. Perseus users are also able to use menus to move directly from part of the database to any other part of the database. When a menu is selected Perseus attempts to take the user to related information. For example, if "Delos" was recently plotted on the atlas and the user selected "site catalog" from a menu then the site catalog card for "Delos" would be displayed. If no obvious connection is made then an index for sites would be displayed.

Reading and Understanding Tools
Perseus provides tools to help the user to understand the information they have found. At the lowest level this includes multiple views of the same object perhaps from a different angle or distance. The presentation of the same information using different symbol systems will also assist some users. For example, a building might be represented by a number of images, a plan and a text description. Perseus also attempts to provide perquisite information in the form of short articles in the encyclopedia and lexical entries in a dictionary.

Collection and Organisation Tools
Perseus contains a path editor which can be used to collect information or nodes in the Perseus database. These paths can be reorganised and annotated in much the same way that you might shuffle note cards after a visit to a library. Figure 11 shows the path card from a path related to the site of Delos.

Figure 11: Path card showing the 24 locations on the "Delos 1" path. The annotation for the 6th location is shown at the bottom right.

Guiding and Telling Tools
A path is a trail through the Perseus database and it could be used as the basis of a lecture or perhaps given to students as recommended reading or for review before an examination. However, paths are much more than simple extracts from the database because they allow the user to wander away from, and return to, the path at will. Thus, the path contains not only the information in the nodes, but also the context in which that information occurs.

The Rhetoric of Hypermedia
Proponents of hypermedia systems suggest that such systems provide the user with enhanced intellectual and physical access to a wealth of contextualized information. This increased access can empower both students and instructors to engage in authentic and situated research activities previously only possible for experts in the field with access to a well-stocked classical library or museum.

However, these hypermedia environments require users to be strategic consumers of information capable of high levels of self-directed learning. Without such skills users are reduced to wandering aimlessly through a forest of disconnected materials and participating in shallow and fragmentary fact collection and unintegrated learning.

Critics also suggest that hypermedia systems are flawed at a more
fundamental level and that navigating through the vast information space is a task beyond that of even the expert. They claim that existing hypermedia environments are less useful than the traditional information environments provided by paper and books. Such a position is plausible given the long development of disciplines such as typography and document design culminating in today's documents. Furthermore people have considerable experience with the use of paper documents and few have similar levels of experience with electronic documents.

Methodology used in this Study
The research methodology chosen was multifaceted and exploratory. This selection was based on the three criteria suggested by Lincoln and Guba (1985): the current state of theory and knowledge in the research domain, the goals of the research, and the characteristics of the phenomena under consideration.

The current state of knowledge about information seeking in electronic environments is not sufficient to allow the identification of a limited number of variables that fully and accurately represent the use of such systems. Furthermore the capabilities of these electronic environments are rapidly developing and the effects of these developments must be identified before they can be compared (Neuman, 1991). In addition to the difficulty of identifying pertinent variables, there is also difficulty operationalizing them to the extent that they can be reliably and validly measured and manipulated. For these reasons a simple two group comparison with the presence of Perseus being the only difference between the groups, is neither possible nor desirable. Similar problems with the use of group comparison studies have been well documented in the literatures of educational computing and educational media (Clark, 1985; Papert, 1986).

The principal goal of the current research is to describe and understand the enabling influences of Perseus on the tasks students do. Thus describing and understanding the research situation is the goal, rather than the development of a predictive model that can be applied, in entirety, to other electronic tools, tasks and contexts.

The selected research methodologies must also be congruent with the phenomena under investigation (Lincoln & Guba, 1985). The participants' use of Perseus will be affected by their intentions, expectations, and prior subject or computer experience. Thus this research must be sensitive to the phenomenology of the individual user working in a specific context and the exploratory research methodologies used offer such possibilities.

Based on the research literature a list of foreshadowing questions was created and these were used to focus the specific data collection methods. Data was collected from participants using the following methods:
- focused and opportunistic observations of people using Perseus;
- interviews with groups of students and individual students;
- examining documents produced through the course;
- questionnaires;
- student performance on examinations and in the course; and
- recording a log of all interactions between users and Perseus.

Interaction logging which automatically records the user's interaction with
Perseus was perhaps the most interesting methodology and this involved the creation of a suite of HyperCard stacks which is currently being marketed (Evans, in press). InterLogger can be used to monitor the interactions between a user and other HyperCard stacks. This paper will now examine how users (students and instructors) within a university course performed tasks using the tools provided by the Perseus hypermedia system.

Users
The Course
Spring 1992 was the first time the "Greek and Roman Religions" course was taught and thus it is impossible to compare it to versions of the course taught without Perseus. Assessment in the course consisted of two class presentations and three examinations. Twenty-eight students participated in the course and a teaching assistant (TA) assisted the instructor throughout the course.

Perseus was used to supplement lectures, and to support student work in the reports and the final examination. When Perseus was used in lectures a path containing relevant materials was prepared before the lecture. These paths were made available for student review after the class.

One class session and one tutorial was allocated to training students to use Perseus. Students were also offered a high level of "on-site" support especially in the early period when people were starting to use Perseus. Students commented that this support was very important: "if I was there by myself I would have probably walked out."

The Students
The twenty-eight students ranged in age from 19 to 62 years with the mean being 25.2. The course did not have a prerequisite and this allowed people from a wide range of academic disciplines to enrol in it. Even including double majors, only 4 students were doing a classics major and fifteen other academic disciplines were involved. Figure 12 shows that the majority of students in the course had completed one or fewer classics courses before this one.

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Figure 12: Number of classics courses completed before CLAS 330.
Thus the students in this course come from a wide range of academic backgrounds and while some had significant background knowledge in the classics, the majority did not. The low number of classics majors and the high number of final year students suggests that a proportion of these students were completing the course to gain credits at the end of their degree rather than as a part of a coherent major.

Use of Perseus by Students
One of the coarsest measures of the use of Perseus is the amount of time it was used. There was great variability in the level of usage by individual groups and individual people. Students were divided into groups of three and while one group used Perseus for a little more than 2.5 hours throughout the course and another group used it for over 12.
In addition to using Perseus in groups while working on reports 1 and 2 all students also used Perseus individually. The average number of hours each
student used Perseus was 12.08 hours with the minimum being 5.09 and the maximum being 36.86 hours. Figure 13 shows the frequency distribution for the different usage categories. The instructor and the teaching assistant used Perseus the most (38.65 and 48.88 hours respectively) however one other student was close behind with 36.86 hours.

Figure 13: Frequency distribution for the number of hours each person used Perseus.

The range in usage of Perseus was mirrored by student ratings for the learnability and usability of Perseus. Figure 14 shows that the majority of students believed that it was easy to learn to use Perseus but a small number believed that it was hard to learn.

Figure 14: Ease of learning to use Perseus.

Related to the ease of learning to use Perseus is the ease of using Perseus once initial learning is complete. Figure 15 shows that while most people found Perseus to be fairly easy to use, a small group believed that it was hard to use.

Figure 15: Ease of using Perseus.

Figure 16 showed that the majority of students believed that they would use Perseus again even if it was not required. It is refreshing to note that students thought of applications outside formal educational tasks, and one believed that it would be a useful resource for planning a trip to Greece.

Figure 16: Most people believed that they would use Perseus again, even it was not required.

There are any number of reasons why students may have used Perseus for differing amounts of time and differed in their ratings of Perseus. Possibilities include different levels of interest in the content and different priorities associated with the course and different experience with computers.

Influence of Previous Classics Experience

As expected the number of classics courses completed before CLAS 330 was correlated with a student's grade in this course ($r=.5569$, $n=25$, $p=.004$). All correlations reported are Spearman correlation coefficients and the probability values are for two-tailed tests. The number of previous classics course was also positively correlated with all measures of Perseus usage, however the only correlation to approach statistical significance was use while completing report 1 ($r=.3380$, $n=28$, $p=.079$). At several times throughout the course the instructor commented that there was a need for students to have a background in the classics if they were to have the necessary information to interpret the materials in the course and the materials contained in Perseus.

Influence of Previous Computer Experience

At the beginning of the course students were asked to rate their computer usage in the previous semester on a 6 point scale. As shown in Figure 17
three students maintained that they "never" used a computer, two students claimed they used a computer for "more than 5 hours per day" and the most frequent response was "1-5 hours per week."

Figure 17: Computer usage in the previous semester. Students were also asked to rate their general comfort level while using computers and the results are shown in Figure 18. While the most common response to this question was "neutral" it should be noted that 8 student felt either "very uncomfortable" or "uncomfortable" using computers.

Figure 18: Comfort levels while using a computer

Interview and observation data suggest that there was a connection between the level of computer experience and the way a student uses Perseus. By the end of the course some students who previously did not like computers were able to effectively use Perseus, but at least three people consistently commented that they did not like Perseus because they were computer phobic. The following comments on the course evaluation are typical of this small group of students.

I think I would have gotten more out of it [the course] without the Perseus component. However, a big part of that assertion is my ineptitude with computers. Clas 330 eval

Lose the Perseus part. It is a great package but I hate computers. Clas 330 eval

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These students were aware of the usefulness of the Perseus materials, and they were able to use Perseus but they did feel disadvantaged because of their "ineptitude with computers." They advised instructors who intend to use Perseus to "beware of computer phobic anachronisms like myself" and warned against making Perseus a central part of the course because "not everyone has the same computer background."

When it was announced that the class would be using computers one student remembers thinking "wait a minute, I signed up for a humanities course, not a computer science course." She also claimed that some students said they would have to "drop this class" because they could not handle computers. Unfortunately no information is available on whether students did drop the class after this announcement.

Spearman correlation coefficients did not show significant correlations between previous experience with computers and Perseus use. However there were significant correlations between the three variables measuring prior experience with computers and the intention to use Perseus in the future. Intention to use Perseus in the future was positively correlated with the number of applications students had used ($r = .4899, n=24, p = .015$), their comfort level using computers ($r = .5720, n=24, p = .003$) and the amount they have used computers ($r = .6072, n=24, p = .002$). There were significant positive correlations between previous use of computers and ease of learning to use Perseus ($r = .4688, n=24, p = .021$) and between comfort using computers and ease of using Perseus ($r = .4273, n=28, p = .023$). Interview data supports this connection.

I was quite surprised how quickly I learned the various components and functions involved in Perseus. Not having much experience with computers, I tend to be intimidated when using one. However, Perseus is a quite
simplistic and organised program. It is tempting to suggest that issues related to differing computer backgrounds will become less important in the future. However, the fact that computers have been used in schools for many years suggests that this will not happen automatically. Instructors who intend to use hypermedia information environments must ensure that students have, or are able to acquire, the necessary skills, knowledge and attitudes to use these systems. To not do this may disadvantage some students by burdening them with undue difficulties and anxieties. Equally, software developers should ensure that their products exhibit features that assist, rather than hinder, use by inexperienced users.

Adoption of Perseus by Instructors

Adoption of Perseus by an instructor requires time and energy. First, instructors face the same learning curve which confronts anyone before they become personally comfortable with using Perseus. Second, the instructor has to find relevant information in Perseus and integrate this into the course. The time demanding nature of this is demonstrated by the fact that the TA and the instructor were the most frequent Perseus users. Talking about a colleague the instructor commented:

If there were [existing] paths for myths, ... [Perseus] might prove useful, but [colleague] is not interested, at this point, in trying to figure out how to duplicate his kind of lecture.

These two issues are not specific to Perseus, and they apply to all educational technologies. As a result most educational innovations come complete with "teacher guides" or "resources of activities" for assisting the instructor to use them.

Related to the time needed to find course relevant information is the fear that the use of Perseus will constrain the course. One student commented:

I would like to see the professor design the course herself, like she always has. And use Perseus . . . [to] supplement her course rather than designing her course with the intent of using Perseus.

The instructor commented that she decides "what I want to say first and then arrange Perseus to fit in with my scheme." However, because the course has not been taught before, it is difficult to gauge the influence of Perseus on the content of the curriculum.

Third, the instructor has to learn how to use Perseus in lectures. Within this course the TA was responsible for manipulating Perseus during the class and this released the instructor to concentrate on the class. While there were sometimes difficulties in coordinating what was shown on the screen and what the instructor was saying, this system did allow the use of Perseus in class.

During the course both the TA and the instructor demonstrated Perseus to several other instructors. Without exception their reaction was that Perseus might be useful but none has yet decided to use Perseus in their teaching. The TA was especially surprised by this and commented that it is "strange that they don't see how it can help students." However, on reflection, there are many reasons why instructors may be reluctant to use Perseus in their teaching. One suggestion is that instructors feel that
they "will be responsible for teaching students to use Perseus and ... that it will be more trouble than it is worth." @cg Instructors are justifiably concerned about losing instructional time to teaching students how to use Perseus.
Additionally instructors may feel that the use of Perseus will result in a devaluation of the skills and resources which they have developed over many years. One instructor was ambivalent about the images in Perseus and the TA commented "her slide library is the pride of her life. She has an enormous personal collection."
A third possibility is that instructors might not be aware of the access problems faced by students when working with the types of materials in Perseus. While an instructor might have relatively easy access to images in a slide library or a private collection, students do not. An art history student commented that students are expected to use images from books in a library reserve collection but this is very difficult because "the reserve list only gives titles, and some of them do not contain pictures, and some of them are in foreign languages. ... You can only get one at a time and when you go through it you might find that it does not have any images and you have to put it back and get another. It is very frustrating ... perhaps she [the instructor] does not know what it is like for a student." cg
In addition to these physical access issues are conceptual access issues related to prior knowledge. Talking about an architectural site the teaching assistant said "maybe because she has been there she can visualise what it looks like. But for a student it is very hard to visualise. The image buttons on the site plans are great because they allow you to go from two dimensions [the plan] to three dimensions [the image] and you can see what it looks like. They are great because they show you the direction and the distance."
Thus, while access to Perseus might be useful for students, the adoption of Perseus requires a large investment in time and energy by the instructor.

Expectations of Perseus
Peoples' expectations of Perseus has an impact on their use of Perseus and their satisfaction with it. People had vastly different expectations of the Perseus system and these expectations fluctuated throughout the course. When asked about her views of Perseus the instructor commented that they change "about twice a day ... sometimes ... you have a specific task and it's impossible to complete it ... it's missing half the stuff you know should be there. ... [at other times] I think it has great potential .J. It's a good tool." es cg tape
These widely divergent attitudes to Perseus were also present in the student group even when asked about a single feature of the program. For example, while some said that images of sites were "boring" others said that they were "fantastic." In a group interview one student commented that Perseus was frustratingly slow but another quickly countered by asking how long it would take to find the same information using a library. A third reflected: "we're a progressively spoiled society" and another suggested: "we have to look at it [Perseus] in context ... not just how
Expectations also differed widely on the amount and type of information contained in Perseus. Some believed that Perseus would contain the majority of information on classical Greek culture. "I think, being a computer gives you the false sense that it's all encompassing and actually it's got a very limited number of sources. . . . It gives you the impression that's it's got everything and it doesn't." group interview A good example of this is the encyclopedia—people expect an encyclopedia to cover a wide range of issues and topics, but the encyclopedia in Perseus provides only limited amounts of information in specific domains. Perhaps the issue is more about people's expectations of Perseus rather than the content of Perseus per se. A student suggested that the developers could address these sometimes unrealistic expectations by providing "25 words or less of PR that tells everyone the potential uses and scope of Perseus." questionnaire Without such a clear statement people will continue to have widely different expectations of, and experiences with, the product.

Related to the expectations people have of Perseus, is their view of how Perseus can be used with other sources of information, for example, books, libraries and the instructor. Some people view Perseus as a source for information to be used in concert with these other sources. However, others seem to adopt a more dichotomous or adversarial role where Perseus is, or aims to be, the sole source of information. One student asserted that Perseus had "taken away the joy of pondering over many a quaint and curious tome of forgotten lore" questionnaire and others maintained that the library should be used in preference to Perseus because it provides more information. A third bluntly asserted: "The professor is FAR more interesting than Perseus!"

While it is unlikely that Perseus could ever be the sole provider of information for users in any context, it is sobering to note that some students seem to be reacting against this possibility. Whatever the cause for the perception of antagonism between Perseus and other sources of information, it is clear that each source has unique strengths and weaknesses and that only by applying each will the most complete picture be gained. One student suggested that Perseus should be "tied into" and refer students to other locally available sources of information. Paths provide such a mechanism but there was little attempt to build links between Perseus and materials available to students in local libraries or museums. While Perseus contains an extensive bibliography, the interaction log shows that this was used for less than 20 minutes during the semester.

Perseus and Library Research
Several students commented that they felt "overwhelmed" doing research in a library. In a study of university students Mellon (1990) reports that between 75% and 85% of students describe their initial response to an academic library as either "fear or anxiety." One student who commented that she initially felt overwhelmed by Perseus said:

Libraries are just so overwhelming and just having text books in front of you can get very boring and this [Perseus] was an exciting way to do
research and not get overwhelmed. You could keep coming back to the
computer, even for 20 minutes. . . . It made research a lot less
intimidating. I think it is very intimidating when you go to a library.
This student particularly liked the global search tools within Perseus
because they returned a list of all hits and "I was able to just take a few
at a time and then come back to them, because it would always be there and
I knew where they were."
Another student said that once she started to search for material related
to her topic she realised that "there's a lot but it's not so much that
we're never going to see it all" and this helped her to be confident that
she would be able to find and use the relevant information. Another
student echoed these comments by claimed "there's so much you can get at
the library that you don't know what to do with it all. . . . If you can
be restricted to this [Perseus] . . . [it] makes it easier."
Throughout the course people often commented that Perseus did not contain
the information they required. While this in itself is not surprising—how
could any one source satisfy all needs—people were surprised by the lack of
information and this had a major effect on the way they perceive Perseus.
For example, one group commented "There wasn't anything very good, on
Medusa, especially considering how well-known she is." Figure 19 indicates
that most people were ambivalent about the likelihood that Perseus would
contain the information they required.

Figure 19: People were ambivalent about the likelihood that the information
they required would be in Perseus.
In a class interview most students said they were confident that they would
be able to find a given piece of information if it was in Perseus. Figure
20 shows the response to a similar end of semester question.

Figure 20: Most people were confident that they would be able to find
information if it was in Perseus.

Thus in summary, many students felt that libraries were an overwhelming
place to do research and in contrast they felt more in control using the
Perseus environment. There are at least two interpretations of this.
First, the amount of information in Perseus is limited and this gives
students the confidence that they are able to "cover it all". And second,
tools in Perseus gives them confidence that they are able to identify all
relevant information and that they are able to use it.

Tasks
Perseus Usage by Goal
Students and instructors used Perseus for different tasks throughout the
course. These tasks included: tutorials and learning Perseus, preparation
of reports 1 and 2, reviewing before exam 1, completing exam 3, preparing
the instructor paths and other purposes. Not surprisingly the level of
Perseus use varied greatly depending on the tasks assigned in the course.
Figure 21 shows the large variability in the number of hours Perseus was
used each week throughout the semester.

Figure 21: Number of hours of Perseus per week partitioned by declared
goal. Data based on interaction log from 363 sessions corresponding to
310.4 hours of use.
This section examines the major ways in which Perseus was used throughout the course.

Perseus as a Lecture Tool

Both the instructor and many students commented that the images did add to the quality of the lectures. "The fact that I [the instructor] can juxtapose things like text and images or vases and architecture . . . gives the lecture a kind of three dimensionality." es cg tape

This three dimensionality was not lost on students, one of whom vividly commented:

I feel like I go to Greece for an hour every day when we have class and when we see these images. . . . I love the way you can get a map and from a map you can locate any point that is referenced and I love the way you can find a site and get plans of a site and get photographs of different views from the site. I really believe I can picture everything just the way it is, as if I was in a satellite and I was just looking down, just to zero in on it. . . . To me it's really powerful. . . . I really feel like it creates . . . an atmosphere . . . it puts things more into perspective for me. DP tape

However, the use of Perseus as a lecture tool is not without its problems. The instructor commented that it was difficult to coordinate what was presented on the screen and what she was talking about. Talking about one episode she commented:

I ended up trying to talk about one thing while you [the TA] were doing something else. . . . I had to go back to the picture and there was a period then that I didn't feel in control. . . . I don't like that lack of smoothness. es cg tape

The instructor also claimed that Perseus might influence the lecture because Perseus simply does not contain any images to support the point that is being made and thus "the rhythm of the lecture gets off." However, despite this and the fact that she had access to a slide library and the lecture room contained a slide projector there was only one occasion when slides were used.

Students were aware of this lack of smoothness and several made comments that Perseus was "clunkie" and "bulky" and that it needed careful coordination to be used effectively. One student suggested that the instructor should do a "thorough dry run before class." q3

While the major use of Perseus in lectures was to display images, it is not possible to directly add images to a path and the path consists of a sequence of catalog cards. Thus, the TA was required to perform at least 4 separate mouse actions each time the instructor wanted the next image displayed. These actions, and the corresponding time delay, was more distracting than the one action and one second delay typical of a slide projector. If the display of images in lectures is an important application of Perseus, then Perseus should provide tools that are at least as good as a slide projector, i.e., one step forward and reverse. Not only does the instructor have to be skilled to use Perseus in lectures but so too do students.
It's very difficult... when we're sitting in class and [the professor] shows it [something from Perseus]... I can't read a text and listen to her at the same time. Either I read or I listen. at tape
Another student remarked that sometimes in class he concentrated on "taking notes more than looking at what was happening on the screen." This student said that he copes with this by often reviewing paths after class because it is "good to be able to go back and look at the images." at tape
Inspection of the interaction log shows that this student was a frequent individual user of Perseus.

Perseus and Student Review
Two days before the first examination the instructor suggested that students might want to review the paths used in lectures and student reports. About one third of students declared that they did this and the majority of these commented that it was a useful way to review the materials. Two representative comments are "I hadn't taken any notes as to what she put in the paths. [The paths were] extremely useful, texts are short and to the point" and "looking at my notebook wouldn't have drawn the same spark as looking through the computer." di tape
While there was a positive correlation between the grade on the first exam and the number of times a student used Perseus for review it was not statistically significant.

Perseus and Student Reports
In the first report groups of three students were asked to find images of an assigned god and temples and local practices related to the worship of this god. This material was then organised into a path and presented in a 15 minute class presentation.
The instructor intended to grade the reports but after they were presented she decided to grade them all as satisfactory. This is partially a reflection of the fact that students were required to perform many novel tasks (learning Perseus, finding and organising information in Perseus, coping with the content, and coordinating a verbal report with images from Perseus) and she felt it was unfair to grade all of these.
The instructor was also dissatisfied with the quality of some of the reports—while some were carefully crafted presentations integrated about a given thesis, others were a collection of disjointed information fragments. Observations of student preparation of the reports confirmed this with some reports being carefully planned away from the computer and others being based on what information was easily available within Perseus. This dichotomy between students who base their assignment work around an integrative thesis statement and those who base in on immediately accessible information has been observed in relation to the way students use libraries (Evans, 1990; Nelson & Hayes, 1988).
Perhaps the reports were not sufficiently integrated because Perseus did not contain the kinds of information which would support this level of integration. While students were able to use Perseus to find images of gods and associated temples they were frustrated with the lack of interpretative material. One group exclaimed that they knew that the god they were researching was important because of the number of depictions on
vases "but we had no idea why, and there was really no way to just say [to Perseus] 'okay, tell me why!'" he tape
Alternatively, Perseus may not have "caused" students to produce weakly integrated assignments but if a group decided to follow an "access" driven strategy, Perseus allowed them to quickly collect information and present such an assignment. "Perseus is a tool that allows students to be intellectually lazy if they choose to be. To use it well requires initiative and effort. If the effort is missing, the results will be minimal." (Mulligan, 1992, p. 11) In future years the instructor intends to provide more instruction and guidance on appropriate ways for using Perseus and what constitutes evidence for such a report.

Perseus as an Information Source
Different people react to Perseus in different ways—some are very impressed while others are less so. In an end of course questionnaire students listed the following as the best features of Perseus:
- providing easy and quick access to information;
- providing lots of information and lots of images; and
- providing easy movement between different types of information to another, e.g., move from images to text.

Ease of Accessing Information
Perhaps the most common positive comment about Perseus was that it provided "finger tip" access to information. Figure 22 shows that most students felt that Perseus was either "useful" or "very useful" in helping them to find information in report one.

Figure 22: Usefulness of Perseus for finding information for report 1.

Often students contrasted the ease of access to information within Perseus with the difficulty of using libraries:
At least we found something without having to dig through books. I mean it's easier to sit down there and find all the information you needed instead of running all over the place. at tape
You can access it on one computer as opposed to flipping through six books. I mean you can at least try to find it. It takes a little less effort.

0214 group interview
The teaching assistant provided another comparison between using Perseus and using a library. She was researching the authenticity of a Roman sarcophagus which depicted a baby between two warring armies. An instructor commented that she believed that there was a reference in Pausanias to a child named Sosipolis which might be relevant to the sarcophagus. Below the TA comments on the unique impact of Perseus on her research.
I first attempted to find the passage in texts from McKeldin Library, but could not find Sosipolis in any index. I then used the English Word Search on Perseus and found the relevant text immediately. I also used the text notes, atlas, and encyclopedia and found useful information. Most importantly, when I used the English Word Search on all areas of Perseus I was led to a temple dedicated to Sosipolis at Delphi. This was a very significant find in relation to my paper and I am sure it would have been
nearly impossible to make without the Perseus program. ... All the books I used to try and find more information (including the one source cited by Perseus) were in German. ... This experience demonstrates what I feel is the most important advantage of Perseus: the ability to make connections between various fields of study quickly (and in English).

Use of a Wider Range of Information
Not only did Perseus provide easy access to information, provided the information was in Perseus, but it also provided students with access to different types of information. For example, people talked about the fact that Perseus provided them with much easier access to images and plans of both sites and buildings than was possible outside Perseus. Almost all students commented that this allowed them to use these different types of information in their assignments.

A student who did a report on Zeus, and thus the site of Olympia, commented that if Perseus was not available: "I wouldn't think of trying to find site plans of Olympia. It would probably take a couple of hours looking through books ... to find something like that. ... I would have never have bothered to use [site plans]. I mean, it would never cross my mind if it wasn't there." ze tape Another said:

I would have only used the literary sources. And with Perseus we're using sculpture and coins and vases ... and plans and temples which I would never have analysed. 0214 group interview

When asked how their report would have been different if they did not have access to Perseus one group commented simply: "The lights would have been on!" In other words, Perseus provided them with a mechanism for finding relevant visual information and also presenting this information in their class report.

Connections between Different Types of Information
The majority of students also praised Perseus for its ability to allow them to easily and quickly move between different types of information. Furthermore they claimed that this helped them to understand the information in a way that would not have been possible otherwise.

The TA commented that the site plans containing image buttons was "one of my favourite features of Perseus ... [and it] provides a unique and extremely valuable experience for the student, impossible to replicate using books, maps, charts or photographs."

Students also praised the connection between text descriptions and the images accompanying most vases, sculpture, coins, sites and buildings. A student working with a vase depicting Dionysos observed: "We wouldn't know, first of all, what the kantharos was, that wine cup. We wouldn't know that the ... clothing he wore was specifically fawn skin. We wouldn't have been able to deduce from the images, ... how his hair was always free-flowing." While they realised that they would probably have recognised these thing if given enough time they maintained that having the descriptions with the images was "so much more helpful and time saving" than having just the images or just the descriptions. di tape and di209.130446 7579 and di210

These comments are supported by the fact that the majority of students believed that Perseus was either "useful" or "very useful" in helping them to find thematic connections between different types of information (see
Figure 23: Most people believed that Perseus was useful for finding thematic connections between different types of information. This anecdotal and questionnaire data is supported by the interaction log data, which shows that people moved fluidly between the catalog cards, the images and the description stacks. While students praised the ease of moving between different types of information there were also negative comments about this. For example, some students said that they had difficulties matching parts of the textual descriptions with the images and suggested a tighter link between the two. Images

Without a doubt the single most positive comment about Perseus was the value of the colour images. Figure 24 shows that most people rated the quality of the images highly.

Figure 24: Student rating of the quality of the images in Perseus. Undoubtedly this is a novelty effect and as the number of data bases with comparable images increases people will be less impressed. While the images were highly praised some people were critical of the quality and one person said that the images:

J. are frequently not good. Photographs are often washed out, occasionally underexposed. Many photographs, especially vases, are too small . . . not sharp enough . . . . Photographing vases is very hard . . . but a commercial product that sells itself mainly on its images should have first rate photographs.

While not all images are as bad these comments suggest there is cause for concern. At least this one classicist was left with the impression that the developers "put in what they had around" without concern for the quality of the images. Another commented "some of the images of the coins are unreadable, due to poor lighting conditions." Examination of the coin images support this comment.

While people were generally pleased with the quality of the images on the computer screen they were much less satisfied with the display of images in lectures. Many lecture rooms are now well set up for the use of slide projectors (build in slide projectors with controls at the front of the class) but this is currently not the case for projecting images from a computer screen. High fidelity projection devices are essential if Perseus images are to be used in lecture presentations.

Instructor Perspective
Instructors must ensure that students have access to sufficient information sources to support research required in a course. Traditionally this is done through student texts and library books. Perseus provided students with access to a corpus of information which would have been difficult to amass otherwise. The fact that Perseus substantially relieved the instructor of this burden may have been a significant reason for her opting to use Perseus.

While there were problems with the information provided within Perseus, these problems also occur when using other information sources. For
example, as the course progressed to time periods which were not covered in Perseus the instructor prepared a list of suitable resources for student use—she carefully screened the resources to ensure that they were appropriate in terms of the subject matter, the level of the coverage and whether the material was well written and understandable. This required a "horrendous amount of time looking for books in the library . . . [and there were] many occasions when books were either at another campus library, or they were on loan or they were not owned by the library." In these cases it effectively meant that the books were not available for the students to use in the report.

Even with such careful filtering of sources there were several occasions where students did not have the skills or the prerequisite knowledge to understand the recommended articles and the instructor was forced to provide this bridging information. For example, the group researching the Magna Mater was severely disadvantaged because "most of the work is done in French and German. There are a couple of books in English but McKeldin [library] owns none of them." The article which she did recommend contained many Greek terms and in a meeting before the class presentation she confessed to the lost student "I am just starting to realise how much I should tell you so this make sense. . . . I remember this as a fascinating article, but then I can read it!"

Thus, while Perseus was often criticised on the grounds that it did not contain enough information or information that was appropriate to the needs of the students, these criticism should be examined in the context of the difficulties students have using other information sources.

Tools within Perseus
The following section examines the use of the Perseus system according to the tools it provides. These tools are:

- content: the raw information within Perseus;
- search and identification: tools designed to help people find information in Perseus;
- navigation and access: tools designed to help people move to relevant information;
- reading and understanding: tools designed to help them to understand information; and
- collection and organising: tools designed help them collect and edit their path;
- guiding and telling: tools designed to guide a user through the data base.

Content
Students and the instructor often commented that the information they required was not in Perseus—this often was translated as "Perseus needs more stuff!"

Selection of Content
In addition to wanting to see more "stuff" in Perseus the instructor would like to see a "better" selection of artifacts which could then be used to develop a richer knowledge of Greek cultural life. "The intent to include
everything meant that no priorities were set in terms of usefulness." She continues by suggesting that the "designers seem to have thought simply in terms of quantities of isolated items" and not selected materials based on their inter-relatedness. The instructor suggests that the existing information should be carefully organised to reflect this interconnectedness and that unrelated information be replaced by more related materials. The Perseus developers concede that many factors impact on the selection of materials to include in Perseus. The collection effort began "with museums in New England, and [is] only slowly expanding to large European museums" (Mylonas, 1992, 194). In addition "[copyright] has had a significant influence . . . . [and Perseus is] restricted to those objects where these rights [unlimited reproduction] can be secured, and where the price, if any, is low." (p. 195)

Of course, the selection of information based on inter-relatedness is itself an interpretative act and as stated elsewhere, the Perseus developers have concentrated more on the collection of materials rather than these interpretive positions. It is possible that higher levels of inter-relatedness will only occur once a sufficient amount of primary materials is in Perseus and that only now is Perseus approaching this threshold.

User Needs
Perhaps a more productive way to think about the amount, scope and depth of information in Perseus is the way this content relates to the needs of a given audience. While Perseus has not been targeted at university level courses this will be a major market and students in this course expressed concerns with the content of Perseus.

Issues concerning the content of Perseus might have been more evident in this study because of the subject matter of the course. The CLAS 330 course is concerned with cultural and religious beliefs, and buildings and artifacts are only important to the degree that they shed light on these issues. The instructor criticised Perseus because it does not provide this type of information. In her words "Architecture is taken as such, so all the technical terms for parts of ancient buildings are defined, but the function of buildings is not treated as interesting. Vases are dated and assigned to painters . . . . sculpture is dated and assigned to schools, etc. Each category has its traditional apparatus, but there is no attention to the new ways of looking at material culture that emphasise function and context." When talking about the description of temples one student commented: "Sometimes the description . . . didn't give me the information that I wanted to know . . . I wanted to know more of the history behind it .J. . I didn't want to know what it was made out of, I wanted to know what went on there."

While audio components of Perseus have long been discussed the current version does not contain any. Classicists are understandably reluctant to include the definitive pronunciation of classical Greek works but the amount of time instructor spent time ensuring that students correctly pronounced the names of gods, people, places and objects suggests that this would be an invaluable addition to Perseus.
Over- and under-representation

Perseus users valued the inclusion of different types of information very differently—some felt that the images were central others felt that they were less important and that the space they occupied could better be filled with other information. While some objects are very well represented in Perseus others are not. For example, when looking at a vase with 109 views one user exclaimed "that is an obscene number of images for one vase!" The same person latter was disappointed because Perseus did not contain a single panathenaic Amphora which is surprising given the importance of such amphora to Athenian cultural life and the fact that many are existent. She commented similarly about the inadequacy of the site plans of Athens "because they cover only the top of the Acropolis and the Agora in any depth and a lot goes on in other places in Athens."

While the massive number of images is a major strength of the Perseus package it also presents people with difficulties attempting to find images relevant to their needs. One person suggested that: "Unless art historians are the primary users of the program I think it would be better to cut the detail shots (palmettes, half-figures, etc.) and go for clear full-screen shots of whole scenes." Another suggested that the images should be more closely tied to the text description of the object—thus if an object, or part of an object, is important enough to warrant an image then it should also warrant a text description and versa visa.

Identification and Searching Tools

The two tool types of search and identification, and navigation and access are closely related and there is not a clear division between them. The first refers to tools which help identify relevant information, for example, a card catalog or a CD-ROM index and they provide information which points to relevant information.

The second set of tools, navigation and access, provide ways of obtaining or viewing the substantive information, for example, obtaining a book from the stacks or using a computer to display the required data file. People are interested in substantive information (Marchionini, 1992) and are only interested in the pointer information as a means of accessing this substantive information.

Search Tools versus Explicit Links

Perseus differs from many hypermedia databases in that there are relatively few explicit links—links which are visible to the user and when activated link to related parts of the database. These links are editorial acts (Marchionini & Crane, in press) and are inserted by the developers in the same way that "see also" links are inserted into an encyclopedia. Explicit links occur within Perseus in three main areas. First, different views or types of information about an object. For example a catalog card might contain a list of different views of the same vase and clicking these displays the appropriate view. Similarly clicking on the "description" button displays a textual description of the current object. Explicit links also are present in the historical overview giving access to supporting evidence and as "see also" links between articles in the encyclopedia.
Such explicit links are very easy to use, typically via a mouse click, and they are virtually guaranteed to take the user to a related piece of information. Furthermore, they advertise their existence and may suggest related information and relationships of which the user might have been totally unaware. Landow claims that hypermedia designers must create links that "assist readers by phrasing statements or posing questions that provide obvious occasions for following links" (Landow, 1991, p97). Explicit links guide the user in a way in which powerful search tools can never do. Perseus users praised the value of these explicit links. Rather than providing explicit links, Perseus contains a number of tools to help the user navigate around the database and search for information. While these tools are both flexible and powerful they place a burden of responsibility on the user which explicit links do not. For example, if I do not know that the Greek god Demeter is related to the Egyptian god Isis it is unlikely that I will spontaneously conduct a search for the word "Isis."

The instructor claims that "the desire to avoid pre-programmed [explicit] links is disingenuous; it means not [to] have to think about the significance of the materials." She contrasted the lack of explicit links in Perseus to the wealth of links within Landow's Context 32. Students were also aware of the lack of explicit links between related information. "There aren't enough interconnections between different bits of information. If you . . . pulled up a piece of text, and it's describing .J. . [a myth] it should be able to throw you to . . . 'these are the catalog images of this myth'. . . . [primary] text isn't really tied into the images and I think it should be." While students agreed that this should be a goal they acknowledged that it would be "a large task to undertake." ze tape

In a recent article Mylonas (1992) states that "in the current Perseus system, it is impossible to manage explicitly encoded links in primary data." (p. 199) and this statement at least implies that there may be some thought given to the inclusion of explicit links between primary materials in the future.

Enhancements to Search Tools

Accepting the decision to provide search tools rather than explicit links, it is important to ensure that these search tools are as powerful and as usable as possible. Two such issues, the selection of search tools and vocabulary control are discussed below.

First, users need a basic understanding of the capabilities of the various search tools. For example, if a person is looking for vases related to Zeus then should they use the English Word Search stack, or the Keyword Search stack, or the HyperCard find command? Would these produce similar results? They don't. As an example, one group was interested in knowing where the Pnyx was located. They first attempted to locate it using the Site Plans, and when this failed they tried using the English Word Search which resulted in a number of literary references and an article on Attica in the encyclopedia. In desperation they tried a HyperCard find in the "site catalog" and found a number of photographs of the Pnyx and from these were able to locate it on a site plan.

Variations in word spelling were also a serious impediment to the power of
some of the search tools within Perseus. For example, the mythical figure Hercules was spelt a number of ways depending on the period of the writing—Heracles, Herakles and Hurcles. Such variations in spellings are not "noise" which should be removed from the database but rather a source of information on the perceptions of and appropriations of mythical figures by various peoples. While it would not be appropriate to standardise these spellings, the provision of a table of common alternative spellings would be invaluable. Users entering a word in this table would be prompted to also look under alternative spellings.

Another group was looking at an image of a satyr playing a "barbiton" and wanted to know exactly what a "barbiton" was. They attempted to look up this work in the encyclopedia by typing the word into the destination box and selecting "encyclopedia" but this resulted in a message that there was no article and they were taken to the first article in the encyclopedia.

They returned to the vase and decided that it was useful to look it up in the subject index of the encyclopedia and they found an entry for "barbitos." di209.130446 7579 and di210 Another group had a similar experience and suggested that Perseus should contain something like the "Franklin speller" to suggest similar words.

Object Keyword Search and English Word Search

These two search stacks greatly improve the usability of Perseus. They are especially useful because they allow the user to search all the resources in Perseus and return a list of hits which can be browsed one at a time. Without these search stacks it is unlikely that Perseus would have been used in this course. In addition the Object Keyword search stack provides some level of intellectual indexing not found in free text based searching mechanisms.

Access and Navigation Tools

One rationale for hypermedia systems is that they should reduce the burden on the user for accessing or navigating to substantive information. This burden being performed by the hypermedia engine. However, this finger tip access often increases the cognitive load on the user perhaps resulting in disorientation.

Disorientation

A large concern with the use of hypermedia systems is that of getting lost. Conklin (1987) refers to this as getting "lost in hyperspace."

Several users commented that they spend much time trying to work out the scope and boundaries of Perseus. A clear statement of the contents of Perseus would have assisted them. It should be noted that this problem, the difficulty of visualising the entirety of the data base, is common to many electronic environments. Despite these difficulties Figure 25 shows that more than half the people in CLAS said that they rarely or never felt lost within Perseus.

Figure 25: How often did you feel lost when using Perseus.

The one students who said that he was "always" lost confirmed this in the interviews and said that this was his greatest problem while using Perseus. This student had minimal experience with computers before the class and was
very uncomfortable with computers. While there was a positive correlation between ratings of being lost and being able to recover while lost and prior experience with computers it was not statistically significant. This picture of a wide range of variability is also maintained in the difficulty students had recovering when they felt lost as shown in figure 26.

Figure 26: How often did you feel lost when using Perseus.

Consistent Interface
Consistency in the way a person interacts with a system is recognised to have an important impact on the way people use the system. Elements of the Perseus interface are not consistent in both the way that information is presented to the user (e.g. using different names for the same object) and in the way the user inputs information to the system (e.g. different ways of selecting objects).

Cost of Accessing Information
The questionnaire and interview data shows that Perseus did provide finger tip access to vast quantities of information. While this was generally the case there were still significant examples of the cost for viewing information within Perseus.

Early in the semester many people complained about the speed of Perseus—the delay after clicking an image caption and the display of that image varied between 10 and 30 seconds depending on the size of the image. This delay caused significant cognitive interruption and dissuaded people from using images as much as they might have.

It takes a while to go from image to image. You got to go from the image back to the [catalog] card, then back to . . . the keyword search and then .J. . . to the other [catalog] card and then go from there to another image. It takes all of like 5 minutes just to get two images.

Midway through the semester software was identified which significantly speed the loading of these images. After the SpeedieCD software (ShirtPocket Software, 1991) was installed this time was reduced to approximately 30% of the original time—10 seconds to load a full screen image rather than 30 seconds. While few people commented on this speed improvement the complaints about slow images also stopped.

Interface for Visual Browsing

The large number of images was an "embarrassment of riches" and this made additional demands on the user to find ways of selecting the images to looked at—while it is possible to look at 3 images it is not feasible to examine 60. Throughout the course students made several suggestions for improving the interface for working with these large numbers of images. Ideally several of these access mechanisms should be provided and the user could select the most appropriate based on their individual needs and the demands of the task.

In addition to different ways of selecting images people suggested different ways of working with images once they were displayed. One
student suggested including only full screen images which could be shrunk so a number could be displayed at the same time and being able to click on part of the image to display the relevant text description.

Reading and Understanding Tools
Perseus contains a number of tools designed to help people to read and understand the information they have found. These include providing multiple views of the same information and linking nodes using different symbol systems to represent the same information. Students claimed that both these mechanisms were successful. Perseus contains several attempts to provide pre-requisite information to help the user to understand terms and the meanings of Greek words. While these were valuable most students commented that they could be expanded.

Most students were unhappy spending large amounts of time reading information displayed on a computer monitor. One computer science major commented that she looked forward to doing a classics course because it would be a semester without eye strain only to be confronted with Perseus!

Collection and Editing Tools
The creation and use of paths was central to almost every use of Perseus within the course—collecting materials for the lectures and the reports, editing and annotating these paths, presenting the lectures and the reports, review for the examinations and execution of the final examination. Without the ability to work with paths Perseus would not have been used in this course.

All student groups prepared a path for report one, and in the majority of cases they had few problems working with the path mechanism. One group commented that they found it to be a very natural way to organise their report and they “probably weren’t even aware that we were being so organised because it was something we had to do within the computer program.”

Figure 27: Ease of incorporating Perseus information into their report.
The ease of working with the paths included adding nodes to the path and also reorganising and editing these nodes. While the path mechanism work surprisingly well there were several problems. First, there should be a way to add images directly to the path so these images could be displayed quickly in lectures. Also it should be possible for a person to annotate a node when it is displayed rather than forcing them to annotate it at a later time. Also the path note window obscures part of the screen and if there is no note for a given node then the note window should not be displayed.

While the path mechanism was very useful as a way of manipulating single path locations within a single path, there is a need for tools to manipulate path locations between different paths and between different path stacks. For example, if two people are using different computers there is currently no mechanism for merging their paths into a single path. Equally there are no mechanisms for compiling paths into a single path stack. Several of these tools were developed by necessity and such tools should become part of the Perseus materials.

A related problem is that the path mechanism depends on HyperCard card IDs
as a way of recording locations and in the past each time a new version of Perseus is produced these IDs have changed. Considering the time involved in the creation of paths, and their importance to the use of Perseus, it will be essential that paths created using version 1 of Perseus continue to work with future versions of Perseus.

Guiding and Telling Tools
Perseus contains very little expository information. The major exception is the Historical Overview and the students who did use this commented that it was useful. However, the overview was minimally relevant to this course and thus was little used.

Students in the class and the instructor criticised Perseus because it did not contain enough secondary materials. The Perseus developers have consciously decided to "concentrate on the collection of a broad range of primary material—primary texts, descriptions and images of objects—rather than to provide extensive secondary coverage" (Mylonas, 1992, 194) for a number of reasons. One is that many different interpretations of the primary materials and the inclusion of any one would necessitate the exclusion of others. Rather than provide this secondary literature the Perseus developers have designed flexible tools for searching and navigating amongst the primary materials. While most users appreciate the differences between these approaches and the unique advantages of each there are many who would like to see more secondary materials in Perseus.

Prepared paths are an important tool for guiding users through the database. However, only a very limited number of such paths were available to students in this course. It is hoped that paths and expository work similar to the historical overview will be submitted to the Perseus project and included in future versions.

Conclusions and Implications
If there is one term that captures the experience of using Perseus in this class it is "bitter-sweet"—some aspects were wonderful, empowering and liberating others were frustrating and constraining. Not only did different people fall at different places along this bitter-sweet continuum but the same person may have had very different experiences of using Perseus depending on the task they were doing. In the midst of this swirling soup of differing expectations and experiences is the ever evolving Perseus system. Even within the 4 months covered in this course Perseus materials have been refined.

Below are a set of recommendations for researchers, educators and hypermedia developers.

For Researchers
The research on which this paper was based was of necessity wide ranging and exploratory. As the experience and theory base in the domain of the use of hypermedia systems grows then it will be possible to conduct more focused research. While more focused research will be possible this does not mean that qualitative methods are not needed. Research in a domain like this must use qualitative and quantitative methods when and where they are suited to the research problem.

In addition to providing an object for research, large highly interactive
Hypermedia systems provide a research tool. Careful examination of the interactions between the user and the system can provide a depth of data that is not possible to collect in non-computational environments. Unobtrusive interaction logging is one such data collection method.

For Developers
As hypermedia systems become more mature there will be an increasing push towards standards and transportability. These standards should include the provision of "hooks" which can be used to log the interaction between the user and the system. These hooks can also be used to implement tools for use by the reader. Such tools might record an annotated history and allow the user to retrace this history or perhaps plot progress through the database. ReadingTools (Evans, 1992) is one such set of tools.

Perseus contained a formative evaluation component and the information collected during this formative evaluation has been used to refine subsequent releases of the product. In fact four beta versions of Perseus have been produced before version 1.0 and each of these contained significant improvements. An important aspect of this formative evaluation was the use of the product to support a Greek religion course over a semester and this resulted in over 100 suggestions for improvements.

For Educators
The adoption of any innovation on the scale of Perseus requires time and energy. Even with a teaching assistant the instructor was required to invest heavily for Perseus to be used.

It is critical that the instructor is personally comfortable with all aspects of the innovation before they use it with students. Equally importantly, the instructor should model different ways in which student can use the innovation. In the current context the students only saw the instructor use Perseus as a delivery mechanism and did not observe her using it as a research environment. It is unrealistic to expect that students will be able to automatically transfer research skills into the Perseus environment and they may require explicit instruction to use it most effectively.

Just as educators may have difficulty learning to use Perseus so too might students. It is sobering to note that in the 1990's some students felt "totally inept" with computers and this translated into them feeling disadvantaged because of the presence of Perseus. Educators intending to use hypermedia systems must ensure that all students have the skills and attitudes to allow effective use of these hypermedia environments.

Educators should also note that while such electronic environments offer great possibilities they also require resources and infrastructure in order to be used effectively. In the current study the computers available for student use were barely able to support Perseus. Equally the projection device was not adequate for the projection of images in lectures.

The Future
The future will undoubtedly be bright with promise and opportunity. Kay claims that "in the near future, all the representations that human beings have invented will be instantly accessible anywhere in the world on intimate, notebook-size computers" (Kay, 1991, p. 138).
While this will be true it is critical that we remember that the use of computers in education is primarily about people and culture rather than about technology. Papert coined the term "technocentrism" to refer to the mistaken tendency for people to ascribe undue importance to the 'technology' rather than to "what are really the most important components of educational situations—people and cultures." (Papert 1986, p.55)

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