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Alternative operations for browsing hypertext

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The relationship between these problems has already been noted. Charney, for instance, explains that by giving the user control of the sequence that is to be read, hypertext imposes a greater burden on the reading process: users may become overwhelmed by the available choices and lose track of their position in the underlying network [5]. Gygi has directly related the problems of managing the complexity faced by the users with a state of cognitive confusion and disorder: as a result the user gets disoriented [8].

The *previewing approach*, presented in this paper, is based onthe fact that a reverse effect in this relationship is expected to occur: by diminishing cognitive overhead conditions the disorientation problem is also reduced.

The approach exploits the interaction between user and hypertext system by offering the user two alternative ways of selecting a hypertext link. Figure 1 represents schemes of the normal link selection operation in part (a), PIO/Consult in part (b) and PIO/NoGo in part (c).

Figure 1:

Part (a) shows that, during the usual interaction operations, the user is transferred from source to destination contexts at once. When the PIO operations are activated, as indicated in the middle block in parts (b) and (c) of Figure 1, the user enters the *previewing stage* and gains access to the previewing information. The contents of the previewing information are intended to help, for instance, clarify the semantics of the link and/or to reduce temporary disorientation.

At the previewing stage the user may also have access to both the source-related information and the previewing information by flipping between them.

The difference between the PIO/Consult and the PIO/NoGo is that, in the former, the user may, at the previewing stage, choose whether or not to complete the selection of the link. In the PIO/NoGo operation, however, the user is *not* allowed to complete the transition. The purpose of the operation is to increment exploratory behaviour and avoid mistaken selections.

The previewing approach is not meant to be used as the only way to reduce the problems of disorientation and cognitive overhead: instead it should be used in conjunction with other mechanisms such as the structuring of the information.

The following sections of this paper discuss related work, define the alternative operations, and present an analysis of the implications of the approach upon overhead factors. Implementations to Unix Guide and HyperCard are introduced next, followed by references to evaluation results and the conclusion.

2. RELATED WORK

This paper addresses the problem that, in general, readers have limitated means of estimating the relevance of a link before they have transversed it. A side issue is that, even when at the destination of the link, readers may no be able to work out why the link was created.

As defined in the previous section the user, when entering the previewing stage, has access to destination- and source-related information which normally corresponds to extra information referring to the source and destination contexts of the associated link. Some implementations of hypertext systems have already offered the user extra information on the semantics of the link (as for instance the *link explainer* field in Intermedia [17]) and on the destination of the link (as in the implementation of the Broadbutton linking mechanism of Langford [9]).

The novelty of the PIO approach is that it extends the behaviour of those mechanisms because it provides better information (not limited to the titles of a *fat* link, for instance) which is applied to *every* link (and not only to the *fat* ones).

The PIO/Consult operation has clear similarities with the description note implemented in Hyperties. (The description note is the text that appears at the bottom of the screen as a result of a link selection, and contains a resumé of the related destination information. After accessing the contents of the resumé, the user may decide whether to abandon or to complete the selection.) Firstly, some of their objectives coincide: the description note "provides a smoother transition between articles and limits the possibility of irrelevant jumps" [14]. Secondly, they are both embedded in the operation of link selection.Thirdly, both give the user the opportunity to decide whether or not to complete the link selection. That being the case, what are the differences?

Although PIO/Consult can, in a sense, be seen as an extension of the technique implemented in Hyperties, there is in fact an important distinction: in the previewing stage, the user may have *continually interchangeable* access to both source-related and previewing information. This is aimed at improving the user's awareness of the transfer of contexts embedded in the link, and also at reducing the related temporary disorientation.

Therefore the PIO model expands the Hyperties model by

- presenting both source and destination related information in the previewing stage;
- complementing the options available by defining the PIO/NoGo alternative;
- applying the PIO approach to both scroll- and frame-based hypertext systems.

An alternative to previewing techniques has been explicitly adopted in KMS: Akscyn suggests that the rapid response upon activating a link in KMS is as practical as accessing a previewing of the destination [1].

Both PIO/Consult and PIO/NoGo gives the user access to the previewing stage. The next two sections present the definitions of these operations.

3. PIO/CONSULT

PIO/Consult allows the user to have access to the previewing stage and then permits the selection to be abandoned or completed.

Table 1 is an interaction table defining the steps involved in the PIO/Consult operation. A mouse is assumed as the input device. The interface may refer to any system where the selection of a link is performed by *pointing* at an anchor and *clicking* the mouse button.

The definition assumes that normal link selection is achieved by *clicking* the mouse button. The aim is to exploit *the moment that the link is selected* to display the previewing information, at the same time that PIO/Consult is established as an *alternative* operation.

user	*1*	*positions mouse cursor over link's source anchor*
	2	*presses mouse button*
system	*3*	*presents previewing information*
	4	*sets cursos shape to 'preview shown'*
user	*5*	*<selection done or consult source?>*
		CONSULT SOURCE
user	*6*	*moves mouse to the left*
system	*7*	*presents source-related information*
	8	*sets cursor shape to 'source shown'*
user	*9*	*<selection abandoned or consult preview?>*
		CONSULT PREVIEW
user	*10*	*moves mouse to the right*
system	*11*	*presents previewing information*
	12	*sets cursor shape to 'preview shown'*
user	*13*	*<selection done or consult source?>*
		SELECTION DONE
user	*14*	*releases mouse button*
system	*15*	*presents resulting information*
	16	*sets cursor shape to normal <end>*
		SELECTION ABANDONED
user	*17*	*releases mouse button*
system	*18*	*presents source information*
	19	*sets cursor shape to normal <end>*

Table 1: Interaction Table for PIO/Consult

The following are comments on some of the steps in the Table 1:

- *step 2:* One of the strengths of the PIO approach is that it is meant to be available as a set of *alternative* operations for the user, i.e., the user should also be offered the usual mechanism of selection where the previewing stage is skipped.
  In this step, if instead of pressing and holding the mouse button the user issues a quick click, the previewing is not activated (equivalent to skipping from step 2 to step 14); this corresponds to the normal selection of the link.

- *step 5:* At this moment the user, after accessing the previewing information, has to choose between accessing the source-related information (equivalent to transferring to step 6) or completing the selection (step 14). (The same applies to *step 13.*)

- *steps 6 and 10:* By alternating between steps 6 and 10, the user can interchange access to the source- and destination-related information.

Given the definition of PIO/Consult, the next section defines PIO/NoGo.

4. PIO/NOGO

PIO/Consult, defined above, gives the user access to the previewing stage and allows the selection to be abandoned or completed.The goal of PIO/NoGo is fundamentally different: the user is stimulated to explore because it is *guaranteed* that a mistaken selection will not occur as a result of the activation of the PIO/NoGo.In a sense, PIO/NoGo is the complementary operation of PIO/Consult: compare parts (b) and (c) of Figure 1.

The steps involved in the user-hypertext interaction of PIO/NoGo are defined in the interaction table shown in Table 2. A two-button mouse is assumed as the input device, and the right button is used for activating the operation. If this mouse button already has a function in a particular system, or if the mouse is a single-button one, a substitute interface must be found (see description of Figure 9 for the solution adopted to the implementation with HyperCard).

Although the selection is never completed, the user has interchangeable access to the auxiliary source- and previewing-related information by alternating between steps 6 and 10 of the table.

The following section discusses the advantages of the previewing approach established by the use of these two operations.

user	*1*	*positions mouse cursor over source anchor of link*
	2	*presses right mouse button*
system	*3*	*presents previewing information*
	4	*sets cursor shape to 'NoGo: preview shown'*
user	*5*	*<NoGo finished or consult source?>*
		CONSULT SOURCE
user	*6*	*moves mouse to the left*
system	*7*	*presents source-related information*
	8	*sets cursor shape to 'source shown'*
user	*9*	*<NoGo finished or consult preview?>*
		CONSULT PREVIEW
user	*10*	*moves mouse to the right*
system	*11*	*presents previewing information*
	12	*sets cursos shape to 'NoGo: preview shown'*
user	*13*	*<NoGo finished or consult source?>*
		NoGo FINISHED
user	*14*	*releases mouse button*
system	*15*	*presents information as in the source context*
	16	*sets cursor shape to normal*

Table 2: Interaction Table for PIO/NoGo

5 The PIO and the cognitive overheads

This section presents arguments to explain how the previewing approach affects some of the factors related to the cognitive overheads embedded in user-hypertext interaction.

- *Identification of the link types:*
  As the user may access the related previewing information with the opportunity of abandoning the link, the identification of the type of the link may be left to the previewing stage. This is particularly useful for novice or casual users, or when a large number of link types is available.

- *Identification of the source anchor of the link:*
  During the previewing stage there is an opportunity for the user to access source-related information which would, ideally, highlight the anchor of the selected link.

- *Activating the command needed to carry out the choice:*

  Two aspects are improved by the availability of the PIO operations. First, there is an opportunity to present distinct link types—which would usually require different operations for their activation—as having the same interface. For example, to select an expansion button or a reference button in OWL's Guide the user must release the mouse button; but to select a note button (presented in a pop-up window) the mouse button must be held down [7]. Similar distinctions normally apply to *goto* and *field* buttons in HyperCard.

  Second, the abandoning of the selection is done consistently. Although in most cases not all the information available at the destination end of a selected link has been accessed in the previewing stage, the option for abandoning the selection during the preview is supposed to be the same regardless of the type of link selected. This represents a point of consistency on interfaces where the undoing of selections must be achieved in distinct ways, depending on the link type.

- *Temporary disorientation:*

  The opportunity to access specially highlighted information regarding both source and destination ends of the link is thought to diminish the temporary disorientation normally associated with the selection of a link.

- *Transfer of contexts:*

  The fact that extra information may be available is an additional benefit to the fact that, during the previewing stage, the user has interchangeable access to source and destination previewing information.

- *Undo procedure:*

  An important benefit introduced by the PIO approach is that partial undoing (relative to the previewing stage) is *always* offered to the user *and* is offered in a consistent manner (as discussed above).

- *User's commitment:*

  The fact that the abandoning of the selection is always a possibility (in the case of PIO/NoGo it is, in fact, the only possibility) will make the user more confident in exploring the available information by reducing the commitment relative to each link selection.

The tradeoff involved in using the PIO operations is an important one: PIO introduces an extra level of complexity by providing new options. After proper training has been carried out, however, the user should not face any difficulties. This is supported by the results of the experiment summarized in section 7: the operations were effectively used, even though the

sessions were short, and therefore the training was not an extensive one. This is important data, since the operations *were* alternative ones.

6. PREVIEWING INFORMATION

The availability of a previewing stage implies that

- extra information must be made available to the user
- associated to the source of each link and
- to the destination of each link.

To demonstrate the feasibility of the PIO approach in both frame- and scroll-based hypertext platforms, the PIO/Consult and PIO/NoGo operations were implemented in both HyperCard [2] and in Unix Guide [4]. These systems were chosen for two main reasons: first, because of the wide range of interface features they implement; second, it was possible to implement the new operations: new message handlers were written in HyperTalk [3], HyperCard's programming language, and new functions were written to the Guide's source code, which was available to the author.

Probably the ideal previewing information would be that generated by the author of the hyperdocument. However the generation of the previewing information, if responsability of the author, would cause an overload on the authoring process which is likely to be unwelcome in most situations.

The approach adopted in the implementations was to generate previewing information automatically—based, mainly, on the type of the link. The intervention of the author in some situations may be necessary and should be permited.

Figures in Appendix A show what the information displayed at the previewing stage is for both Unix Guide and Hypercard.

The hyperdocument used in Guide is an example of the Unix manual page for the commands *rm* and *rmdir*. The Hypercard document uses a stack based on a tabloid newspaper, the *adscene* stack.

7. EXPERIMENT

This section presents a concise description of an experiment carried out to evaluate the PIO operations; a full description is available in [12].

7.1 Method

Subjects: 30 subjects volunteered to the experiment; most of them were beginning a Master of Science Computing conversion course at the Computing Laboratory at UKC. The subjects were

divided into two groups: the first using the standard version of the Unix Guide system (the control group), and the second group using the modified version of Guide (the PIO group). The subjects were randomly allocated to the groups and were equally likely to have had the same general experience concerning computer usage.

Approach: The approach adopted in the experiment was to: observe if there were any differences between the time taken by the groups to perform a given task; observe significant differences and similarities occurring between the two groups, with regard to the evaluation of the systems; observe the usage of the PIO generally.

The experimental session: Each experimental session included phases for informal background consultation, introduction to the hypertext concept, introduction to usage of the Guide system, free browsing, task directed browsing and questionnaire. The task demanded from the user navigate in the hyperdocument using the main types of hypertext links available in Guide to be able to answer a questionary concerning the structure of the document.

Questionnaire: The questionnaire was divided into four parts: contents and concepts; computing expertise, age and English language domain; evaluation of the system.

7.2 Results concerning sample and population

Data from the questionnaire show that the users in the two groups had approximately the same background as far as the user interface and hypertext concepts considered were concerned. Moreover the whole group (mean age around 28) contained novices and experienced users, being representative of a diverse population.

7.3 Results concerning task time

The time required to perform the task was about 27% less for the PIO group than for the Control group. An analysis of the variance, done by means of a t-test, gave as results: t *value* = *1.83,* $df=24$, $p=0.08 < 0.1$ *(2-tailed).* Although these results are not considered to be statistically significant in general, the $p = 0.08$ value supports a trend towards an important difference.

The fact that the PIO group encountered a more complex interface has to be considered. Although the aim of the PIO operations are to help the user, the first contact with the interface is quite complex: the user has to learn what all the possible options are and how to use them. This point has been, in fact, mentioned in the users' comments.

7.4 Comparison between Control and PIO groups

The indication of a trend by the analysis of the time taken to perform the task, as discussed above, supported the undertaking of additional comparisons between the two groups. A number of correlation analyses were conducted; the results, presented in Table 3, are discussed next.

			Control	PIO
A	The system was easy to use	The replace facility was easy to understan	.1266	*.5590
B	The system was easy to use	It was easy to undo a replace button	.3662	**.7139
C	It was easy to undo a replace button	It was easy to undo a glossary button	.1806	**.6846
D	You 'knew where you were'	It was difficult to decide whether or not to select a button	-.0734	*-.6162
E	You 'knew where you were'	It was easy to recognize what the information was when selecting a button	.4886	*.6389
		sign ≤ 0.05 ** sign. ≤ 0.01 (2-tailed)		

Table 3: Correlations

Correlation (A): The ease of understanding the link relationship was one of the main goals of the design of the PIO operations. The significant correlation (A), found in the PIO group and absent in the Control group, provides evidence for the suggestion that the goal has been achieved.

Correlation (B): Among the requirements for the design of the PIO was that the user should be offered an easy way to abandon the link selection, the aim was to reduce related cognitive overheads. The fact that correlation (B) is significant to the PIO group only suggests that the availability of the PIO operations concerning the undoing operations have influenced the user's rating of how easy it was to use the system.

Correlation (C): This relationship is interesting because, for the PIO group, the undoing of distinct types of buttons is achieved in the same way (when only the previewing perspective is considered). As the linear relationship is absent for the Control group, the subjects in this group may have treated the selection of the two types of button as distinct operations. The advantage of the PIO approach is that, by being able to treat the interfaces similarly, the operations are seen by the users as consistent and, as a consequence, more natural to use.

Correlation (D): The main hypothesis of the PIO approach is that it would make it easier for the user to make link selections, and this would reduce the transfer of context and temporary disorientation cognitive overheads. The significant relationship (D) suggests that the PIO

approach, by helping with the task of deciding whether or not to select a link, has also influenced the users' feeling of orientation during the navigation.

Correlation (E): By placing the previewing information under the user's control, the temporary disorientation overhead related to the selection of the link was expected to be reduced. The relationship (E) suggests that the overall user's orientation was also correspondingly affected by the rate of how easy it was to recognize the new information.

7.5 Analysis of the PIO group

Background recording implemented in the version used by the PIO group made it possible to obtain a record of the selections performed (including details of the operation used and the type of button), as well as a record of the *undo* operations activated (both finished and abandoned). Regression analyses were conducted to find out whether standard navigation operations would be predictors for the alternative PIO operations. The results, summarized in Table 4, are discussed next.

	Dependent	Independent	r^2_{adj}	F	Sign F
A	PIO:all	Click: all	.26	5.96	< .05
B	PIO/NoGo:all	Undo: all	.25	5.46	< .05
C	PIO/NoGo:replace	Undo: finished	.23	4.99	< .05
D	PIO/NoGo:glossary	Click: glossary	.26	5.96	< .05
E	Undo:all	Click: all	.47	13.25	< .005

- *PIO:all* corresponds to all PIO operations PIO/Go (holding time longer than .60s), PIO/Back, PIO/ConsultGo,
- PIO/ConsultBack, PIO/NoGo — considered all types of hypertext buttons;
- *PIO/NoGo:all* corresponds to the use of the PIO/NoGo upon all link types;
- *PIO/NoGo:replace* corresponds to the use of the PIO/NoGo upon replace button. Ditto for *PIO/NoGo: glossary*;
- *Undo:all* corresponds to all undo operations performed (finished or abandoned);
- *Undo: finished* corresponds to all undo operations which were completed;
- *Click:all* considers all standard click selections issued (holding time less than or equal to .60s).

Table 4: Regressions within the PIO Group

Regression (A): The PIO operations, considered individually, were not predicted by the standard operation of selection (*click*). Nevertheless, when all operations are considered, the results indicate that the number of click selections performed is a predictor for the number of PIO operations issued by the user. This important result states that the PIO operations, as a whole, will represent a significant part of the operations used for link selection.

Regression (B): The PIO/NoGo, all button types considered, is predicted by the number of Undo operations issued (finished or abandoned). As the PIO/NoGo presents the destination of the link and automatically performs the undo, they represent an exploratory selection by the user. The proposal of the undo operation, in general, not only has a corrective aim but also an exploratory one [15]. The result indicates that the PIO/NoGo will represent a significant part of the undo operations used in the navigation. This is further confirmed by the result presented next.

Regression (C): The number of PIO/NoGo issued upon replace buttons (the most commonly used type) was predicted by the number of effective (not abandoned) undo operations. The PIO/NoGo operation has an exploratory aim, and so has the effective undo operation. The result further reinforces that the user, when exploring, will use the PIO/NoGo as an alternative operation to undoing.

Regression (D): The most specific predictor found was related to the glossary button: the number of PIO/NoGo operations issued by the user is predicted by the number of click selections. This result indicates that, for the glossary button type, the PIO/NoGo would represent part of the effective operations of selection issued (in contrast with the exploratory selections indicated in the two previous cases). This result confirms the user's to tendency use the PIO/NoGo operation effectively when the destination information is going to be presented for a short period of time.

Regression (E): The result (E) states that the number of standard click selections was, as expected, a predictor of the number of (abandoned or completed) undo operations issued. Some related data available in the literature, concerning the KMS frame based system, states that "Backtracking is a frequent activity - for every move forward there tends to be a compensating move back [1]." The regression (E) suggests that the number of performed undo operations is about half the number of selections achieved by click only.

8. CONCLUSION

The aim of the PIO approach is to tackle some of overhead factors imposed on the user-hypertext interaction. The purpose is to diminish cognitive overhead and disorientation problems by reducing some of their causes.

Shneiderman's *Eight Golden Rules of Dialog Design* [13] are used in this section as a template to discuss attributes of the PIO approach. In some of the items there is a reference to validation information obtained from the evaluation experiment presented above and detailed in [12].

1. *Strive for consistency*

   The PIO approach offers an opportunity for the system to present the user with a more consistent way to select distinct link types. Moreover, the user may abandon the selection using the same operation, regardless of the type of link involved. The overall consequence is that the previewing presents a more consistent interface to the user. A validation of this argument is suggested by the correlation found between the questions "It was easy to undo a glossary button" and "It was easy to undo a replace button"', which was found to be significant only in the group having access to the PIO operations.

2 *Enable frequent users to use shortcuts*

   The normal operation of selection represents a shortcut of the PIO operations since they are, by definition, requested as alternatives to the normal link activation. In fact, in the study carried out within the group having access to the PIO operations it was found that the normal operation of selection was a strong predictor for the number of PIO operations issued.

   The abandon option represents a shortcut for the sequence *selection* + *undo*, therefore diminishing the number of "irrelevant jumps" and at the same time reducing the number of commands needed to explore the available links. Its use was confirmed within the group having access to the PIO operations, as the number of undo operations performed was a strong predictor of the number of PIO/NoGo operations issued.

3. *Offer informative feedback*

   The idea is that the information concerning source and destination of the link be presented as feedback upon user activation of the link: with minimum effort (in terms of issued commands) the user has access to much of the information available regarding the link. The feedback offered by the version used in the experiment was acknowledged by freely-made comments from users: "highlight during selection" and "arrows during selection" made it easier to find the way around the document.

4. *Design dialogs to yield closure*

   It is possible to observe both from Figure 1 and from the definition of the operations that the alternative operations have:

   a beginning: the activation of the operations is acknowledged through the presentation of the previewing information;

   a middle: users access source- and destination related information for as long as they want;

   an end: when the previewing stage is left.

5. *Offer simple error handling*

   A serious error cannot be made with the previewing approach in itself.

   PIO/Consult: if the user should want to reverse the result chosen in the PIO/Consult, PIO that could be done either by activating a regular undo, for the cases when the selection has been completed, or by activating a link selection operation (normal or PIO/Consult), for the cases where the selection has been abandoned. Exceptions to this rule should be made clear and, as a matter of fact, the previewing stage creates an opportunity for the system to make the user aware of such a situation.

   PIO/NoGo: the operation is meant to be used as a way of preventing mistaken selections.

6. *Permit easy reversal of actions*

   The operations have been designed to offer the user easy alternatives to undo an unwanted selection. Their availability ought to make the system easier to use. This suggestion has also been supported by the results obtained in the experiment: the correlation between the answers to the questions "The system was easy to use" and "It as easy to undo a replace button" was found to be strongly significant only in the group using the PIO operations.

7. *Support internal locus of control*

   As far as the selection of hypertext links is concerned, the user is always in command: the selection is or is not activated. This characteristic is preserved, and extended, in the definition of the PIO approach. A correlation which was significant in the PIO group only ("It was difficult to decide whether or not to select a button" and "You knew where you were") suggests that the PIO approach, by helping the user to decide upon the selection of a link, has also influenced the user's overall feeling of orientation.

8. *Reduce short-term memory load*

   The possibility of having interchangeable access between source- and destinatun-related information in the same operation alleviates the load on short-term memory. This is further exploited when the system, during the previewing stage, provides additional feedback on the source and destination anchors involved in the selection. The fact that such an approach benefits the user is supported by the correlation between ``It was easy to recognize what the new information was when selecting a button" and ``You knew where you were", which was significant amongst the users of the PIO operations only.

From the discussion above it can be said not only that the previewing approach complies with all the rules, but also that its availability makes the normal operation of link selection better to conform with them.

Although the implementations cited in this paper concerned the selection of hypertext links only, the approach may also be applied to secondary navigational modes such as landmarks and graphical browsers. The implementation in the HyperCard stack *adscene* has included previewing of the *back*, *next* and *previous* buttons. The approach can be generalized even further: discussions held in [11] consider the application of the previewing approach when activating scroll—bars and the playback of a piece of video/audio information, and also defines multi-level previewing.

Further experiments are planed to investigate the usage of the PIO perations in HyperCard. There are plans for implementing multimidia and multi-level previewing, as discussed in [11].

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A Commented figures

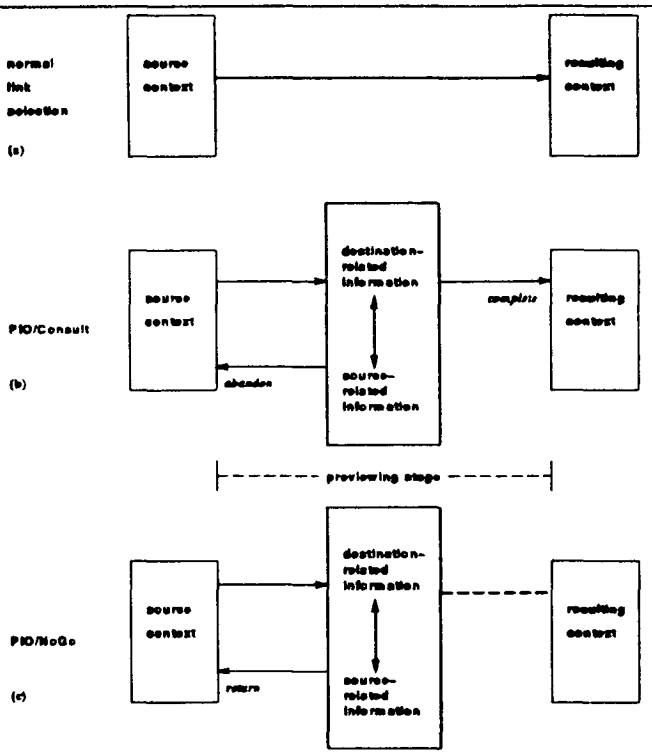


Figure 1: *Schemes for the selection of a link*
(a) normal, (b) PIO/Consult and (c) PIO/NoGo

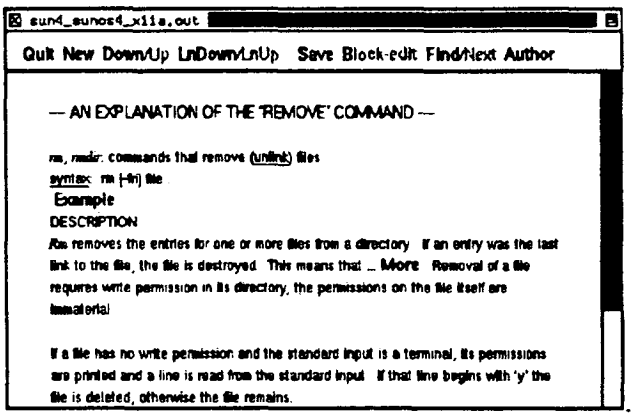
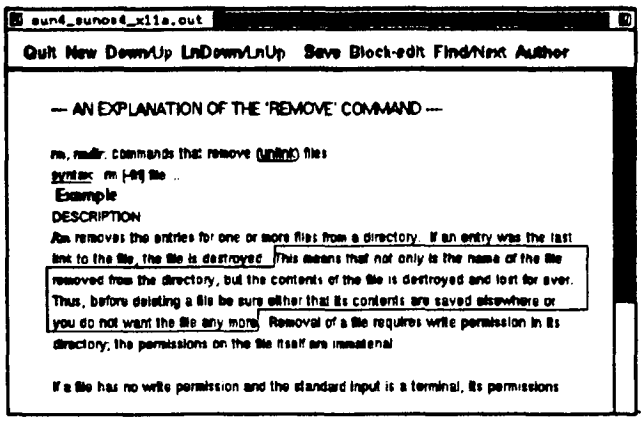


Figure 2: *A Unix Guide window containing a menu, a scroll bar and the document area. Replace buttons are shown in bold and glossary buttons are shown underlined.*
The normal selection of a replace button causes the associated replacement to be inserted *in situ*. The normal selection of a glossary button causes the corresponding definition to appear in a sub-window, the glossary view, at the button of the Guide window. The users activate the PIO/Consult by holding down the left-hand mouse button whilst the mouse cursor is over the hypertext button. PIO/NoGo is activated when the right-hand mouse button is used.



'igure 3: *When one of the PIO operations is activated to replace button* More, *the replacement text is inserted* in itu *and its extension is highlighted to facilitate the identification of new information.*
f the user releases the mouse button at this stage, the highlighting is removed and the selection is completed. If he user decides to consult the source-related destination, a movement to the left with the mouse brings about the lisplay of Figure 4.

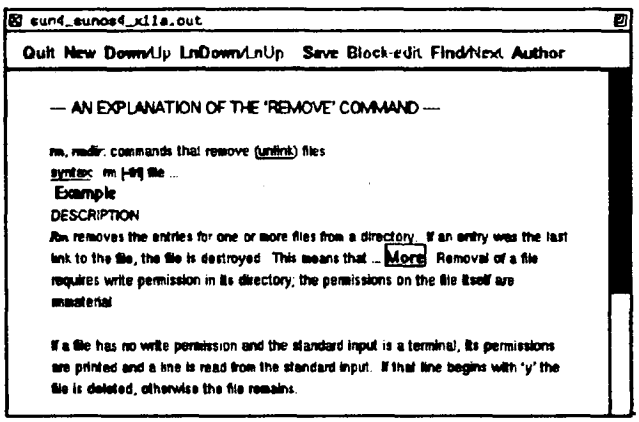


Figure 4: *The source-related information in the previewing stage corresponds to the same information available before the insertion of the replacement, with the addition that the selected button,* More, *is highlighted.*
At this stage the user may release the mouse button, causing the selection to be abandoned, or move the mouse cursor to the right. The latter corresponds to the consultation, again, of the destination related information, as presented in Figure 3. The consultation of source-related and destination related information can last for as long as the user wishes.

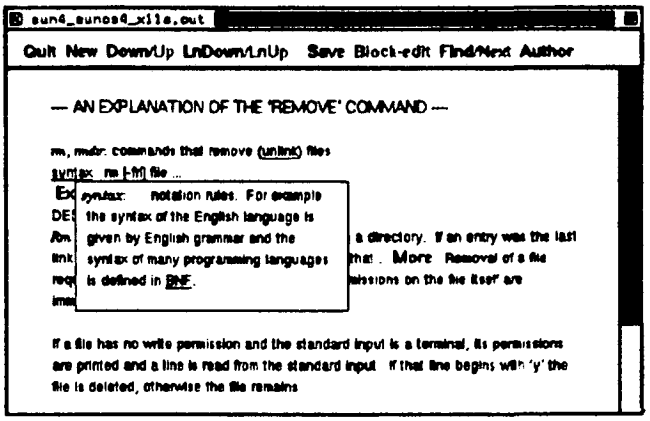


Figure 5: *Previewing information associated to the glossary button Syntax in Figure 2.*
The associated definition is presented in a pop-up window instead of in the glossary view (which would be a separate subwindow at the bottom of the screen). Such a presentation resembles the interface adopted by the note button in OWL Guide, and saves the users from having to transfer their attention to the bottom of the screen.
The user may release the mouse button to complete the selection (the result is presented in Figure 6); or move the mouse cursor to the left to cause the presentation of the source-related information, in a situation similar to that described in Figure 4.

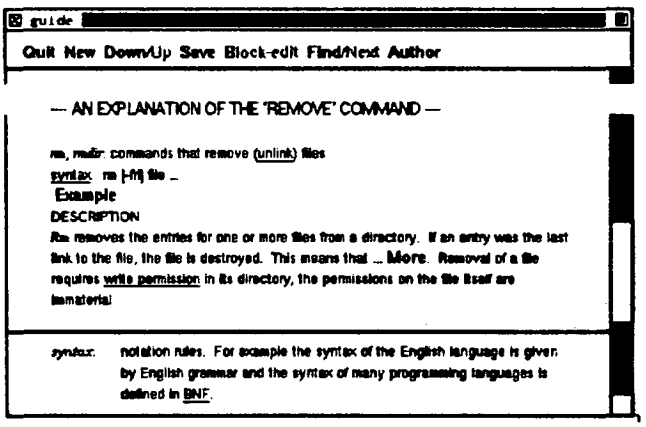
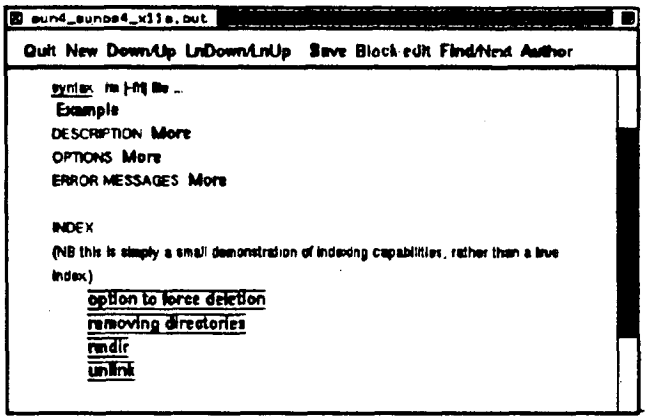
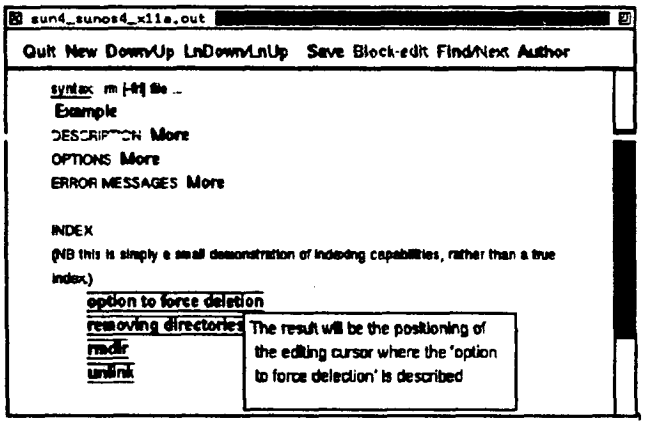


Figure 6: *Result of the completed selection of Syntax*
The definition is put in a special glossary view (at the bottom of the screen) if the user decides to finish the selection.



igure 7: *In another view of the same document, four action buttons (shown underlined and overlined) are available or selection.*

n action button can be associated to a broad range of commands, for instance the launching of a Unix shell-script, hich may not always be undoable. Clearly, such an action button cannot readily be previewed in its entirety. In he implementation it was decided to present the user with extra information at the previewing stage.



igure 8: *The previewing information associated to the action button is presented in a pop-up window: the contents hould help the user to understand the semantics of the link and provide a further opportunity to find more about the esult of the selection.*

leally, the text presented in the pop-up window is specially prepared by the author. In this particular implementation, if such information does not exist, the very text of the command to be executed is presented to the ser.

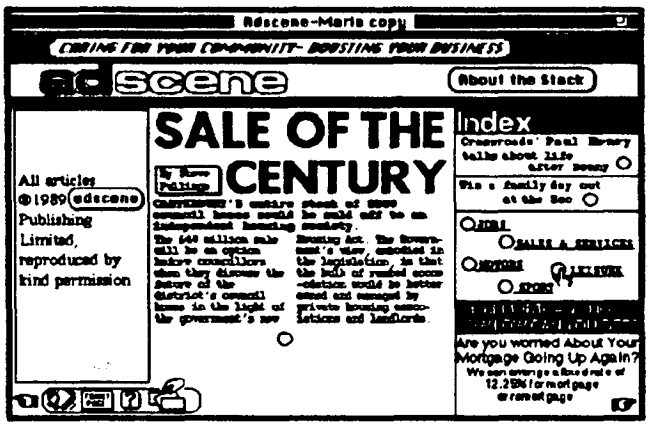


Figure 9: *Front Page* card of *adscene* stack. All the circles ○ correspond to *goto* buttons. The buttons **adscene** and **About the Stack** activate pop-up fields. The icons at the lower left and right corners correspond to *goto* buttons leading to cards containing *landmark*-related information.
To activate PIO/Consult, the users keeps the mouse button down when selecting the hypertext button; to activate PIO/NoGo, the *command* key is held down before the mouse button is pressed.

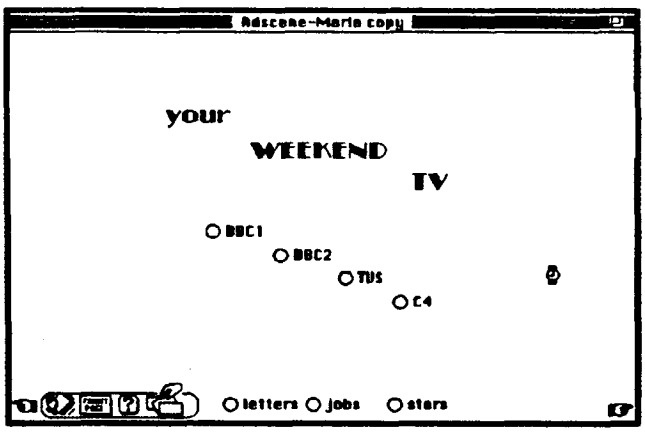
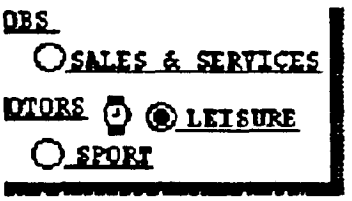
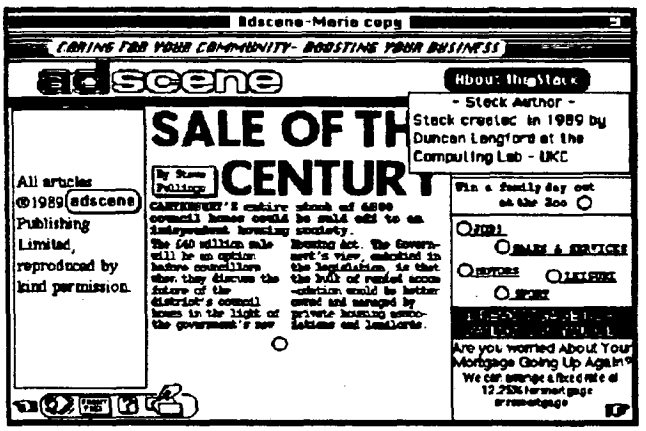


Figure 10: *During the previewing of the* goto button ○LEISURE *in Figure 9, the card containing a menu to "your weekend TV" is presented.*
At this stage the user may release the mouse button, completing the selection, or move the mouse cursor to the left, causing the source card to be presented, as shown in the next figure.



'igure 11: *The source-related information corresponds to the presentation of a source card with the selected button ighlighted: this figure corresponds to a fragment of Figure 9, where the button* ◯LEISURE *is highlighted.*
'he user may release the mouse button at this point, causing the selection to be abandoned. The other option is o move the mouse button to the right, causing the destination-related information (i.e. Figure 10) to be presented gain.



'igure 12: *Card showing a pop-up field during the previewing stage. The field is presented as usual, and its persistence ifter the previewing stage is decided by the reader.*
'he source-related information consists on the removal of the pop-up note and the highlighting of the selected button s defined

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