Towards a description of information seeking tasks contributing to the design of communications objects and services

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1. Introduction

useit.com, the site of one of the leading specialists in Web ergonomics, Jacob Nielsen, contains many interesting considerations concerning the Web, Wap and the development of communications objects. In brief, the success of the Internet and the Web from the mid 1990s onwards led observers to believe that it was possible to design almost anything in the field of communications objects, in particular in terms of information and document access. Fairly soon, however, it became clear that more than half of the information searches performed on the Web resulted in failure. Furthermore, Web and Wap access via communications objects such as mobile telephones or PDAs, which were initially considered to be a development or extension of the Web, have not proved themselves to be particularly usable and are employed only very infrequently. A number of hypotheses have been considered on the basis of this observation. It was thought that technical advance, in particular in terms of data rates would solve some or all of the problems relating to the development of any given tool. Other analysts suggested that users' skills would develop, as they always do, and thus solve the utilization problem. In brief, the development of usability was expected to boost utilization.

In this chapter we intend to defend a different point of view. We may consider that, considering among other things its usability characteristics, any given communications object is specifically useful for a particular information seeking task but not for others. A description and a categorization of the information seeking tasks and the establishment of a relation between this categorization and the communications objects which do or do not permit the implementation of each of these tasks would allow designers to choose the most appropriate tools in the light of the services that they want to develop. According to Tricot and Nanard [TRICOT, 1998] the description of an information task should take account of:

- *The user's representation*: the representation that users construct of the task and their level of expertise in the field in question together with their skill in using the tool or the information service;

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- *The implementation of the goal*: the address and the number of targets in the system, the procedures to be used in order to access these targets, the general structure of the system and the interface;
- *The context of the activity*: the reason why a subject chooses to use a particular system in order to search for certain information (learning, document design, problem solving etc.).

We have defined four objective variables which are independent of the user or the topic in question, and which make it possible to characterize the implementation of the goal in an information seeking task. These variables are the repetitiveness of the task, the level of explicitness of the targets, the location of the targets and the quantity of targets. We have started to analyze the hierarchical relations which may exist between these variables. This has enabled us to describe 12 information seeking tasks and classify these tasks on the basis of the mean performances they result in during information searches on the Web.

2. Wap ergonomics

Nielsen [NIELSEN, 2000] reports a study into Wap usability that was conducted in late 2000. Since Nielsen is acknowledged as the leading specialist in the field of Wap ergonomics and given that the study in question was extremely thorough, this report is our exclusive reference point. This study reveals that, in its current state, Wap utilization is not satisfactory. During their information seeking tasks, users are regularly confronted with a range of problems that occur at various levels and relate, for example, to connection, navigation or information retrieval. These problems are due to a large extent to the fact that Wap is still a very new technology and it is to be expected that the connection and download problems will be solved within a few years. However, the problems relating to information searches and retrieval will not be entirely resolved by technological advances. These are design problems which will have to be solved by designers and engineers. The constraints due to the size of the screen and the limitations in the way these tools can be handled (small keypad) would seem to make it clear that the data available via Wap and the navigation options that can be used to obtain this data should be specific to this type of tool. However, it would appear that this is not always the case.

2.1 Searching for information

Wap navigation is based on the same principles as Internet navigation. The idea is that users choose options from a series of menus until they find what they are looking for.
Each of the Wap networks attempts to provide all the information that is likely to be of interest to its customers. To do this, it offers all the services that users might need in the form of lists and makes these available directly via the gateway. The limited screen size makes it impossible to display all the options clearly and precisely in a single screen. These are therefore grouped into simple categories in a portal (news, entertainment, etc.). Once the required option has been found, a sublist with a new set of options is displayed. Given the large number of available options, users have to pass through

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many menus and submenus before they access the desired information. However, they often do not get that far after being prematurely disoriented in their search. Users have also pointed out another problem: some of the options or sites that are proposed are actually links to non-existent addresses or sites that are currently being built. Wap therefore offers its users data which is not actually available.
Apart from the data which is directly accessible via the options, users may also need to perform specific searches and they are able to use search engines to do this. However, these functions are not easy to find and few users access them. This is another consequence of the size of the screen since even if these search engines are available, they are not indicated clearly. To give an example, there are six good search engines available on Wap, yet during the study only five out of 20 users found them. After finding the search engines, the users had considerable difficulty formulating their requests. The small size of the keypad makes it difficult to enter data and increases the risk of error.

2.2 Retrieving information

After searching for information, users have to process it. In Wap, the data is distributed over several screens that users can browse through using a scroll bar. This confronts users with new difficulties. The first is the use of these scroll bars which they consider to be hard to manipulate. The second is reading the screen display. The ability to read small screens differs from user to user. Some are prepared to read large amounts of text while others are not. However, for 70% of them the small size of the screen is a consideration which dissuades them from using Wap.
Finally, the users were generally fairly critical of the quality of the information they obtained, finding most of it to be unsatisfactory. It should be noted that these results were obtained in a context in which the range of available services was still relatively restricted (December 1999) and was offered via a mobile telephone. The study conducted by Salembier and co-workers [SALEMBIER, this volume] seems to indicate that PDAs, on the one hand, and multimodal techniques (voice, tactile, gestural, embodied), on the other, may provide users with a more satisfactory solution.

2.3 Conclusion

Nielsen's study brings to light two positive points: the use of mobile telephones for Wap access is learnt easily and users can easily remember the various functions of the buttons. However, overall, Wap is affected by serious problems of usability, in particular when we consider the criteria of efficiency, the management and prevention of errors, and user satisfaction. Users are confronted with many difficulties, lose their connections and the few instructions that do exist do not enable them to take sufficient control of the system and make it truly effective. The navigation and option labelling often make the user/machine interface totally uncommunicative. Searching for information is a painstaking task which all too often yields unsatisfactory results.
It might be imagined that tools that allow subjects to customize their portals and the various download sites would represent a considerable aid to users in allowing them to access the options they require much more swiftly. However, this is not enough. These

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tools must also be capable of helping users perform their information seeking tasks in a much more effective way. We can well imagine that interfaces that adapt automatically to the user's operating habits and query types (adaptive interfaces) would be extremely useful here. Going further, intelligent agents could allow users to simply describe what they are looking for and then let the system perform the search for them. Such tools would probably make Wap simpler to use and lead to more satisfactory search results. However, Wap does not enable users to perform all the information searches that are available on the Internet and adaptive interfaces do not provide the necessary performance for all types of information search. In effect, the integration of adaptive interfaces for Internet-based information seeking tasks makes it necessary to define the type of task for which they are to be adapted. The problem concerning the Internet here is the same as the one we have already formulated for Wap: what are the types of information seeking task for which these communications objects (mobile, PDA, laptop PC) or these protocols (Web, Wap) are suitable? Before we can answer these questions we must be able to provide a description of the information seeking tasks.
As a first stage, be intend to study (a) the implementation of the goal or "the objective characteristics of the information seeking task", and (b) the effects of these characteristics on users' activities. We believe that some of these characteristics will correspond to cases in which an adaptive interface is useful and, indeed, to cases in which a particular communications object makes it possible to search for information effectively.

3. Objective characteristics of an information seeking task

The study of the field of the description of tasks and adaptive interfaces has allowed us to identify four objective variables which are independent of the subject and make it possible to characterize an information seeking task. These variables are "the repetitiveness of the task", "the level of explicitness of the targets", "the location of the targets" and "the quantity of targets".

3.1. The repetitiveness of the task

The study of adaptive interfaces has shown us that intelligent agents are useful for repetitive tasks. These are tasks that are performed on a regular basis which require the use of the same operations in order either to retrieve the same information or a similar piece of information. They are distinguished from non-repetitive tasks which are one-off tasks

3.2. The level of explicitness of the targets

Ever since the first empirical studies of the use of hypertexts (for example [ROUET, 1990]), researchers have distinguished between explicit and implicit targets. An "explicit" target corresponds to an extract from a document, for example a text paragraph, which simply has to be understood by the subject. The subject does not need to search for any other information or produce any inferences to attain the goal. In contrast, an "implicit" target requires the subject to call on additional information or knowledge in order to achieve the goal since the target is not sufficient in itself.

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On the basis of an analysis of a variety of empirical data, Tricot [TRICOT, 1993] has defined two other objective variables which make it possible to specify a search task. These are the quantity of targets and the location of the targets.

3.3 The location of the targets

A target's location is the place at which it can be found on the information networks. Here we distinguish between precisely located and distributed targets. If a target is local then it is fully present on a single page (in certain cases, it may also be redundant, i.e. it may be present "in the same way" on several different pages). If a target is distributed then it is present on several pages and the subject must view all these pages in order to obtain all the information. If the target is "local" then the search terminates as soon as the site containing the target is found. In contrast, if the target is "distributed" then the search has to be continued if all the information is to be retrieved. The search for "distributed" information may take some time and imply a greater cost.

3.4 The quantity of targets

The "quantity of targets" variable defines the number of targets that exist for a search task. For this variable, the information is fully present on each of the pages on which it is present but there may be one or more pages or sites containing this information. If the information is "unique", it is only present on a single page and the difficulty for the subject is finding it. Otherwise, if the target is "multiple" the subject has a number of equivalent ways of finding the target.
We want to assess the effects of these variables on users' activities. We imagine that it will be more or less difficult for subjects to perform information seeking tasks as a function of the values of these variables. The adaptive and customizable interfaces as well as the new media (mobile, PDA) correspond to specific utilizations. We imagine that the study of the effect of our objective variables on the search tasks conducted on the Web will enable us to arrive at a partial description of these utilizations.
To do this, we have defined an experimental protocol by means of which we evaluate subjects' performances when performing information seeking tasks defined on the basis of our variables. In the multimedia field, assessing subjects' performance is not an easy task since the behaviour of one and the same subject may be judged to be good by one author but not by another. Nevertheless, there are rational criteria which are acknowledged to permit a good assessment of subjects' performances. These are the recall and precision indexes. Recall evaluates the number of targets attained by the subject out of the total number of existing targets. When the recall index has the value one, the subject has found all the targets. Precision is the ratio of the number of targets found by the subject to the number of pages opened. If the subject has opened only relevant pages during the search then the precision value is one. We evaluated subjects' performances on the basis of these two indices.

4. Experiment

4.1. Subjects and method

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25 subjects took part in this experiment. These subjects were interested in the Web and new technologies. They all regularly used the Internet. The experiment was performed using a laptop computer equipped with a mouse. Searches were performed using the Voilà portal.

4.2 The task types

Using the values of our four variables, we developed twelve types of task resulting from an almost complete crossing of the modes of our variables: repetitive/non-repetitive; explicit/implicit; local/distributed; unique/multiple. We performed all the possible crossings. Below is an example task and the accompanying description.
Task 1. Find a way of getting from Toulouse to Montpellier by public transport this Friday (arriving between 4 and 5 pm).

- The quantity of targets variable here is "unique" since the only way of getting from Toulouse to Montpellier by public transport on this date and at this time is by train. The timetable is located on a single page in a single site, namely that of SNCF (the French railway operator).
- The target distribution variable here has the value "local" since the timetables are all on the same page in the SNCF site.
- The target explicitness variable here has the value "explicit" since the subject did not need to produce inferences or look for any other information in order to know whether or not there was a train matching the requested times.

4.2.1 Protocol

The subjects completed two pre-tests, one concentrating on their Web browsing skills and the other relating to their knowledge in the various fields.
The 25 subjects were randomly divided into two subgroups, one consisting of 15 subjects and the other of 10 subjects. The group of 15 subjects performed the non-repetitive tasks while the group of 10 subjects performed the repetitive tasks. In the group of subjects performing the non-repetitive tasks, each subject performed three tasks, namely one autonomous tasks and two prescribed tasks. In the other group, each subject performed one autonomous and one repetitive task followed, if time permitted, by a second repetitive task. The subjects started their searches from the Voilà portal interface and performed the tasks on the basis of the instructions given to them. Each of the non-repetitive tasks was performed by five subjects and each of the repetitive tasks was performed by two subjects. While the task was being performed, the path taken by the subjects was stored in order to keep a record of their search. Their comments were recorded and the time was measured.

4.2.2 Instruction

"You will see the Voilà portal interface and you must search for the information that you will be asked to find from this portal. After that, you will be asked to fill in a questionnaire concerning these searches.
First of all, what is the last information search that you have performed on the Internet at your own initiative? Could you repeat it, describing aloud what you did, i.e. what you clicked on and what you entered?

Now you are going to perform the search tasks that I am going to ask of you. You will start each task from the Voilà portal. For each defined task you will have to reformulate what is asked of you (and tell me how you intend to go about it)."

4.3 Results

We adopted an exploratory, qualitative approach in order to define our research hypotheses. For this reason, the results below are essentially qualitative and we have not performed any significance tests.

Our intention is to determine the effect of our four variables: "level of explicitness of the target", "quantity of targets", "distribution of targets" and "task repetitiveness" on the subjects' behaviour in an information seeking task. To do this, we used the recall and precision indices.

In order to analyze the results, we attempted to develop an optimal search model for each of the search tasks. This model was to act as a reference when evaluating the searches performed by the subjects. We did not define information search models for the two search tasks: "repetitive, multiple, distributed and implicit" and "non-repetitive, multiple, distributed and implicit" since the number of equivalent possibilities was too great. The results obtained from the subjects on these tasks were not therefore taken into account in the calculation of the recall and precision indices. Nevertheless, an observation of the subjects during their search operations together with a qualitative analysis of the results allowed us to note that recall and precision appear to be at their weakest for these tasks. That is why it should be pointed out that the results below for the implicit, distributed and multiple tasks are probably better than the actual results.

4.3.1 Recall

Variables	Mode	Mean recall	Difference between the modes of each variable
Quantity of targets	unique	0.59	0.04
	multiple	0.55	
Distribution of targets	local	0.6	0.16
	distributed	0.44	
Explicitness of the target	explicit	0.66	0.23
	implicit	0.43	
Repetitiveness of the task	repetitive	0.72	0.22
	non-repetitive	0.5	

Table 1. Mean recall for each value of each variable and difference in mean recall between each mode of each variable

The recall index is the ratio of the number of targets accessed by the subject to the number of existing targets.

4.3.2 Precision

The precision index is the number of targets accessed by the subject divided by the number of pages opened by the subject.
We observed a greater or lesser effect of the variables on user's activities. The variables which had the greatest effect on task success were also those that had the greatest effect on the precision of the information search, namely "repetitiveness of the task" and "level of explicitness of the targets". We observed that users performed repetitive and explicit tasks successfully and accurately. In contrast, the non-repetitive, distributed and implicit tasks were performed with difficulty and inaccurately.

Variables	Mode	Mean precision	Difference between the modes of each variable
Quantity of targets	unique	0.39	0.06
	multiple	0.45	
Distribution of targets	local	0.44	0.05
	distributed	0.39	
Level of explicitness of the target	explicit	0.49	0.15
	implicit	0.34	
Repetitiveness of the task	repetitive	0.64	0.3
	non-repetitive	0.34	

Table 2. Mean precision for each value of each variable and difference in mean precision between each mode of each variable

4.3.3 Effect of the different task types on users' activities

Our intention was to study the effect of crossing the modes of the variables on users' activities. However, it was difficult to study the results of the "repetitive" tasks given that only two subjects were tested for each of these tasks. The difference between the "repetitive" tasks and the "non-repetitive" tasks is due to the fact that one was performed just once whereas the other was performed a number of times. We can therefore hypothesize that the conclusions that we are able to draw from the "non-repetitive" tasks will also apply to the "repetitive" tasks if we consider that, generally speaking, these will be characterized by higher recall and precision indices.

The figure below represents the effect of crossing the variables in the non-repetitive tasks on subjects' activity.

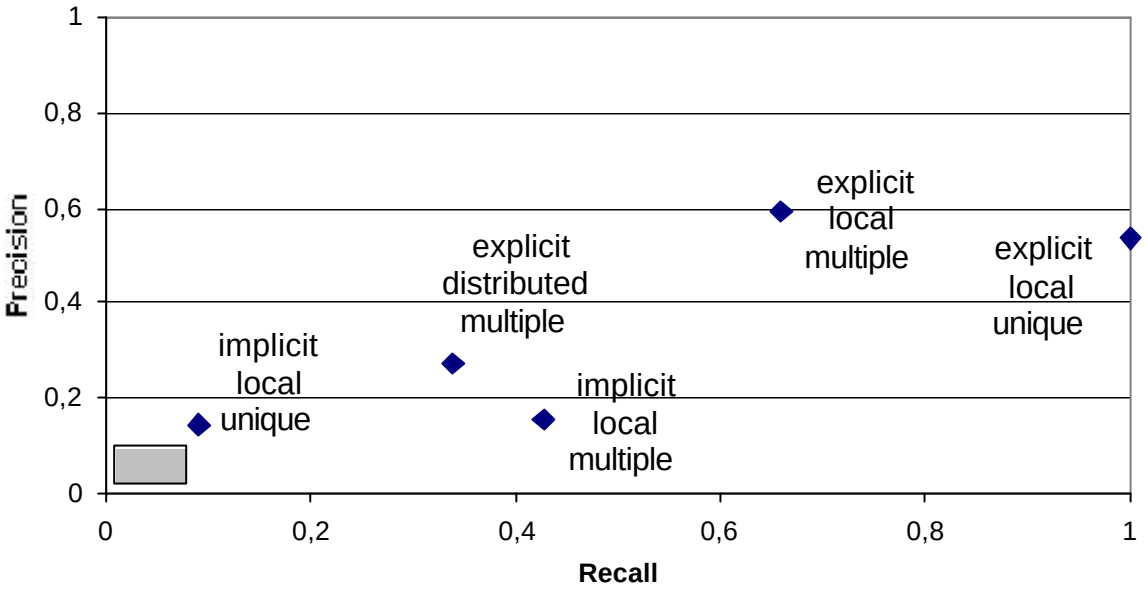

Figure 1. Mean recall and precision for each task type across all the subjects (the position of the "implicit, multiple, distributed" task is indicated in grey; our hypothesis is that this task should have lower recall and precision indices than the other tasks).

We can observe that, overall, as recall increases from one type of task to another, precision also increases and vice versa. The tasks for which recall and precision are high are the tasks in which the subjects made few errors and found a large number of targets. In contrast, the tasks for which these two indices were low were the tasks in which the subjects made a large number of errors and found only a few targets. This relation between recall and precision is unusual. In fact, the usual relation between these two indices is of the type: precision = 1 - recall (inversely proportional) [BUCKLAND, 1994]. In other words, generally speaking the broader the search conducted by the subjects and the larger the number of pages opened, the greater the likelihood that a large number of targets will be accessed. [BUCKLAND, 1994] describes the results we have obtained as "perverse": precision increases with recall. Everything suggests that, depending on the nature of the task, all the subjects either manifested imprecise behaviour in opening a large number of pages irrespective of their content or precise behaviour consisting of opening only the relevant pages.

One approach that would permit us to develop interesting hypotheses concerning subjects' activities would be to find a way of predicting the effect of each of the variables on each task type. To do this, we decided to arrange our variables hierarchically as a function of their effect on recall and precision

4.3.4 Hierarchical organisation of the variables

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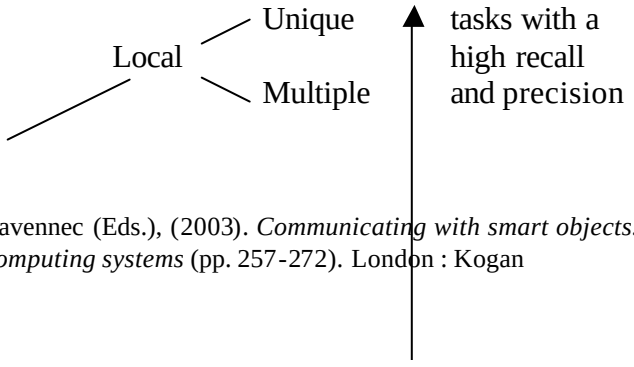
We used a contrastive approach to perform this task classification. First of all, we calculated the variable that had the greatest effect (all other variable values confounded) and we then arranged the two modes of this variable in hierarchical order on the basis of their recall and precision scores. We repeated this operation for each value of each variable, thus gradually reducing the number of variables for comparison. We then applied the results obtained for the non-repetitive tasks to the repetitive tasks. This results in a tree structure with the variables arranged from left to right as a function of their effect on recall and precision and the tasks arranged from top to bottom as a function of their recall and precision levels.

5. Discussion

The results that we obtained permit us to conclude that each of our variables had an effect on the information seeking tasks. The greatest effect was exerted by the "repetitiveness of the task" and "explicitness of the targets" variables while the "target location" and "target quantity" had a lesser effect.

We observed that when subjects successfully perform the first task in a series of repetitive tasks, they apply the same search strategy in the succeeding tasks which they also perform successfully. Recall and precision for each of the "repetitive" tasks are therefore high. In contrast, we observed that subject who failed in the first task, performed the second and subsequent tasks on the basis of the results obtained in the preceding tasks and either changed their strategy or re-used the same strategy in an attempt to improve it. This results in an increase in recall and precision scores. We may well imagine that the fact of repeating the task allows subjects to improve their searches through a learning process. We may therefore hypothesize that repetitive tasks are tasks that are frequently performed successfully. This would seem to call into the question the utility of adaptive interfaces for information seeking tasks. Nevertheless, repeating the same actions or sequences of actions is time-consuming to users. We might therefore imagine that adaptive interfaces which automatically perform this job would prove to be very useful in that they could enhance ease of use by eliminating time-consuming repetitions.

We also observed that the "explicitness of the target" had a large impact. The results obtained for the explicit tasks were better than those observed in the implicit tasks. During the experiment, we noticed that this variable could be influenced by the subjects' knowledge. These were simple tasks and, if subjects did indeed possess any relevant knowledge, this took the form of the location at which the information might be found and the method required to access it. These subjects therefore performed more accurate searches than the others. The implicit tasks were more difficult to perform.



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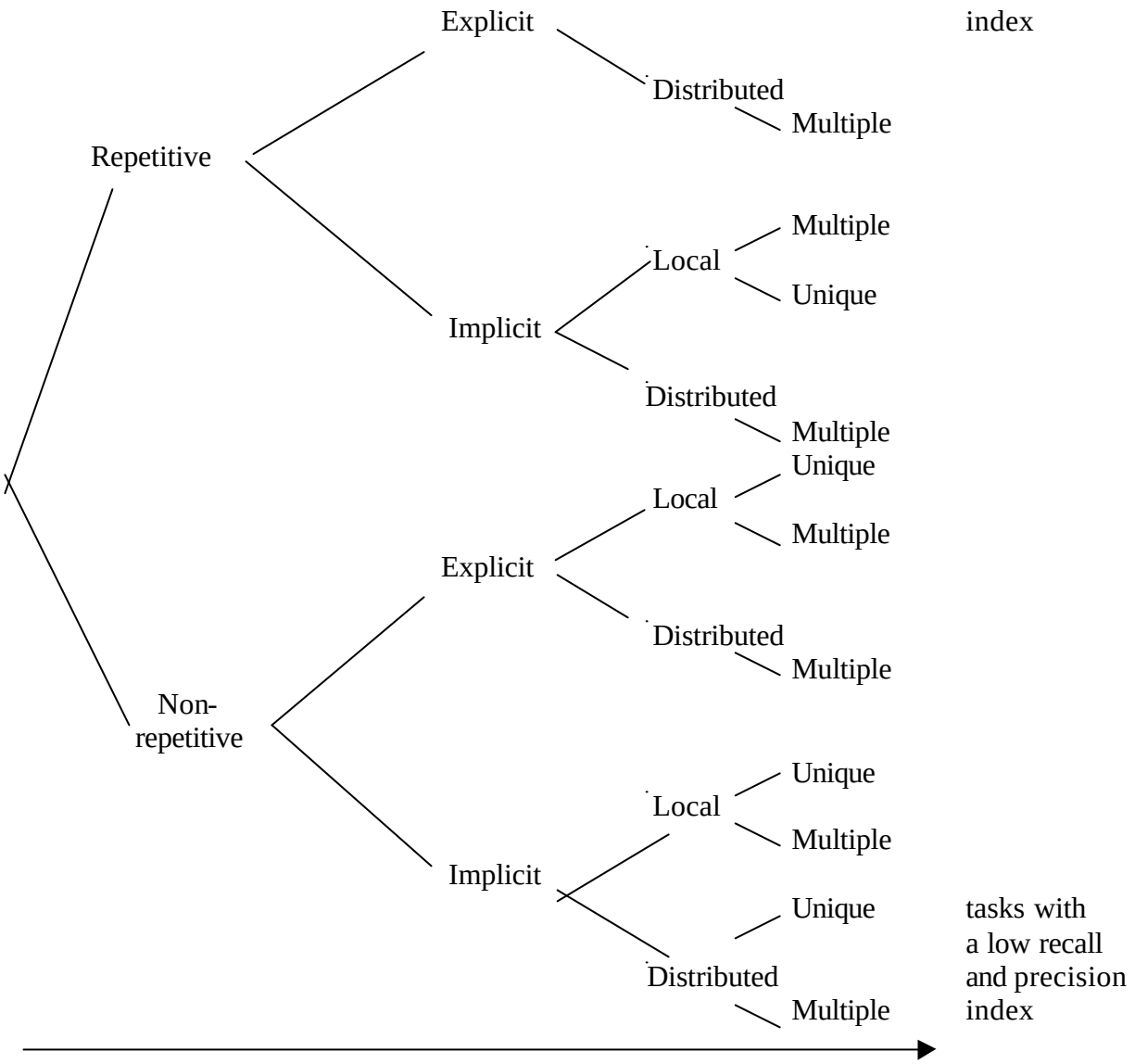

Figure 2. Classification of the types of information seeking tasks as a function of the recall and precision indices and of the effect of each of the variables.

In the majority of cases, if subjects had any knowledge then this related to the content of the topic in question but not the location of the target. Furthermore, we observed, that the subjects who had some knowledge concerning the content of the target topic also had a more accurate representation of the target than the others. Thus, as of the moment when they found the target they were in a better position to respond rapidly to the question since they simply had to check the information without needing to analyze it. However, in general the subjects were largely unsuccessful in this type of search. However, this might have been due to the experimental conditions which were not

suitable for this type of task. The comments made by the subjects suggested that they needed more time either in order to perform a more extensive search or to summarize the results of the information they had found.
In situations such as those used in this protocol, subjects are working under optimum search conditions. They could not print the documents and their search was stopped if it took longer than 20 minutes. This suggests that the level of performance achieved in implicit searches is low when the search time is less than 20 minutes and the documents can only be consulted on screen. However, this does not exclude the possibility that such searches may be performed successfully under different conditions.

We observed that the "target distribution" and "target quantity" variables had a lesser effect. We can well imagine that this could be due to the choice of the modes associated with our variables. As we stated in the description of our results, we would probably have observed a greater effect for the "target quantity" variable if we had chosen different modes. We assume that this same observation applies to the "target distribution" variable. We observed that when the targets were distributed the subjects had difficulty finding them. When targets are distributed, subjects must continue their search until they have found all the information. The search for "distributed" information takes time and even though our subjects were not placed under any time constraints they expressed the need to find the information quickly. In many cases, the subjects abandoned their searches before finding all the relevant information. However, a "distributed" target may be spread over a greater or lesser number of pages. According to Tricot and co-workers [TRICOT, 1999], performance in a search for a "distributed" target can vary depending on the number of pages that exist within the search field. In other words, for a given number of pages that may contain the information, subjects will more easily find all the information if the targets are distributed through all the pages than if they are present on certain pages. We can therefore suppose that the size of the effect of the "target distribution" variable will vary as a function of the number of pages which may contain these targets or, in other words, the target distribution effect is undoubtedly very closely related to the effect of task "selectivity". Tricot and co-workers [TRICOT, 1999] have also hypothesised that one relevant characteristic of the task is the complexity of the procedure that has to be implemented, i.e. the number of different decisions that have to be made between the start and end of the activity. We should therefore also like to assess the effect of other objective variables such as the number of different decisions that have to be made in order to attain the goal (complexity of the procedure), but also whether the target is defined a priori or discovered a posteriori, the type of sensory modality (auditory/visual) involved in processing the target, the amount of data to be transferred or stored, the volume of data to be displayed (e.g. number of words).
The hierarchical organization of the tasks allowed us to describe the types of information seeking task more precisely. For each type of task, we have been able to evaluate the effect of each of the variables and the associated level of performance. Finally, we wish to test the hypothesis which holds that the more difficult a task is, the less suitable it is for a communications object which does not itself offer a high level of usability (for example: the more difficult an information seeking task is, the less

suitable it is for a mobile telephone). In a second stage, this should permit us to describe the set of tasks that can be performed using each type of communications object.

It is important to fix the limits of validity of our (present and future) results as well as of our approach. Our hierarchical organization was developed within a precise context (limited time, information retrieval restricted to reading on screen) and the tasks that the subjects were asked to perform had the sole aim of enabling them to answer a question. However, Internet applications are more varied than this. For example, Bernstein [BERNSTEIN, 1993] distinguishes between three types of hypermedia application, namely information "mining", "manufacturing" and "farming". Information "mining" searches involve an attempt to extract information. In this type of task, the relevant information *is a valuable resource which has to be extracted effectively and refined*. Information "manufacturing" searches are searches which make it possible to design or draft a document. This type of information search *conceives of the acquisition, refinement, assembly and maintenance of information as an ongoing endeavour*. Information "farming" *conceives of the "tending" of information as a continuous, cooperative activity conducted by groups of individuals working together in order to accomplish changing individual and communal objectives*. Bernstein notes that the appraisal criteria used in these three activities are radically different and that any attempt to perform an activity in a system which has not been designed for this purpose is doomed to failure. Given Bernstein's categorization, we may imagine that our hierarchical organization is relevant for one defined type of application, namely information "mining" and, consequently, is unsuited for the evaluation of "manufacturing" or "farming" type tasks.

6. Conclusion

We have provided a model of the objective characteristics of information seeking tasks. This model permits a precise definition of the objective variables that may play a role during an information seeking task, the hypothetical effect of each of these variables and a hypothetical hierarchical organization of these effects. These characteristics also permit us to assess the different information seeking tasks that can be performed in terms of their information search performance. These results clearly deserve validation in a better controlled experiment with larger groups of subjects who are more representative of the user population and which would permit the statistical processing of the information. We therefore intend to conduct a meta-analysis of the empirical results available in this field in order to verify whether they bear out our hypothesis
However, this model only takes account of one dimension of task description and ignores the user's model and the context within which the activity is performed, i.e. two considerations that play a role during an information seeking task.
Furthermore, when developing our protocol, we assigned binary values to our variables. It would be interesting to design an alternative hierarchical organization with more than two mode values for each variable. Such an organization would enable us to provide an even more precise description of information seeking tasks and consequently formulate more precise hypotheses concerning the characteristics which might indicate the cases in which an adaptive interface would be useful or even cases in which a given

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communications object (mobile phone, PDA, laptop etc.) permits an effective information search using a particular protocol (Web, Wap).

However, our model does seem to provide a relevant description on "information mining" tasks. It can therefore provide us with a framework enabling a comparison of search tasks performed using different communications objects. Our aim is to design a new experiment in which we intend to compare search tasks based on different media. These search tasks will be developed on the basis of our classification while bearing in mind that we will probably need to assign more than two values to our variables. This experiment will permit us to identify the respective capabilities of the various communications objects and the usefulness of adaptive interfaces.

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Glossary

Adaptive interface: interface which adapts automatically to the user's habits

Information farming: continuous, cooperative information collection activity conducted by groups of individuals working together in order to accomplish changing individual and communal objectives.

Information manufacturing: activity of exploiting information including the acquisition, processing, assembly and maintenance of information

Information mining: information extraction activity in which the target is a valuable resource which has to be extracted effectively and refined

Portal: Web site whose main function is to provide access to other Web sites

Recall: number of targets accessed by the subject divided by the number of existing targets

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Precision: number of targets accessed by the subject divided by the number of pages opened by the subject
Target: relevant document, reference or piece of information.
Task: goal to be achieved in a given environment by means of (physical) actions or (mental) operations with or without the use of tools
Wap (Wireless Access Protocol): protocol for accessing information networks via mobile telephones or personal assistants (PDAs)
Web (World Wide Web): protocol for accessing the Internet information network which makes it possible to establish links between data stored on remote computers

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