Searching the World Wide Web Made Easy? The Cognitive Load Imposed by Query Refinement Mechanisms

Simon Dennis (s.dennis@psy.uq.edu.au)
School of Psychology; University of Queensland
Brisbane, 4072, Australia

Robert McArthur (mcarthur@fit.qut.edu.au)
School of Information Systems, Queensland University of Technology
GPO Box 2434, Brisbane, 4001, Australia

Peter Bruza (bruza@icis.qut.edu.au)
School of Information Systems, Queensland University of Technology
GPO Box 2434, Brisbane, 4001, Australia

Abstract

This article addresses the effectiveness of search reformulation using query refinement mechanisms on the Internet. Cognitive load was measured using a secondary digit-monitoring task. The load was found to be lower when using the refinement mechanisms than when perusing document summaries - suggesting that the development of refinement mechanisms can make Internet searching easier. Two refinement mechanisms, one based on statistical term co-occurrence and the other on a shallow natural language parsing technique were tested. No difference in load was found, possibly because of the limited time that subjects spent in the refinement process.

Introduction

Short queries on the WWW result in large, imprecise result sets. If longer queries could be elicited from the user, then the precision in the retrieval could be improved. For this reason a number of query formulation aids have appeared in conjunction with web-based search engines. For example, the Excite search engine produces lists of keywords that the user can use to make the initial query more specific. Similarly, the Hyper Index Browser[1] (HIB) provides the user with a list of phrases that include the initial query terms and that can be used in subsequent calls to the retrieval engine.

The challenge for query refinement mechanisms is to provide an interface to the search space that makes searching easy and productive for the user through the careful selection of information to present. In this abstract, we address two key issues.

Firstly, what are the merits of remaining in the refinement processes rather than perusing document summaries? The commitment to query refinement mechanisms hinges on the assumption that it is easier and more productive for users to process the refinements than to peruse a list of document summaries. Perhaps, however, there is no substantive difference between refinement and summary processing and the query refinement mechanisms are unlikely to lead to more effective search.

Secondly, how should a refinement mechanism choose candidate refinements for the users perusal? Excite produces candidate keywords for query refinement using term co-occurrence statistics. The refinements selected are words that tend to occur with the target terms. By contrast, the Hyper Index Browser (HIB) selects phrases that contain the initial query. For example, if the query is "Internet", refinements like "Internet security", or "guide for Internet" are presented. The second question we address is whether the statistical or linguistic approach to refinement generation leads to more effective search.

To test these hypotheses cognitive load was measured using a secondary digit-monitoring task while subjects were engaged in a search task. The dependent variables were the time taken to respond to repeated digits and the number of misses.

Results and Discussion

No difference was found between the HIB (M=1867 milliseconds) and Excite (M=1800 milliseconds) refinement reaction times $F(1, 39)= 0.029$, $p=0.865$. Nor was there a difference between the reaction times as a function of refinement (M=1823 milliseconds) versus summary state (M=1885 milliseconds) $F(1,186)= 0.059$, $p=0.808$. The miss rate was calculated as the number of misses divided by the total number of double digits played (the number of hits plus the number of misses). Using the Wilcoxon matched-pairs signed ranks test there was a significant difference between the miss rate during the refinement state and the summary state ($T=3$, $p < 0.05$).

This abstract makes two main contributions. Firstly, the current results suggest refinement mechanisms do reduce the cognitive load experienced by the user.

Secondly, we have demonstrated the use of dual task methodology in the assessment of refinement mechanisms. The digit-monitoring task has been shown to be appropriate as a secondary task and both reaction time and miss rate are sensitive to load variations while conducting internet search tasks.

[1] http://www.dstc.edu.au/cgi-bin/RDU/hib/hib