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**Natural Language for Database Queries:
A Laboratory Study***

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ABSTRACT

Technical feasibility and promise of practical use for querying databases in natural language (for example, English) has been demonstrated by a large number of experimental systems, and the commercial availability of at least one such system. Yet natural language continues to be the most controversial among the language interfaces that have been proposed for direct interaction with databases. Most Natural Language Query Systems (NLQS) have focused on a certain class of users - application specialists not required to possess technical skills - and have emphasized easy transportability to a variety of application domains. Based on these principles, and considering the limitations of state-of-the-art natural language processing, these NLQS have adopted particular design structures and goals. Are these query systems meeting their design goals? More importantly, are these the "appropriate" goals? These seem to be the major questions for which no conclusive answers have yet been given.

Most experimental research in the area has addressed the first question. Field studies alone are often hampered by implementation limitations, and of course, by the lack of a controlled environment. Thus, a negative answer to the first question, as is usually the case with prototype systems, makes the determination of an answer for the second question very difficult.

A recently completed study at New York University constitutes a step toward resolving some of the issues pertaining to the use of natural language for database queries. The overall approach involves a combination of exploratory field evaluations with controlled laboratory studies to examine these issues by comparing performance between subjects using

*This work was carried out as part of a joint study being conducted with the IBM Information Systems Group in White Plains, N.Y. This paper is forthcoming in the MIS Quarterly, Volume 7, Number 4, December 1983.

the formal database language SQL and subjects using a prototype natural language query system (NLQS) developed in the IBM Heidelberg Scientific Center. This paper describes in detail a laboratory study which was conducted as part of the project. In the laboratory study, paid subjects were trained in the application and the respective languages (SQL and NLQS) and then given an exam.

Results

No difference in subject performance was found on the basis of language type (SQL and NLQS). In addition, there were few significant differences in performance for individual questions and overall subjects favored no language in particular. On the other hand, a group of NLQS subjects with no prior language training performed very poorly in the exam. These subjects tended to answer questions by describing algorithmic procedures, rather than directly querying the database. The need for training to use natural language query systems, which are quite demanding in restrictions, may be a major reason why NLQS subjects did not perform better than SQL subjects.

Even after NLQS training, the subjects had a strong tendency to write non-grammatical answers, an indication that natural language systems should be very flexible in accepting English requests.

SQL subjects took significantly longer to answer questions than did NLQS subjects, and were consistently more verbose (there were more words used in SQL than in NLQS for all queries).

In addition to testing hypotheses about the performance of the two languages (NLQS and SQL), this laboratory study allowed for the investigation of other fundamental research questions. These questions address the design goals and structure of natural language systems. Word usage in particular is very important for the design of an NLQS and for the development of NLQS applications. NLQS provide a set of application independent words as a core. It is the responsibility of application developers to add the words that pertain to a particular application. For these two phases of creating the lexicon some guidance is needed.

The results here were positive. It seems possible to impose a fairly small vocabulary in such systems, since subjects did not use very many words and tended to use some common words very frequently. Also, after training, subjects used similar strategies in answering questions.

The laboratory study results supported all tested hypotheses. The study also explored some fundamental research

questions, and we believe the results offer some evidence for the feasibility of using natural language for database queries with a restricted vocabulary.