MAGNITUDE FEEDBACK DURING DATABASE SEARCHING

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Abstract

This paper reports initial results from a study of magnitude feedback during database searching, including: (1) the frequency of magnitude feedback occurrences during 40 mediated database searches, (2) the user and search intermediary magnitude feedback behavior, and (3) the number of postings which leads to the completion of a cycle and the display of retrieved items. Feedback has been identified as an important but little researched element of database searching (Spink, 1993a). Results indicate that magnitude feedback occurred frequently during the mediated database searches with different patterns of magnitude feedback behavior by users and search intermediaries.

Introduction

This paper reports selected results from an ongoing exploratory study investigating the history, types and human aspects of feedback during database searching (Spink, 1993a, b). Feedback has been an important yet under researched area and a major determinant in database searching affecting search strategy (Saracevic, Mokros & Su, 1990; Spink, 1993a, b). Reported here are initial findings concerning magnitude feedback behavior, or feedback behavior based on the number of posting retrieved with a search statement (or statements) during 40 mediated database searches.

Boolean retrieval systems are based on an inverted file structure which provides the user with a numerical output (postings) corresponding to the number of items which contain the user's search terms. Research studies have shown that one of the major problems users' experience when using a boolean retrieval system to search large bibliographic or full-text databases or online public access catalogs is the often large number of postings they retrieve (Bates, 1984; Blair, 1980; Fidel, 1985; Larson, 1991; Meadow, 1992; Oldroyd & Citreon, 1977; Saracevic, Mokros and Su, 1990; Shute, 1989; Wiberley & Daugherty, 1988; Wood, Ford & Walsh, 1994). Studies exploring the use of postings information and users' magnitude criteria are a growing area of research with implications for information retrieval system design (Barbuto & Cevaltos, 1991; Wallace, 1993; Weinberg & Cunningham, 1983; Wood, Ford & Walsh, 1994).

The problems of magnitude to some extent pre-date and have provided impetus for research examining users' relevance criteria to become a major area of information retrieval research. Often users' must deal with magnitude criteria before the display of items allows any relevance judgements. One can speculate on the number of searches that have been abandon by users due to their inability to deal with large numbers of postings.

The problems of magnitude have also long been recognized by information retrieval system designers, who have developed a number of automatic retrieval techniques, in an attempt to overcome the problems of large postings and provide a smaller set of items to the user based on differing relevance criteria. These retrieval techniques, including ranked systems (Lee, Kim & Lee, 1994; Salton, 1968; Wong & Lee, 1993) and relevance feedback techniques (Blair, 1990; Salton, 1971; Salton & Buckley, 1990), are based on the assumption that users will often retrieve more items than they can reasonably be expected to judge for relevance, and so methods are used to sort the items automatically based on a pre-determined relevance criteria. This is not a totally automatic process, as the user must initiate a ranking method or relevance feedback technique. In other words the user must decide the number of postings they wish to sort, and these techniques may be utilized throughout the database search.

This paper explores the occurrence of magnitude feedback or feedback based on the number of postings retrieved with a search statement (or statements) during

database searching. The concept of magnitude feedback refers to the user process of ascribing meaning to the size of the postings of an information retrieval system as an impetus to the modification of search strategy.

Research into individual differences and traits during database searching has been an important area of research in information retrieval (Saracevic, 1991), but little research has focused on the role of interactional variables such as feedback. This study is representative of a shift towards the examination of human interactional variables, such as feedback behavior and also users' magnitude criteria which may provide new insights into individual differences in database searching behavior and suggestions for improved information retrieval system design.

Research Questions

Specific questions examined were: What was the frequency of magnitude feedback occurrences during the 40 mediated database searching?, Who utilized magnitude feedback: Users or search intermediaries? and: What was the number of postings which leads to the completion of a cycle and the display of retrieved items? The third research questions relates to the size of the size of the number of postings which triggered a shift from a searching mode to a browsing mode, or the display of retrieved items.

Research Design

Data Collection

Data utilized in this study was collected during a pioneering study of mediated database searching, reported in part elsewhere (Saracevic, et al., 1991). Forty users with real requests were videotaped participating in a pre-online interview and online interactive search on DIALOG conducted by a professional search intermediary. All forty user-intermediary dialogue transcripts, the videotapes and the database searching logs with user relevance judgements were analyzed during the current study. The study reported in this paper follows analysis reported previously (Spink, 1993a, b).

Methodology

The exploratory micro-analysis utilized an inductive grounded theory methodology (Strauss & Corbin, 1990), or theory-generating methodology rather than a theory testing orientation. Resulting theories provide generalizations grounded in the data and provided preliminary operationalizations of concepts based on the feedback occurrences.

Magnitude Feedback Unit of Analysis

Magnitude feedback occurrences were identified through a detailed micro-analysis of the forty online search logs, in conjunction with the videotapes and transcripts of the discourse between user and search intermediary during each database searching interaction. Each user and search intermediary utterance related to the

size of the number of postings was transcribed onto the related section of the database search log showing the number of postings, i.e., utterances directly repeating or quoting the size of the postings or making a direct comment interpreting the size of the number of postings.

Data was collected on the number and sequences of magnitude feedback occurrences, and whether they were user or search intermediary initiated. User and/or search intermediary utterances were often related to the preceding output, however at times they relate to the context of the previous actions as a whole. In other words, when it comes to utterances, the process is not linear, but contextual. Operational examples of a magnitude feedback occurrences are provided in the results section of this paper.

Cycle Analysis

To further examine the question of the role of magnitude additional analysis was conducted to determine if the number of postings was reduced, increased or accepted during each cycle: (1) Determine the number of cycles in each online search, and (2) Examine each cycle in each of the 40 database searches to identify types of cycles, based on the function of each cycle..

After the display of the number of postings retrieved, either new search terms may be entered to modify the number of postings or a decision is made to display or print all or part of the retrieved items. This section of a database search, from the beginning of a search command to a type command has been called a cycle

(Fenichel, 1980).

A number of research studies have examined cycles during the database searching process (Chapman, 1981; Fenichel, 1981; Penniman, 1975). Saracevic, Kantor, Chamis and Trivison (1988) found that, the number of cycles had no significant effect on search outcome and a high number (above mean) number of cycles increased relevance odds by a factor of 1.18.

Results

Magnitude Feedback Occurrences

Table 1 shows that there were 396 magnitude feedback occurrences during the 40 database searches, with a mean of 9.9 per search and range of 3 - 27 feedback occurrences. Magnitude feedback occurrences represented 45% of the 885 total feedback occurrences and was found to occur during each of the 40 online interactions. This paper focuses on the nature and occurrences of magnitude feedback, a more detailed analysis of the types and frequency of all the feedback types identified in Spink (1993a, b).

Detailed below are two examples of magnitude feedback occurrences (U = User & I = Search Intermediary).

Magnitude Feedback Example 1: Search 2

The results of the search on the word "classroom communication" produced 2028 items.

SS Classroom Communication

S28 2028 Classroom Communication

I: Let's try that first. That maybe it is classroom communication

let's see how big a term it is two thousand okay let's try restricting.

U: Classroom communication and recitation.

The search intermediary suggests restricting the search and user suggests that this may be accomplished by a combination of the terms "classroom communication" and recitation.

Magnitude Feedback Example 2: Search 2

The results of the search on the search statement 56 produced 119 items.

SS56 (S55 or Discussion()Groups) and (S28 or S39)

S57 119 (S55 or Discussion()Groups) and (S28 or S39)

I: This hundred and....now that's for fifty years is it okay?

U: Yeah like the last five years.

The user and search intermediary then decide to reduce the number of items by limiting the output to the last five years.

Table 2 provides a summary of feedback types shows the number of magnitude feedback occurrences as positively skewed towards the lower frequencies.

Magnitude Feedback Occurrences: User - Search Intermediary

Table 3 shows the frequency of magnitude feedback occurrences by users and intermediaries during each mediated search. During the data collection 43

database searches were collected, but due to technical difficulties three searches (numbers 3, 13 and 23) were not used.

Table 3 also shows a total of 322 (81%) or approximately 4 out of 5 magnitude feedback occurrences were by search intermediaries and 74 (19%) or 1 out of 5 were by users. Search intermediaries were more attuned to the problems of large or small numbers of postings than users during the database searching process, with intermediary magnitude feedback occurrences in all 40 searches. User magnitude feedback occurred in 27 of the 40 database searches.

Cycles Analysis

What is the number of postings which lead to the completion of a cycle and the display of retrieved items? The aim of the analysis was to: (1) determine the number of cycles in each database search (Table 4), (2) examine each cycle in each of the 40 database searches to identify types of cycles, based on the function of each cycle (Table 5 & 6), and (3) determine the number and range of postings which preceded the first type command during a cycle; and determine the mean size of the postings which preceded the first type command during a cycle (Table 7).

Number of Cycles

To determine the number of cycles in each database search, the commands utilized in each were first examined to identify the beginning and completion of a cycle.

Table 4 provides a summary of the number and types of commands utilized during the 40 database searches. The total of 1591 (91%) of the commands were select and type commands.

Table 5 shows the summary of the cycles per search with a total of 306 cycles during the 40 database searches, with a mean of 7.55 per search and range of 2-22.

Types of Cycles

Each cycle was classified into three types: (1) Postings Reduction Cycle - reduction of postings during the cycle using the addition, deletion or combining of search terms, (2) Postings Increase Cycle - increase in postings during the cycle, and (3) Non-Modification of Postings Cycle - number of postings is accepted without modification and retrieved items are displayed.

Table 6 details the number of cycles of each type in each of the 40 database searches, showing a total of 306 cycles; 217 (71%) reduce postings cycles, 78 (25%) non-modification cycles and 11 (4%) increase postings cycles. The number of postings was reduced during a large proportion (71%) of the cycles during the 40 database searches. This corresponds with the large proportion of magnitude feedbacks (396) concerned with reduction in the number of postings during the 40 database searches representing 45% of the total feedback occurrences.

As shown in Table 3, the intermediary in particular (in consultation with the user) was concerned with the magnitude of the number of postings. A casual

analysis of the dialogue between user and search intermediary reveals a concern in most cases with reducing the number postings and less with accepting or increasing the number of postings. This whole issue, dealing with qualitative decisions has not been systematically explored here, however, impressions are reported wherever appropriate (and characterized as such) in order to shed further light on the process and propose hypotheses.

Number of Postings Which Preceded the First Type Command During a Cycle

This analysis looks only at the number of postings at the FIRST type commands, even if there were more type commands following before another search command. Each cycle was analyzed to determine: (1) number os postings which preceded the first type command, (2) range of postings which preceded the first type command, and (3) mean number of the postings which preceded the first type command.

Table 7 shows that the mean number of postings retrieved during the 40 database searches which initiated the first type command of a cycle was 123 postings (range 1 - 17626), but with the outlier scores from Search 40 and Search 42 removed the number is reduced to 69 postings. Also despite the often large number of postings in many searches, there were 14 (35%) where the number of postings did not exceed 30 in any cycle.

Discussion

As end-users increasingly access large bibliographic and full-text databases to find relevant documents, in many cases before they can start to make relevance judgements they have to make magnitude judgements. The users and intermediaries in this research study were frequently confronted with magnitude judgements due to large postings, to the extent that a major determinant and pre-occupation during the searches was how to reduce the number of postings. At a certain point, what Blair (1990) calls the user's "futility point" in this reduction exercise, they decided to display the smaller set of retrieved items.

Saracevic, Mokros and Su (1990) suggested that 150 items was the approximately the number of items which triggered a change for searching to the display of retrieved items. My data analysis indicated that the mean number of postings was 123 at the first type command (if the two outlier scores are removed, the mean is reduced to 69). This study also differs from other studies investigating postings information (Barbuto & Cevàltos, 1991; Wallace, 1993; Wood, Ford & Walsh, 1994) which reported lower postings thresholds, as the 40 mediated searches were conducted for faculty and graduate students with often complex subject searches.

A cursory examination of the pre-online discussion between the users and intermediaries also revealed that intermediaries often discussed the likelihood of large postings with the user before the database interaction. This anticipation of

large postings led to the development of contingency plans (such as language or date limitations) to be utilized during the database search.

A recent study by Wood, Ford and Walsh (1994) also indicated that postings' information was used by end-users in order to narrow their search results. They also point to the importance of training end-users in the value of postings information, but further suggest that we know little about how postings information should be used at different stages of the database searching process.

Further research is needed exploring the criteria on which users' magnitude judgements or futility points are based: situational, problem based, information seeking stage, previous domain knowledge, knowledge of the literature, user persistence in scanning items (Wiberley, et al., 1990)? Also how important are magnitude judgements as opposed to relevance judgements in the search process? Magnitude criteria research has implications for the future development of information retrieval systems and end user training.

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Table 1 Summary of Feedback Types and Occurrences

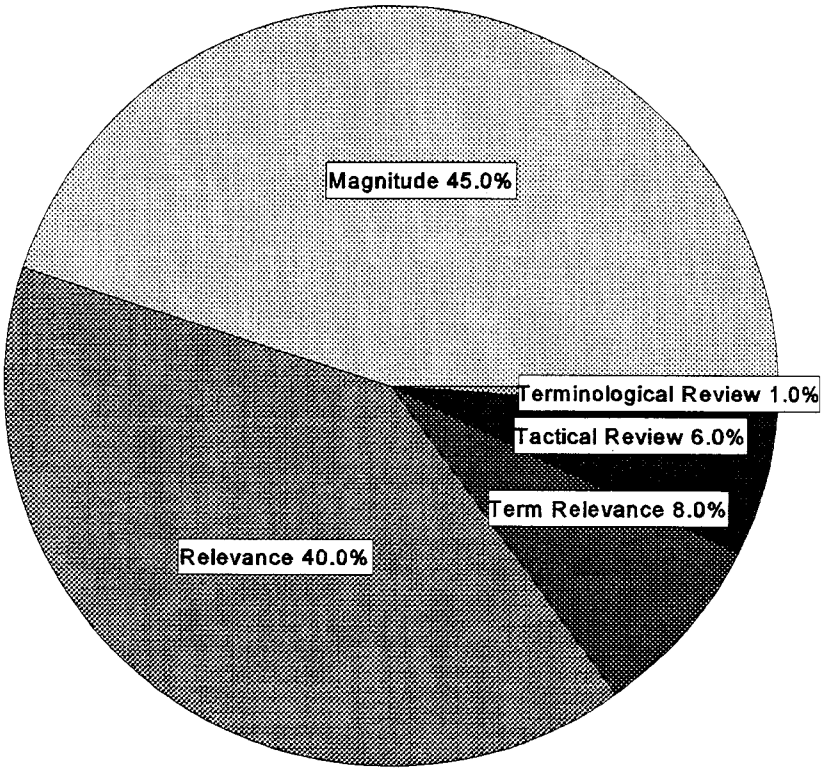

Table 2. Summary of Magnitude Feedback Occurrences

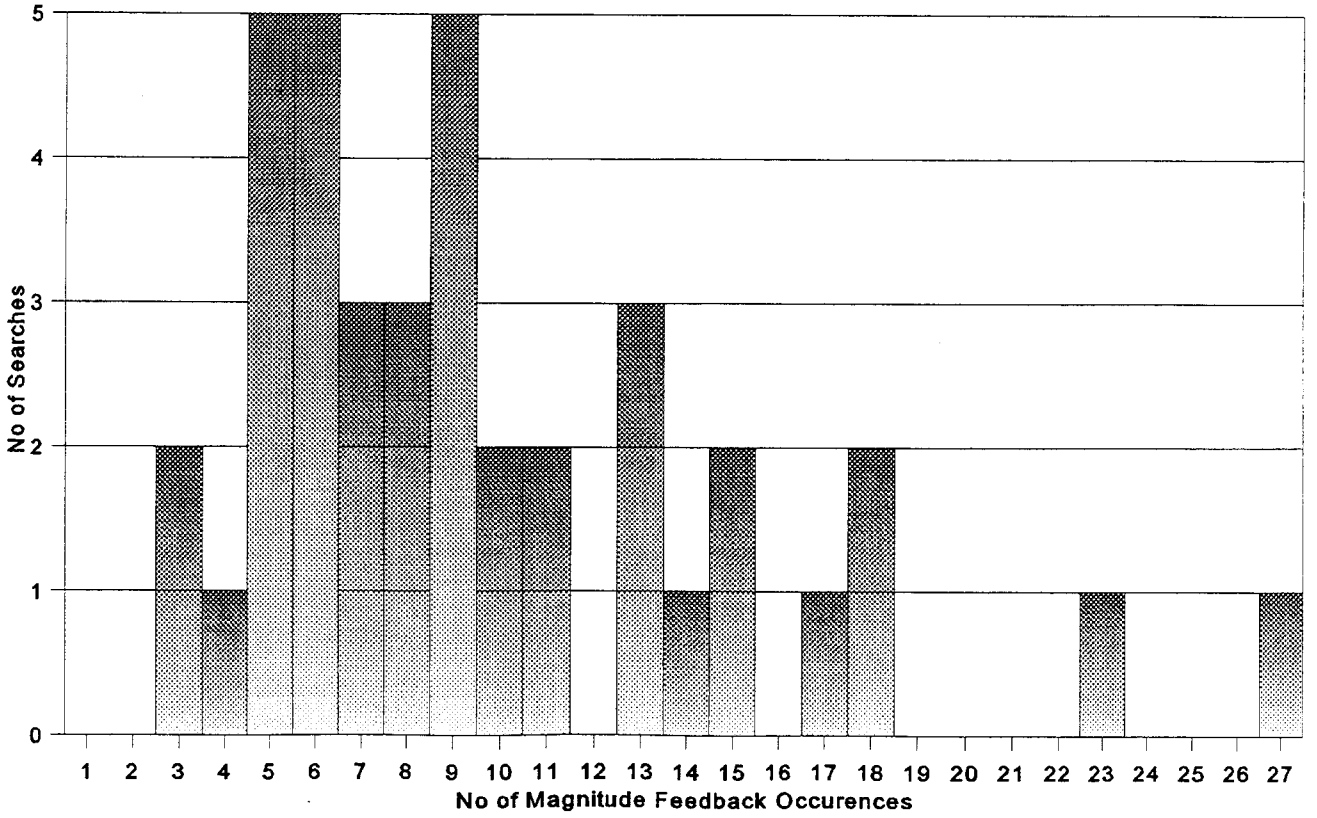

Table 3. Magnitude Feedback Utilized by Users and Search Intermediaries

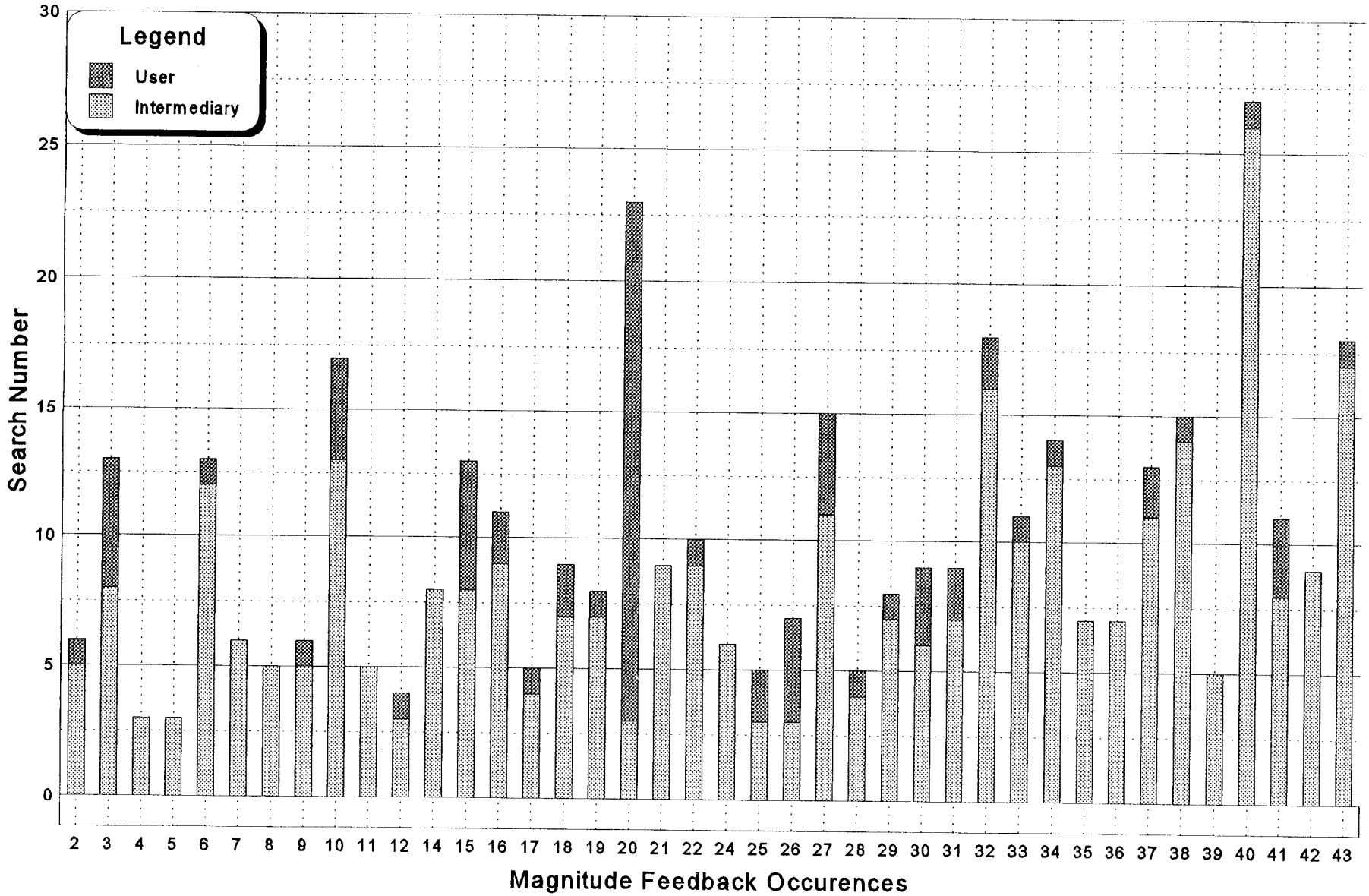

Table 4 Summary of Command Analysis

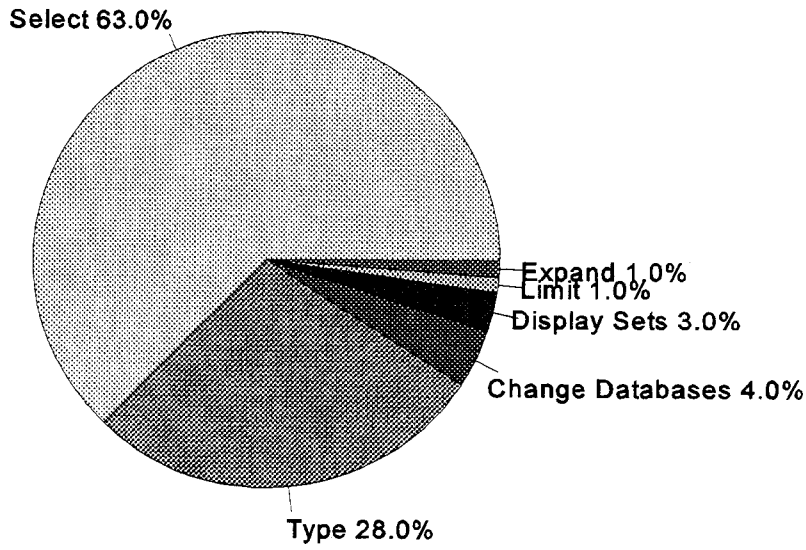

Table 5. Summary of Cycles per Search

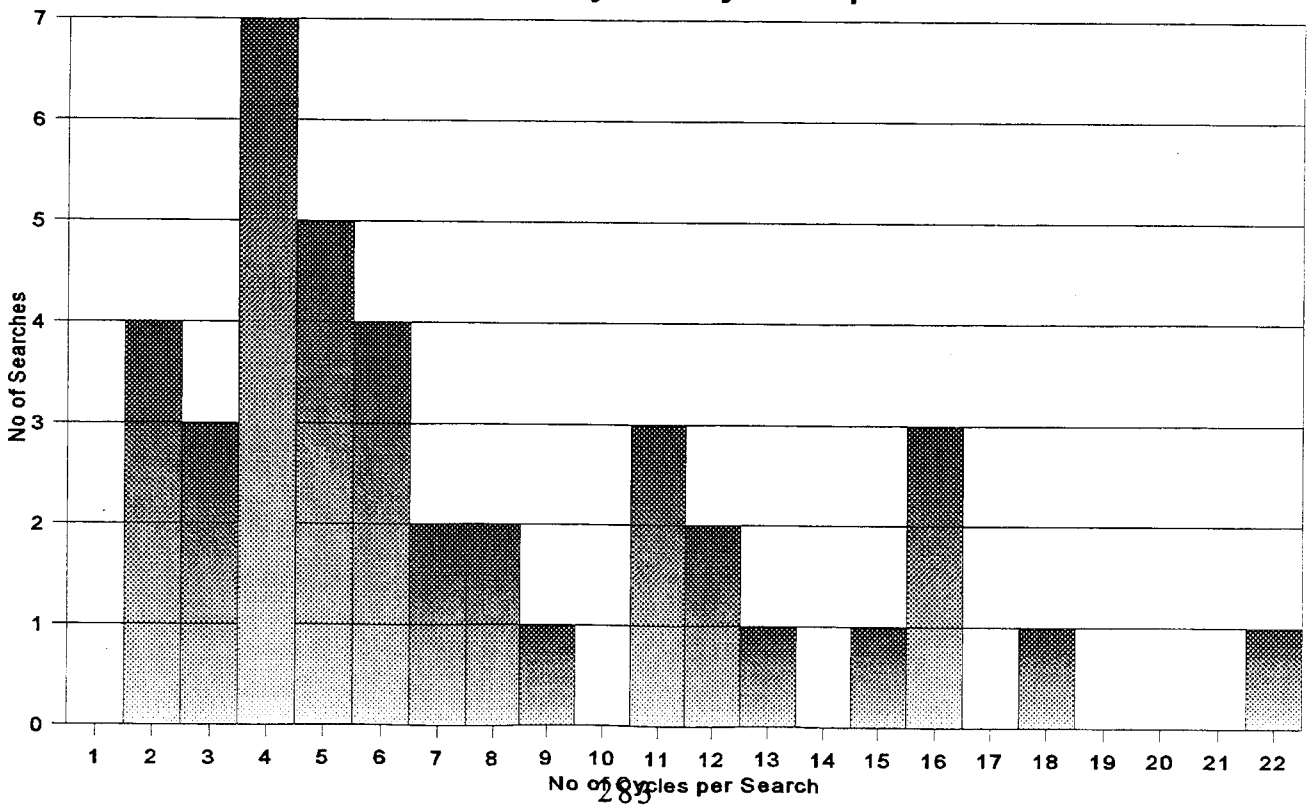

Table 6 Types of Cycles

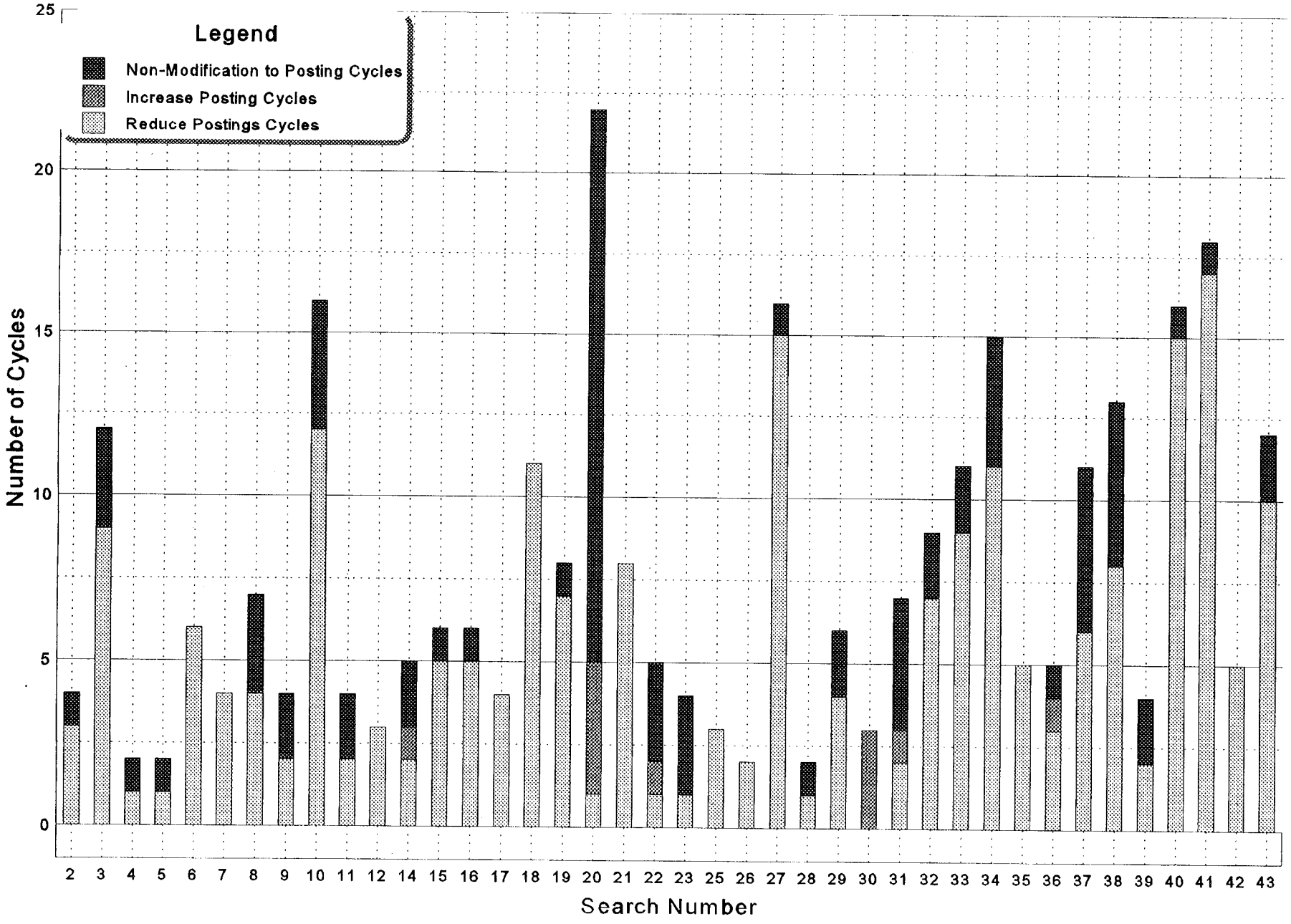

Table 7. Mean number of postings at first type command.

Search Number	No. First Type Command	Range of Postings Min	Max	Mean Number Postings
2	4	7	344	150
3	12	3	200	34
4	2	14	33	23
5	2	4	127	75
6	6	10	189	73
7	4	2	294	77
8	7	1	65	18
9	4	1	83	29
10	16	1	242	30
11	4	10	45	32
12	3	21	125	88
14	5	27	72	41
15	6	1	13	5
16	6	1	91	31
17	4	5	22	14
18	11	3	233	67
19	8	9	60	25
20	22	1	140	16
21	8	5	573	154
22	5	48	174	144

Table 7. (continued)

Search Number	No. First Type Command	Range of Postings Min	Max	Mean Number Postings
24	4	31	252	94
25	3	44	127	73
26	2	2	84	52
27	16	1	146	27
28	2	18	71	47
29	6	3	112	48
30	3	1	6	2.6
31	7	1	68	21
32	9	2	98	50
33	11	2	394	80
34	15	3	487	93
35	5	27	140	80
36	5	3	73	29
37	11	1	194	27
38	13	1	2086	209
39	4	62	187	118
40	16	9	17626	1243
41	18	1	5574	441
42	5	2	5588	1047
43	12	2	77	23
Total	307			Mean = 123