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When Search Engines "Speak" Your Language: The Role of Communication Accommodation Theory in Personalized Systems

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ABSTRACT

Communication Accommodation Theory contends that speakers alter their communicative style to converge toward addressees to win approval and facilitate efficient communication. However, we know little about accommodation in computer-mediated text-based environments. In a lab experiment involving product search and choice tasks, users evaluated accommodating search engines that presented them with product search results containing familiar terms, defined as the user's search term for the products, and non-accommodating search engines that used less familiar, synonymous terms. Results showed that overall, users tend to choose products at the top of the results list, thus suggesting a relationship between serial position and choice. However, when results contained familiar and unfamiliar terms, users were more likely to choose products at the bottom of the list that contained their familiar term, thus reducing the effect of serial position. Included are managerial implications for personalization systems, product retrieval, and query expanded search result presentations.

Keywords

Communication Accommodation Theory, personalization systems, human computer interaction, search engines

INTRODUCTION

Determining how to better deliver adaptive web-based content to provide personally relevant information to users represents an important area within Information Retrieval (IR) and Human Computer Interaction (HCI) research. However, due to the variety and complexity of user needs and preferences, determining the optimal approach has often proved to be difficult (Gauch, Wang and Rachakonda, 1999).

Personalization and customization represent two techniques that attempt to accomplish this. Although the current study's focus is personalization, it is useful to differentiate between customization and personalization due to confusion surrounding the meanings of these concepts. In customization, "…consumers have the ability to alter or even create products that contain precisely those attributes that the individual consumer specifies (Godek, 2002, p. 155)." The user actively determines the look and feel of the system (Russel, 2003). In personalization, "… firms directly elicit or indirectly infer consumer preferences and then identify which of the firm's existing products provides the best fit for these preferences (Godek, 2002, p. 155)." In an information systems context, the system adapts to accommodate users based on their past behavior (Russel, 2003). Recently, there has been increased interest in research on user interface design and enabling technologies associated with personalization (Riecken, 2000). This study will extend personalization research by introducing Communication Accommodation Theory (CAT) from sociolinguistics as a theoretical framework for understanding user choice behavior and approval with a search engine that utilizes a personalization technique to adapt search result set terms to those familiar to the user.

THE SEARCH PROCESS AND "THE VOCABULARY PROBLEM"

Longer queries lead to better search performance because more search terms match those in documents; however, typical user queries are only a two to three words long (Spink, Wolfram, Jansen, and Saracevic, 2001) and contribute to poor performance (Belkin, Cool, Kelly, Kim, Kim, Lee, Muresan, Tang, and Yuan, 2003). Furnas, Landauer, Gomez and Dumais (1987) refer

to this term mismatch in the information systems literature as the "vocabulary problem," define it as the lack of agreement between two parties regarding word preferences used to describe something and note that there would be no problem if we all used the same words to describe the same object.

Various methods of query expansion that add terms to the user's original query have been used to solve this vocabulary problem with increasing success. Efthimiadis (1996) categorizes the major methods as manual, automatic and interactive. Both automatic and interactive query expansion can be based initial search results, as in the case of adding *n* terms from the first *n* documents retrieved where top ranked documents are assumed the most relevant (Xu and Croft, 1996), or based on knowledge structures that are either collection dependent or independent (Efthimiadis, 1996). Collection or corpus dependent query expansion usually utilizes term clustering (Efthimiadis, 1996), constructing thesauri automatically (Qui and Frei, 1993), or latent semantic indexing (Gauch et al., 1999). Term clustering involves "clustering single index terms together (using different techniques) before the user [submits] a query by constructing a similarity matrix of terms (Efthimiadis, 1996, p.25)." This matrix then is used to identify groups of similar terms based on cluster type definitions. Automatic thesauri collect terms together by how often they occur together in a collection of documents (Gauch et al., 1999). In latent semantic indexing, terms and documents are thought of as vectors in a latent semantic space. Latent semantic indexing reduces that space or reduces the number of terms and documents based on semantic factors (Deerwester, Dumais, Furnas, Landauer and Harshman, 1990). Collection independent methods of query expansion involves using such electronic sources as general thesauri, other lexicons or dictionaries, or WordNet, which is a database of lexical relations. Interactive query expansion involves users interacting with the system by providing feedback regarding the relevance of documents in relation to their original query (Shneiderman, Byrd and Croft, 2003). This user feedback is referred to as relevance feedback. This method has been shown to improve performance significantly (Harmon, 1992).

While query expansion methods increase the number of relevant results, the vocabulary problem still presents problems. How do we know users are familiar enough with the newly added synonymous terms to realize they are relevant? Are we creating another vocabulary problem with query-expanded results in which users see different words that name the same object? For example, on eBay, a 10-12 inch stainless steel pan is referred to by the following different words: *skillet*, *sauté pan*, *omlet pan*, *omlette pan*, *omelet pan*, *frypan*, *fry pan*, and *frying pan* (www.ebay.com). If users receive all those products in a single result set, are they equally likely to click on them or more likely to click on links that include their familiar terms? How do these multiple terms affect their search behavior? In the next section, we will introduce CAT as a theoretical framework that offers an explanation for the effects of term familiarity on choice.

COMMUNICATION ACCOMMODATION THEORY

Communication Accommodation Theory (CAT) suggests that speakers adapt their speech toward that of the addressee in order to achieve specific goals, such as establishing an identity with members of a different cultural group (Rampton, 1995 in Wolfram and Schilling-Estes, 1998), or to seek approval and increase communicative efficiency (Giles, Coupland and Coupland, 1991). This type of adaptive communication in linguistic literature is known as style shifting. Previous research by Giles, Taylor and Bourhis (1973, in Giles, et al., 1991) empirically demonstrates that the more a person attempts convergence with another person, the more favorably that person is evaluated. This was evidenced in cases where English-speaking Canadians attempted to communicate with French-speaking Canadians. They found that English-speaking Canadians who made more of an effort at convergence (the more French they used in conversation) were evaluated more favorably.

Although CAT has been primarily used in studies examining verbal phenomena, previous research suggests that CAT can be used to explain phenomena in a written context such as email (Campbell and Bunz, 2002). In a study that asked one hundred and fifty-five subjects to match discourse fragments in an email message to adjectives such as appreciative, assertive, bold, enthusiastic, formal, and friendly, certain fragments in the email messages consistently were associated with certain tones when placed in different contexts (Campbell and Bunz, 2002).

Though little research has investigated the extent or effects of written style shifting in computer mediated environments, it is reasonable to expect that effects would be similar to those in a spoken language environment. This expectation is reasonable because text-based computer-mediated communication, from search engines to instant messaging, is interactive, much like spoken interaction.

MODEL AND HYPOTHESES
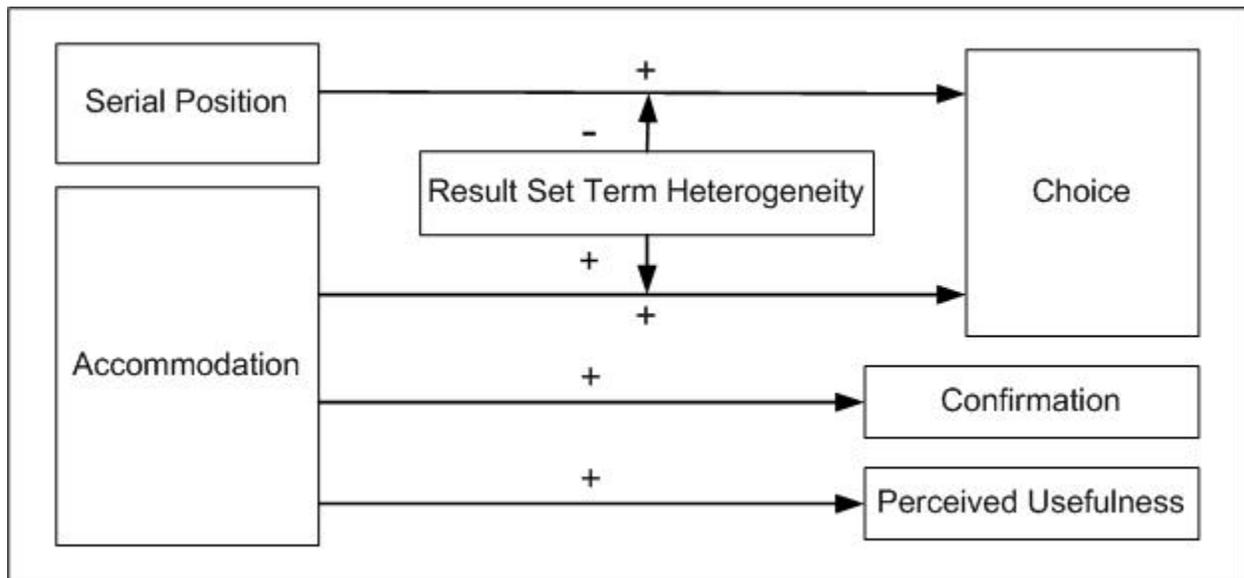
Figure 1. Theoretical Model of Accommodation in Search Engine Evaluation and Choice with Propositions[1]

The current study uses both a theoretical model (see Figure 1 shown above) and an operational model (see Figure 2 on next page). The theoretical model facilitates better understanding regarding how system accommodation affects search engine evaluation and result choice while the operational model (see Figure 2) enables the testing of specific hypotheses that relate to the propositions proposed in the theoretical model. In the theoretical model, serial position refers to rank of the result, that is, whether it appeared in first or second serial position. Result set term heterogeneity refers to whether the two items in the result set were the same or whether the product labels were different. Accommodation in the current study is operationalized as the inclusion in the result set of the user's familiar term for the product.

Recent research analyzing query logs associated with thousands of queries submitted to a major search engine shows that after users enter approximately two keywords, they rarely modify queries. Additionally users rarely look at more than the first ten results which suggests the importance of serial position (Jansen, 2000). In a more direct study of the effects of serial position, Hoque and Lohse (1999) found serial position has a significant effect on choice in online environments and suggested this occurs because it lowers search costs. Thus proposition 1 and 1a are given:

P1: There is a positive relationship between serial position of items in the search engine result set and choice.

P1a: The odds of a user choosing the product in the second serial position are lower in homogeneous sets of results than in heterogeneous sets.

CAT explains style shifting as a means of facilitating communicative efficiency (Giles et al., 1991). In addition, cognitive research shows it is faster and more efficient to identify identical words than synonyms in a result set (Tversky, 1979). This is particularly relevant in a product search encounter. Hoque and Lohse (1999) investigated product choice in three versions of telephone directory pages: two different online electronic versions and a print version. They found that people make choices that result in lower search costs. Thus proposition 2 and 2a are given:

P2: There is a positive relationship between the use of accommodation and choice.

P2a: Users tend to choose products described by terms they are familiar with more than terms they are less familiar with when the set of results contains heterogeneous results.

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[1] The six constructs in the model are distributed as follows: confirmation and perceived usefulness are taken from Bhattacherjee (2001); serial position and choice are taken from Hoque and Lohse (1999); and accommodation and result set term heterogeneity are defined by the current authors.

CAT also suggests that speakers shift their speech style in an effort to win approval from, or satisfy, the addressee (Giles et al., 1991). Though these results occurred in a speech environment, it is reasonable to expect similar effects in a text-based search environment because text-based computer-mediated communication, from search engines to instant messaging, is more interactive, much like spoken interaction. Additionally, previous research suggests that users may be more satisfied with a search service when they find what they want quickly because it may reduce cognitive effort (Peterson and Merino, 2003). In a study of online banking, Bhattacherjee (2001) found that users who are satisfied often continue using the online service. Bhattacherjee's model found confirmation, which is a direct measurement of the difference between users' expectations and the system performance, and perceived usefulness, from Davis' TAM model (1986 in Bhattacherjee, 2001) to be antecedents to system satisfaction. Thus propositions 3 and 4 are given:

P3: There is a positive relationship between an information system's use of accommodating communication techniques and user confirmation of the system.

P4: There is a positive relationship between an information system's use of accommodating communication techniques and perceived usefulness of the system.

From the theoretical model and propositions, the following operationalized model and testable hypotheses were derived (see Figure 2):
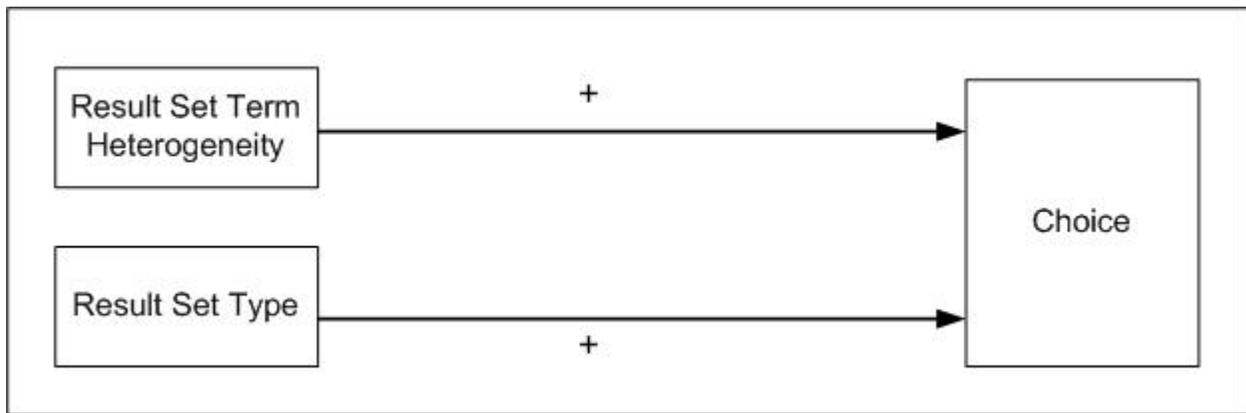

Figure 2. Operationalized Model of Accommodation in Search Engine Evaluation with Hypotheses

Hypothesis 1 relates to Proposition 1 and 1a such that in cases where results sets are homogeneous, we predict that users will choose the product in the first serial position more than when result sets are heterogeneous. Thus, hypothesis 1 is given:

H1: The probability of choosing a product link in lower serial position is higher in heterogeneous sets than in homogeneous sets.

In the operationalized model above, the construct "Result Set Type" refers to the makeup of the result set containing the two results returned by the search engine; it incorporates serial position, result set term heterogeneity and accommodation from the theoretical model. The four types of result sets are shown in Table 1.

Set	Template of Terms in Result Set	Result Set Term Heterogeneity	Accommodation	Is your familiar term in First Serial Position?	Is your familiar term in Second Serial Position?
Set A	Not My Word My Word	Heterogeneous	Accommodating	No	Yes
Set B	My Word	Heterogeneous	Accommodating	Yes	No

Set C	Not My Word My Word My Word	Homogeneous	Accommodating	Yes	Yes
Set D	Not My Word Not My Word	Homogeneous	Non-accommodating	No	No

Table 1. Four Result Set Types Shown to Users

Hypothesis 2 relates to Propositions 2 and 2a which suggested that users would choose their word more often in heterogeneous results sets. However, hypothesis 2 also incorporates aspects of serial position. Thus Hypothesis 2 is given:

H2: Compared to all other result set types, the odds of choosing the term in the second serial position of the result list are highest when both the user's familiar term appears only in the second serial position and when the set is heterogeneous.

METHOD

Procedure

Searching for a product is a natural, common occurrence for the participants in the current study. The 22 participants were from a Junior-level introductory Management Information Systems course at a medium-sized public university in the southern region of the United States and received extra credit for participation. The sample, which included MIS and non-MIS business majors, was comprised of 39 percent male and 61 percent female students.

The study used a between-subjects design, with random assignment of the accommodating or non-accommodating search engine items. Similar item images were used in both search engines (see Appendix 1). In both systems, participants were presented with a referent image. They then entered a search term for the referent in the search box and clicked the "SEARCH" button. The search term they entered is considered their familiar term. Both systems returned two results. In the non-accommodating system, the result set always included a pair of homogeneous items neither of which contained the user's familiar term. Thus, the two systems differed in the responses returned to the user. For example, if the user saw an image of a knit cap, and enters the word *toboggan*[2], the non-accommodating system might return two results, both for "new watch cap $7.99." The accommodating system, however, would always include the user's familiar term in the result set, either in the first result, the second result or both results. For example, if the user saw an image of a knit cap, and entered the word *toboggan*, the following three sets of results are possible: new toboggan $7.99, new watch cap $7.99; new watch cap $7.99, new toboggan $7.99; or new toboggan $7.99, new toboggan $7.99. In both systems, the participant clicked an option button titled "For More Info" which is analogous to clicking a link in a search result set list. The participant then clicked the "NEXT ITEM" button until 10 search tasks are completed (see Appendix 2 for software screenshots).

Instruments

Accommodation to the user was operationalized as a dichotomous independent variable indicating whether the search engine returned results that specifically contained the participant's familiar term. Familiarity was operationalized as the search term participants used to search for products in their query while all other terms not used by participants indicated lack of familiarity. Serial position was operationalized as a dichotomous independent variable coded 1 if the result was in the first position, at the top of the list, and 0 if the result was in the second position. Result set term heterogeneity was operationalized as a dichotomous independent variable with heterogeneity indicated by product descriptors in the result set being labeled with

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[2] A knit cap is often called a *toboggan* by south and south midland dialect speakers (personal conversation with Dictionary of Regional English Chief Editor Joan Hall, 2004), but not by northerners, who use *toboggan* to refer to a snow riding device. On eBay (accessed April 5, 2004), there were 68 *toboggans* for sale: 18 sleds; and 8 hats (five containing only *toboggan* in the title and referring to hats while three items containing *toboggan* and *hat* in the title) and 42 other results (toys, prints, etc). All water-related toboggan prints and hats show item locations to be in south and south midland states. Often, someone searching for a knit cap using the word *toboggan* will not get the same results as those searching with other terms, such as *knit cap*, nor is the person entering *knit cap* likely to see hats sold by sellers living in the south and south midland states. Results from our experiment show that, after the knit cap image prompt, the top two search terms were spelling variants of *toboggan*, with 9 responses (33.3%), and *beanie*, with 6 responses (22.2%).

different terms and homogeneity indicated by product descriptors in the result set being labeled with identical terms. Choice was operationalized as a dichotomous dependent variable coded 1 if the item in the second serial position was clicked and 0 if not. Thus, with a two-item result set, a choice of 0 indicated that the item in the first serial position choice was clicked.

DATA ANALYSIS AND RESULTS

The data set originally contained 20 search tasks for each of the 22 subjects for a total of 440 separate searches. However, there was a small malfunction in the software during the latter portion of the search tasks on the second search engine for the group that evaluated the accommodating search engine first. While evaluating the non-accommodating search engine, an image from the accommodating system and set of spurious results appeared on the eighth, ninth or tenth trials. Only choices prior to the malfunction were included in the analysis, for a total of 426 choices. The graph in Figure 3 shows the data for the 426 choices that participants made.

The last two types of result sets are homogeneous sets with products having the same name. Choices in homogeneous sets appear driven by serial position as 91percent of the choices were for links in the first serial position. On the other hand, serial position appears to play a lesser role in the first two types of result sets which are heterogeneous sets in which the users' terms appear once in either first or second serial position. In heterogeneous sets, only 65 percent of the choices for results in first serial position. In addition, term familiarity appears to play a larger role. When the users' terms appeared in the first position, users chose the first link 75 percent of the time, and when the users' terms appeared in second position, users selected the first link only 55 percent of the time (see Figure 3).
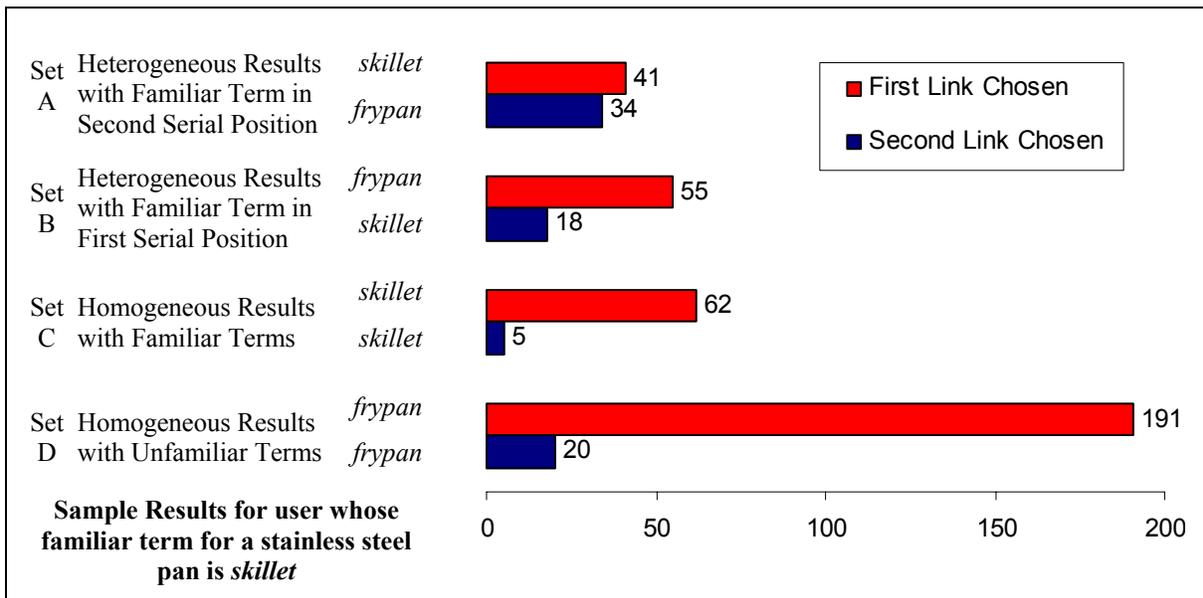

Figure 3. User Choice Data for 426 Choices For the Four Result Set Types

Logistic regression analysis was used to predict the probability that participants would choose the link in the second serial position given the result set term heterogeneity. The logistic regression coefficient, Wald test, and odds ratio for each of the predictor appear in Table 2 below.

Predictor	B	Wald χ^2	p	Odds Ratio
Result Set Term Heterogeneity	1.701	39.331	<.0001	5.482
Constant	-2.315	121.88	<.0001	.099

Table 2. Logistic Regression Predicting Choice From Result Set Heterogeneity

If the result set contains homogeneous results, the probability of picking the second choice is 9 percent. However, if the result set contains heterogeneous results, the probability of picking the second choice rises to 35 percent. Comparing the two

conditions, the odds of choosing the second choice are 5.42 times higher in heterogeneous result sets than in homogeneous result sets. Thus hypotheses 1 is supported.

Logistic regression analysis was used to predict the probability that participants would choose the link in the second serial position thereby testing the effects of the result set composition and accommodation on choice. The logistic regression coefficient, Wald test, and odds ratio for each of the predictors appears in Table 1 below. A test of the full model, compared to the intercept only model, was significant, $\chi^2(3, N = 426) = 46.9$, $p < .001$. The model was had an overall success rate of 81.9 percent. Using a .05 criterion of statistical significance, all of the result set dummy variables had significant partial effects.

Predictor		B	Wald χ^2	p	Odds Ratio
	Result Set Type				
Set A	Not My Word		46.90	<.001	
	My Word				
Set B	My Word	-.930	6.78	.009	0.395
	Not My Word				
Set C	My Word	-2.330	20.12	<.001	0.097
	My Word				
Set D	Not My Word	-2.069	39.27	<.001	0.126
	Not My Word				
Constant		-.187	.65	.420	.829

Table 3. Logistic Regression Predicting Choice From Result Set Accommodation and Heterogeneity

Set A was used as the reference group. Inverted odds ratios for these dummy variables indicate that the odds of choosing the second product link in Set A are 2.53 times higher than in Set B, 10.31 times higher than in Set C, and 7.94 times higher than in Set D. Thus, hypotheses 2 is supported.

The results for the above analysis, which used a between subjects design with participants randomly assigned to the accommodating or non-accommodating search engine[3], are summarized in the Table 4.

	Hypothesis	p	Supported
Hypothesis 1	The probability of choosing a link in lower serial position is higher in heterogeneous sets than in homogeneous sets.	< .0001	yes
Hypothesis 2	Compared to all other result set types, the odds of choosing the second link are highest when both the user's familiar term appears in the link and when the set is heterogeneous.	<.0001	yes

Table 4. Summary of Results from Testing of Operationalized Model

DISCUSSION AND IMPLICATIONS

The purpose of this study was to investigate the role that accommodation has on user behavior in computer mediated product search tasks. Though serial position of the product in a list was a strong predictor of user choice behavior, the notion that

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[3] A repeated measures design was not usable due to a software error with some of the second search engines evaluated. The spurious result set that occurred for the 15 participants evaluating the non accommodating search engine second could have affected their subsequent evaluation of that search engine. After removal of the data from these 15 subjects, the resulting data set was not large enough to measure reliability or test for unidimensionality of the perceived usefulness and confirmation instruments used. However, preliminary results of differences in perceived usefulness between across the two search engines appear promising. Even with as few as seven participants in the group rating non-accommodating search engines first, and a p value of .10, there was a significant difference in their ratings of the two search engines.

users may also be motivated to click on product descriptions that contain familiar terms has important implications for management and marketers.

Increasing our understanding of how users interact with search engines is critical particularly as traditional means of marketing, such as buyer-seller interactions, are increasingly being enhanced or even replaced by computer-based information systems (Colby and Parasuraman, 2003). In these cases, technology may in fact be the enabler that facilitates satisfaction through more effective customization or personalization of service offerings, improvements in the ability to recover from service failures, and improvements in the ability to spontaneously delight customers (Bitner et al., 2000).

Managers need to explore ways to both understand and tailor communication with users. Few companies deal with purely homogeneous customers. It certainly is possible to train both employees and technologies that users interact with to more effectively and efficiently deal with users by adapting to their communication style. As companies employ more natural language processing systems that perform such tasks from responding to users' email requests to recommending products to extracting information from company documents, accommodation is not only possible but also must increasingly be taken into consideration as part of customer relationship management strategy.

LIMITATIONS AND FUTURE RESEARCH

There are certainly limitations to the experimental design concerning the image sets and the number of results in the result set. In particular, having only two results in a set is not consistently realistic, though it certainly does occur with unusual objects in web auction environments. Also, it is unusual to receive completely non-accommodating results; most current techniques query the database with the user's terms and potentially expand that query adding more terms that may or may not be familiar to the user. It would certainly be interesting to present the user with a typical page of 10 results with one system more accommodating than the other.

Another area ripe for research is understanding why users do not select their own terms. Perhaps term granularity plays a role in that users enter coarse grained terms to facilitate cross merchant comparisons. For example, a user may enter a basic level term like *table* knowing that results are likely to include various table types from different sellers with the intention of selecting a more specific term from the list of results. Utilized in this way, users are actually exploiting search engines as a way to circumvent the vocabulary problem.

In conclusion, the findings from the present study serve as further theoretical and practical guidance toward a better understanding of the underlying mechanisms that influence user search behavior. Everyday, users around the world conduct hundreds of millions of searches. Search engines communicate with an increasingly diverse and growing audience. To facilitate efficient, effective communication, it may behoove search engines to speak like they're spoken to.

ACKNOWLEDGMENTS

REFERENCES

1. Belkin, N.J., Kelly, D., Kim, G., Kim, J.-Y., Lee, H.-J, Muresan, G., Tang, M.-C, Yuan, X.-J, and Cool, C. (2003) Query length in interactive information retrieval. *Proceedings of the 26th International ACM Conference on Research and Development in Information Retrieval (SIGIR)*, Toronto, Canada.
2. Bhattacherjee, A. (2001) Understanding Information Systems Continuance: An Expectation-Confirmation Model, *MIS Quarterly*, 25, 3, 351-370
3. Campbell, S., and Bunz, U. (2002, November) Communication Accommodation in Electronic Mail, Or: Answers to the Old "What's in a Word?" Question, *The National Communication Association Convention*, New Orleans, LA.
4. Colby, C.L. and Parasuraman, A. (July/August, 2003) Technology Still Matters: Never Mind the Doomsayers: E-Services are Alive, Well and Positioned for Growth, *Marketing Management*, 12, 4, 28-33.
5. Deerwester S., Dumais S. T., Furnas G. W., Landauer T. K., Harshman R. (1990) Indexing by Latent Semantic Analysis, *Journal of the Society for Information Science*, 41,6.
6. Efthimiadis, E. (1996) Query Expansion, *Annual Review of Information Science and Technology*, 31, 121-187.
7. Furnas, G.W., Landauer, T.K., Gomez, L.M. and Dumais, S.T. (1987) The Vocabulary Problem in Human-System Communication, *Communications of the ACM*, 30, 11, 964-971.

8. Gauch, S., Wang, J., and Rachakonda, S.M. (1999) A Corpus Analysis Approach for Automatic Query Expansion and Its Extension to Multiple Databases, *ACM Transaction on Information Systems*, 17, 3, 250-269.

9. Giles, Coupland and Coupland (1991) Contexts of Accommodation, Cambridge University Press, New York.

10. Godek, J. (2002) Special Session Summary, Personalization and Customization: Implications for Consumer Decision Making and Behavior, *Advances in Consumer Research*, 29, 1, 155-157.

11. Hall, J. (2004) Personal communication, March 31, 2004.

12. Harman, D. (1992) Relevance feedback revisited, *Proceedings of the 15th Annual International ACM Conference on Research and Development in Information Retrieval SIGIR*, Copenhagen, Denmark.

13. Hoque, A.Y. and Lohse, G.L. (August, 1999) An Information Search Cost Perspective for Designing Interfaces for Electronic Commerce, *Journal of Marketing Research*, 36, 387-394.

14. Jansen, B.J. (2000) An Investigation Into the Use of Simple Queries on Web IR Systems, *Information Research.: An Electronic Journal,6,1.*

15. Peterson, R.A. and Merino, M.C. (February 2003) User Information Search Behavior and the Internet., *Psychology and Marketing*, 20, 2, 99-21.

16. Qiu, Y. and Frei, H.P. (1993) Concept based query expansion, *Proceedings of the 16th International Conference on Research and Development in Information Retrieval (SIGIR)*, Pittsburg, PA.

17. Riecken, D. (August 2000) Personalized Views of Personalization, *Communications of the ACM*, 43, 8, 27-29.

18. Russel, J. (2003) Making it personal: Information that adapts to the reader, *Proceedings of the 21st Annual International Conference on Documentation*, San Francisco, CA

19. Shneiderman, B., Byrd, D. and Croft, B. Clarifying Search, http://www.dlib.org/dlib/january97/retrieval/01shneiderman.html.   Accessed on October 15, 2003.

20. Spink, A., Wolfram, D., Jansen, B.J. and Saracevic, T. (2001) Searching the Web: The Public and their Queries, *Journal of the American Society for Information Science,* 53,2, 226-234.

21. Tversky, B. (1979) Pictorial Representations in Adults And Children, *Quarterly Journal of Experimental Psychology*, 31, 397-408.

22. Wolfram, W. and Schilling-Estes, N. (1998) American English: Dialects and Variation, Blackwell, Malden/Oxford.

23. Xu, J. and Croft, B. (1996) Query expansion using local and global document analysis, *Proceedings of the Nineteenth Annual International ACM SIGIR Conference on Research and Development in Information Retrieval*, Zurich, Switzerland.

Appendix 1

Matched Items Used in Study

	Accommodating System	Non-Accommodating System
Kitchen cooking item		
Clothing item		
Table type of item		
Business organizer item		
Tool item		
Wheel item		
Beverage covering item	For canned beverages	The red thing, not the white teapot
Furniture		
Bed covering	The thing on the bed	The green & white thing on the couch
Furniture		

APPENDIX 2

Screenshots of Software Created in Excel Using VBA