















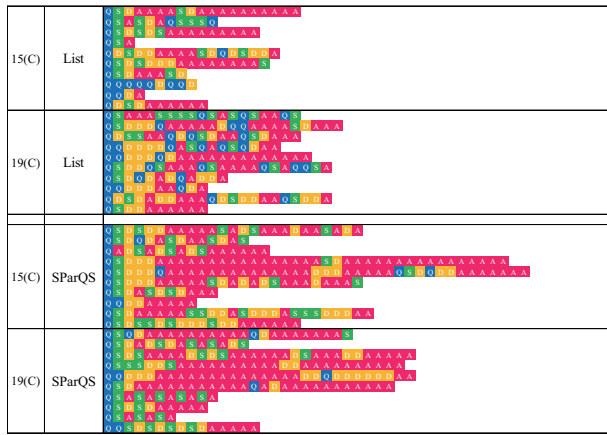








(a) Behavior patterns of Information Gathering tasks.



(b) Behavior patterns of Entity Comparison tasks.

**Figure 5: Behavior patterns of each task.** A horizontal sequence represents the behavior pattern of each subject, which consist of the transition between query input (Q) in blue, query suggestion selection (S) in green, document viewing (D) in yellow, and answer submission (A) in red.

### 8. ACKNOWLEDGMENTS

This work was supported in part by KAKENHI (No. 10J04687) and a Kyoto University GCOE Program entitled “Informatics Education and Research for Knowledge-Circulating Society.”

### 9. REFERENCES

[1] A. Amin, M. Hildebrand, J. van Ossenbruggen, V. Evers, and L. Hardman. Organizing suggestions in autocompletion interfaces. In *Proc. of ECIR*, pages 521–529, 2009.

[2] A. Anagnostopoulos, L. Becchetti, C. Castillo, and A. Gionis. An optimization framework for query recommendation. In *Proc. of WSDM*, pages 161–170, 2010.

[3] P. Anick. Using terminological feedback for web search refinement: a log-based study. In *Proc. of SIGIR*, pages 88–95, 2003.

[4] R. Baeza-Yates, C. Hurtado, and M. Mendoza. Query recommendation using query logs in search engines. In *Current Trends in Database Technology-EDBT 2004 Workshops*, pages 588–596, 2004.

[5] P. Boldi, F. Bonchi, C. Castillo, D. Donato, A. Gionis, and S. Vigna. The query-flow graph: model and applications. In *Proc. of CIKM*, pages 609–618, 2008.

[6] P. Boldi, F. Bonchi, C. Castillo, and S. Vigna. From Dango to Japanese Cakes: Query Reformulation Models and Patterns. In *Proc. of WI*, pages 183–190, 2009.

[7] H. Cao, D. Jiang, J. Pei, Q. He, Z. Liao, E. Chen, and H. Li. Context-aware query suggestion by mining click-through and session data. In *Proc. of KDD*, pages 875–883, 2008.

[8] S. Dumais and N. J. Belkin. The TREC interactive tracks: Putting the user into search. In E. Voorhees and D. Harman, editors, *TREC: Experiment and Evaluation in Information Retrieval*, pages 123–152. MIT Press, 2005.

[9] S. Dumais, E. Cutrell, and H. Chen. Optimizing search by showing results in context. In *Proc. of CHI*, pages 277–284, 2001.

[10] J. Guo, X. Cheng, G. Xu, and H. Shen. A Structured Approach to Query Recommendation With Social Annotation Data. In *Proc. of CIKM*, pages 619–628, 2010.

[11] J. Guo, G. Xu, X. Cheng, and H. Li. Named entity recognition in query. In *Proc. of SIGIR*, pages 267–274, 2009.

[12] Q. He, D. Jiang, Z. Liao, S. Hoi, K. Chang, E. Lim, and H. Li. Web query recommendation via sequential query prediction. In *Proc. of ICDE*, pages 1443–1454, 2009.

[13] R. Johnson and D. Wichern. *Applied multivariate statistical analysis, 4th ed.* Prentice Hall, 1998.

[14] M. Kamvar and S. Baluja. Query suggestions for mobile search: understanding usage patterns. In *Proc. of CHI*, pages 1013–1016, 2008.

[15] D. Kelly, A. Cushing, M. Dostert, X. Niu, and K. Gyllstrom. Effects of popularity and quality on the usage of query suggestions during information search. In *Proc. of CHI*, pages 45–54, 2010.

[16] D. Kelly, K. Gyllstrom, and E. Bailey. A comparison of query and term suggestion features for interactive searching. In *Proc. of SIGIR*, pages 371–378, 2009.

[17] M. Komachi and H. Suzuki. Minimally supervised learning of semantic knowledge from query logs. In *Proc. of IJCNLP*, pages 358–365, 2008.

[18] H. Ma, H. Yang, I. King, and M. Lyu. Learning latent semantic relations from clickthrough data for query suggestion. In *Proc. of CIKM*, pages 709–718, 2008.

[19] Q. Mei, D. Zhou, and K. Church. Query suggestion using hitting time. In *Proc. of CIKM*, pages 469–478, 2008.

[20] G. Nemhauser, L. Wolsey, and M. Fisher. An analysis of approximations for maximizing submodular set functions-I. *Mathematical Programming*, 14(1):265–294, 1978.

[21] E. Sadikov, J. Madhavan, L. Wang, and A. Halevy. Clustering query refinements by user intent. In *Proc. of WWW*, pages 841–850, 2010.

[22] S. Sekine, K. Sudo, and C. Nobata. Extended named entity hierarchy. In *Proc. of the Third International Conference on Language Resources and Evaluation (LREC-2002)*, pages 1818–1824, 2002.

[23] S. Sekine and H. Suzuki. Acquiring ontological knowledge from query logs. In *Proc. of WWW*, pages 1223–1224, 2007.

[24] J. Sim and C. Wright. The kappa statistic in reliability studies: use, interpretation, and sample size requirements. *Physical therapy*, 85(3):257–268, 2005.

[25] Y. Song and L. He. Optimal rare query suggestion with implicit user feedback. In *Proc. of WWW*, pages 901–910, 2010.

[26] Y. Song, D. Zhou, and L.-w. He. Post-ranking query suggestion by diversifying search results. In *Proc. of SIGIR*, pages 815–824, 2011.

[27] J. Wen, J. Nie, and H. Zhang. Clustering user queries of a search engine. In *Proc. of WWW*, pages 162–168, 2001.

[28] R. White and G. Marchionini. Examining the effectiveness of real-time query expansion. *Information Processing & Management*, 43(3):685–704, 2007.

[29] K. Yee, K. Swearingen, K. Li, and M. Hearst. Faceted metadata for image search and browsing. In *Proc. of CHI*, pages 401–408, 2003.

[30] X. Yin and S. Shah. Building taxonomy of web search intents for name entity queries. In *Proc. of WWW*, pages 1001–1010, 2010.