Investigating the Learning Process in Job Search: A Longitudinal Study

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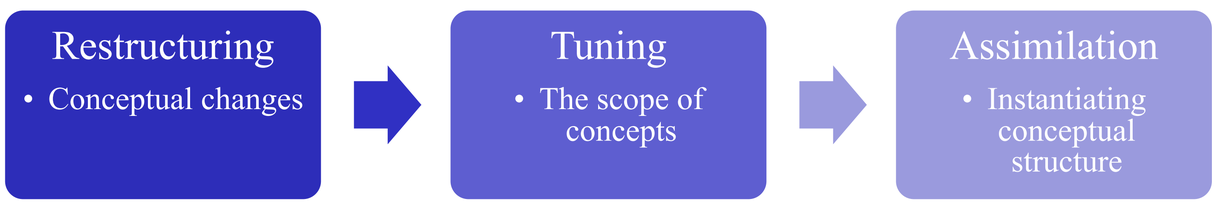
Background: Search as Learning

- Users learn new knowledge and search strategies during search
  - Exploratory search
  - Completing complex search tasks
- Understanding the learning process in search tasks can enable better support for complex search tasks
- The learning process in search has been studied in IIR
  - Kuhlthau's Information Search Process (ISP) model (Kuhlthau, 1993)
  - Vakkari's 3-stage model for the learning process in search (Vakkari, 2001)(Vakkari, 2016)



Background: Job Search

- Job seeking: a complex search task
  - Search, evaluate, and compare available jobs
  - The process lasts for days or weeks
  - The collection of available jobs may change during the process
- Job seekers learn over time about available jobs and how to search for a job
- Investigating the how their search behavior changes during the job seeking process is essential for building a better job search engine

Motivation

- Revisit the learning process in search for job search tasks
  - The information need is relatively stable
  - We can investigate behavioral changes within a single task by analyzing job seeker's queries within a time window
- Conduct a log-based, longitudinal study for job search
- Discuss how the empirical findings support or contradict existing models of the learning process in search

Research Questions

- **RQ1**: How is job seekers' search behavior characterized?
- **RQ2:** How does the behavior change over time?
- **RQ3:** Does information consumption (result clicks) and response behavior (application lodging) change over time?

Methodology

- Data collection
  - ~125,000 queries from thousands of randomly sampled users of SEEK
  - No personally identifiable information was available or used in experiments
  - Contains:
    - Queries
    - # clicks, click-through rate, application rate
    - Filters on job classification, work type, job location, salary range, and posting time
- Partition the query log into job search tasks
  - Assumption: it is unlikely that a job seeker will be involved in multiple job search tasks at the same time
  - Used a 14-day gap in logged actions as boundary of distinct search tasks
- Investigate the changes of search behavior over time
  - Divide the process of each search task into three stages of equal time
  - Compare users' querying, click, and application behavior in three stages
  - Conduct one-way ANOVA to test whether the behavioral measures differ between stages

Characterizing Job Search Tasks

- The statistics of job search tasks
  - Job search is complex
    - lasts for 8.6 days
    - submits 11.1 queries
    - 45.75% of the tasks exceed one day in duration

	All search tasks		*Search tasks last longer than one day*	
# search tasks	11,267		5,159	
Time span, in # days	8.56	(16.04)	17.51	(20.36)
# queries	11.14	(35.29)	20.75	(50.39)
# displayed pages	15.66	(47.02)	29.13	(66.83)
# displayed results	268.63	(837.17)	503.35	(1 191.65)

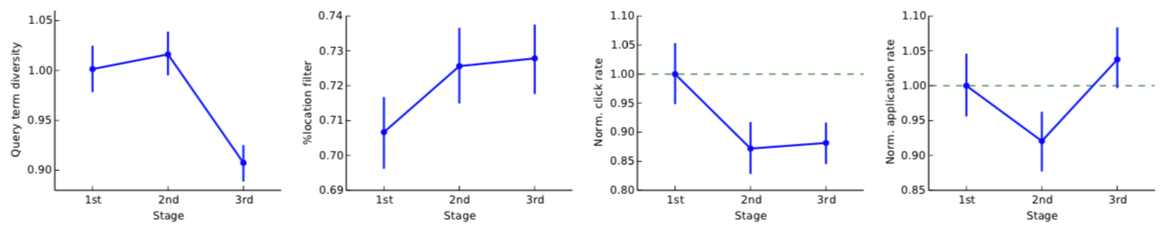
- The statistics of querying behavior
  - Job seekers tend to use short queries
  - The query diversity ($\frac{\#\{unique\ terms\}}{\#queries}$) is low
  - The location filter is widely used in job search

	All search tasks		*Search tasks last longer than one day*	
# search tasks	11,267		5,159	
Length in characters	11.95	(10.30)	12.30	(13.08)
Length in terms	1.65	(1.58)	1.69	(2.11)
Query term diversity	0.923	(0.69)	0.646	(0.46)
% classification filter	0.239	(0.37)	0.236	(0.34)
% location filter	0.704	(0.37)	0.720	(0.31)
% date filter	0.105	(0.28)	0.108	(0.27)
% work type filter	0.099	(0.26)	0.105	(0.24)
% salary filter	0.105	(0.27)	0.112	(0.26)

Changes in User Behavior over Time

- The statistics of search behavior in three stages (n = 5, 159 × 3 = 15, 477)

	1st stage	*2nd stage*	*3rd stage*	*F-value*	*p-value*
Querying Behavior					
Length in characters	12.263	12.304	12.325	0.03	0.974
Length in terms	1.680	1.693	1.692	0.05	0.953
Query term diversity	1.001	1.016	0.908	33.21	< 0.001
%classification filter	0.240	0.237	0.234	0.38	0.686
%location filter	0.707	0.726	0.728	4.87	0.008
%date filter	0.105	0.110	0.109	0.42	0.658
%work type filter	0.098	0.110	0.109	2.78	0.062
%salary filter	0.107	0.117	0.116	1.67	0.189
Clicking and Application Behavior					
Norm. click rate	1.000	0.872	0.882	10.44	< 0.001
Norm. application rate	1.000	0.921	1.038	7.30	0.001



(a) Query term diversity 1st>3rd**, 2nd>3rd** (b) % location filter 1st<2nd*, 1st<3rd* (c) Norm. click rate 1st>2nd**, 1st>3rd** (d) Norm. application rate 1st>2nd*, 2nd<3rd**

*/** indicate the difference is significant at α = 0.05/0.01 level with a post hoc comparison using the Tukey's HSD test.

Discussion

- Vakkari's model predicts that at the last assimilation stage, users will:
  - Have a clear usefulness criteria
  - Have a lower click rate
  - and a higher use/selection ratio (i.e. a higher application rate)

  ✓ **Supported by our findings**
  - Use more unique query terms
  - Increase the specificity of terms
  - Use more synonyms

  ✗ **Not supported by our findings**
- Extends existing model with a fourth stage: monitoring
  - After learning knowledge of how to find jobs in a particular field, the job seeker monitors the updates of new jobs with relative static queries
  - Other search tasks may also have such a monitoring stage
  - The search system for a dynamic collection should detect and provide better support for this stage

Conclusions

- **RQ1**: How is job seekers' search behavior characterized?
  - Job search is a complex search task that requires multiple queries over a long period of time to complete
  - Job seekers like to use short queries with different filters
- **RQ2:** How does the behavior change over time?
  - Job seekers tend to use more filters and less diverse query terms over time
- **RQ3:** Does information consumption (result clicks) and response behavior (application lodging) change over time?
  - The click rate decreases while the application rate increases over time

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