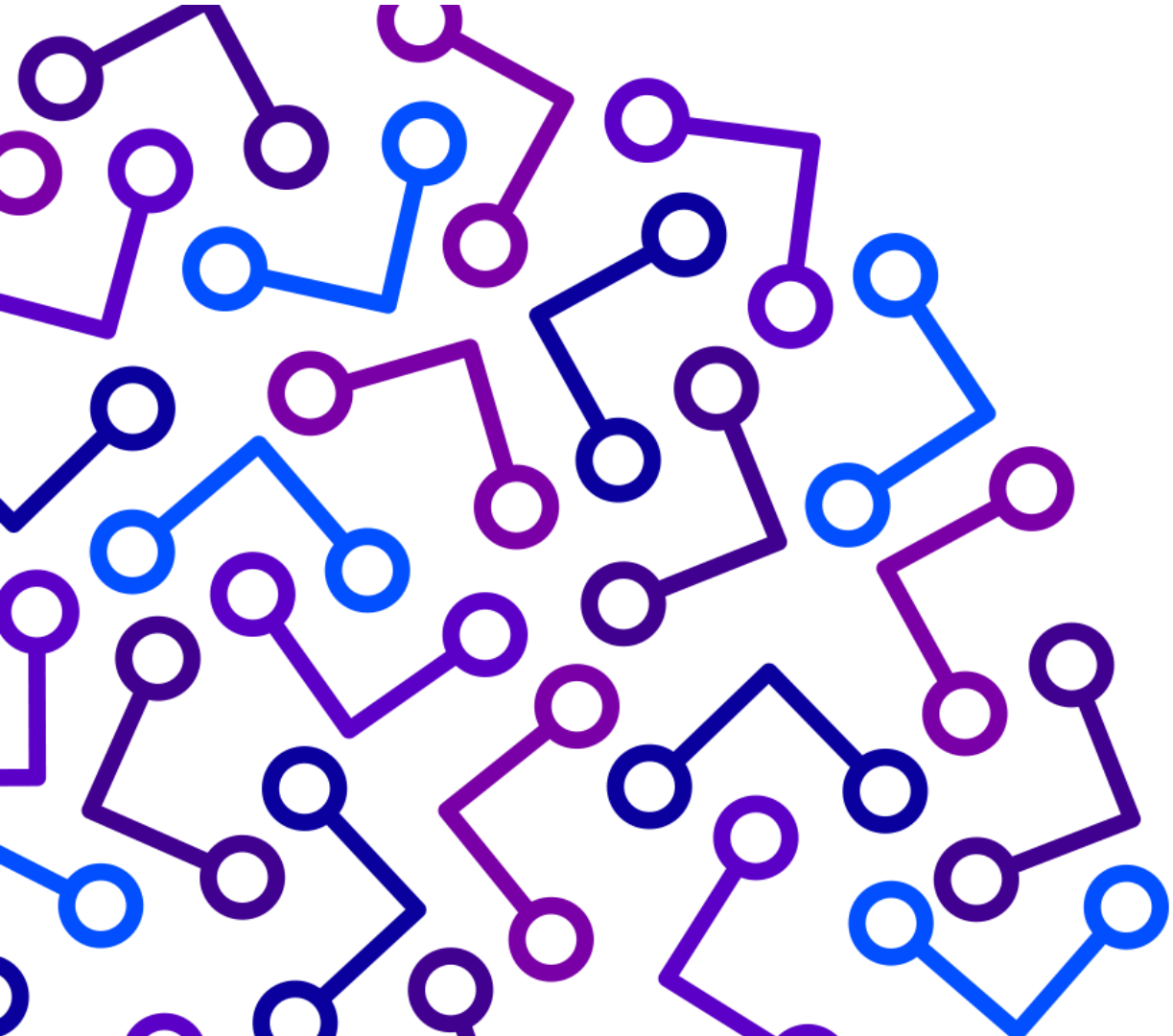


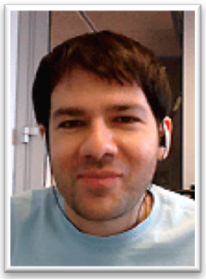
TECH PULSE
2014

YAHOO!

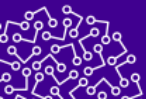
Impact of Response Latency on User Behavior in Web Search

Ioannis Arapakis, Xiao Bai, B. Barla Cambazoglu





Introduction



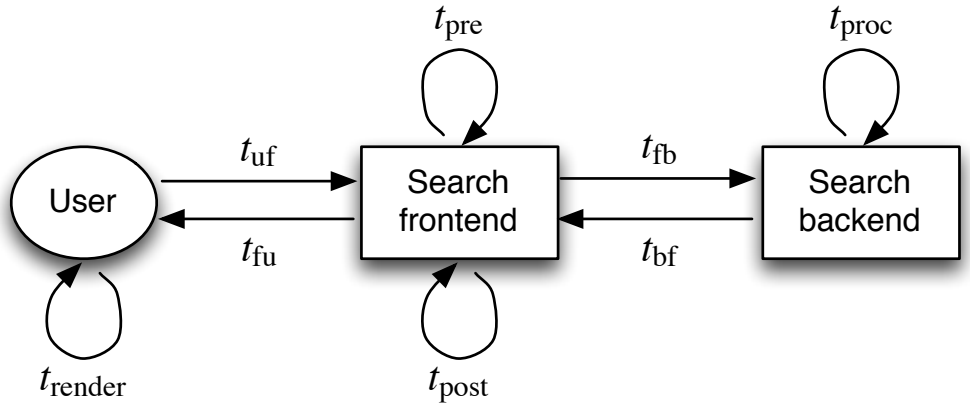
Web Search Economics

- Trade-off between the speed of a search system and the quality of its results
- Too slow or too fast may result in financial consequences for the search engine

Web Search Economics

- Web users
  - are impatient
  - have limited time
  - expect sub-second response times
- High response latency
  - can distract users
  - results in fewer query submissions
  - decreases user engagement over time

Components of User-Perceived Response Latency



- network latency: $t_{uf} + t_{fu}$
- search engine latency: $t_{pre} + t_{fb} + t_{proc} + t_{bf} + t_{post}$
- browser latency: t_{render}

Experimental Design

User Study 1: User Sensitivity to Latency

User Study 2: Impact of Latency on Search Experience

User Study 1

User Sensitivity to Latency

Experimental Method (Task 1 & 2)

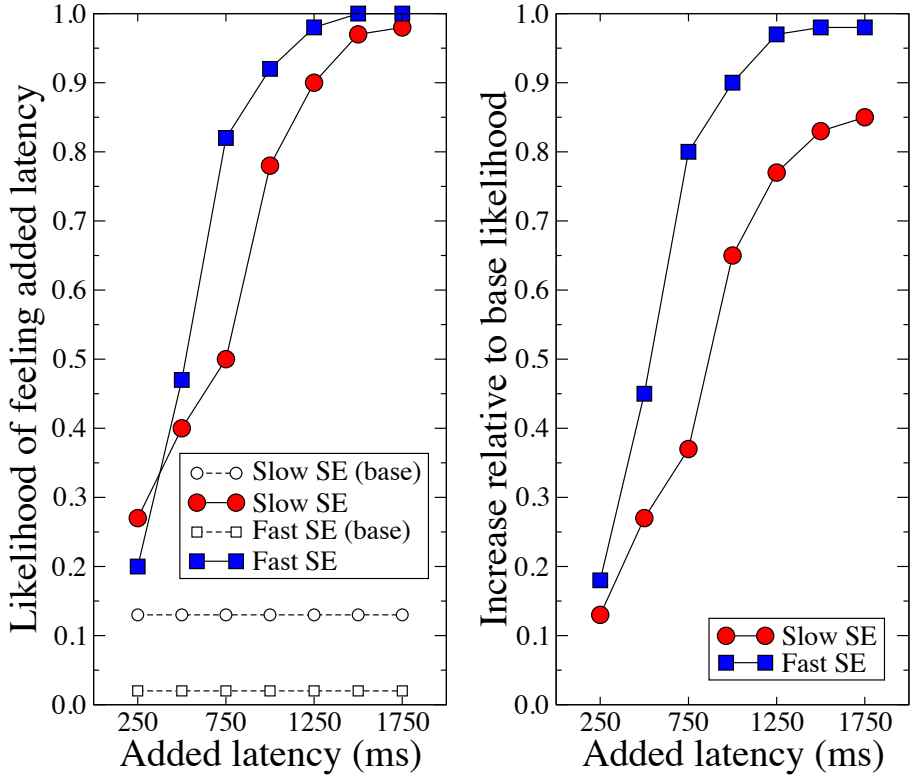
- Independent variables:
  - Search latency (0 – 2750ms)
  - Search site speed (slow, fast)
- 12 participants (female=6, male=6)
  - aged from 24 to 41
  - Full-time students (33.3%), studying while working (54.3%), full-time employees (16.6%)

Task 1: Procedure

- Participants submitted 40 navigational queries
- After submitting each query, they reported if the response of the search site was “slow” or “normal”
- For each query we increased latency by a fixed amount (0 – 1750ms), using a step of 250ms
- Each latency value (e.g., 0, 250, 500) was introduced 5 times, in a random order

Task 1: Results

- Delays <500ms are not easily noticeable
- Delays >1000ms are noticed with high likelihood



Task 2: Procedure

- Participant submitted 50 navigational queries
- After each query submission they provided an estimation of the search latency in milliseconds
- Search latency was set to a fixed amount (500 – 2750ms), using a step of 250ms
- Each latency value (e.g., 0, 250, 500) was introduced 5 times, in a random order
- A number of training queries was submitted without any added delay

Task 2: Results

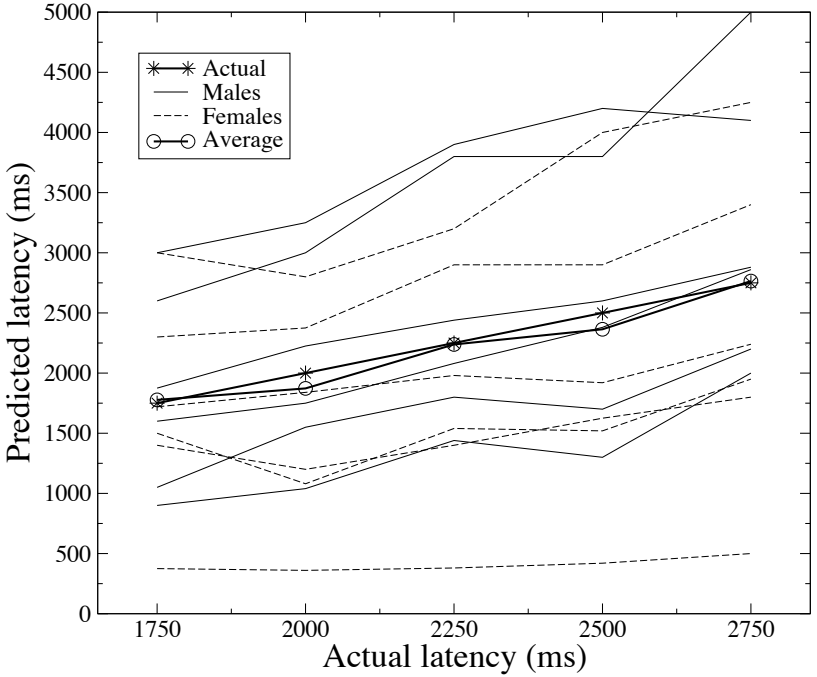


Fig. 1: Slow search engine

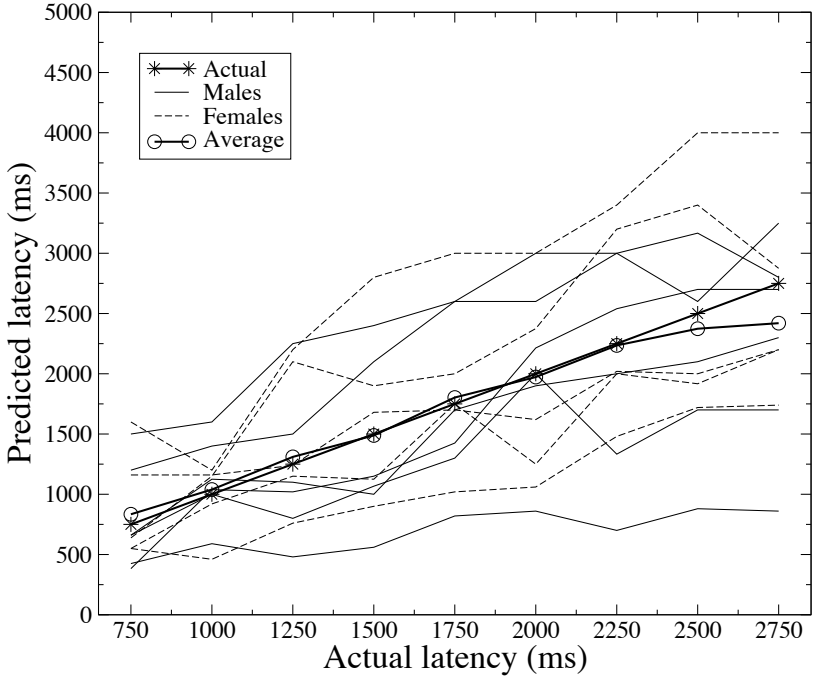


Fig. 2: Fast search engine

User Study 2

Impact of Latency on Search Experience

Experimental Method

- Two independent variables
  - Search latency (0, 750, 1250, 1750)
  - Search site speed (slow, fast)
- Search latency was adjusted by a desired amount using a custom-made JS deployed through the Greasemonkey extension
- 20 participants (female=10, male=10)

Procedure

- Participants performed four search tasks
  - Evaluate the performance of four different backend search systems
  - Submit as many navigational queries from a list of 200 randomly sampled web domains
  - For each query they were asked to locate the target URL among the first ten results of the SERP
- Training queries were used to allow participants to familiarize themselves with the “default” search site speed

Questionnaires

- User Engagement Scale (UES)
  - Positive affect (PAS)
  - Negative affect (NAS)
  - Perceived usability
  - Felt involvement and focused attention
- IBM's Computer System Usability Questionnaire (CSUQ)
  - System usefulness (SYSUSE)
- Custom statements

Descriptive Statistics (M) for UE and SYSUSE

	SE_{slow} latency				SE_{fast} latency			
	0	750	1250	1750	0	750	1250	1750
Post-Task Positive Affect	16.20	14.50	15.50	15.20	20.50	19.00	20.80	19.30
Post-Task Negative Affect	7.00	6.80	7.60	6.90	6.80	7.40	7.40	7.20
Frustration	3.20	3.10	2.90	3.30	2.80	3.00	3.50	2.60
Focused Attention	22.80	22.90	19.90	22.20	27.90	26.60	23.90	29.50
SYSUS	32.80	28.90	29.80	27.90	35.20	31.30	29.80	33.20

- Positive bias towards SE_{fast}
- SE_{fast} participants were more deeply engaged
- SE_{fast} participants' usability perception was more tolerant to delays

Correlation Analysis of Beliefs and Reported Scales

Correlation Matrix

Beliefs	postPAS	postNAS	FA	CSUQ-SYSUS	custom-1	custom-2	custom-3
SE_{slow} will respond fast to my queries	.455**	.041	0.702**	.267	.177	.177	.082
SE_{slow} will provide relevant results	.262	-.083	.720**	.411**	.278	.263	.232
SE_{fast} will respond fast to my queries	-.051**	.245	.341*	.591**	.330*	.443**	.624**
SE_{fast} will provide relevant results	-.272	.133	-.133	.378*	.212	.259	.390*

*. Correlation is significant at the .05 level (2-tailed). **. Correlation is significant at the .01 level (2-tailed)

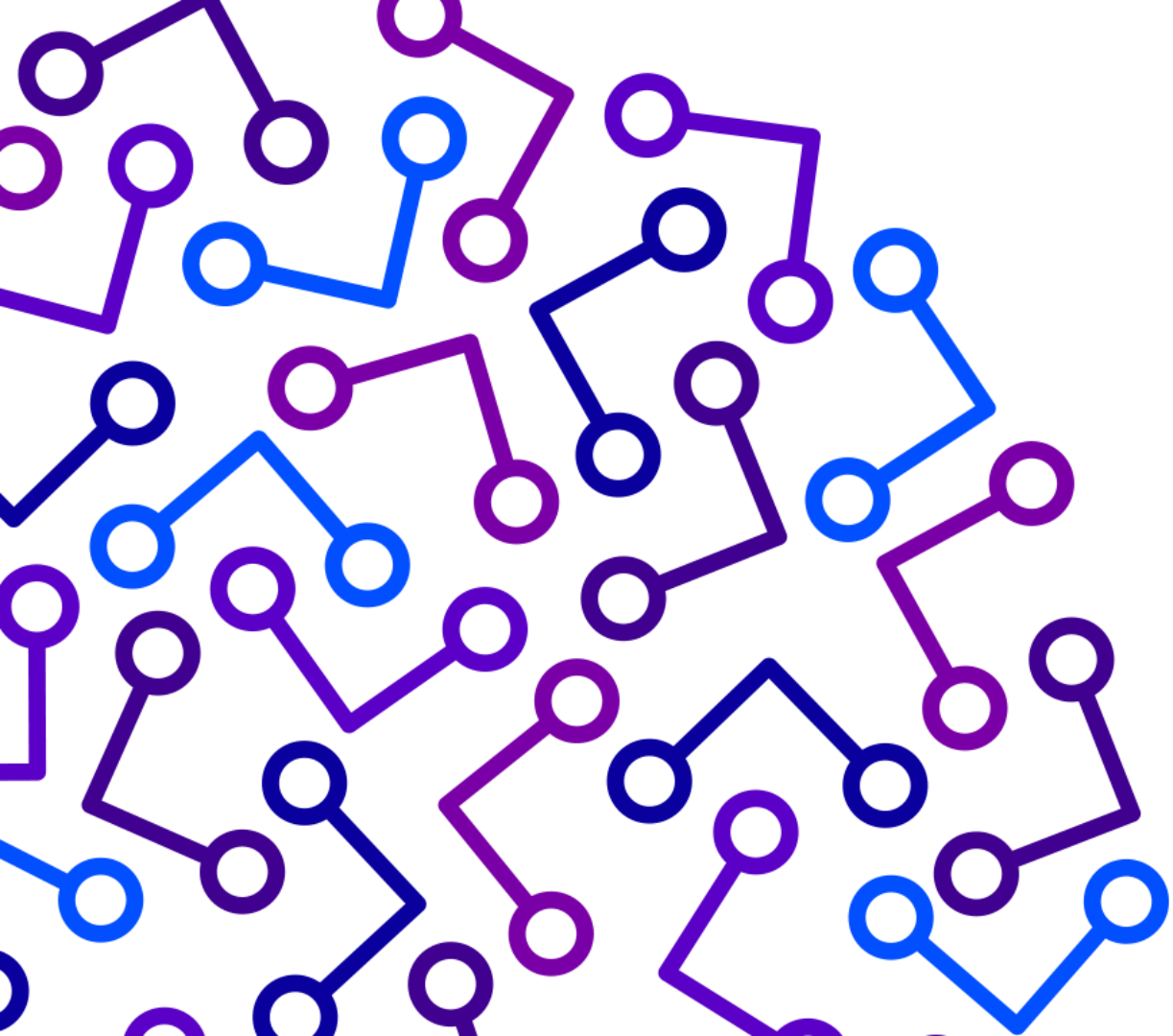
Conclusions

Conclusions

- Up to a point (500ms) added response time delays are not noticeable by the users
- After a certain threshold (1000ms) the users can feel the added delay with very high likelihood
- Perception of search latency varies considerably across the population!

Conclusions

- The tendency to overestimate or underestimate system performance biases users' interpretations of search interactions and system usability
- Participants of the SE_fast:
  - were generally more deeply engaged
  - their usability perception was more tolerant to delays



TECH PULSE
2014

Thank you for your attention!

YAHOO!