



UNC
SCHOOL OF INFORMATION
AND LIBRARY SCIENCE

CAROLINA
PUBLIC
HUMANITIES

Connecting People Through Ideas

Finding Knowledge in the Digital Age: Cognitive Abilities and the Quest for Better Searching

Dr. Jaime Arguello

School of Information and Library Science
University of North Carolina at Chapel Hill

Background

HELLO
MY NAME IS



Interactive Information Systems Lab



Me



Dr. Rob Capra



Wonderful Students
(more later)

My Goals for Today

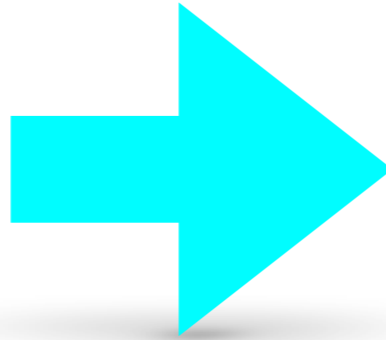
1. Introduce you to my research field: information retrieval (IR)
2. Convince you that IR research is important, challenging, and fun!
3. Introduce you to some of my recent research projects

What is Information Retrieval?

- Designing, developing, and evaluating systems to help people find and use information to support their goals.

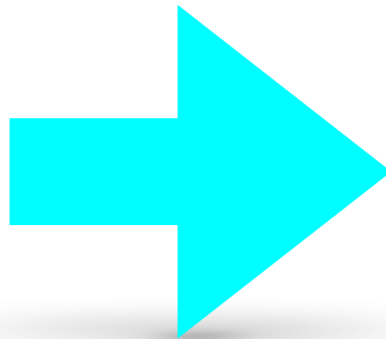
What is Information Retrieval?

Designing



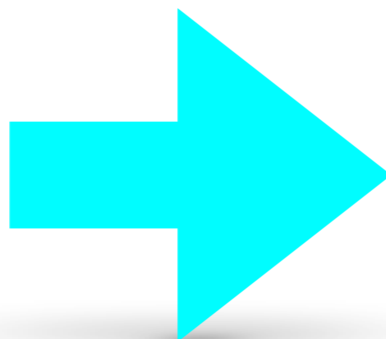
Understanding humans as information-seekers, problem-solvers, and learners

Developing



Using computer programming + math (now called AI) to build “stuff”

Evaluating



Developing methods to figure out if the “stuff” is any good

What is Information Retrieval?

- IR systems help people find information, and are:
 - ▶ Predictive: make (hopefully) educated guesses
 - ▶ Interactive: support back-and-forth interaction
 - ▶ Dynamic: evolve automatically with the environment

Many Types of IR Systems

The Google logo is centered on the page. It consists of the word "Google" in its signature multi-colored font: the 'G' is blue, the first 'o' is red, the second 'o' is yellow, the 'g' is blue, the 'l' is green, and the 'e' is red.

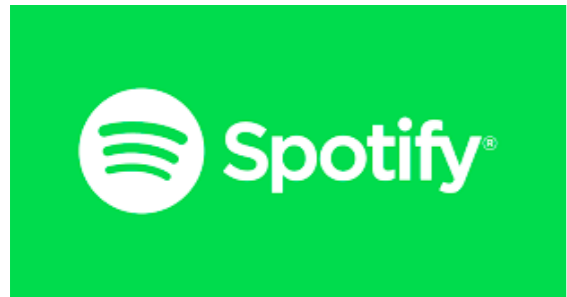
Many Types of IR Systems



twitter



Instagram



bing

match.com

PANDORA

mapquest m

Google



YAHOO! ANSWERS

flickr



yelp

LinkedIn



The New York Times

Westlaw



YouTube
Broadcast Yourself

LexisNexis

IR Systems have Important Societal Benefits

- We use them to:
 - ▶ Understand the world
 - ▶ Do our jobs
 - ▶ Find our jobs
 - ▶ Perform day-to-day tasks
 - ▶ Acquire new knowledge / skills
 - ▶ Make important decisions
 - ▶ Find entertainment
 - ▶ Support our hobbies
 - ▶ Meet people
 - ▶ Find inspiration
 - ▶ Ponder the meaning of life

IR Systems have Important Societal Challenges

- “One size does not fit all”
 - ▶ Individual differences
 - ▶ Situational differences
- Personalization (i.e., tailoring the search experience) helps, but raises questions about:
 - ▶ Privacy, filter bubbles, etc.
- More importantly, personalization remains narrowly focused
 - ▶ Mostly topical (i.e., personal interests)

Interactive Information Systems Lab



Me



Dr. Rob Capra



Wonderful Students
(more later)

Interactive Information Systems Lab

Common Threads

- **Understanding humans:** factors that influence needs and behaviors
- **Lab studies:** participants + manipulations + observations
- **Complex tasks:** not simple fact-finding nor navigation
- **Novel paradigms:** beyond keyword queries + ranked lists
- **Novel tools:** interfaces and tools to alleviate challenges



Interactive Information Systems Lab

Sandeep Avula



Embedding search systems into messaging platforms to support multiple collaborators in real-time

Interactive Information Systems Lab

Bogeum Choi



Understanding the role of working memory ability on how people search and learn

Interactive Information Systems Lab

Yuan Li



Understanding how people pause and resume complex tasks across multiple (long-term) sessions

Interactive Information Systems Lab

Kelsey Urgo



Understanding how characteristics of learning objectives influence task-decomposition and needs

Interactive Information Systems Lab

Austin Ward



Embedding search systems in virtual reality environments

Case (Research) Study

36

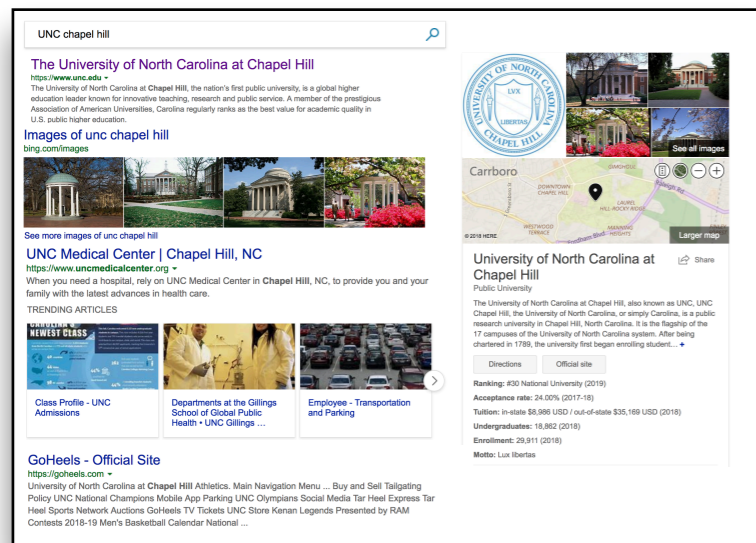
The Effects of Working Memory, Perceptual Speed, and Inhibition in Aggregated Search

JAIME ARGUELLO and BOGEUM CHOI, School of Information and Library Science,
University of North Carolina at Chapel Hill

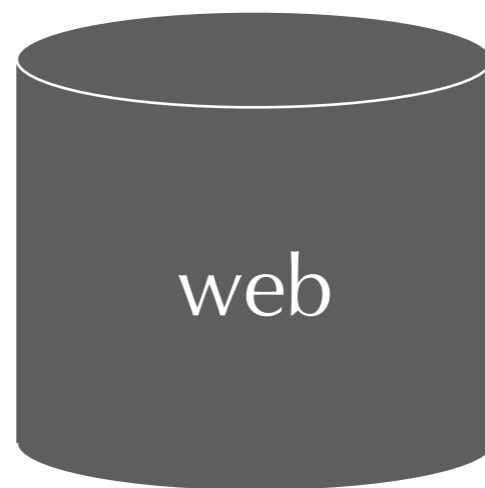
Prior work has studied how different characteristics of individual users (e.g., personality traits and cognitive abilities) can impact search behaviors and outcomes. We report on a laboratory study ($N = 32$) that investigated the effects of three different cognitive abilities (perceptual speed, working memory, and inhibition) in the context of aggregated search. Aggregated search systems combine results from multiple heterogeneous sources (or *verticals*) in a unified presentation. Participants in our study interacted with two different aggregated search interfaces (a within-subjects design) that differed based on the extent to which the layout distinguished between results originating from different verticals. The *interleaved* interface merged results from different verticals in a fairly unconstrained fashion. Conversely, the *blocked* interface displayed results from the same vertical as a group, displayed each group of vertical results in the same region on the SERP for every query, and used a border around each group of vertical results to help distinguish among results from different sources. We investigated three research questions (RQ1–RQ3). Specifically, we investigated the effects of the interface condition and each cognitive ability on three types of outcomes: (RQ1) participants' levels of workload, (RQ2) participants' levels of user engagement, and (RQ3) participants' search behaviors. Our results found different main and interaction effects. Perceptual speed and inhibition did not significantly affect participants' workload and user engagement but significantly affected their search behaviors. Specifically, with the interleaved interface, participants with lower perceptual speed had more difficulty finding relevant results on the SERP, and participants with lower inhibitory attention control searched at a slower pace. Working memory did not have a strong effect on participants' behaviors but had several significant effects on the levels of workload and user engagement reported by participants. Specifically, participants with lower working memory reported higher levels of workload and lower levels of user engagement. We discuss implications of our results for designing aggregated search interfaces that are well suited for users with different cognitive abilities.

Aggregated Search

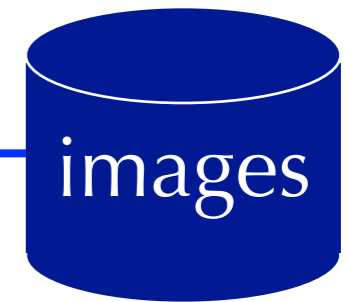
- Integrating results from different, heterogeneous back-end systems in a unified presentation



"unc chapel hill"



⋮



verticals

Web Search Portals (e.g., Google)

UNC chapel hill



The University of North Carolina at Chapel Hill

<https://www.unc.edu>

The University of North Carolina at **Chapel Hill**, the nation's first public university, is a global higher education leader known for innovative teaching, research and public service. A member of the prestigious Association of American Universities, Carolina regularly ranks as the best value for academic quality in U.S. public higher education.

Images of unc chapel hill

<bing.com/images>



See more images of unc chapel hill

UNC Medical Center | Chapel Hill, NC

<https://www.uncmedicalcenter.org>

When you need a hospital, rely on UNC Medical Center in **Chapel Hill**, NC, to provide you and your family with the latest advances in health care.

TRENDING ARTICLES



Class Profile - UNC Admissions



Departments at the Gillings School of Global Public Health • UNC Gillings ...

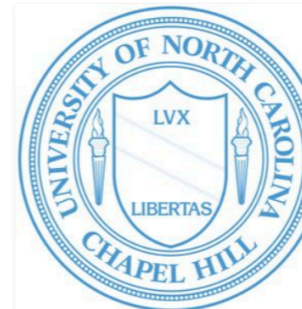


Employee - Transportation and Parking

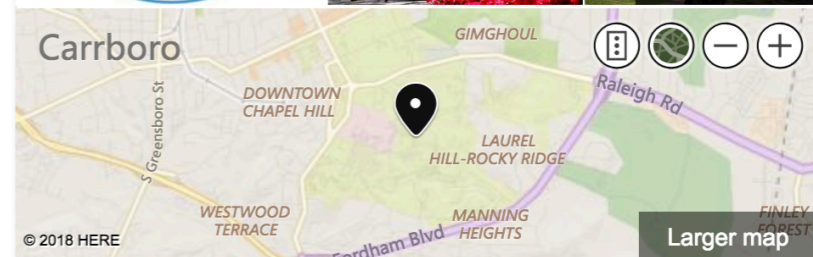
GoHeels - Official Site

<https://goheels.com>

University of North Carolina at **Chapel Hill** Athletics. Main Navigation Menu ... Buy and Sell Tailgating Policy UNC National Champions Mobile App Parking UNC Olympians Social Media Tar Heel Express Tar Heel Sports Network Auctions GoHeels TV Tickets UNC Store Kenan Legends Presented by RAM Contests 2018-19 Men's Basketball Calendar National ...



See all images



University of North Carolina at Chapel Hill

Share

Public University

The University of North Carolina at Chapel Hill, also known as UNC, UNC Chapel Hill, the University of North Carolina, or simply Carolina, is a public research university in Chapel Hill, North Carolina. It is the flagship of the 17 campuses of the University of North Carolina system. After being chartered in 1789, the university first began enrolling student... +

Directions

Official site

Ranking: #30 National University (2019)

Acceptance rate: 24.00% (2017-18)

Tuition: in-state \$8,986 USD / out-of-state \$35,169 USD (2018)

Undergraduates: 18,862 (2018)

Enrollment: 29,911 (2018)

Motto: Lux libertas

Web Search Portals (e.g., Google)

UNC chapel hill



The University of North Carolina at Chapel Hill

<https://www.unc.edu>

The University of North Carolina at **Chapel Hill**, the nation's first public university, is a global higher education leader known for innovative teaching, research and public service. A member of the prestigious Association of American Universities, Carolina regularly ranks as the best value for academic quality in U.S. public higher education.

Images of unc chapel hill

bing.com/images



[See more images of unc chapel hill](#)

UNC Medical Center | Chapel Hill, NC

<https://www.uncmedicalcenter.org>

When you need a hospital, rely on UNC Medical Center in **Chapel Hill**, NC, to provide you and your family with the latest advances in health care.

TRENDING ARTICLES



[Class Profile - UNC Admissions](#)



[Departments at the Gillings School of Global Public Health • UNC Gillings ...](#)

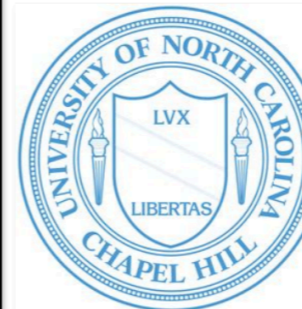


[Employee - Transportation and Parking](#)

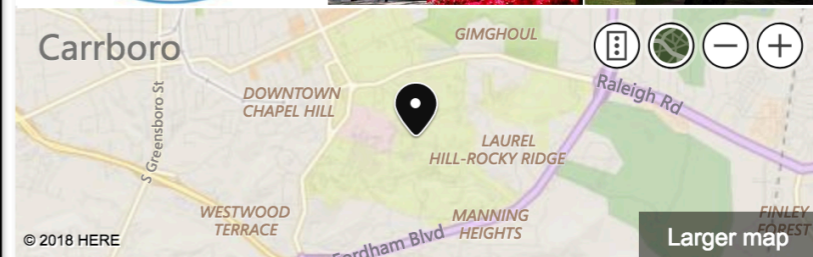
GoHeels - Official Site

<https://goheels.com>

University of North Carolina at **Chapel Hill** Athletics. Main Navigation Menu ... Buy and Sell Tailgating Policy UNC National Champions Mobile App Parking UNC Olympians Social Media Tar Heel Express Tar Heel Sports Network Auctions GoHeels TV Tickets UNC Store Kenan Legends Presented by RAM Contests 2018-19 Men's Basketball Calendar National ...



[See all images](#)



© 2018 HERE

[Larger map](#)

University of North Carolina at Chapel Hill

[Share](#)

Public University

The University of North Carolina at Chapel Hill, also known as UNC, UNC Chapel Hill, the University of North Carolina, or simply Carolina, is a public research university in Chapel Hill, North Carolina. It is the flagship of the 17 campuses of the University of North Carolina system. After being chartered in 1789, the university first began enrolling student... +

[Directions](#)

[Official site](#)

Ranking: #30 National University (2019)

Acceptance rate: 24.00% (2017-18)

Tuition: in-state \$8,986 USD / out-of-state \$35,169 USD (2018)

Undergraduates: 18,862 (2018)

Enrollment: 29,911 (2018)

Motto: Lux libertas

Academic Search (e.g., PubMed)

NCBI Resources ▾ How To ▾ Sign in to NCBI

PubMed Help

US National Library of Medicine
National Institutes of Health

Create RSS Create alert Advanced

Article types: Clinical Trial, Review, Customize ...

Text availability: Abstract, Free full text, Full text

Publication dates: 5 years, 10 years, Custom range...

Species: Humans, Other Animals

Clear all

Show additional filters

Format: Summary ▾ Sort by: Best Match ▾ Per page: 20 ▾ Send to ▾ Filters: [Manage Filters](#)

Sort by:

Results by year ▾

Search results

Items: 1 to 20 of 166235 << First < Prev Page 1 of 8312 Next > Last >>

[Multimodal medical information retrieval with unsupervised rank fusion.](#)

1. Mourão A, Martins F, Magalhães J.
Comput Med Imaging Graph. 2015 Jan;39:35-45. doi: 10.1016/j.compmedimag.2014.05.006. Epub 2014 May 23.
PMID: 24909951
[Similar articles](#)

[Health Professionals' Use of Online Information Retrieval Systems and Online Evidence.](#)

2. Lialiou P, Pavlopoulou I, Mantas J.
Stud Health Technol Inform. 2016;228:801-3.
PMID: 27577498
[Similar articles](#)

[A passage retrieval method based on probabilistic information retrieval model and UMLS concepts in biomedical question answering.](#)

3. Sarrouti M, Ouatik El Alaoui S.
J Biomed Inform. 2017 Apr;68:96-103. doi: 10.1016/j.jbi.2017.03.001. Epub 2017 Mar 7.
PMID: 28286031 **Free Article**
[Similar articles](#)

[Effects of Information Access Cost and Accountability on Medical Residents' Information Retrieval Strategy and Performance During Prehandover Preparation: Evidence From Interview and Simulation Study.](#)

4. Yang XJ, Wickens CD, Park T, Fong L, Siah KT.
Hum Factors. 2015 Dec;57(8):1459-71. doi: 10.1177/0018720815598889. Epub 2015 Sep 1.
PMID: 26328592
[Similar articles](#)

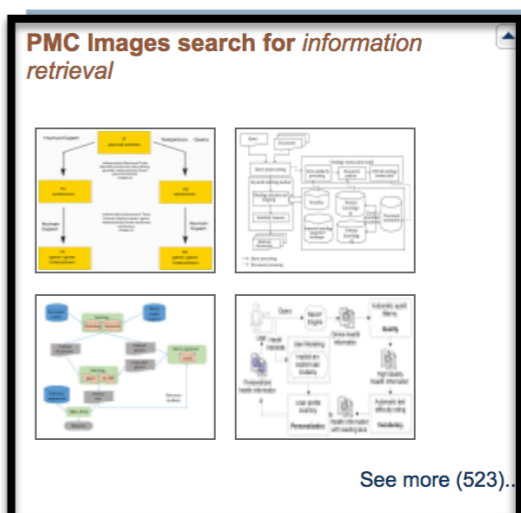
[Accelerating Information Retrieval from Profile Hidden Markov Model Databases.](#)

5. Tamimi A, Ashhab Y, Tamimi H.
PLoS One. 2016 Nov 22;11(11):e0166358. doi: 10.1371/journal.pone.0166358. eCollection 2016.
PMID: 27875548 **Free PMC Article**
[Similar articles](#)

[Experiments with Cross-Language Information Retrieval on a Health Portal for Psychology and Psychotherapy.](#)

6. Andrenucci A.
Stud Health Technol Inform. 2016;228:75-9.

PMC Images search for information retrieval



See more (523)...

Titles with your search terms

Information Retrieval in Food Science Research: A Bibliographic Data [J Food Sci. 2018]

Innovation in information retrieval methods for evidence synthesis st [Res Synth Methods. 2018]

Value of Information Based Data Retrieval in UWSNs. [Sensors (Basel). 2018]

See more...

Find related data

Database:

Library Search (e.g., UNC Libraries)

Home > Search & Find > Articles+Catalog Search Results

information retrieval

Catalog E-Research by Discipline more >>

Recommendation: We found specialized collections that might help you.

[ERIC](#) - Produced by the Educational Resource Information Center, ERIC provides indexing and abstracting for journal and...(more)

Books & More

Library books, videos, CDs, printed music, microform, local resources

Showing 1 - 20 of 26180 results for search: "information retrieval".


[View All Results](#)

Articles+

Full-text articles, e-books, electronic subscription resources

Showing 1 - 20 of 2207458 results for search: "information retrieval".


[View All Results](#)



Emerging ideas on information filtering and retrieval : DART 2013 : Revised and invited papers

Author: DART 2013 (2013 : Turin, Italy)

Published: Cham : Springer, [2018]

Format:  eBook

Full text available via the UNC-Chapel Hill Libraries Online Access


Limited preview available via Google Book Search Limited Preview

[Temporal information retrieval](#)

by Kanhabua, Nattiya; Blanco, Roi and Nrvåg, Kjetil

Foundations and Trends in Information Retrieval, **Record has both ISBN and ISSN!**, 2015, Volume 9, Issue 2, pp. 91 - 208


Temporal dynamics and how they impact upon various components of **information retrieval** (IR... *Temporal databases, Information retrieval, TOPICS, WIKIPEDIA, PERFORMANCE, NEWS, DYNAMICS, COMPUTER SCIENCE, INFORMATION SYSTEMS, LANGUAGE MODELS, TIME, LATENT DIRICHLET ALLOCATION, TRENDS, WEB SEARCH ENGINES*



Laboratory Experiments in Information Retrieval [electronic resource] : Sample Sizes, Effect Sizes, and Statistical Power


Author: Sakai, Tetsuya, author. author
<http://id.loc.gov/vocabulary/relators/aut>

Published: Singapore : Springer, 2018.

Format:  eBook

Full text available via the UNC-Chapel Hill Libraries Online Access

Limited preview available via Google Book Search Limited Preview

 Journal Article: [Full Text Online](#)




Social Media Search (e.g., Facebook)

The screenshot shows a Facebook search results page for 'UNC Chapel Hill'. The search bar at the top contains the text 'UNC Chapel Hill' and a magnifying glass icon. The user's name 'Jaime' and navigation links 'Home', 'Create', and notification icons are visible in the top right. Below the search bar is a horizontal menu with tabs for 'All', 'Posts', 'People', 'Photos', 'Videos', 'Pages', 'Places', 'Groups', 'Apps', 'Events', and 'Links'. The 'Pages' tab is selected and highlighted with a black border.

Filter Results




- POSTS FROM**
 - Anyone
 - You
 - Your Friends
 - Your Groups
 - Public
 - [+ Choose a Source...](#)
- POST TYPE**
 - All Posts
 - Posts You've Seen
- POSTED IN GROUP**
 - Any group
 - Your Groups
 - [+ Choose a Group...](#)
- TAGGED LOCATION**
 - Anywhere
 - Carrboro, North Carolina
 - Tegucigalpa, Honduras
 - [+ Choose a Location...](#)
- DATE POSTED**
 - Any date
 - 2018
 - 2017
 - 2016
 - [+ Choose a Date...](#)

Pages [See All](#)

-  **The University of North Carolina at Chapel Hill** [Like](#)
275K like this · Public & Government Service
Adam Burns and 16 other friends like this
[UNC-Chapel Hill](#), the nation's first public university, is among the ...
-  **UNC-Chapel Hill - Office of Undergraduate Admissions** [Like](#)
7.5K like this · [Chapel Hill](#), North Carolina · College & University
No matter what you're inspired to do, Carolina isn't the place to thi...
-  **UNC-Chapel Hill Library** [Like](#)
2.7K like this · [Chapel Hill](#), North Carolina · Library
Andal Narayanan and 4 other friends like this
The [UNC](#) Library supports inquiry and learning at the University of ...

[See All](#)

Articles [See All](#)

-  **BREAKING: Mack Brown will be next UNC football head coach, Inside Carolina reports**
Mack Brown is coming home. Shortly after a announceme...
dailytarheel.com
4 hours ago · 188 shares
-  **UNC-Chapel Hill hires Mack Brown to lead football program**
North Carolina has employed Mack Brown to steer its footb...
newzparot.com
2 hours ago · 1 shares
-  **No. 1 UNC field hockey wins National Championship with a 2-0 victory over Maryland**
It is the program's seventh national title and the conclusion...
dailytarheel.com

English (US) · Español · Português (Brasil) · Français (France) · Deutsch [+](#)

[Privacy](#) · [Terms](#) · [Advertising](#) · [Ad Choices](#) · [Cookies](#) · [More](#)
Facebook © 2018

Aggregated Search Systems

- Vary based on the extent to which the visual layout differentiates between results from different sources
- Use Gestalt principles (to different extents) to convey relations between results
- **Proximity:** items closer together are related
- **Similarity:** items that look similar are related
- **Common region:** items in a common region are related

Research Questions

- The effects of 3 cognitive abilities and 2 interface conditions on:
 - RQ1: effort
 - RQ2: user engagement
 - RQ3: search behaviors
- **Interfaces:** varied in the extent to which Gestalt principles were used to distinguish between results from different verticals (web, images, news, shopping, video)

Cognitive Abilities

- **Working memory:** the ability to hold (and work with) information in active memory
- **Perceptual speed:** the ability to quickly scan for information
- **Inhibition (or attention control):** the ability to ignore (or inhibit attention to) stimuli not relevant to the task at hand

Interface Conditions: Blocked Interface

Everything Web Images Videos News Shopping

search blue

russia 2018 fifa world cup Search

images

WEB RESULTS: 1-10 of 47

Everything

Web


Images

Videos

News

Shopping

Image Results



→ more for russia 2018 fifa world cup images

2018 FIFA World Cup Russia? - FIFA.com
Are you planning to visit **Russia** for the **2018 FIFA World Cup**? Welcome2018.com is the tourist portal of the Russian government and provides fans travelling to **Russia** with useful information about the host nation of the next **FIFA World Cup**.
<https://www.fifa.com/worldcup/>

2018 FIFA World Cup - Wikipedia
A ceremony in Moscow launching the countdown from 1,000 days until the **2018 FIFA Football World Cup** begins in **Russia**.
https://en.wikipedia.org/wiki/2018_FIFA_World_Cup

2018 FIFA World Cup Russia? Tourist Portal
Russia is the **world's** largest country. More than half of the population are football fans or at least follow the sport occasionally. **FIFA World Cup 2018 in Russia** is a phenomenally powerful magnet.
<http://welcome2018.com/en/>

Russia 2018 World Cup schedule: Complete fixture, dates ...
The **2018 FIFA World Cup** is right around the corner. In just about three weeks, the greatest soccer players on the planet will take center stage in **Russia**.
<https://www.cbssports.com/soccer/world-cup/news/russia-2018-world-cup-schedule-complete-fixture-dates-start-times-tv-channels-live-stream-info/>

Fan Guide: 2018 FIFA World Cup Tournament | FOX Sports
Find everything you need to know about the **2018 FIFA World Cup** in **Russia**, including key dates, qualifying & draw info, match schedules, stadiums & more at **FOX Sports**.
<https://www.foxsports.com/soccer/fifa-world-cup/fan-guide>

2018 FIFA World Cup: Russia - UEFA.com
The **2018 FIFA World Cup** final tournament will be played in **Russia** from 14 June?15 July 2018.
<https://www.uefa.com/worldcup/season=2018/finals/index.html>

2018 FIFA World Cup Russia? - FIFA.com
SAINT PETERSBURG, **RUSSIA** - JULY 02: A player tracking tablet is seen on the bench at half time during the **FIFA Confederations Cup Russia 2017** Final between Chile and Germany at Saint Petersburg Stadium on July 2, 2017 in Saint Petersburg, **Russia**.
<http://resources.fifa.com/worldcup/>

2018 FIFA World Cup Russia (TM) Hospitality Packages
Ticket-inclusive hospitality packages for the **2018 FIFA World Cup Russia**?. Official website of the exclusive hospitality rights holder appointed by **FIFA**.
<https://hospitality.fifa.com/hospitality2018>

Schedule | 2018 FIFA World Cup Russia?
World Cup schedule: teams, cities, stadiums, dates and time.
<http://welcome2018.com/en/matches/>

FIFA: Russia World Cup 2018 is struggling to find sponsors
With roughly six months to go before **World Cup 2018** kicks off in **Russia**, **FIFA** is struggling to find **sponsors**.
<http://money.cnn.com/2017/12/01/news/fifa-sponsors-russia-2018/index.html>

1 2 3 4 5 next

News Results

Russia 2018 FIFA World Cup: Team previews for all 32 teams
Time is running out as the **2018 FIFA World Cup** kicks off on June 14 when host **Russia** takes on Saudi Arabia. And it's time for you to get caught up on every team, what there is to know, when they'll play and how you can watch. Below you will find links to ...
[CBSSports.com](https://www.cbssports.com) 19 hours ago

World Cup 2018: Schedule, group matches, how to watch live
Group stage matches for the **2018 World Cup** in **Russia** are set ... Thirty-one soccer teams earned the right to play for the **FIFA World Cup** trophy and **Russia** was given an automatic bid into the competition to complete the field as is customary for the ...
[Sporting News](https://www.sportingnews.com) 15 hours ago

Kia Provides 424 Vehicles for Official Use at 2018 FIFA World Cup Russia
Kia Motors has provided 424 vehicles to assist operations at the much-anticipated **2018 FIFA World Cup Russia**. The handover of the provisional fleet took place May 31 at the Luzhniki Stadium in Moscow, where the **World Cup** Final will be held on July 15.
[The Drive](https://www.thedrive.com) seconds ago

→ more for russia 2018 fifa world cup news

Video Results

12 DAYS TO GO! Goals galore at Switzerland 1954
Duration: 55 seconds

Brazilian Player Alex Sandro full information (Best Brazilian player 2018 in Fifa World Cup Russia)
Duration: 3 minutes

FIFA World Cup Russia 2018 ? Official Promo ??
Duration: 2 minutes

Brazil vs Argentina Bangla Funny Dubbing | FIFA World Cup 2018 Russia | Binodon TV | Messi, Neymar
Duration: 2 minutes

FIFA World Cup Russia 2018 ? Official Promo
Duration: 3 minutes

→ more for russia 2018 fifa world cup videos

Shopping Results

PANINI FIFA World Cup Russia 2018. New, Pick Any 10 Stickers. Free Shipping.
\$5.0 Condition: Brand New

2018 PANINI RUSSIA FIFA WORLD CUP SOCCER STICKERS - FACTORY SEALED 50 PACK BOX
\$37.95 Condition: Brand New

Panini Fifa World Cup Russia 2018 - Individual Stickers Pick any 10
\$4.99 Condition: Brand New

2018 Panini Russia FIFA World Cup Soccer Stickers - Factory Sealed 50 Pack Box
\$44.99 Condition: Brand New

Panini FIFA World Cup Russia 2018 Stickers Pick 20 30 40 50 THOUSANDS AVAILABLE
\$9.9 Condition: Like New

→ more for russia 2018 fifa world cup shopping

news

video

shopping

Interface Conditions: Interleaved Interface (truncated)

Everything
Web
Images
Videos
News
Shopping

WEB RESULTS: 1-10 of 47

Everything

Web

Images

Videos

News

Shopping

[Image Results](#)

[2018 FIFA World Cup Russia? - FIFA.com](#)

Are you planning to visit **Russia** for the **2018 FIFA World Cup**? Welcome2018.com is the tourist portal of the Russian government and provides fans travelling to **Russia** with useful information about the host nation of the next **FIFA World Cup**.

<https://www.fifa.com/worldcup>

[Russia 2018 FIFA World Cup: Team previews for all 32 teams](#)

Time is running out as the **2018 FIFA World Cup** kicks off on June 14 when host **Russia** takes on Saudi Arabia. And it's time for you to get caught up on every team, what there is to know, when they'll play and how you can watch. Below you will find links to ...

[CBSsports.com](#) 18 hours ago

[2018 FIFA World Cup - Wikipedia](#)

A ceremony in Moscow launching the countdown from 1,000 days until the **2018 FIFA Football World Cup** begins in **Russia**.

https://en.wikipedia.org/wiki/2018_FIFA_World_Cup

[12 DAYS TO GO! Goals galore at Switzerland 1954](#)

The 12 goals scored in Austria 7-5 Switzerland in the 1954 FIFA World Cup Switzerland? quarter-finals make it the highest-scoring match in the history of the global ...

Duration: 55 seconds

[2018 FIFA World Cup Russia? Tourist Portal](#)

Russia is the **world's** largest country. More than half of the population are football fans or at least follow the sport occasionally. **FIFA World Cup 2018 in Russia** is a phenomenally powerful magnet.

welcome2018.com/en

[PANINI FIFA World Cup Russia 2018. New. Pick Any 10 Stickers. Free Shipping.](#)

\$5.0

Condition: Brand New

[Russia 2018 World Cup schedule: Complete fixture, dates ...](#)

The **2018 FIFA World Cup** is right around the corner. In just about three weeks, the greatest soccer players on the planet will take center stage in **Russia**.

<https://www.cbssports.com/soccer/world-cup/news/russia-2018-world...>

[World Cup 2018: Schedule, group matches, how to watch live](#)

Group stage matches for the **2018 World Cup** in **Russia** are set ... Thirty-one soccer teams earned the right to play for the **FIFA World Cup** trophy and **Russia** was given an automatic bid into the competition to complete the field as is customary for the ...

[Sporting News](#) 15 hours ago

[Fan Guide: 2018 FIFA World Cup Tournament | FOX Sports](#)

Find everything you need to know about the **2018 FIFA World Cup** in **Russia**, including key dates, qualifying & draw info, match schedules, stadiums & more at **FOX Sports**.

<https://www.foxsports.com/soccer/fifa-world-cup/fan-guide>

[Kia Provides 424 Vehicles for Official Use at 2018 FIFA World Cup Russia](#)

Kia Motors has provided 424 vehicles to assist operations at the much-anticipated **2018 FIFA World Cup Russia**. The handover of the provisional fleet took place May 31 at the Luzhniki Stadium in Moscow, where the **World Cup** Final will be held on July 15.

[The Drive](#) seconds ago

images

web

news

web

video

web

shopping

web

news

web

news

...

User Study

(N=32)

- 4 search tasks (2 with each interface)
- 2 post-task questionnaires (effort, engagement)
- (Short break)
- 3 post-study psychometric tests

Comparative Tasks

- Compare 3 items (alternatives) along 3 dimensions (criteria)
- Bookmark at least 10 pages + provide justification

“You are planning an extended hiking trip with your friend for this fall. You’ve recently heard that it can be unsafe to drink water directly from streams and rivers due to the possibility of contamination from bacteria, parasites, and pollutants. Now, you are trying to do some research on methods for purifying naturally-sourced water. Consider the following water purification methods: (1) boiling water (2) water purification tablets (3) using a portable water filter. For this task, your goal is to compare and contrast these methods based on the following criteria: (1) the types of bacteria eliminated by the method, (2) how much the method costs, and (3) how the method works.”

	bacteria eliminated	equipment cost	how it works
boiling water			
purification tablets			
portable filter			

RQ1: Effort

NASA TLX

Mental demand: How mentally demanding was the task?

Physical demand: How physically demanding was the task?

Temporal demand: How hurried or rushed was the pace of the task?

Failure: How successful were you in accomplishing what you were asked to do?

Effort: How hard did you have to work to accomplish your level of performance?

Frustration: How insecure, discouraged, irritated, stressed, annoyed were you?

RQ2: User Engagement

O'Brien's UES

FA1: I lost myself in this search experience.

FA2: The time I spent searching just slipped away.

FA3: I was absorbed in the search task.

PU1: I felt frustrated while doing the search task. (reverse coded)

PU2: My search experience was taxing. (reverse coded)

PU3: I found the search system confusing to use. (reverse coded)

AE1: The search system was attractive.

AE2: The search system was aesthetically appealing.

AE3: The search system appealed to my senses.

RW1: My search experience was worthwhile.

RW2: My search experience was rewarding.

RW3: I felt interested in the search task.

RQ3: Search Behaviors

15 Behavioral Measures

- Queries
- Clicks
- Bookmarks
- Completion Time
- Time to 1st bookmark
- Query-to-click time
- Click-to-bookmark time
- Time b/w events
(queries, clicks,
bookmarks)
- Clicks w/o bookmarks
- Queries w/o clicks
- Queries w/o mouseover events
- Queries w/o scrolls
- Queries w/o bookmarks
- Quick reformulations (< 1 min.)
- Queries with repeated intent
(qualitative analysis)

RQ3: Search Behaviors

Factor Analysis

- 3-factor solution explained 68% of variance

	Factor 1	Factor 2	Factor 3
queries without bookmarks	0.888	0.021	0.216
queries with repeated intent queries	0.867	0.029	0.217
queries without clicks	0.863	-0.285	0.214
quick query reformulations	0.811	-0.412	-0.083
queries without mouseovers	0.696	0.118	-0.018
queries without scrolls	0.577	-0.370	-0.004
time between events	-0.259	0.887	-0.027
time to first bookmark	0.019	0.718	0.202
bookmarks	-0.045	-0.659	0.242
click-to-bookmark time	-0.207	0.626	-0.072
query-to-click time	0.134	0.523	-0.065
clicks	0.143	-0.462	0.851
clicks without a bookmark	0.161	-0.033	0.835
completion time	0.045	0.577	0.674

RQ3: Search Behaviors

Factor Analysis

- Factor 1: difficulty identifying relevant SERP results

	Factor 1	Factor 2	Factor 3
queries without bookmarks	0.888	0.021	0.216
queries with repeated intent queries	0.867	0.029	0.217
queries without clicks	0.863	-0.285	0.214
quick query reformulations	0.811	-0.412	-0.083
queries without mouseovers	0.696	0.118	-0.018
queries without scrolls	0.577	-0.370	-0.004
time between events	-0.259	0.887	-0.027
time to first bookmark	0.019	0.718	0.202
bookmarks	-0.045	-0.659	0.242
click-to-bookmark time	-0.207	0.626	-0.072
query-to-click time	0.134	0.523	-0.065
clicks	0.143	-0.462	0.851
clicks without a bookmark	0.161	-0.033	0.835
completion time	0.045	0.577	0.674

RQ3: Search Behaviors

Factor Analysis

- **Spoiler:** perceptual speed affected measures related to Factor 1

	Factor 1	Factor 2	Factor 3
queries without bookmarks	0.888	0.021	0.216
queries with repeated intent queries	0.867	0.029	0.217
queries without clicks	0.863	-0.285	0.214
quick query reformulations	0.811	-0.412	-0.083
queries without mouseovers	0.696	0.118	-0.018
queries without scrolls	0.577	-0.370	-0.004
time between events	-0.259	0.887	-0.027
time to first bookmark	0.019	0.718	0.202
bookmarks	-0.045	-0.659	0.242
click-to-bookmark time	-0.207	0.626	-0.072
query-to-click time	0.134	0.523	-0.065
clicks	0.143	-0.462	0.851
clicks without a bookmark	0.161	-0.033	0.835
completion time	0.045	0.577	0.674

RQ3: Search Behaviors

Factor Analysis

- Factor 2: pace of interaction

	Factor 1	Factor 2	Factor 3
queries without bookmarks	0.888	0.021	0.216
queries with repeated intent queries	0.867	0.029	0.217
queries without clicks	0.863	-0.285	0.214
quick query reformulations	0.811	-0.412	-0.083
queries without mouseovers	0.696	0.118	-0.018
queries without scrolls	0.577	-0.370	-0.004
time between events	-0.259	0.887	-0.027
time to first bookmark	0.019	0.718	0.202
bookmarks	-0.045	-0.659	0.242
click-to-bookmark time	-0.207	0.626	-0.072
query-to-click time	0.134	0.523	-0.065
clicks	0.143	-0.462	0.851
clicks without a bookmark	0.161	-0.033	0.835
completion time	0.045	0.577	0.674

RQ3: Search Behaviors

Factor Analysis

- **Spoiler:** inhibition affected measures related to Factor 2

	Factor 1	Factor 2	Factor 3
queries without bookmarks	0.888	0.021	0.216
queries with repeated intent queries	0.867	0.029	0.217
queries without clicks	0.863	-0.285	0.214
quick query reformulations	0.811	-0.412	-0.083
queries without mouseovers	0.696	0.118	-0.018
queries without scrolls	0.577	-0.370	-0.004
time between events	-0.259	0.887	-0.027
time to first bookmark	0.019	0.718	0.202
bookmarks	-0.045	-0.659	0.242
click-to-bookmark time	-0.207	0.626	-0.072
query-to-click time	0.134	0.523	-0.065
clicks	0.143	-0.462	0.851
clicks without a bookmark	0.161	-0.033	0.835
completion time	0.045	0.577	0.674

RQ3: Search Behaviors

Factor Analysis

- Factor 3: effort

	Factor 1	Factor 2	Factor 3
queries without bookmarks	0.888	0.021	0.216
queries with repeated intent queries	0.867	0.029	0.217
queries without clicks	0.863	-0.285	0.214
quick query reformulations	0.811	-0.412	-0.083
queries without mouseovers	0.696	0.118	-0.018
queries without scrolls	0.577	-0.370	-0.004
time between events	-0.259	0.887	-0.027
time to first bookmark	0.019	0.718	0.202
bookmarks	-0.045	-0.659	0.242
click-to-bookmark time	-0.207	0.626	-0.072
query-to-click time	0.134	0.523	-0.065
clicks	0.143	-0.462	0.851
clicks without a bookmark	0.161	-0.033	0.835
completion time	0.045	0.577	0.674

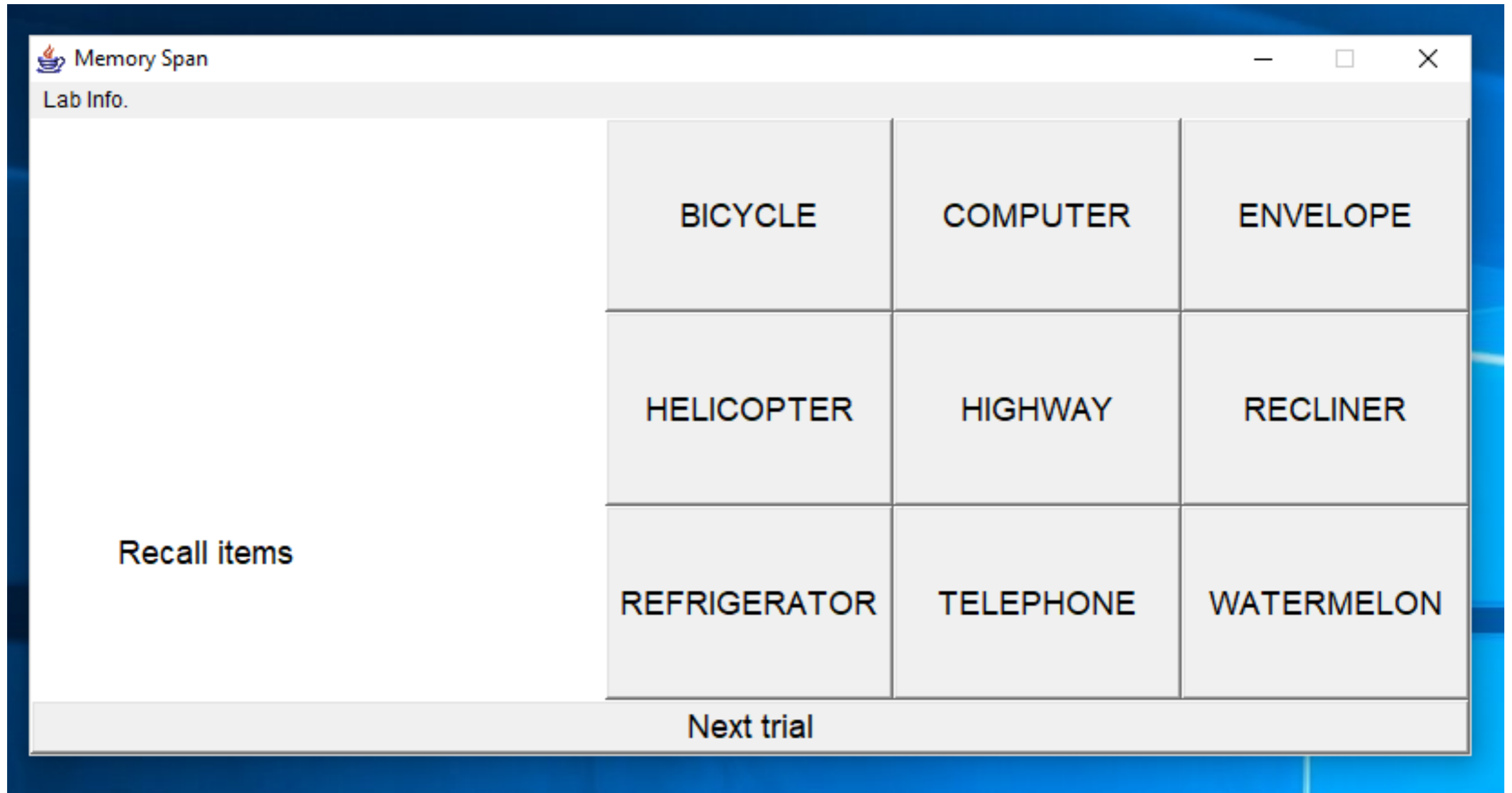
Psychometric Tests

Perceptual Speed: Finding A's Test

1	2	3	4	5
cider	east	stripe	insert	defend
bough	blind	coarse	court	settle
fudge	chord	govern	pearl	lodge
greet	solar	perfect	bridle	oaken
fault	spoon	special	recess	crown
leap	piece	consist	soapy	quest
count	rinse	mostly	able	glimpse
shore	drawn	shrink	pledge	every
ease	fleet	pencil	refuse	break
define	sense	hinder	better	where
entire	uncle	solace	patrol	thorn
ghost	white	keeper	judge	pause
knife	coach	night	defect	hence
hedge	south	clock	trust	short
petal	period	picnic	other	person
scope	millar	smart	straw	warm
ripen	slogan	finger	noisy	juice
under	height	useful	defer	enter
heard	event	slowly	field	ordeal
quite	bond	meant	mend	nurse
jump	west	quick	skill	cool

Psychometric Tests

Working Memory: Memory Span Test



The screenshot shows a software window titled "Memory Span" with a "Lab Info." header. The main area contains a 3x3 grid of words. The words are: BICYCLE, COMPUTER, ENVELOPE (top row); HELICOPTER, HIGHWAY, RECLINER (middle row); and REFRIGERATOR, TELEPHONE, WATERMELON (bottom row). To the left of the grid is the label "Recall items". Below the grid is a "Next trial" button.

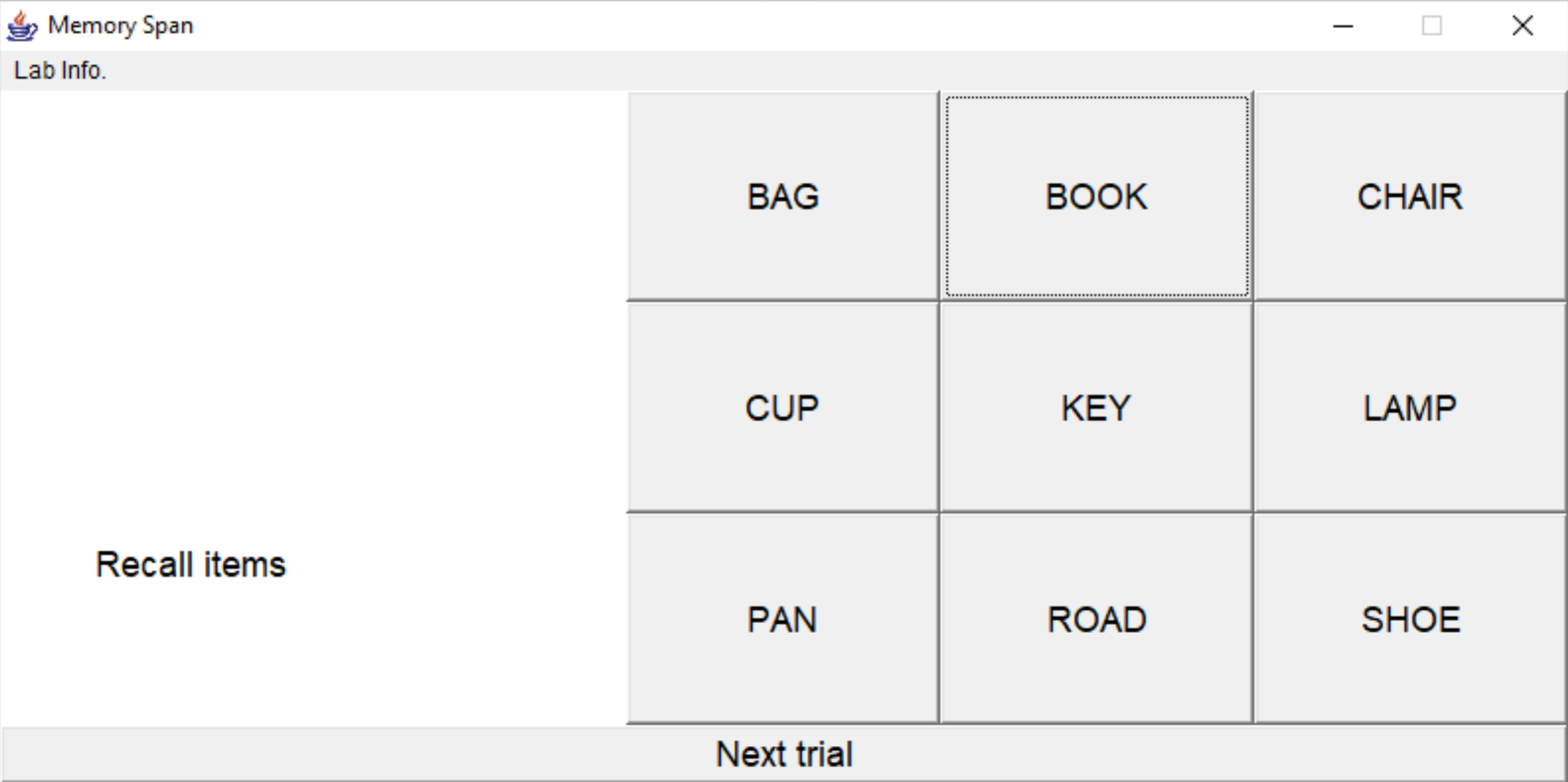
	BICYCLE	COMPUTER	ENVELOPE
	HELICOPTER	HIGHWAY	RECLINER
Recall items	REFRIGERATOR	TELEPHONE	WATERMELON

Next trial

(long words)

Psychometric Tests

Working Memory: Memory Span Test



The screenshot shows a software window titled "Memory Span" with a "Lab Info." header. The main area contains a 3x3 grid of words. The words are: BAG, BOOK, CHAIR in the first row; CUP, KEY, LAMP in the second row; and PAN, ROAD, SHOE in the third row. The word "BOOK" is highlighted with a dashed border. To the left of the grid is a text input area labeled "Recall items". At the bottom of the window is a button labeled "Next trial".

	BAG	BOOK	CHAIR
	CUP	KEY	LAMP
Recall items	PAN	ROAD	SHOE

Next trial

(short words)

Psychometric Tests

Working Memory: Memory Span Test

The screenshot shows a software window titled "Memory Span" with standard window controls (minimize, maximize, close). Below the title bar is a "Lab Info." section. The main area contains a 3x3 grid of cells, each containing a number from 1 to 9. The cell containing the number 2 is highlighted with a dotted border. To the left of the grid is a large white area labeled "Recall items". At the bottom of the window is a button labeled "Next trial".

	1	2	3
	4	5	6
Recall items	7	8	9

Next trial

(numbers)

Psychometric Tests

Working Memory: Memory Span Test

Memory Span

Lab Info.

	B	C	D
	E	G	P
Recall items	T	V	Z

Next trial

(letter that sound similar)

Psychometric Tests

Working Memory: Memory Span Test

Memory Span

Lab Info.

	F	H	J
	L	M	Q
Recall items	R	S	W

Next trial

(letter that sound dissimilar)

Psychometric Tests

Inhibition: Stroop Test

Identify the color of the font and ignore the name of the word.

Press the h key for red, the j key for green, and the k key for blue

GREEN

(congruent condition)

Psychometric Tests

Inhibition: Stroop Test

Identify the color of the font and ignore the name of the word.

Press the h key for red, the j key for green, and the k key for blue

GREEN

(incongruent condition)

Psychometric Tests

Ranges and Correlations

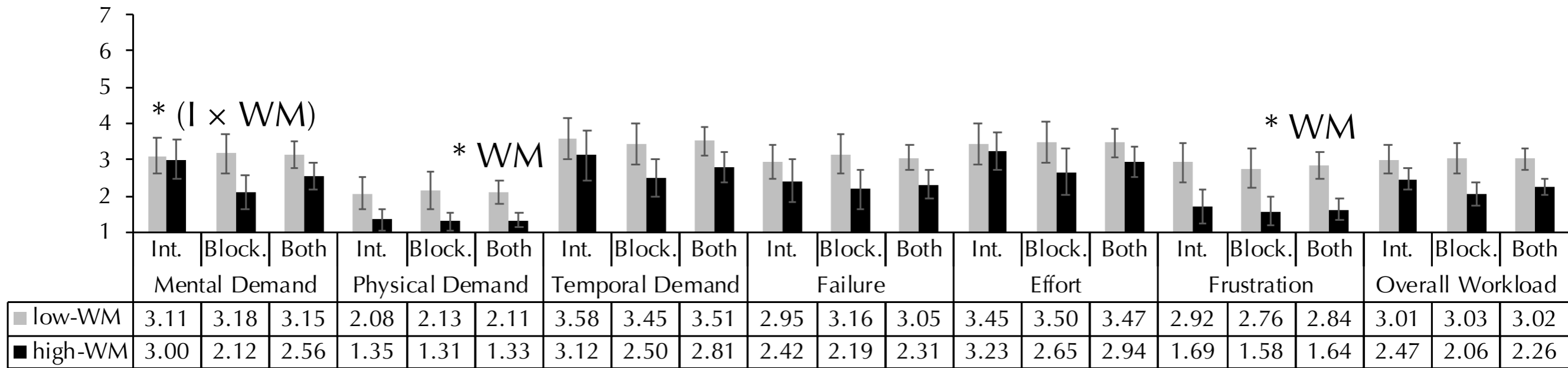
	Working Memory	Perceptual Speed	Inhibition
Possible Range	0-9	0-200	unbounded
Mean (SD)	4.86 (0.79)	64.16 (12.00)	107.80 (166.27)
Median	5.60	63	101.80
Min, Max	3.80, 7.20	44, 90	-272.20, 449.13

- WM vs. PS: $r = .069$ ($p = .707$)
- WM vs. IN: $r = .133$ ($p = .469$)
- PS vs. IN: $r = .165$ ($p = .366$)

Results

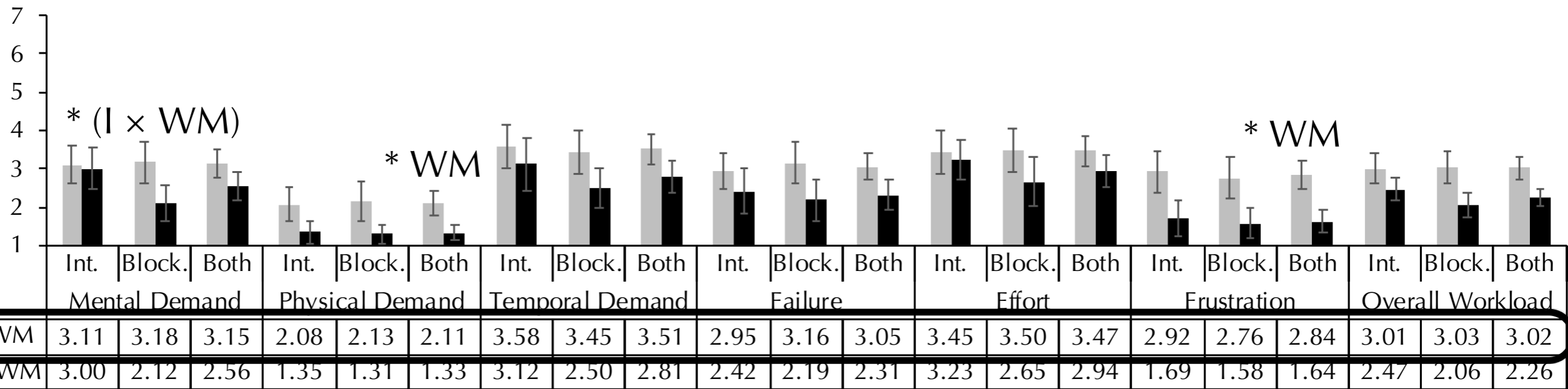
RQ1: Workload

Working Memory



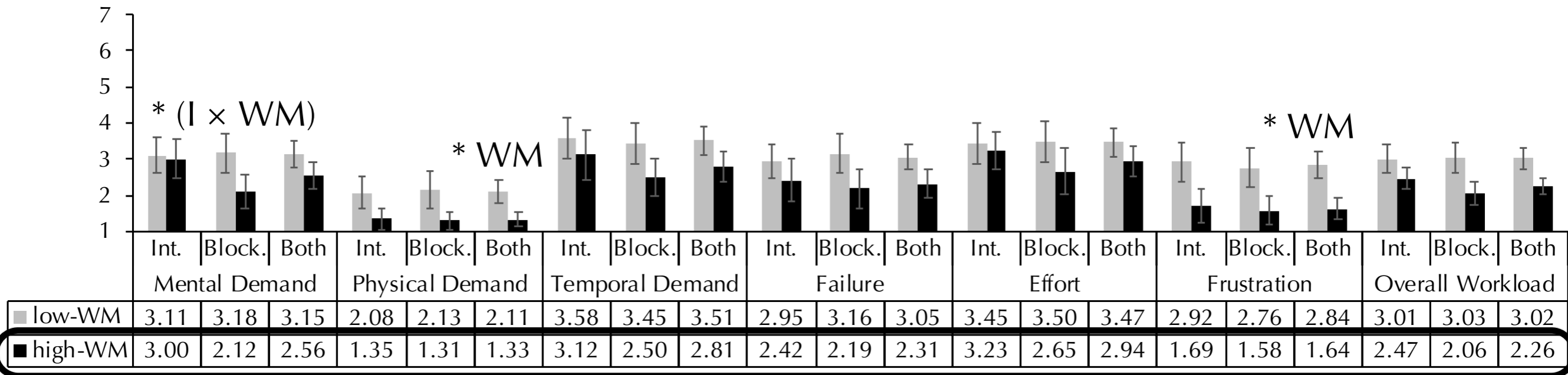
RQ1: Workload

Working Memory



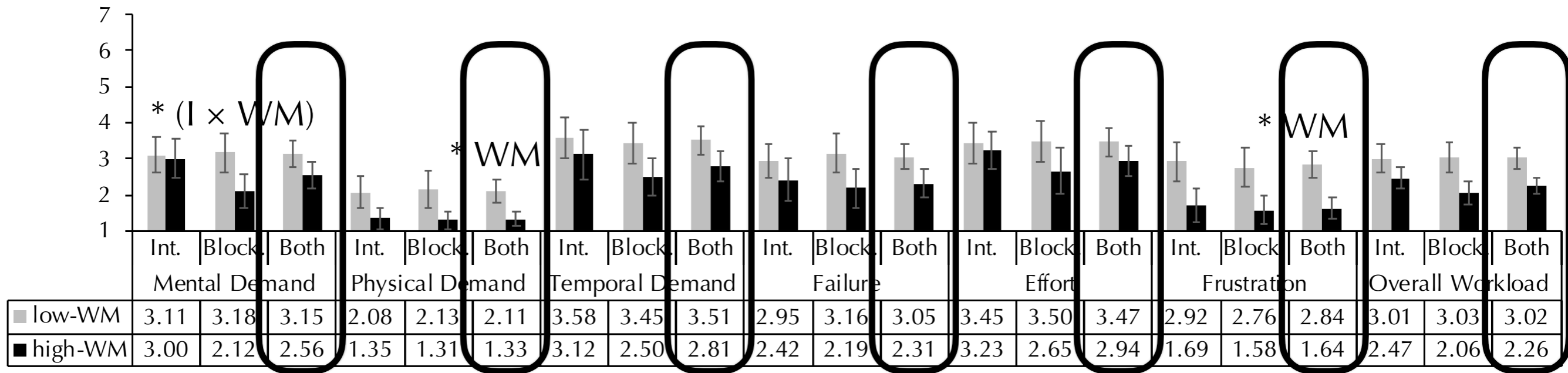
RQ1: Workload

Working Memory



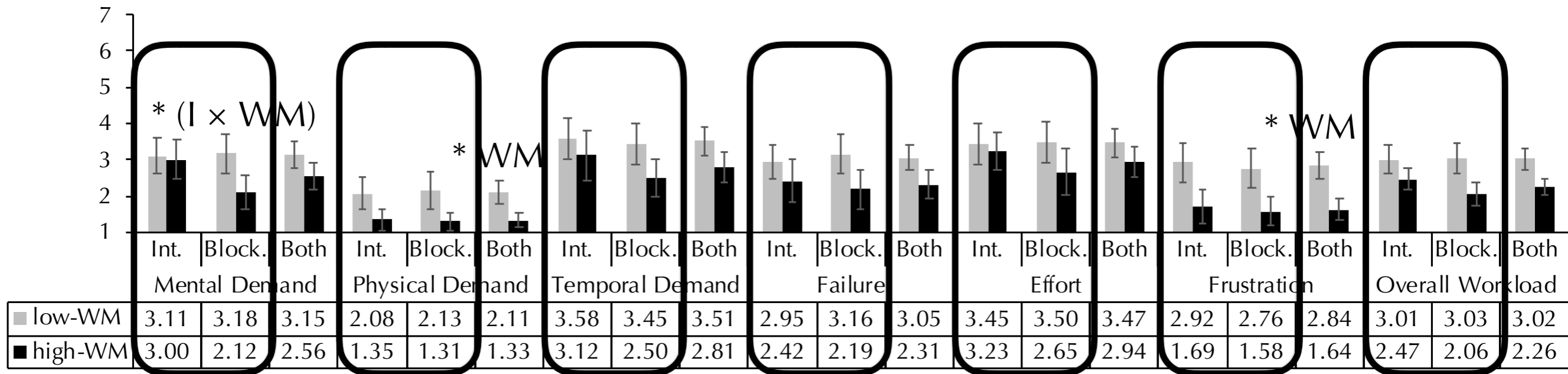
RQ1: Workload

Working Memory



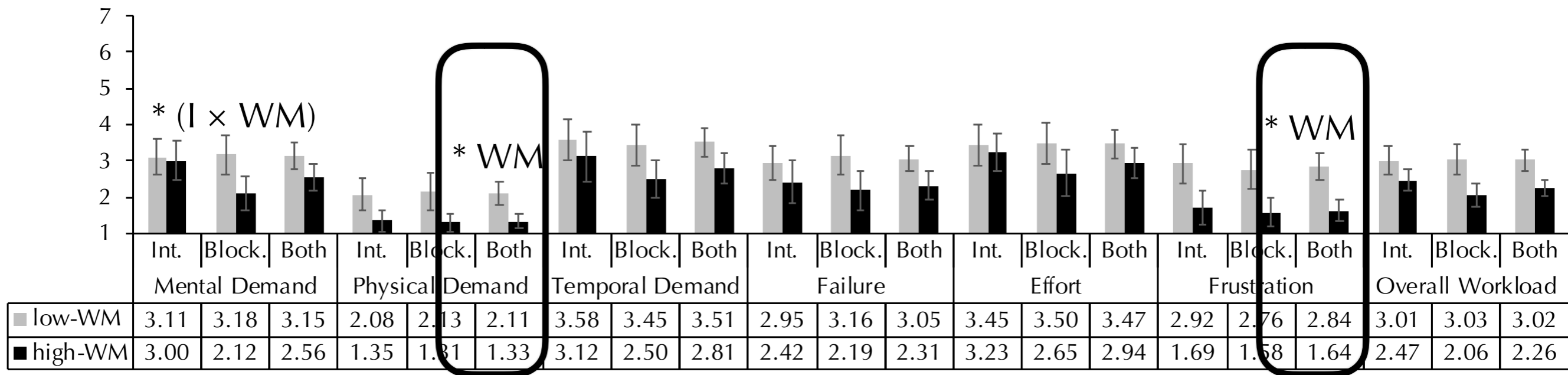
RQ1: Workload

Working Memory



RQ1: Workload

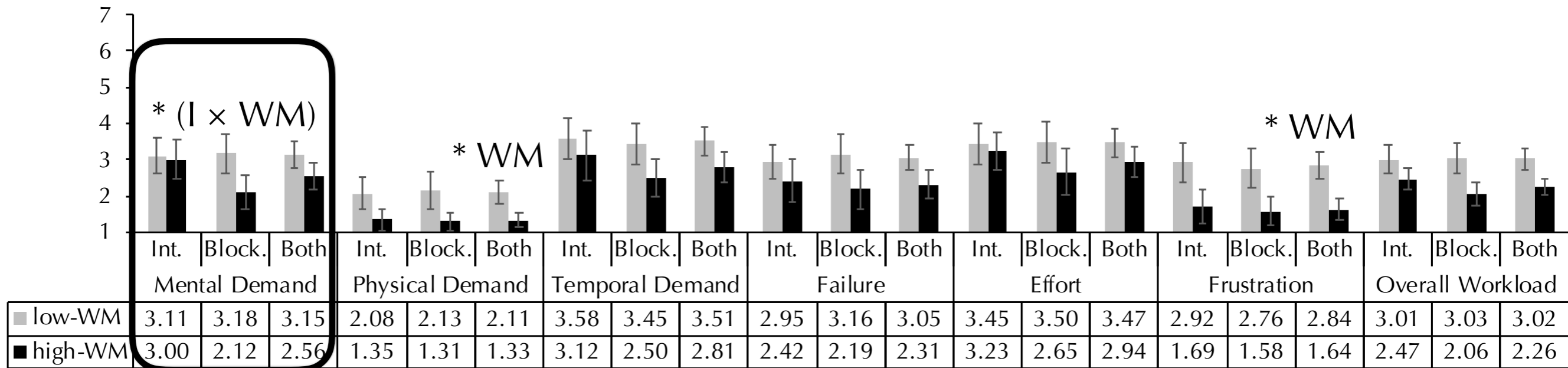
Working Memory



- Irrespective of the interface, high-WM participants reported lower physical demand and frustration ($p < .05$)

RQ1: Workload

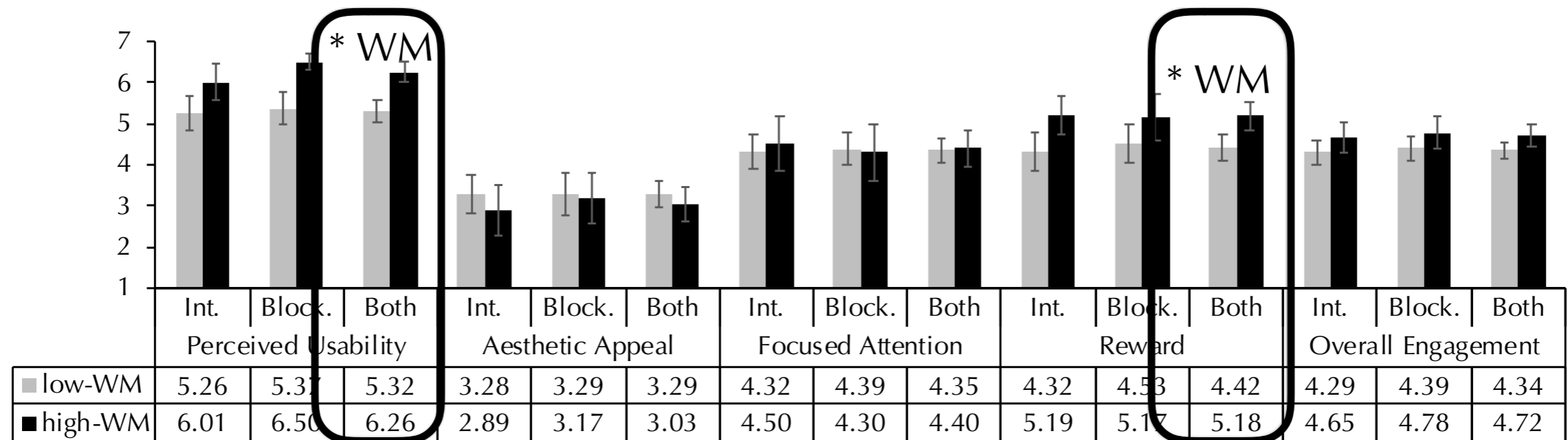
Working Memory



- With the interleaved interface, both participant groups report similar levels of mental demand
- With the blocked interface, high-WM participants reported lower levels of mental demand
- **Possible Explanation:** high-WM participants were more effective at leveraging the fixed layout of the blocked interface

RQ2: Engagement

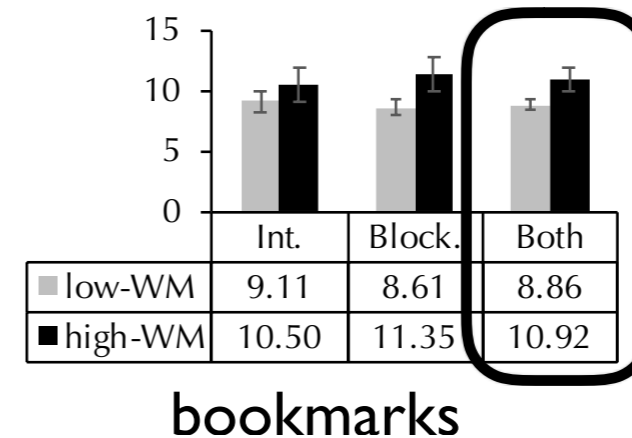
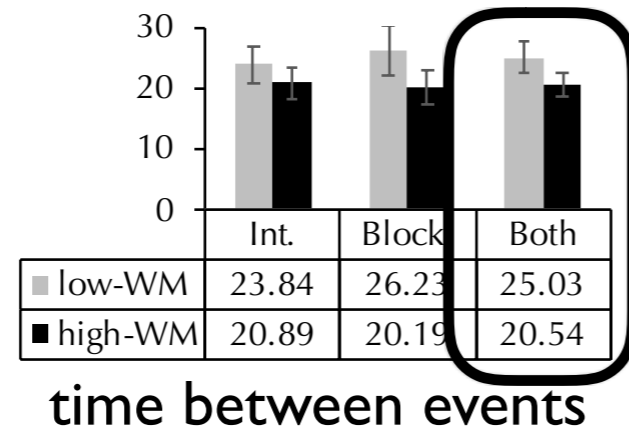
Working Memory



- Irrespective of the interface condition, high-WM participants reported higher perceived usability and reward ($p < .05$)

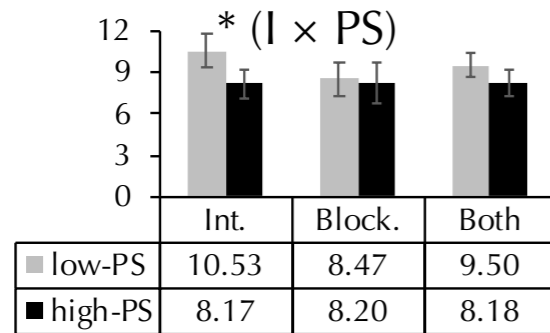
RQ3 Results: Effects on Search Behaviors

RQ3 Results: Working Memory on Search Behaviors

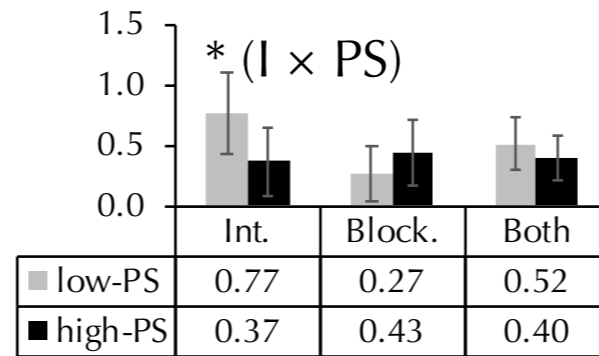


- Working memory had no significant effects on search behaviors
- **General trend:** high-WM participants worked faster and produced more bookmarks ($p=.06$)

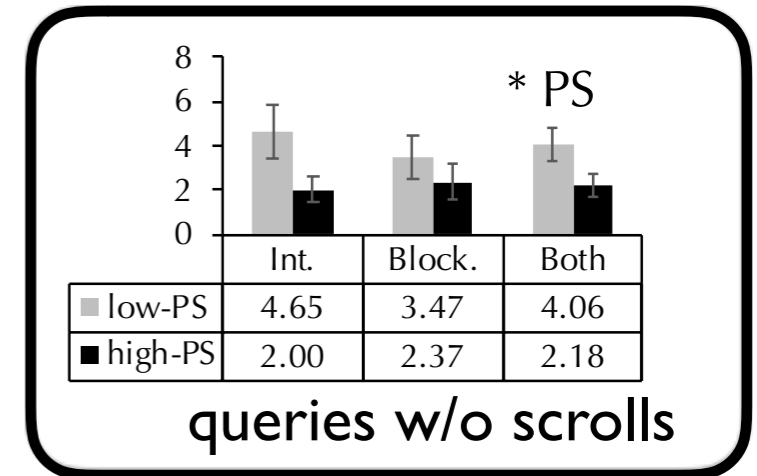
RQ3 Results: Perceptual Speed on Search Behaviors



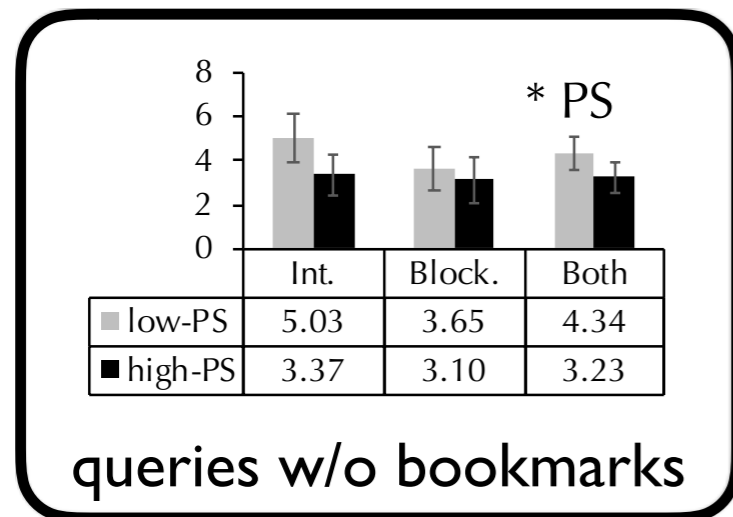
queries



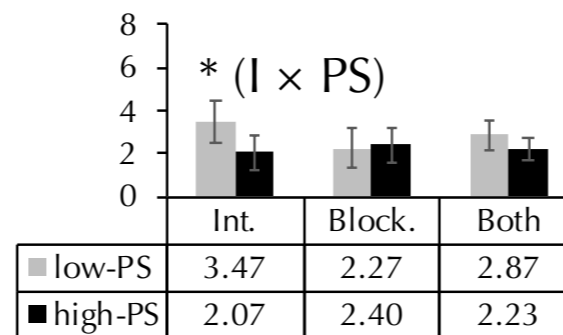
queries w/o mouseovers



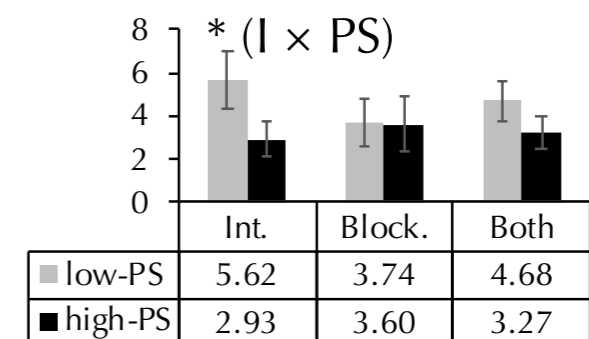
queries w/o scrolls



queries w/o bookmarks

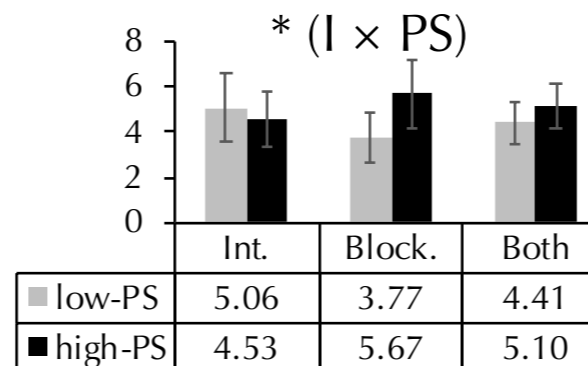


repeated intent queries



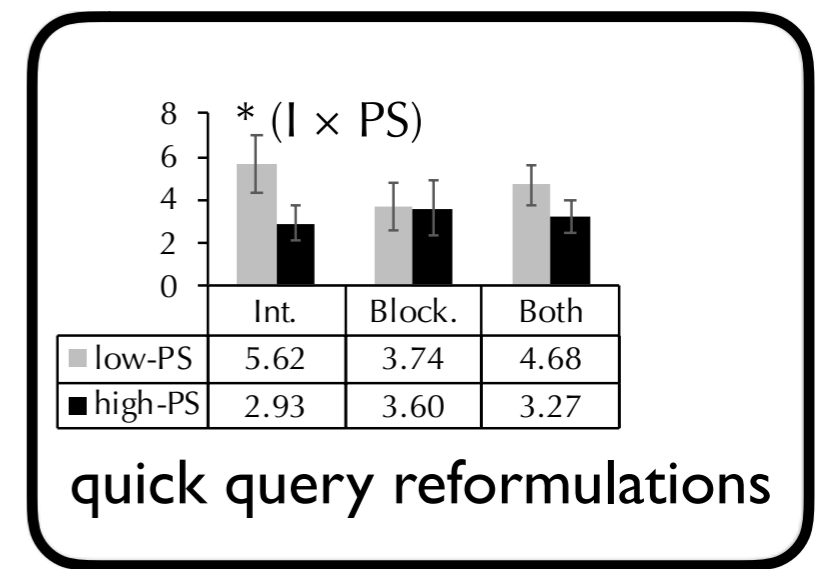
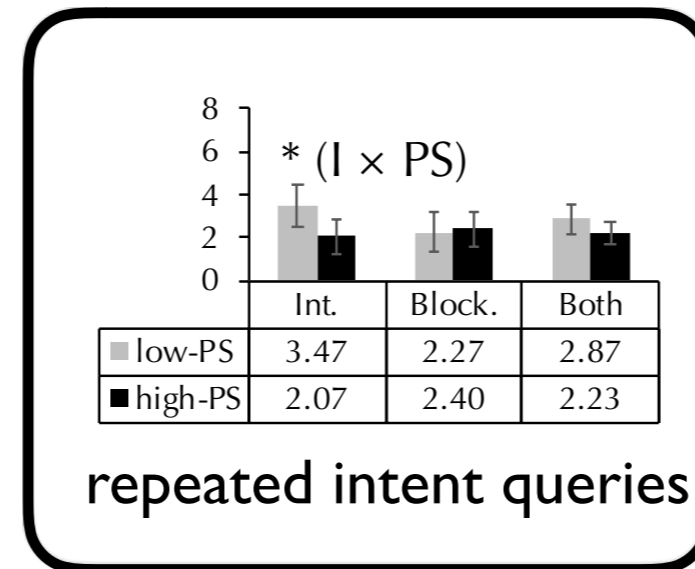
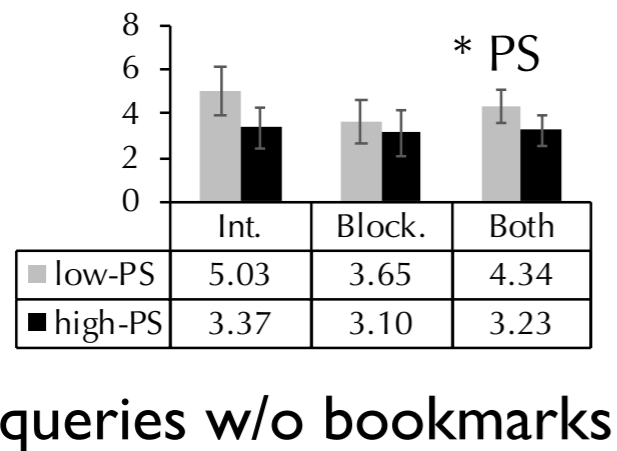
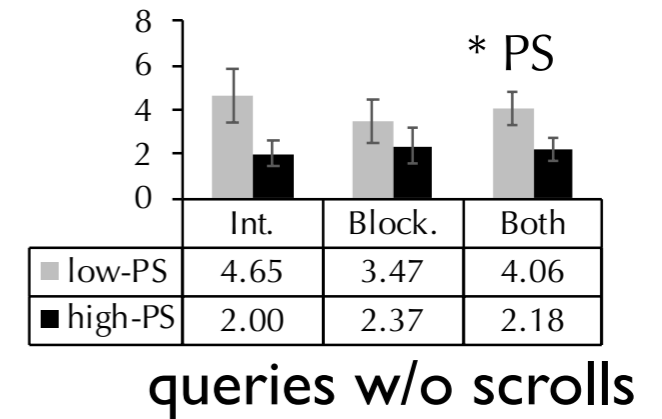
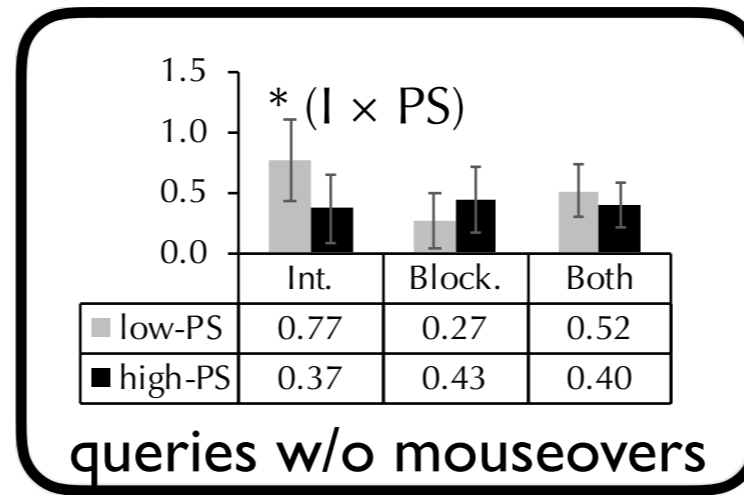
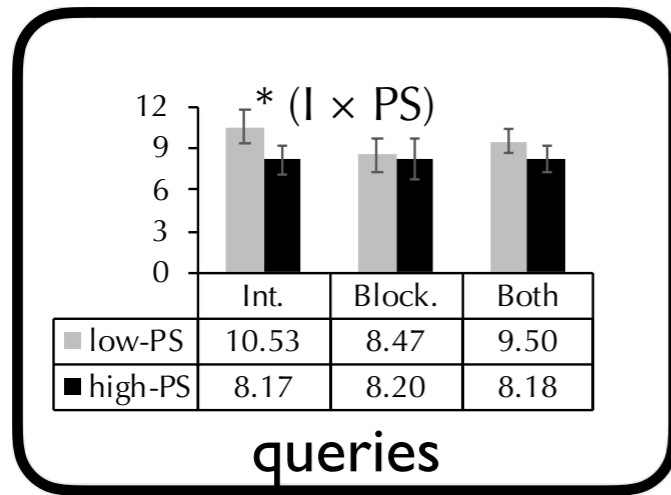
quick query reformulations

Factor I Measures

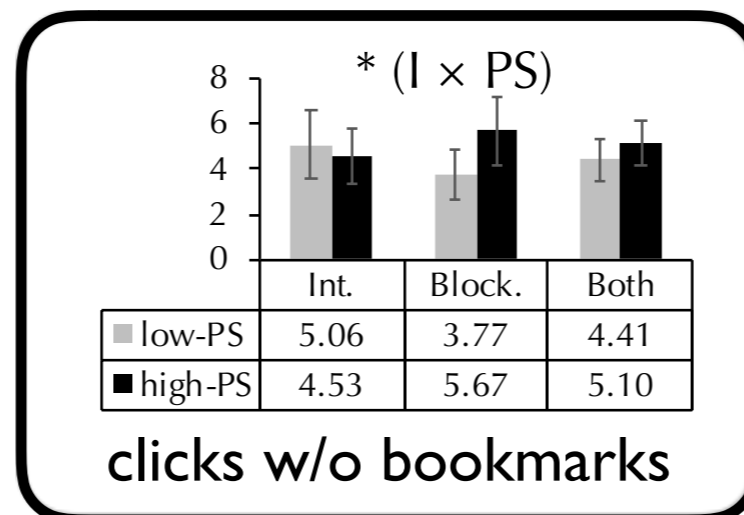


clicks w/o bookmarks

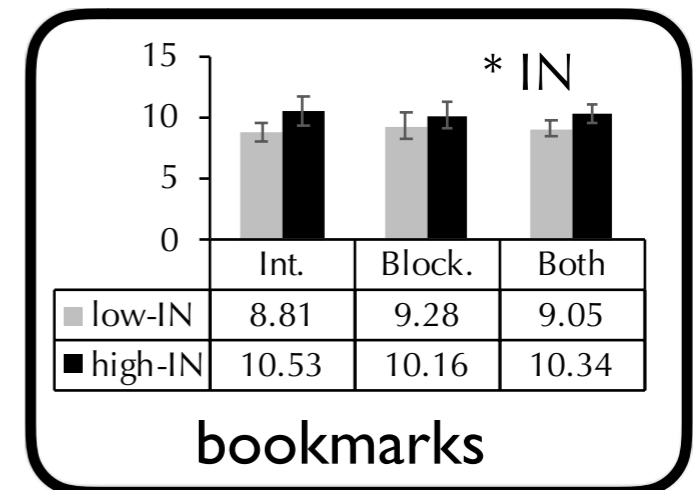
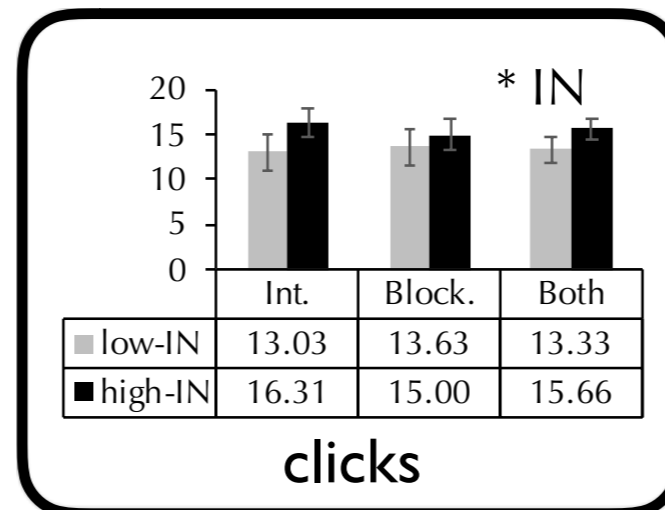
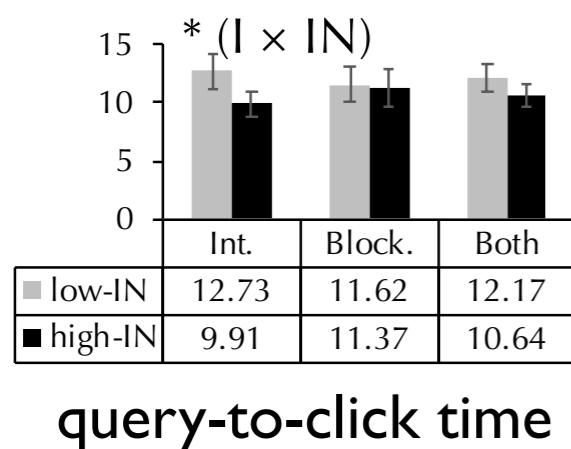
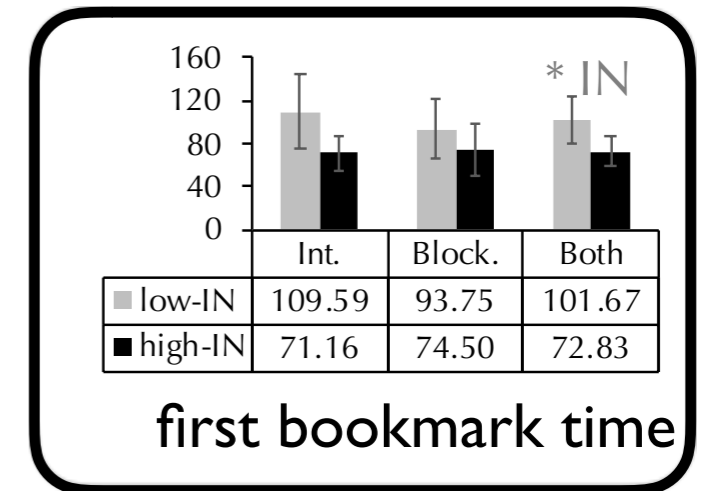
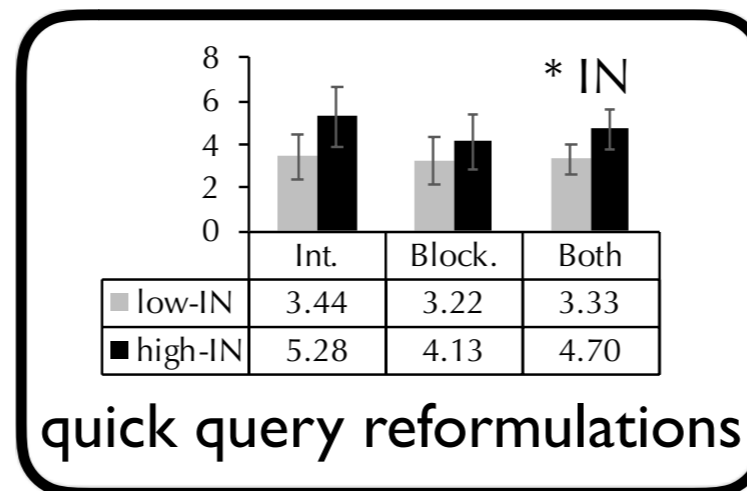
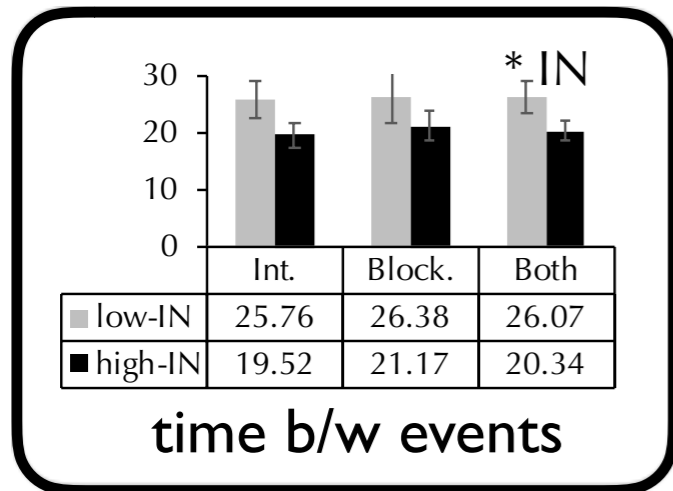
RQ3 Results: Perceptual Speed on Search Behaviors



Factor I Measures

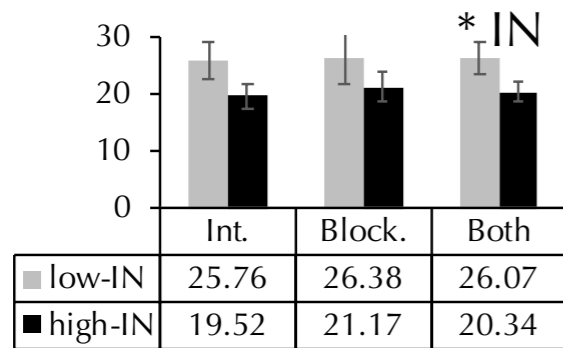


RQ3 Results: Inhibition on Search Behaviors

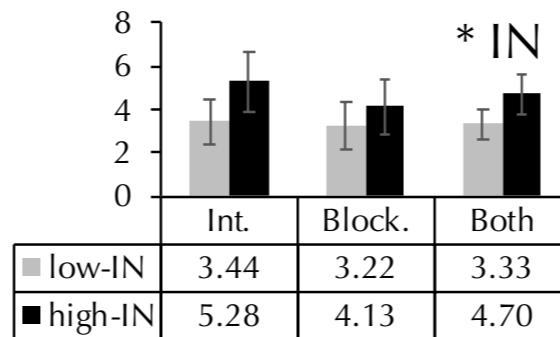


Factor 2 Measures

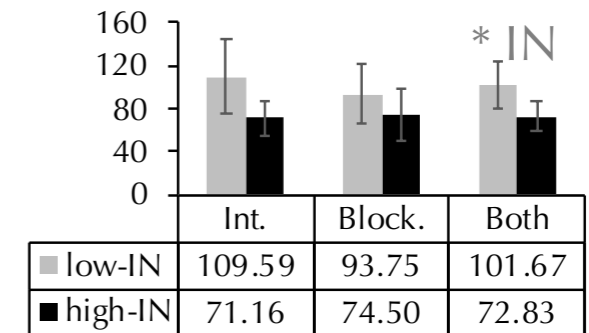
RQ3 Results: Inhibition on Search Behaviors



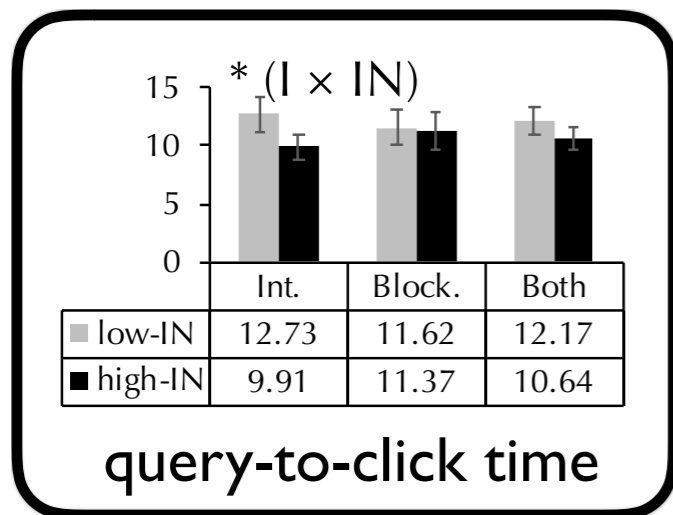
time b/w events



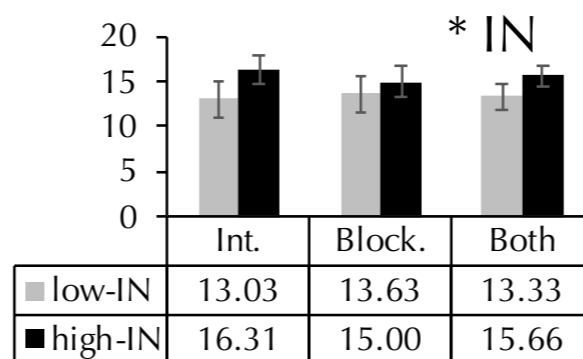
quick query reformulations



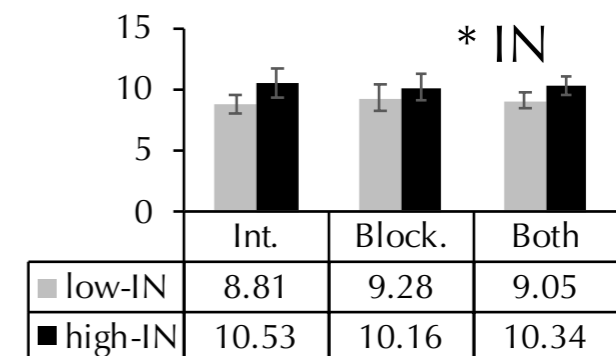
first bookmark time



query-to-click time



clicks



bookmarks

Factor 2 Measures

Summary

	Workload (RQ1)	Engagement (RQ2)	Behaviors (RQ3)
Working Memory	High-WM participants reported lower workload, especially with blocked interface	High-WM participants reported higher engagement	None
Perceptual Speed	None	None	Low-PS participants had more difficulty finding relevant results on SERP, especially with the interleaved interface
Inhibition	None	None	Low-IN participants had slower pace of interaction, especially with the interleaved interface

Possible Implications

- Aggregated interfaces based on Gestalt principles aim to clearly convey relations between search results
- Help users focus on specific groups of results and ignore others
- May provide benefits for specific groups of users: high-WM, low-PS, low-IN users

Possible Implications


- Aggregated interfaces based on Gestalt principles aim to clearly convey relations between search results
- Help users focus on specific groups of results and ignore others
- May provide benefits for specific groups of users: high-WM, low-PS, low-IN users
- More accurate inferences from behavioral data:
 - ▶ **low-PS users:** more abandoned queries
 - ▶ **low-IN users:** slower pace of interaction

Possible Implications

- Aggregated interfaces based on Gestalt principles aim to clearly convey relations between search results
- Help users focus on specific groups of results and ignore others
- May provide benefits for specific groups of users: high-WM, low-PS, low-IN users
- More accurate inferences from behavioral data:
 - ▶ **low-PS users:** more abandoned queries
 - ▶ **low-IN users:** slower pace of interaction
- Some cognitive abilities may be more difficult to infer than others (e.g., working memory)

Other (Ongoing) Studies

Working Memory + Note-Taking



New York Times Results: 1-10 of 200

Filter by Year:

- 2005
- 2006

Filter by Topic:

- Arts
- Books
- Business
- Education
- Front Page
- Health
- Home and Garden
- Magazine
- New York and Region
- Opinion
- Sports
- Style
- Technology
- U.S.
- Washington
- Week in Review
- World

[Despite Steps, Disaster Planning Still Shows Gaps](#) - Technology, Front Page, U.S.
that, in the aftermath of **Hurricane Katrina**, became an international symbol of dysfunction... hard by **Hurricane Katrina**. With these and other stockpiles -- at least twice the inventory
Saturday August 26, 2006

[RELIEVED TEXANS RETURNING HOME AS STORM FADES](#) - Front Page, U.S.
a month after his administration drew heavy criticism for its **response** to **Hurricane Katrina**. After... blunt criticism of the government's **response** to **Hurricane Katrina** along with praise
Monday September 26, 2005

[Government Saw Flood Risk but Not Levee Failure](#) - Front Page, U.S.
of **Hurricane Katrina** posed unprecedented difficulties. "There are amazing challenges and obstacles," said... that the first, life-saving phase of **hurricane response**, which usually lasts a matter of hours, in this case
Friday September 02, 2005

[Storm Lashes Coast; Levees Breached in New Orleans](#) - Front Page, U.S.
, where the Bush administration had been criticized for its slow **response** to **Hurricane Katrina**... neighborhoods, which had been devastated nearly a month earlier by **Hurricane Katrina** and submerged under
Saturday September 24, 2005

['Katrina Effect' Pushed Texans Into Gridlock](#) - Front Page, U.S.
in their planning, the failure to account for the psychological effects of **Hurricane Katrina**, or what... seriously frightened by **Hurricane Katrina**. "Not one of our 15,000 employees is a psychologist," he
Saturday September 24, 2005

[That FEMA Seal of Approval](#) - New York and Region, Opinion
responsible for the agency's botched **response** to **Hurricane Katrina**. Before 9/11, the agency identified... to the **Hurricane Katrina** disaster and alarmed by the chaotic evacuation of Houston before **Hurricane Rita**
Sunday October 09, 2005

[Homeland Security Chief Outlines FEMA Overhaul](#) - U.S.
that it would never again prove so inadequate in its **response** to catastrophes like **Hurricane Katrina**... after **Hurricane Katrina** hit, he noted, he could not get the FEMA director on the phone
Thursday October 20, 2005


[Committee Focuses on Failure to Aid New Orleans's Infirm](#) - Health, U.S.
Government complacency, poor planning and dereliction of duty during **Hurricane Katrina** contributed... said Tuesday. In the second day of Senate hearings on the **hurricane response**, the focus was on what
Wednesday February 01, 2006

[Republicans' Report on Katrina Assails Administration Response](#) - Front Page, U.S.
the government's **response** to **Hurricane Katrina**, is the first of three major investigations.... The **response** to **Hurricane Katrina** and its aftermath, in which about 1,400 people died along the Gulf
Monday February 13, 2006

[Bus Evacuating Senior Center Burns, Killing 24 Near Dallas](#) - Front Page, U.S.
facilities in New Orleans during **Hurricane Katrina**, three weeks ago, according to local officials...A **bus** evacuating frail residents from a suburban Houston senior-living center burst into flames
Saturday September 24, 2005

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 next

Working Memory + Note-Taking





OrgBox


Filter by Year:
 2005
 2006



Filter by Topic:
 Arts
 Books
 Business
 Education
 Front Page
 Health
 Home and Garden
 Magazine
 New York and Region
 Opinion
 Sports
 Style
 Technology
 U.S.
 Washington
 Week in Review
 World


Long-term Impacts on FEMA



Drag text here to add a new item or


[Homeland Security Chief Outlines FEMA Overhaul](#)  
The agency must have a better working relationship with the military, so the federal government can more quickly deploy troops, and it needs more managers seasoned in handling disasters, Mr. Chertoff told the House panel. FEMA must also be more adept at rapidly gearing up to field calls from victims and to distribute financial aid efficiently.

-  Tighter relationship with the military

[Homeland Security Chief Outlines FEMA Overhaul](#)  
And the agency must have more reliable communications systems, so that it knows exactly what is occurring in the disaster zone, Mr. Chertoff said. Just after Hurricane Katrina hit, he noted, he could not get the FEMA director on the phone.



-  More reliable communication systems


[Senate Committee Leaders Urge FEMA Dismantling](#)  
Since Hurricane Katrina hit, Michael Chertoff, the secretary of homeland security, has been working on his own alternative to the agency's current structure, which he has described as "retooling" FEMA. That has meant bringing in professional disaster managers to replace the former director Michael D. Brown and other senior officials, many of whom had little emergency management experience.



-  Replacing senior officials with professional disaster managers.


Places affected



Drag text here to add a new item or


[Hurricane Drenches Florida And Leaves Seven Dead](#)  
Hurricane Katrina churned through the Gulf of Mexico on Friday, increasing its strength and threatening the Florida Panhandle and neighboring states, after cutting a drenching swath through southern Florida and leaving seven dead.

-  Florida

[Katrina Victims Say Agents Advised Against Flood Coverage](#)  
Six weeks before Hurricane Katrina tore up the Gulf Coast of Mississippi last August, Dr. Munson Hinman went to see his insurance agent to buy flood coverage for his home near the beach.



-  Mississippi coast


[The Storm That Blew New Orleans Apart](#)  
It was still dark, at 4:30 a.m. Aug. 29, when Hurricane Katrina skipped off course and made landfall downriver from New Orleans at Buras, La., as a Category 4 storm. The hurricane obliterated the place.

-  New Orleans

Reaction to President Bush

Drag text here to add a new item or

[A President Who Can Do No Right](#)  
We should be used to it by now. There are a couple of Congressional committees trying to investigate the tragic Hurricane Katrina debacle, but the Bush administration is refusing to turn over certain documents or allow certain senior White House officials to testify before the committees under oath.

-  Investigation

Comparative Tasks + Structured Note-taking + Search Completion

search blue Malaysia Airlines Flight 17 Search Open Matrix Tool

Washington Post Results: 1-10 of 200

Filter by Year:
 2014
 2015
 2016
 2017

Filter by Topic:
 Act Four
 Arts and Entertainment
 Asia & Pacific
 Business
 Checkpoint
 Early Lead
 Erik Wemple
 Europe
 Gridlock
 Health & Science
 In the Loop
 Innovations
 Letters to the Editor
 Middle East
 Monkey Cage
 Morning Mix
 National
 National Security
 Opinions
 Politics
 Post Nation
 Post Politics
 PostEverything
 PostPartisan
 PowerPost
 Storyline
 Tablet
 The Fix
 The Intersect
 The Post's View
 The Switch
 Transportation
 Travel
 Wonkblog
 World
 WorldViews

[After a Malaysian plane is shot down in Ukraine, grief and outrage ripple worldwide](#) - World
Malaysia Airlines Flight 17 dropped in wheat fields five miles east of Goryushko's house. The bodies... soul cannot stand it." Pieces of **Malaysia Airlines Flight 17**, a number now retired from the carrier's
Thursday July 24, 2014

[Years after Flight 370 disappearance, Malaysia Airlines agrees to track its planes from space](#) - Innovations
, **Malaysia Airlines Flight 17**, traveling from Amsterdam to Kuala Lumpur, was downed by a missile over...Just after midnight local time on March 8, 2014, **Malaysia Airlines Flight 370** took off from Kuala
Thursday April 20, 2017

[Malaysia Airlines likely to suffer greatly in aftermath of second disaster](#) - Business
Malaysia Airlines says it saw "major short-term reaction in consumer behavior" after **Flight MH370's** disappearance. (Joe Pries/AP) The tragedy of **Malaysia Airlines Flight 17** follows another air
Thursday July 17, 2014

[Total liability in Flight 17 crash could climb to \\$1 billion](#) - Wonkblog
crash that killed all 298 people aboard **Malaysia Airlines Flight 17** on Thursday, the victims' families...A long and complicated legal battle awaits over who's liable for the crash of **Malaysia Airlines**
Saturday July 19, 2014

[Malaysia Air is still running Flight 17, but it's avoiding Ukraine](#) - Wonkblog
Malaysia Airlines Flight 17 is a daily **flight** running from Amsterdam to Kuala Lumpur. In the wake... Turkey. Many other airlines are doing the same. **Malaysia Air** will likely retire the call sign
Friday July 18, 2014

[New poll finds many Russians believe Ukraine shot down MH17](#) - WorldViews
Cows graze near the wreckage of **Malaysia Airlines Flight 17** in eastern Ukraine's Donetsk region... 18 to 21, one day after **Malaysia Airlines Flight 17** was downed. It's an exceptionally difficult
Wednesday July 30, 2014

[A step toward justice in the shutdown of Flight 17](#) - The Post's View
A **Malaysia Airlines** crew member places a flower next to candles forming the letters MH17 after multi-faith prayers for the victims of the downed **Malaysia Airlines Flight 17** near Kuala Lumpur. (Lai
Friday October 16, 2015

[What the search for Flight MH370 tells us about national security in Asia](#) - Monkey Cage
into the pilots of missing **Malaysia Airlines flight 370** intensified on March 17 after officials confirmed... citizens on board the **flight** and **Malaysia Airlines'** handling of the passengers' families. Intelligence
Tuesday March 18, 2014

[Netherlands grapples with loss of 192 citizens in Malaysia Airlines disaster](#) - World
rose after another to people mourning the loss of **Malaysia Airlines Flight 17**, which claimed the lives... that was shot down: **Flight 17**. Yet the crash dominated people's thoughts. In the Netherlands
Friday July 18, 2014

[Ukraine gets \\$200 million a year for allowing overflights](#) - WorldViews
of overflight charges. After **Malaysia Air Flight 17** apparently was shot down over Ukraine, some critics... went down on July 17, **Malaysia Air** has been routing the same **flight** -- Amsterdam to Kuala Lumpur
Wednesday July 23, 2014

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 next


Comparative Tasks + Structured Note-taking + Search Completion

	Location of incident	Death toll	Cause of incident
Malaysia Airlines Flight 17	<p>☆ - After a Malaysian plane is s... It ended over Ukraine, a nation torn in two. The jet was shot out of the sky, a...</p>	<p>☆ - After a Malaysian plane is s... One plane, 298 people, tumbled from the sky, wreckage from an explosion that no ...</p>	<p>☆ - After a Malaysian plane is s... The jet was shot out of the sky, according to U.S. intelligence officials, most ...</p>
Malaysia Airlines Flight 370	<p>☆ - Years after Flight 370 disap... The plane never made it to China, instead vanishing somewhere over the Indian Oc...</p>	<p>☆ - Years after Flight 370 disap... Just after midnight local time on March 8, 2014, Malaysia Airlines Flight 370 to...</p>	<p>☆ - Years after Flight 370 disap... At some point on Flight 370, the transponder stopped working (whether it failed ...</p>
EgyptAir Flight 804		<p>☆ - Discovery of debris offers f... CAIRO The discovery of human remains, wreckage and passenger belongings from an ...</p>	<p>☆ - Discovery of debris offers f... A day after a top official in Egypt said that terrorism appeared more likely tha...</p>

Comparative Tasks + Structured Note-taking + Search Completion



Washington Post Results: 1-10 of 200

	Location of incident	Death toll	Cause of incident
Malaysia Airlines Flight 17	<p>☆ - After a Malaysian plane is s... It ended over Ukraine, a nation torn in two. The jet was shot out of the sky, a...</p>	<p>☆ - After a Malaysian plane is s... One plane, 298 people, tumbled from the sky, wreckage from an explosion that no ...</p>	<p>☆ - After a Malaysian plane is s... The jet was shot out of the sky, according to U.S. intelligence officials, most ...</p>
Malaysia Airlines Flight 370	<p>☆ - Years after Flight 370 disap... The plane never made it to China, instead vanishing somewhere over the Indian Oc...</p>	<p>☆ - Years after Flight 370 disap... Just after midnight local time on March 8, 2014, Malaysia Airlines Flight 370 to...</p>	<p>☆ - Years after Flight 370 disap... At some point on Flight 370, the transponder stopped working (whether it failed ...</p>
EgyptAir Flight 804		<p>☆ - Discovery of debris offers f... CAIRO The discovery of human remains, wreckage and passenger belongings from an ...</p>	<p>☆ - Discovery of debris offers f... A day after a top official in Egypt said that terrorism appeared more likely tha...</p>



Thank you!
Questions?

Studies

- The effects of working memory, perceptual speed, and inhibition in aggregated search
- The effects of working memory during search tasks of varying complexity

Research Questions

- The effects of working memory and task complexity on:

RQ1: workload

RQ2: satisfaction

RQ3: search behaviors

RQ4: outcomes

Task Complexity Manipulation

(2 x 2) vs. (4 x 4)

- Evaluate tasks:
 - ▶ compare N alternatives along M criteria
 - ▶ complete N x M spreadsheet (as needed)
 - ▶ make a selection
 - ▶ write a justification
- Simple tasks: 2 alternatives, 2 criteria
- Complex tasks: 4 alternatives, 4 criteria

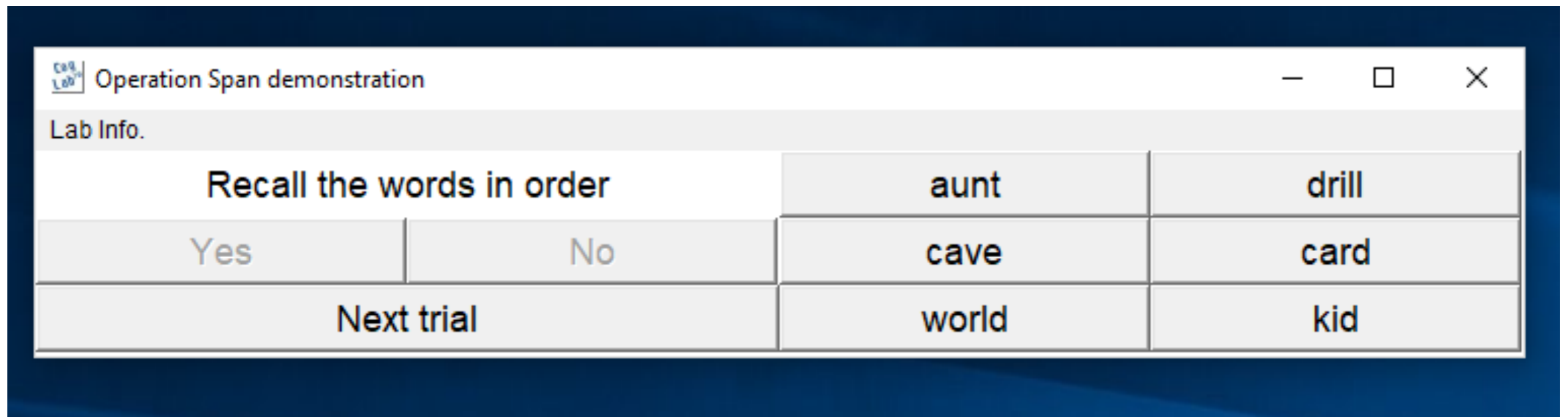
User Study

(N=24)

- 2 search tasks (1 simple, 1 complex)
- 2 post-task questionnaires (workload, satisfaction)
- (Short break)
- 1 post-study psychometric test

Psychometric Test

Working Memory: Operation Span Task



The screenshot shows a software window titled "Operation Span demonstration". Below the title bar is a header "Lab Info." followed by a table. The table has three rows and three columns. The first row contains the instruction "Recall the words in order" in the first column, and the words "aunt" and "drill" in the second and third columns. The second row contains the response options "Yes" and "No" in the first two columns, and the words "cave" and "card" in the second and third columns. The third row contains the instruction "Next trial" in the first column, and the words "world" and "kid" in the second and third columns.

Lab Info.		
Recall the words in order	aunt	drill
Yes	No	cave card
Next trial	world	kid

Psychometric Test

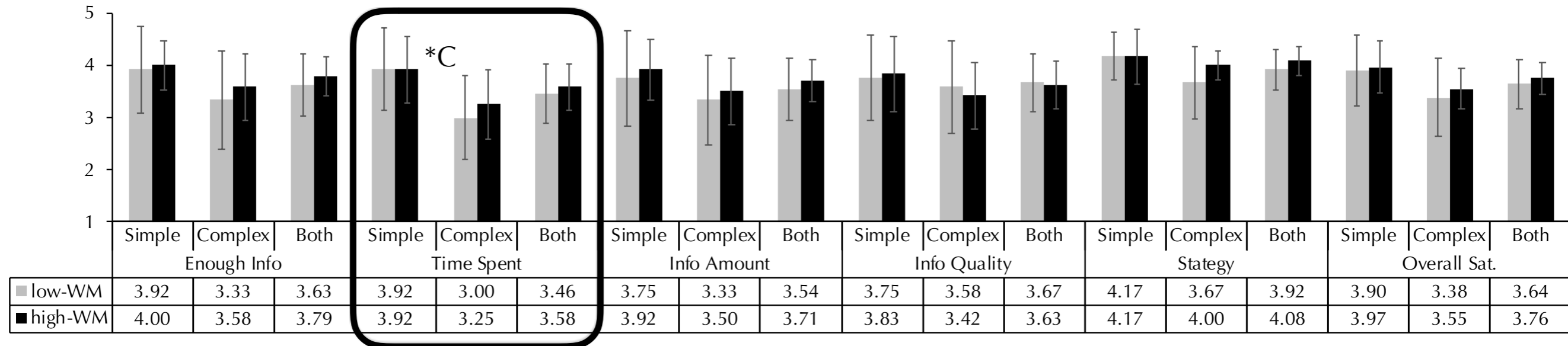
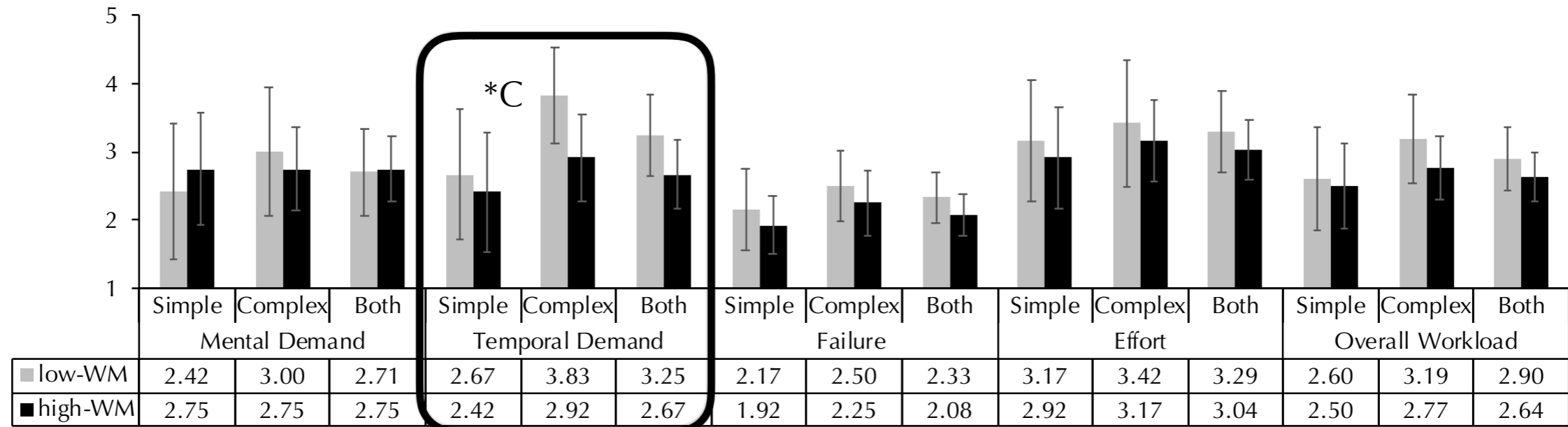
Working Memory: Operation Span Task

The screenshot shows a software window titled "Operation Span demonstration" with a "Cog Lab" icon. Below the title bar is a "Lab Info." header. The main content area contains a table with the following structure:

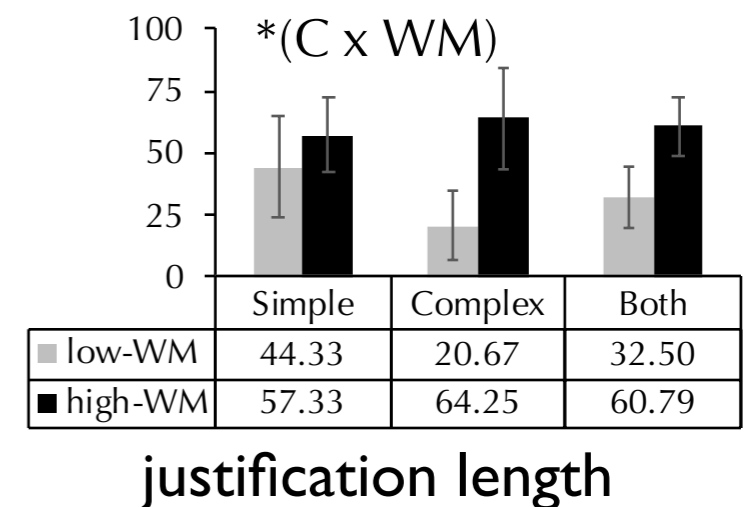
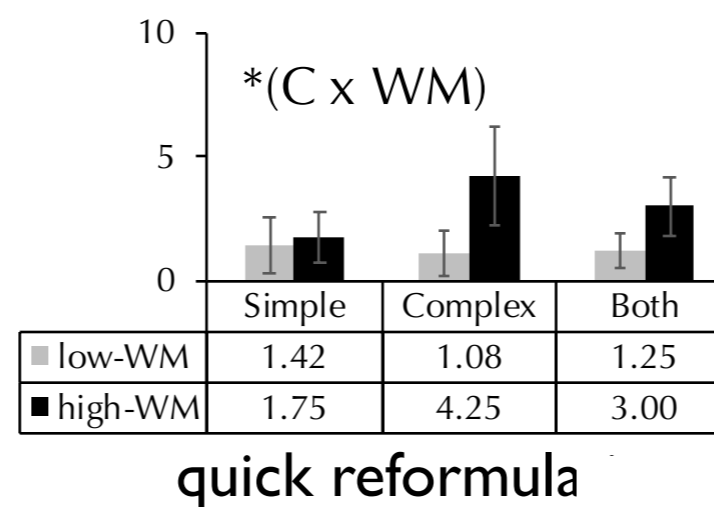
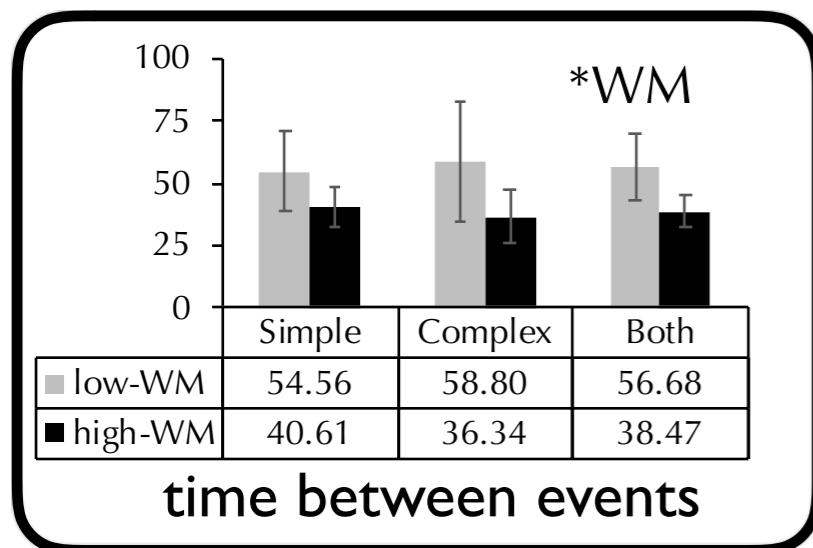
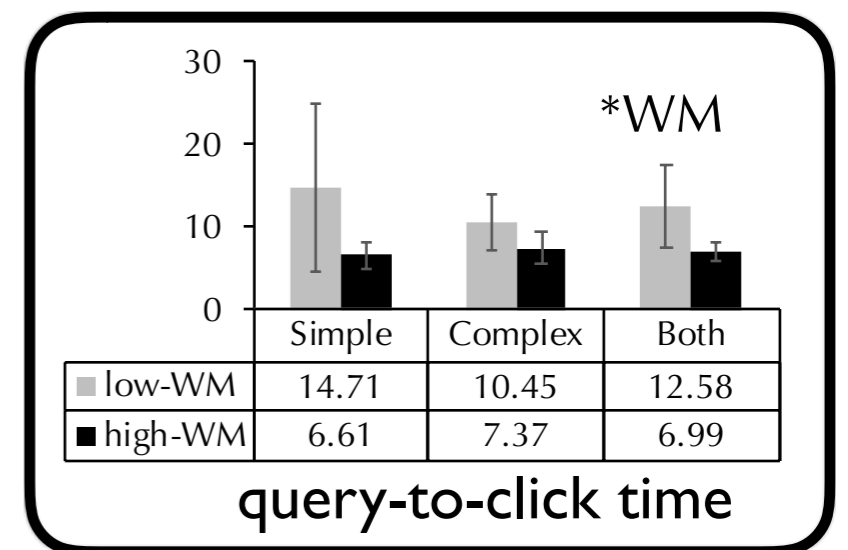
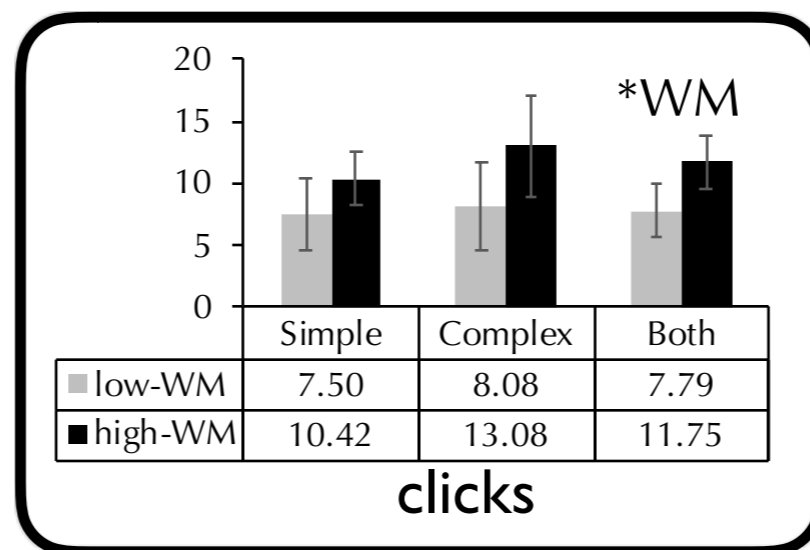
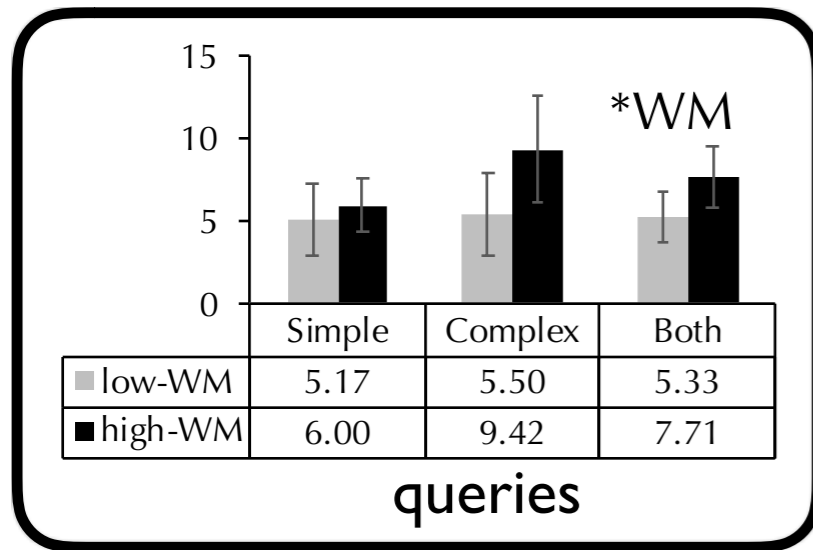
is $(8 \times 1) + 5 = 13?$			
Yes	No		
Next trial			

Results

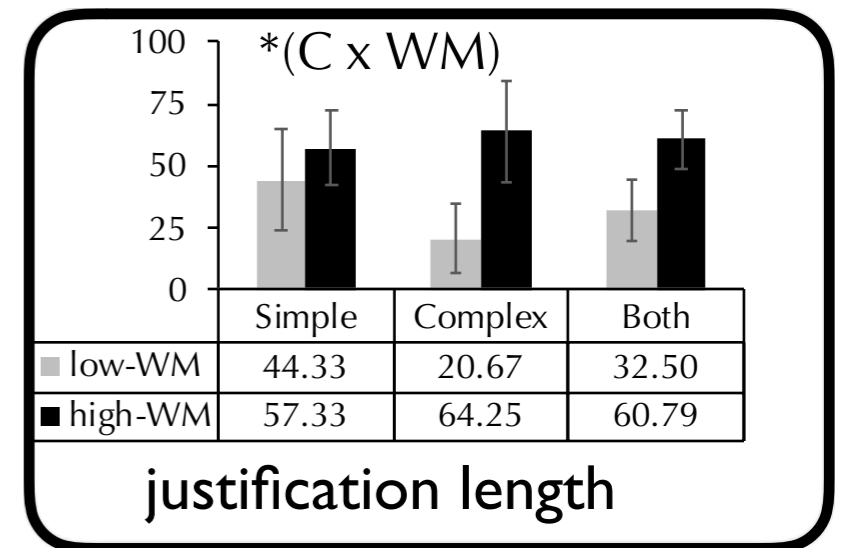
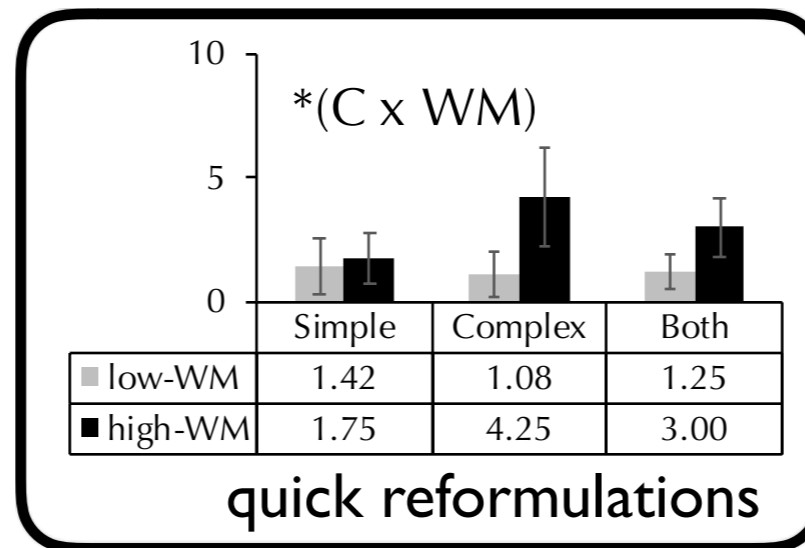
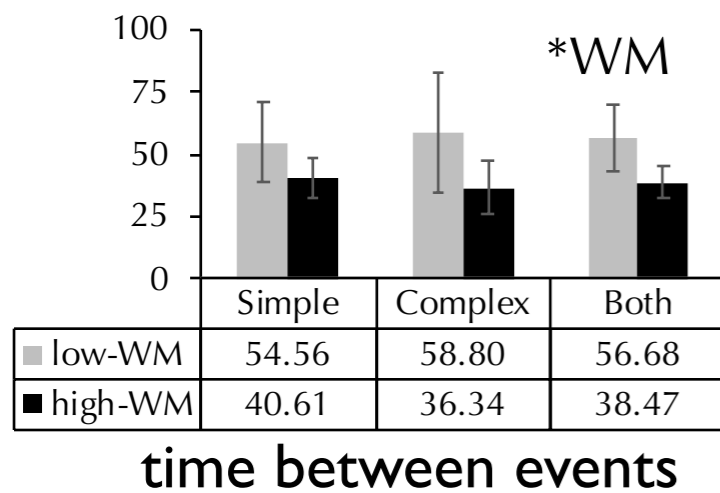
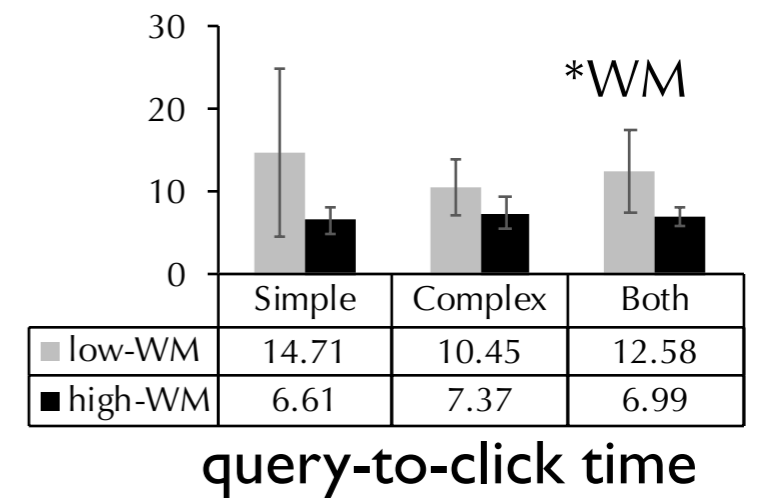
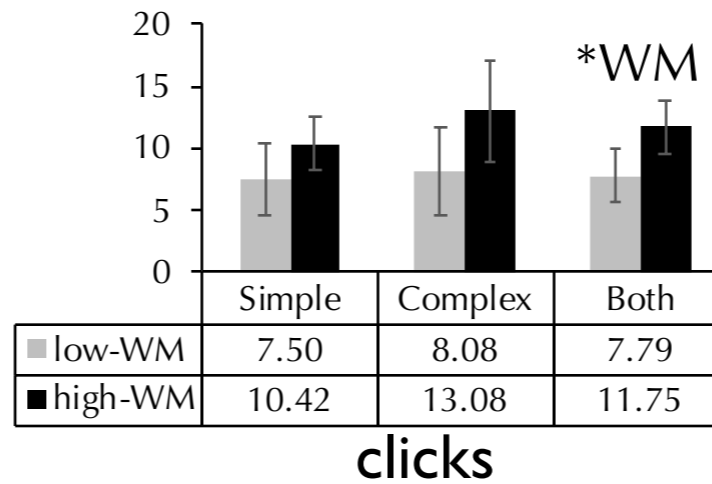
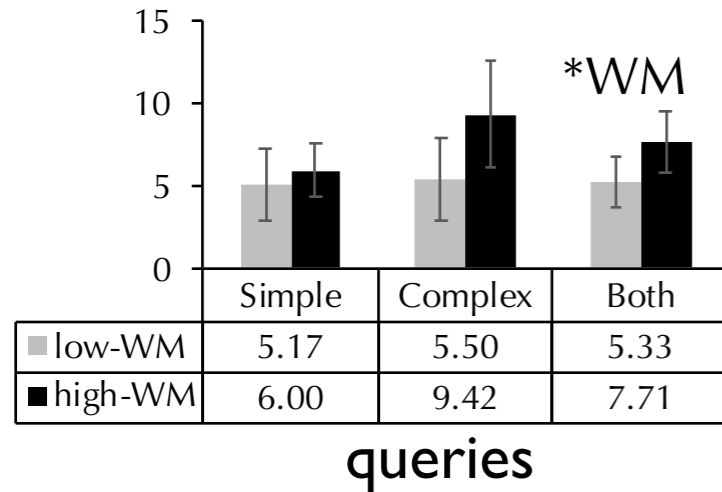
RQ1-2 Results: Workload + Satisfaction



RQ3-4 Results: Search Behaviors + Outcomes



RQ3-4 Results: Search Behaviors + Outcomes



Main Trends and Implications

- High-WM participants exerted more effort and had “better” outcomes, especially for more complex tasks
- WM did not have strong effects on workload and satisfaction
 - ▶ Satisficing?
- Inferring working memory from behavioral data may require knowing the task’s complexity

Conclusions

- Cognitive abilities can impact behaviors and outcomes
- Can impact behaviors without impacting perceptions
- Can impact perceptions without impacting behaviors
- Interface and task characteristics can have moderating effects

Future Work

- More directly mapping cognitive abilities to search activities
 - ▶ getting started
 - ▶ identifying relevant sources
 - ▶ navigating
 - ▶ constructing queries
 - ▶ constraining the search results
 - ▶ recognizing useful information
 - ▶ tracking progress (knows and don't knows)
- Personalized support
 - ▶ visualizations + interactions
 - ▶ note-taking applications



Thank you!
Questions?

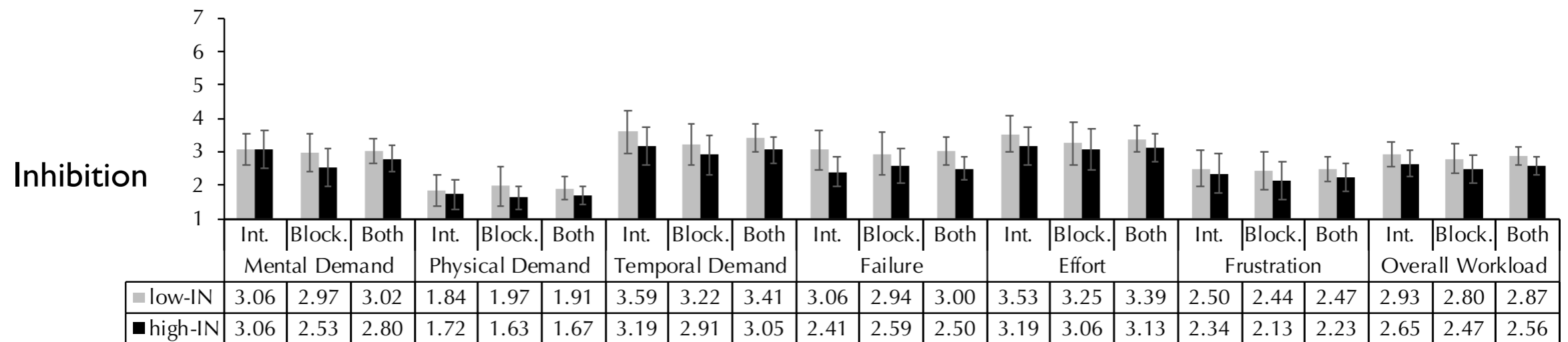
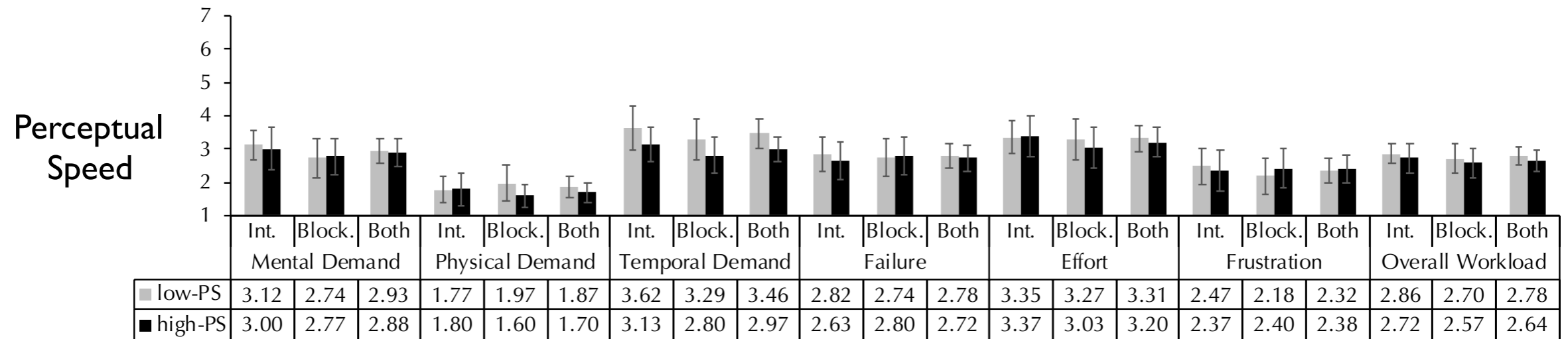
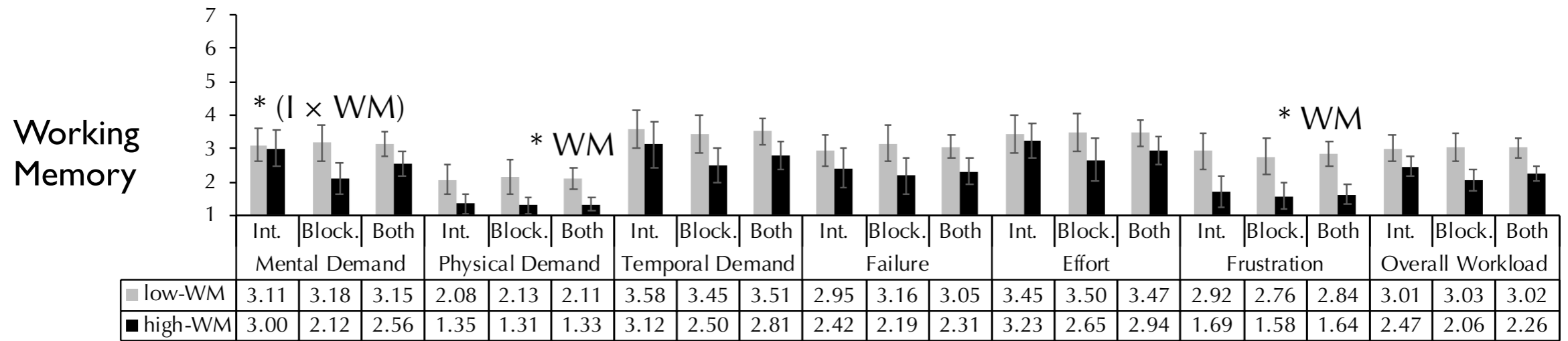
Supplemental Slides

Data Analysis

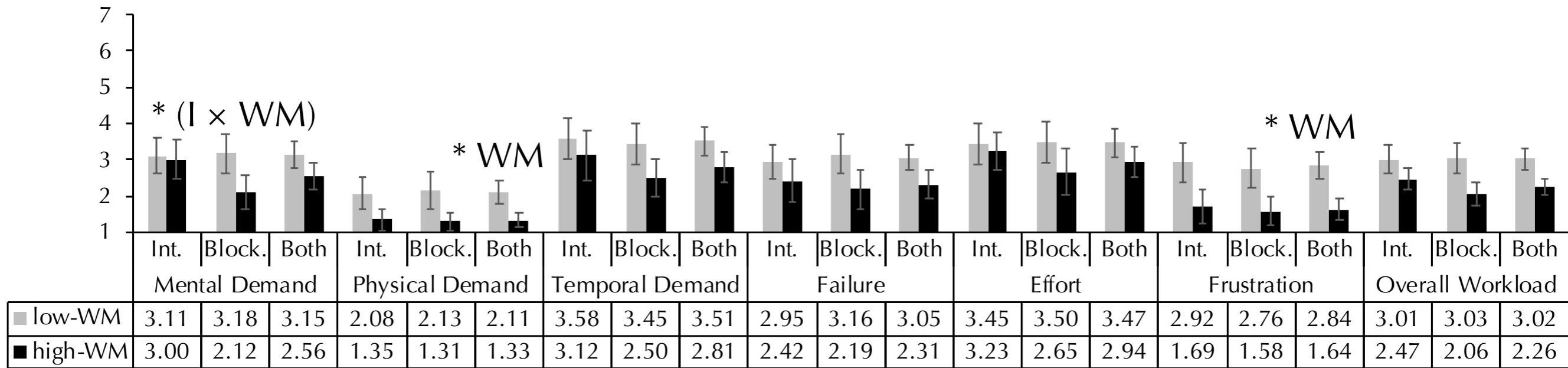
- Multilevel modeling:

$$Y_{ijk} = \underbrace{\beta_0 + \mu_j + \mu_k}_{\text{random intercept}} + \underbrace{\beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_N X_{Ni}}_{\text{fixed factors}}$$

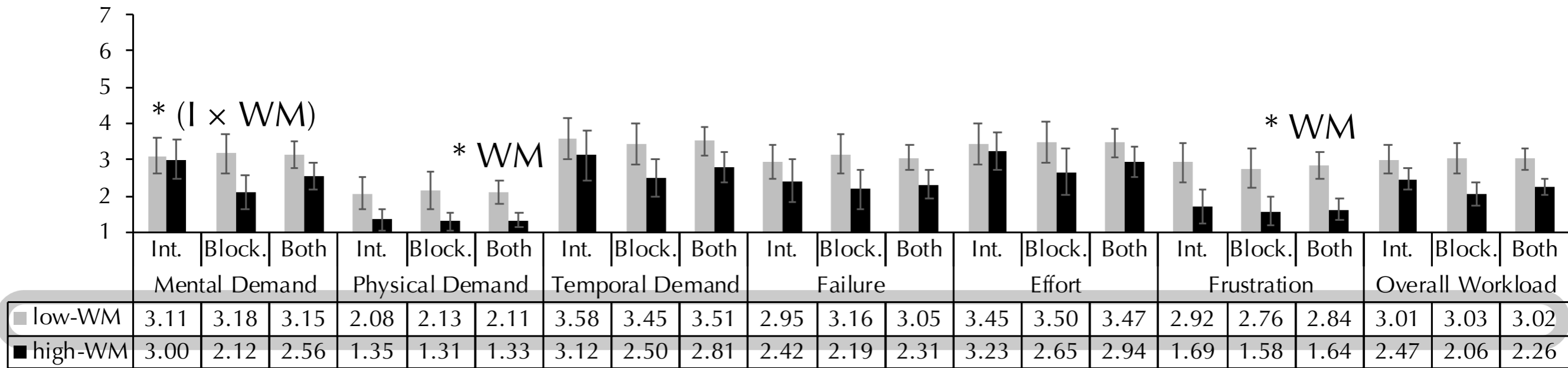
RQ1 Results: Workload



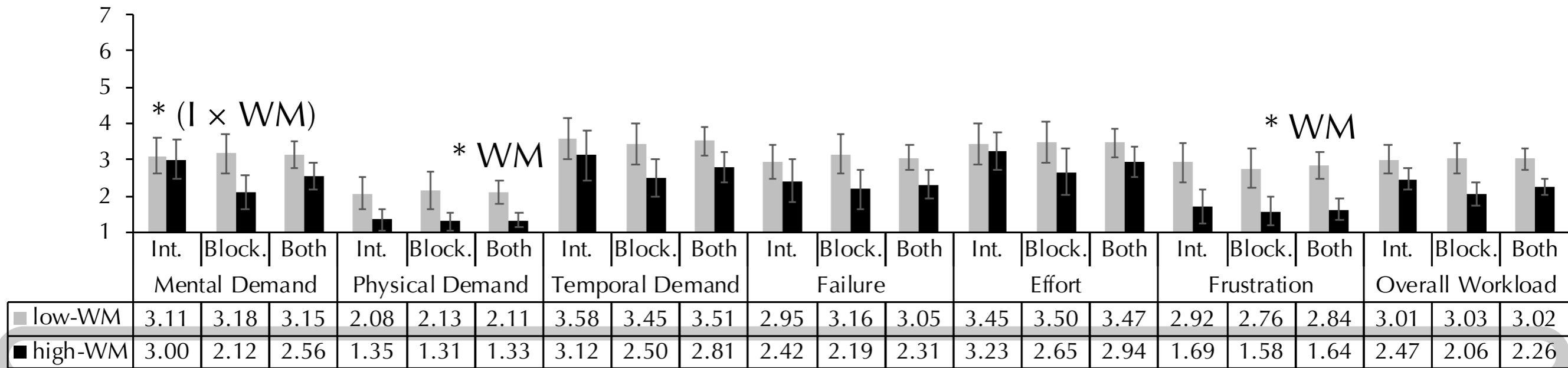
RQ1 Results: Workload



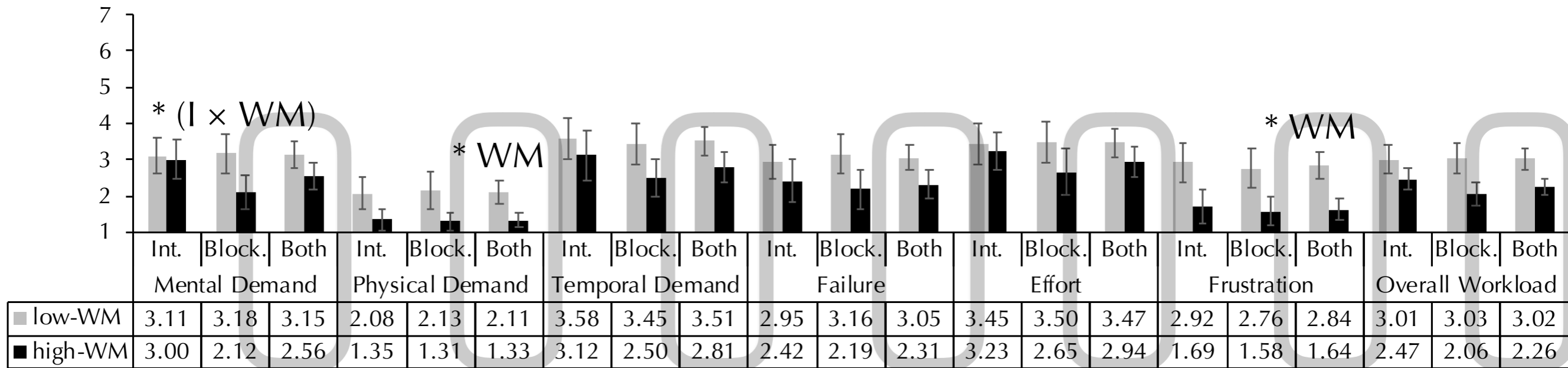
RQ1 Results: Workload



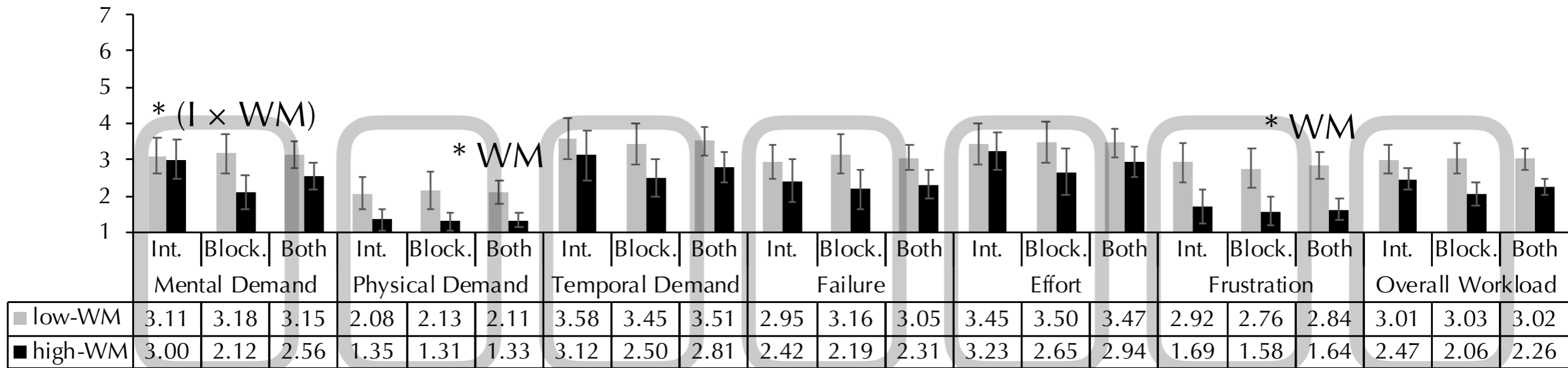
RQ1 Results: Workload



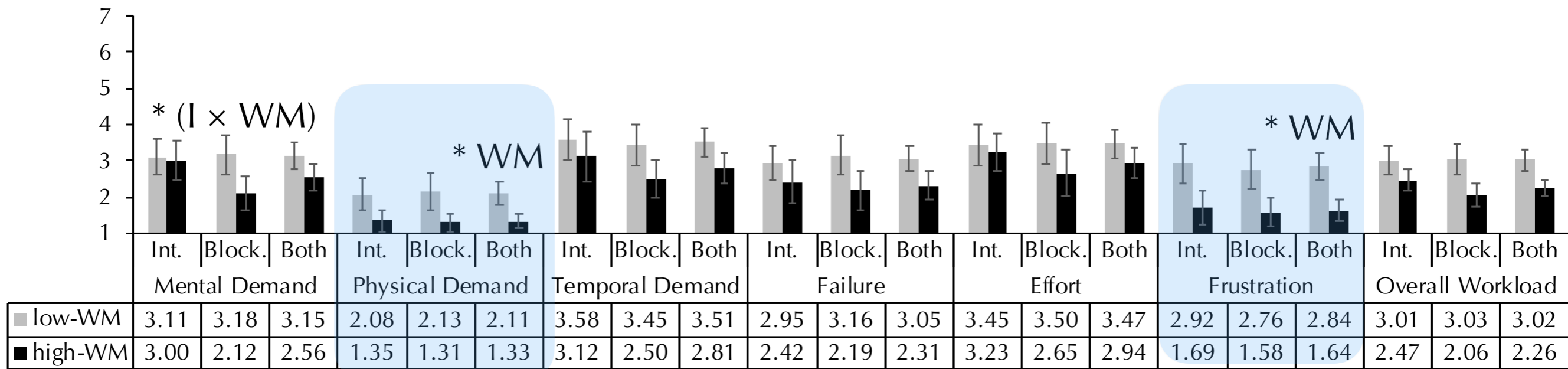
RQ1 Results: Workload



RQ1 Results: Workload

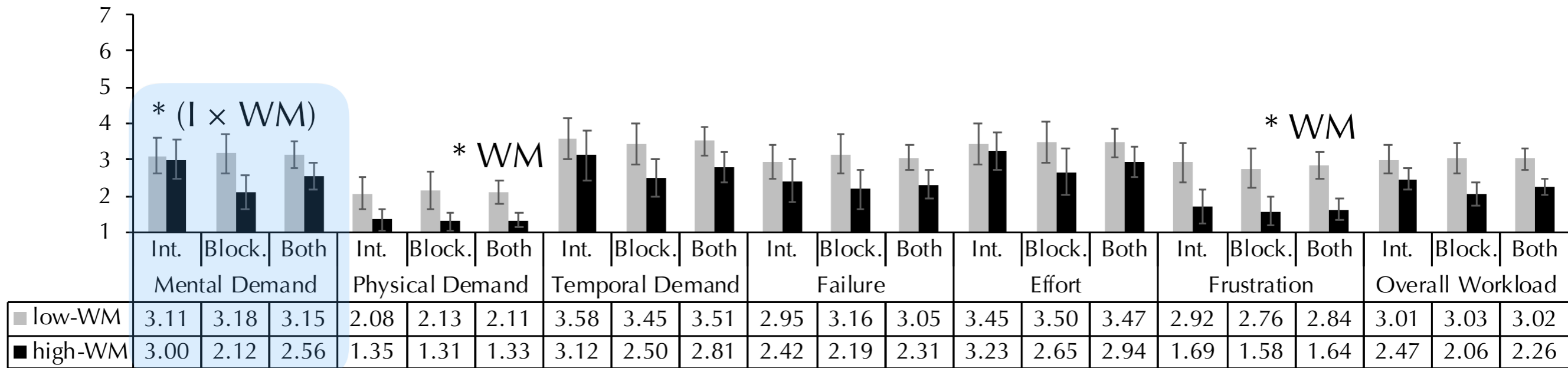


RQ1 Results: Workload



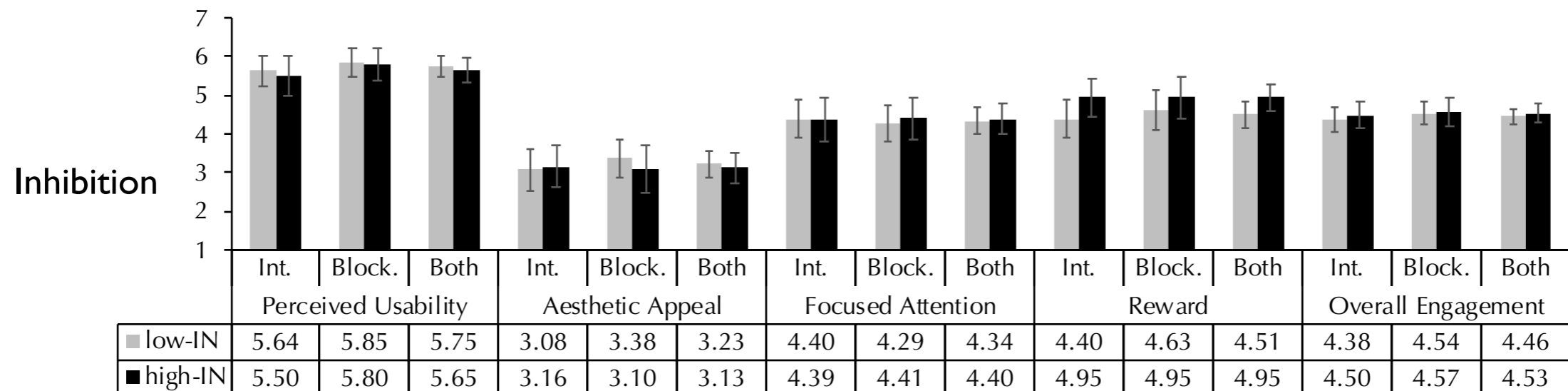
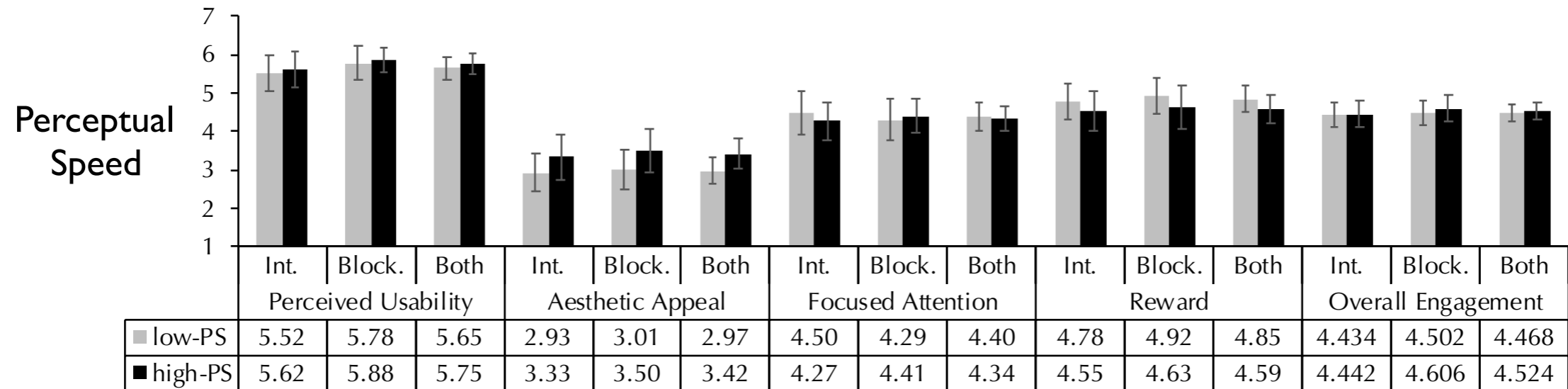
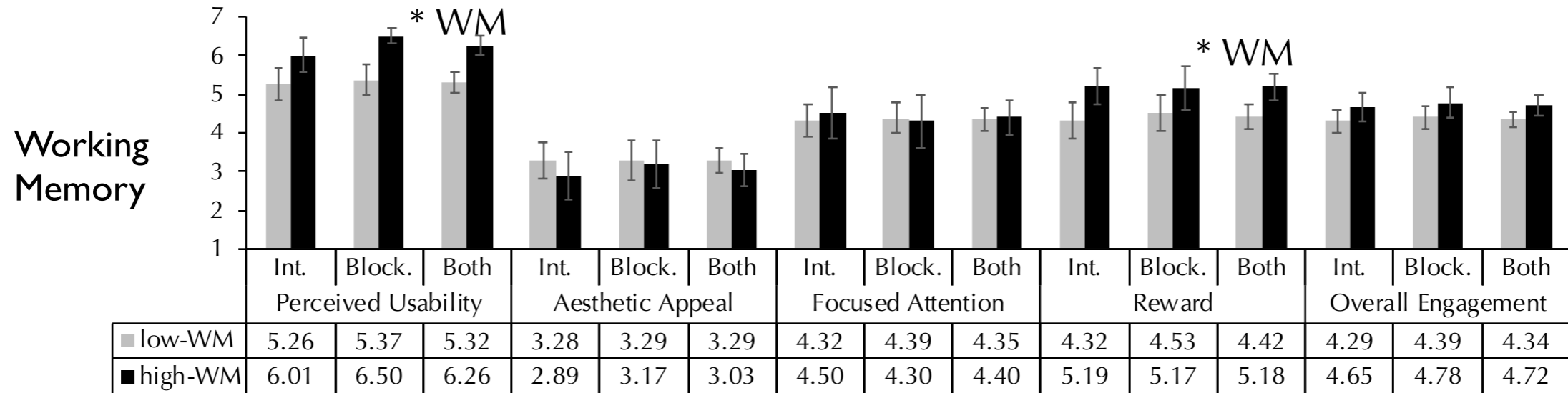
- Irrespective of the interface condition, high-WM participants reported lower physical demand and frustration ($p < .05$)

RQ1 Results: Workload

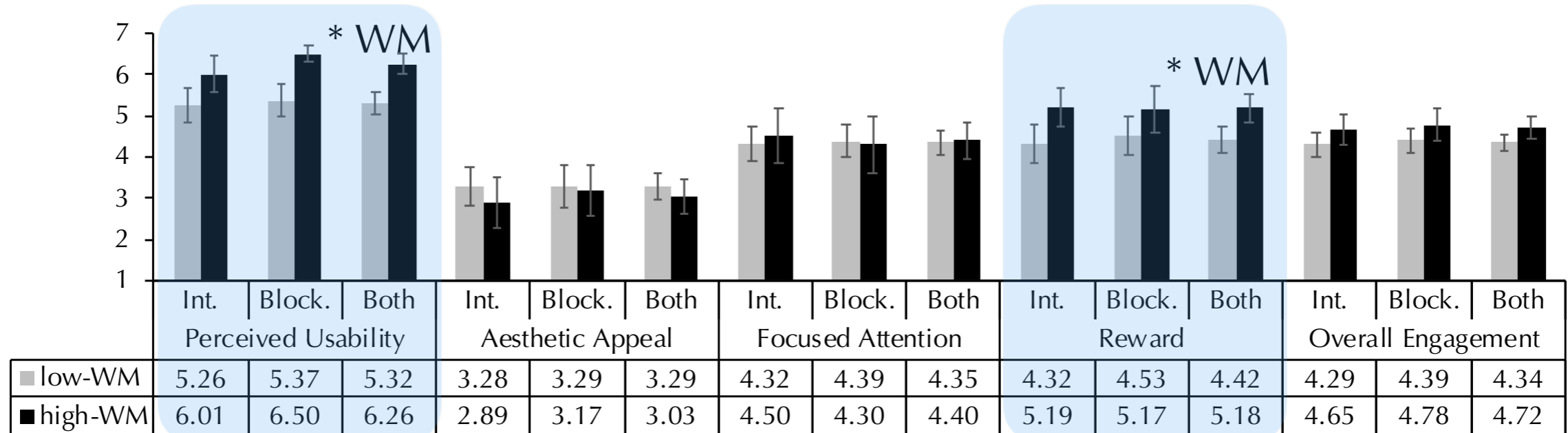


- With the interleaved interface, both participant groups report similar levels of mental demand
- With the blocked interface, high-WM participants reported lower levels of mental demand
- **Possible Explanation:** high-WM participants were more effective at leveraging the fixed layout of the blocked interface

RQ2 Results: Engagement

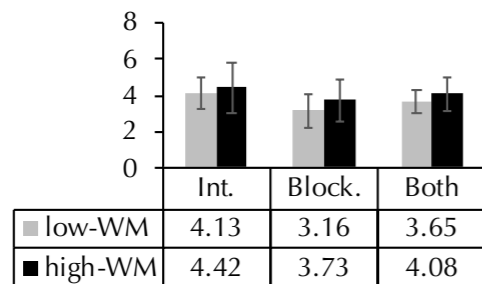


RQ2 Results: Engagement

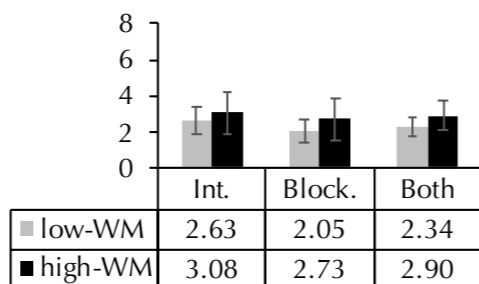


- Irrespective of the interface condition, high-WM participants reported higher perceived usability and reward ($p < .05$)

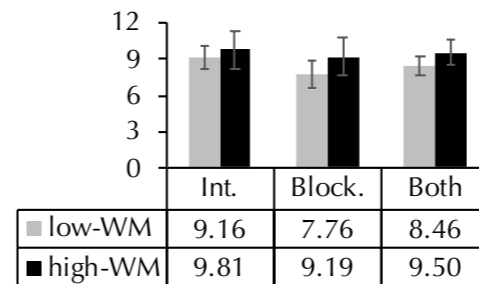
RQ3 Results: Working Memory on Search Behaviors



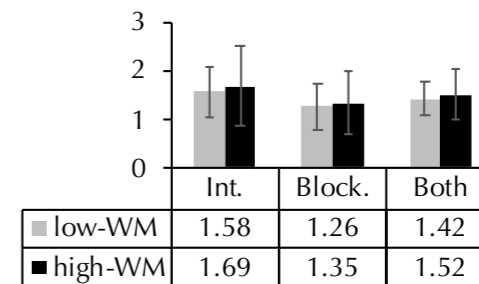
(a) Queries w/o bookmarks



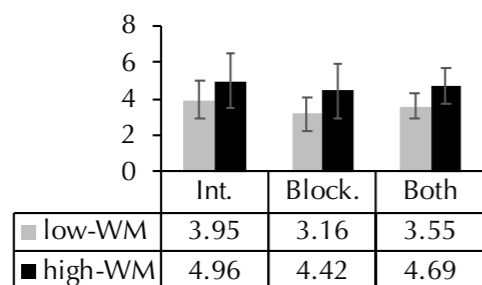
(b) Repeated intent queries



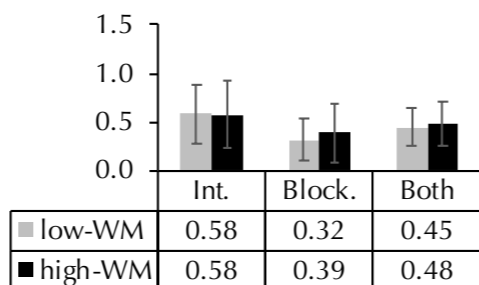
(c) Queries



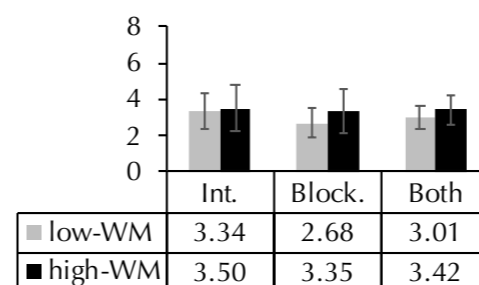
(d) Queries w/o clicks



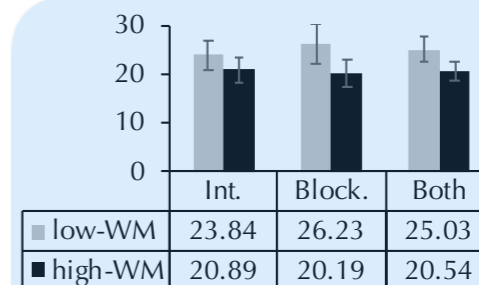
(e) Quick reformulations



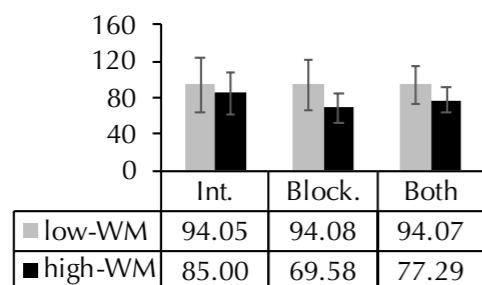
(f) Queries w/o mouseovers



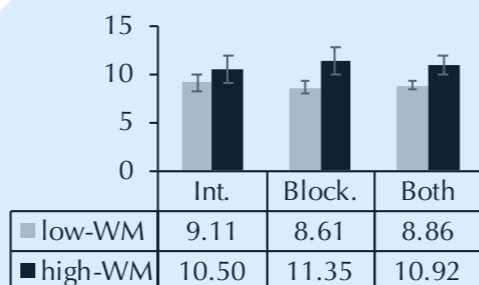
(g) Queries w/o scrolls



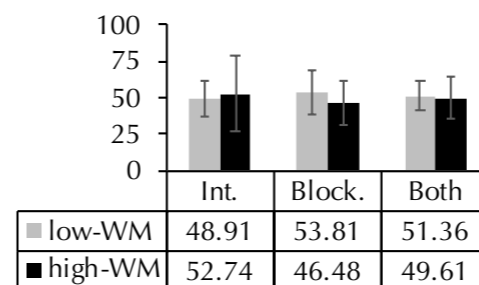
(h) Time b/w events



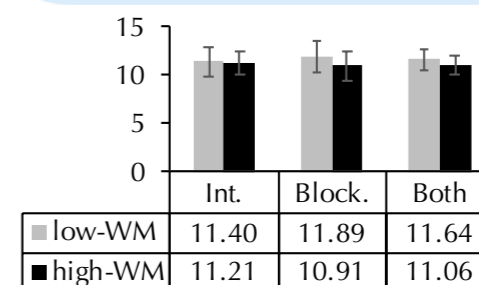
(i) First bookmark time



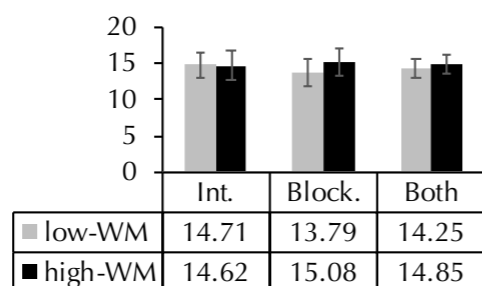
(j) Bookmarks



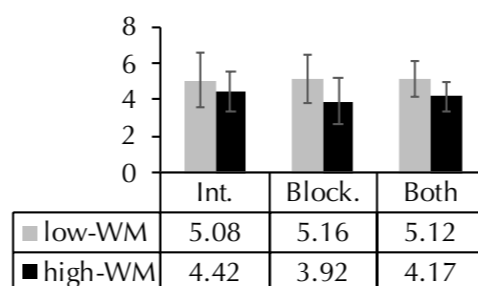
(k) Click-to-bookmark time



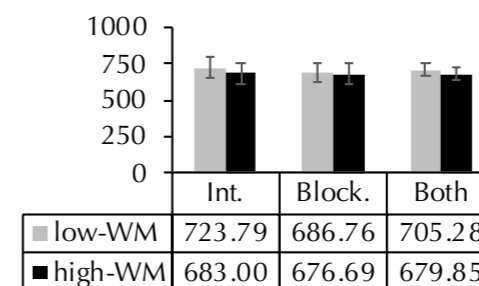
(l) Query-to-click time



(m) Clicks

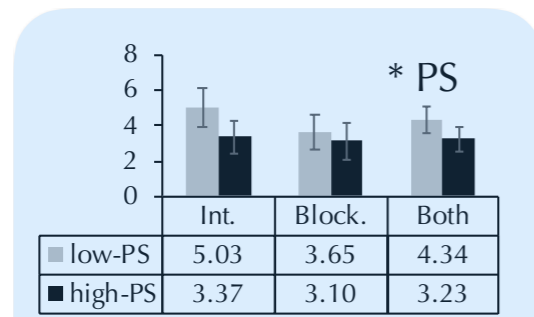


(n) Clicks w/o bookmarks

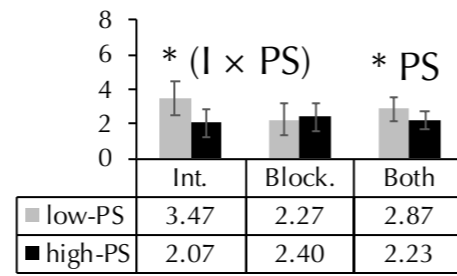


(o) Completion time

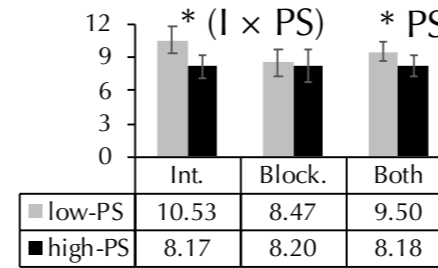
RQ3 Results: Perceptual Speed on Search Behaviors



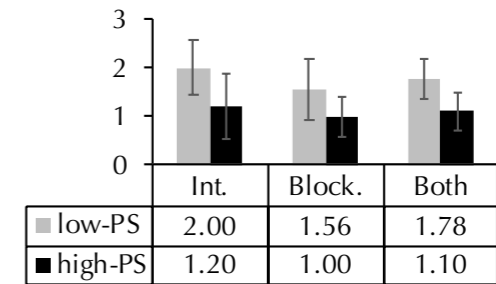
(a) Queries w/o bookmarks



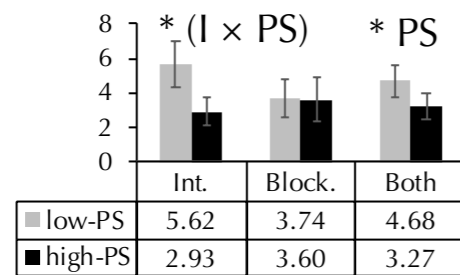
(b) Repeated intent queries



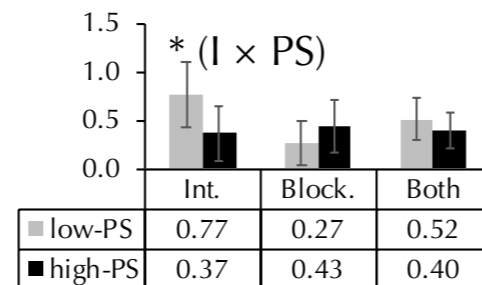
(c) Queries



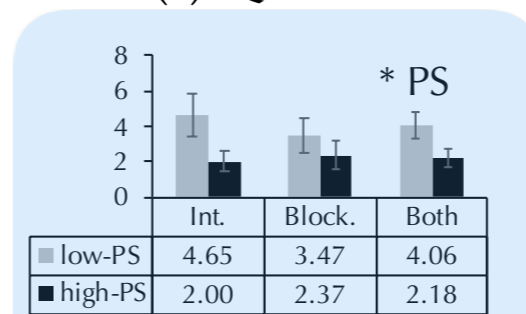
(d) Queries w/o clicks



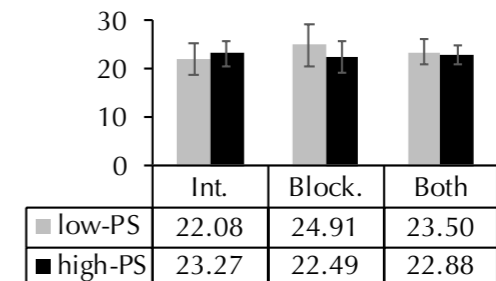
(e) Quick reformulations



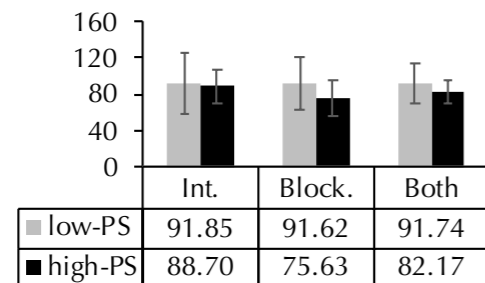
(f) Queries w/o mouseovers



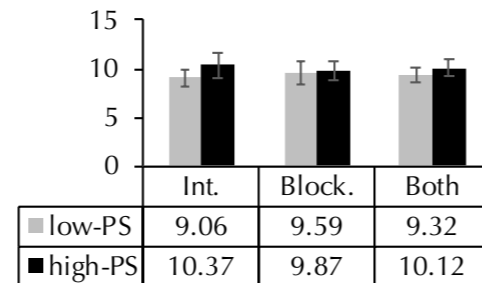
(g) Queries w/o scrolls



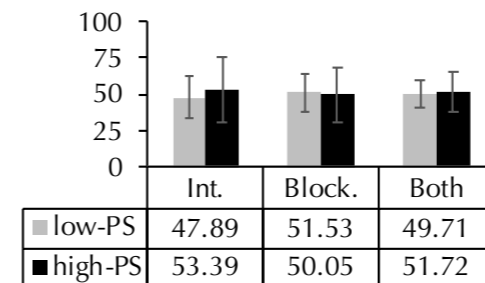
(h) Time b/w events



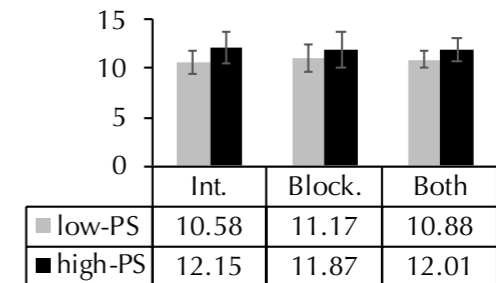
(i) First bookmark time



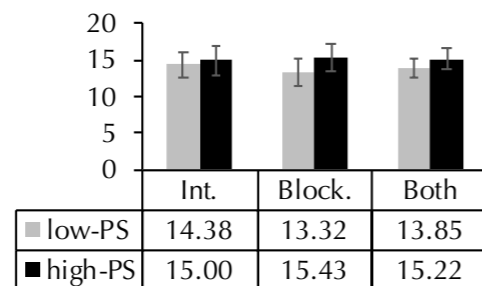
(j) Bookmarks



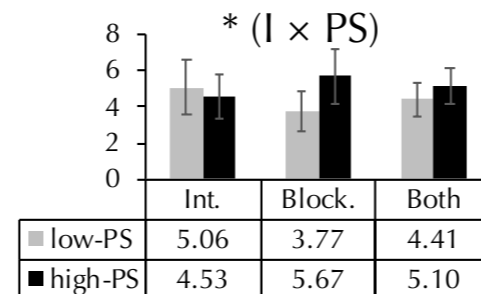
(k) Click-to-bookmark time



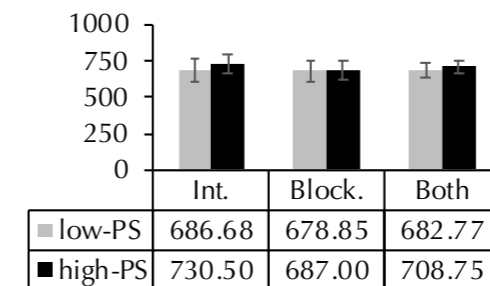
(l) Query-to-click time



(m) Clicks

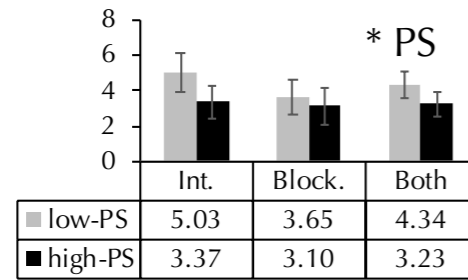


(n) Clicks w/o bookmarks

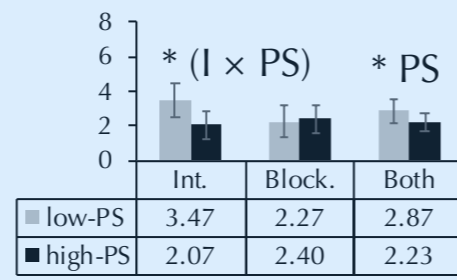


(o) Completion time

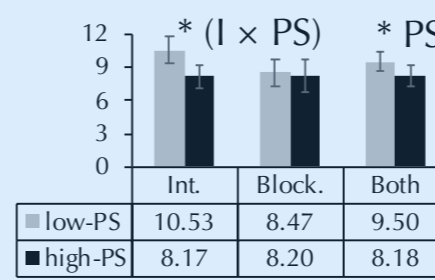
RQ3 Results: Perceptual Speed on Search Behaviors



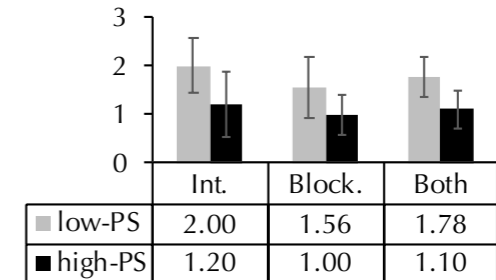
(a) Queries w/o bookmarks



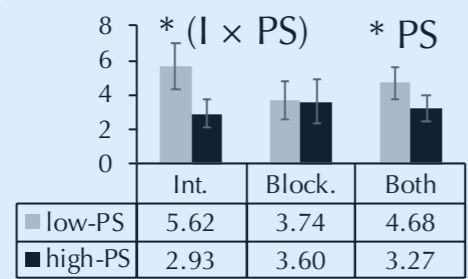
(b) Repeated intent queries



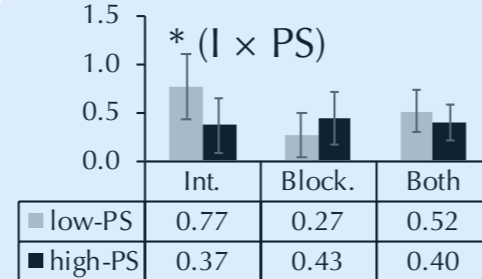
(c) Queries



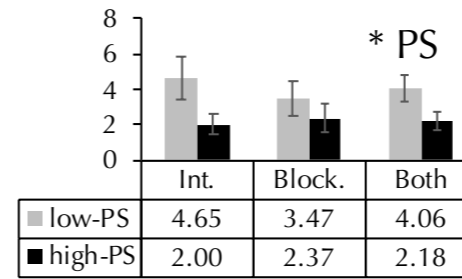
(d) Queries w/o clicks



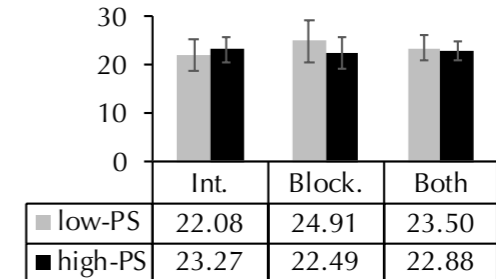
(e) Quick reformulations



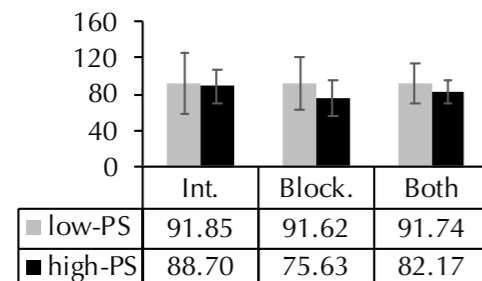
(f) Queries w/o mouseovers



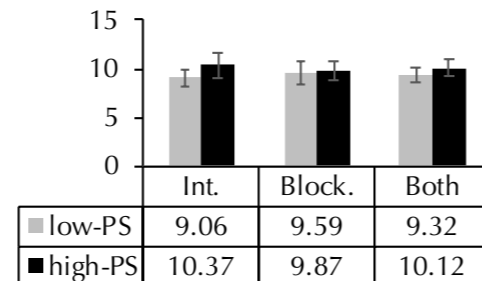
(g) Queries w/o scrolls



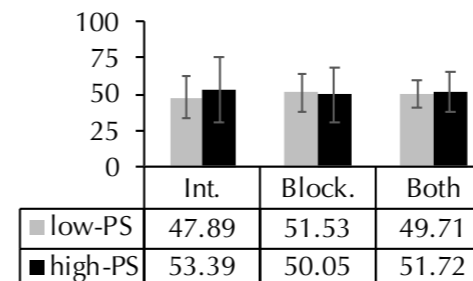
(h) Time b/w events



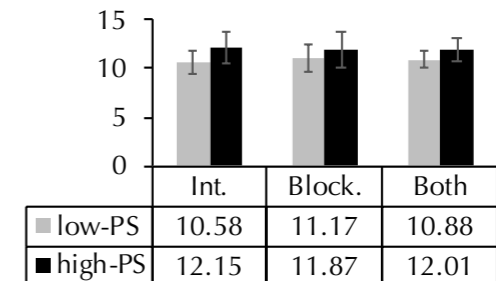
(i) First bookmark time



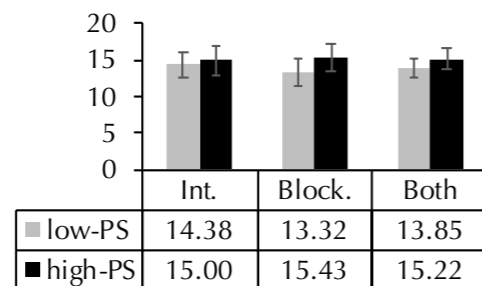
(j) Bookmarks



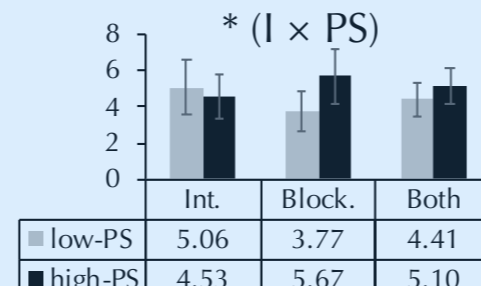
(k) Click-to-bookmark time



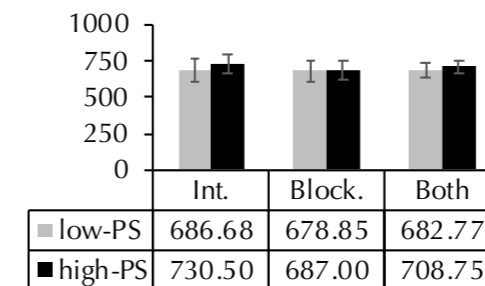
(l) Query-to-click time



(m) Clicks

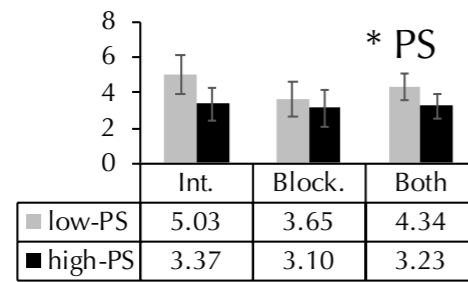


(n) Clicks w/o bookmarks

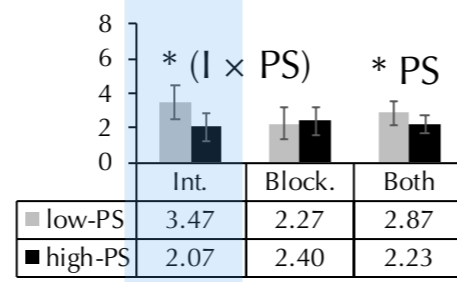


(o) Completion time

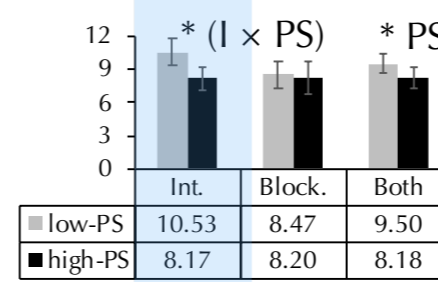
RQ3 Results: Perceptual Speed on Search Behaviors



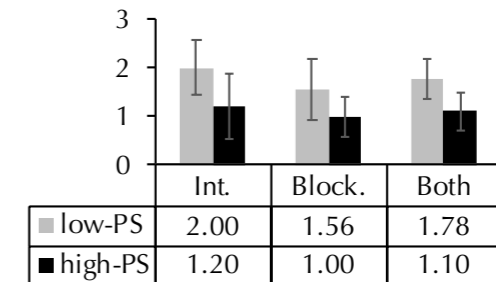
(a) Queries w/o bookmarks



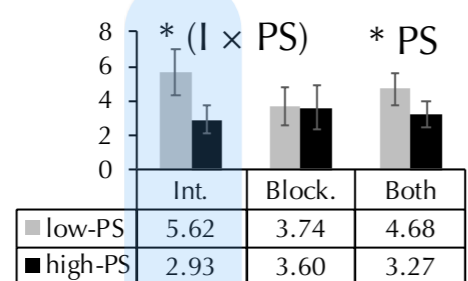
(b) Repeated intent queries



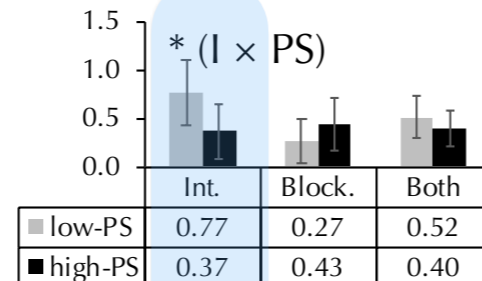
(c) Queries



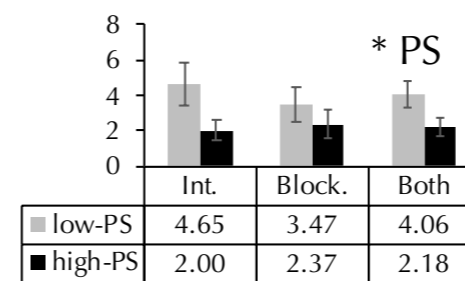
(d) Queries w/o clicks



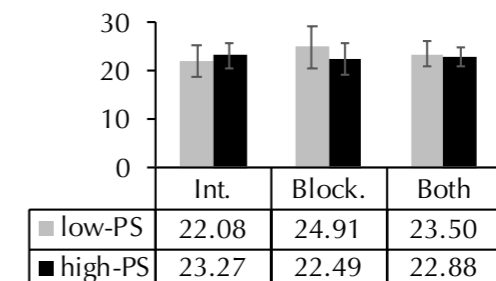
(e) Quick reformulations



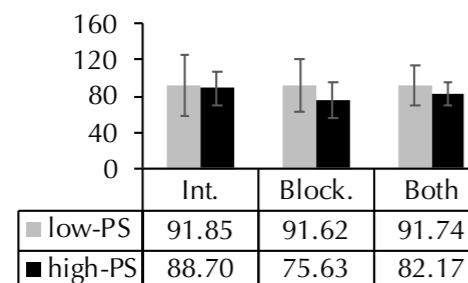
(f) Queries w/o mouseovers



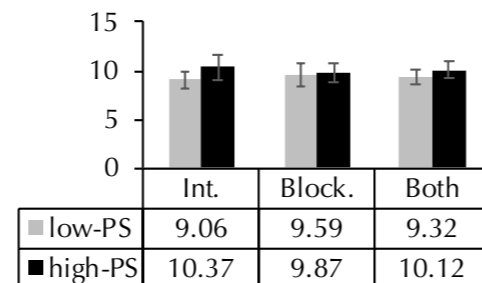
(g) Queries w/o scrolls



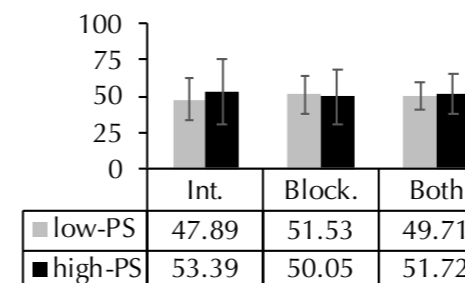
(h) Time b/w events



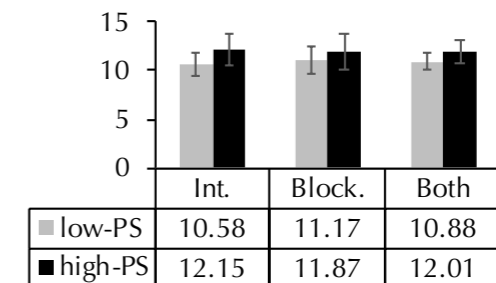
(i) First bookmark time



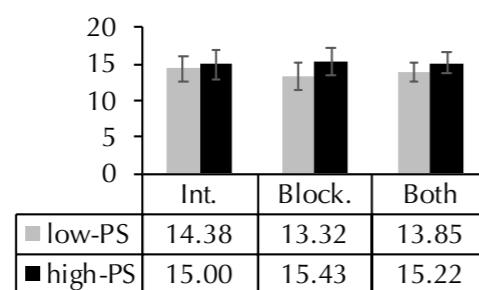
(j) Bookmarks



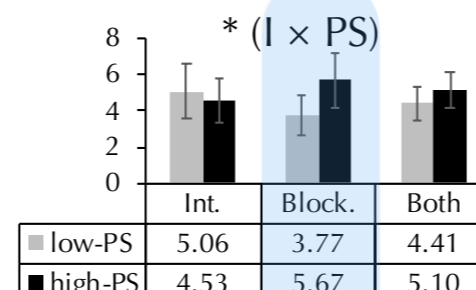
(k) Click-to-bookmark time



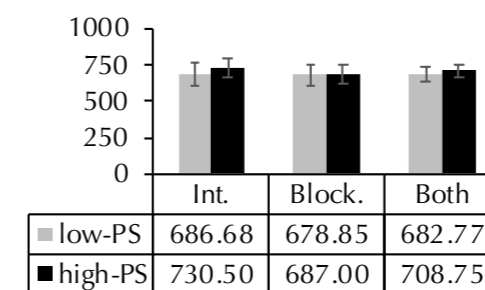
(l) Query-to-click time



(m) Clicks

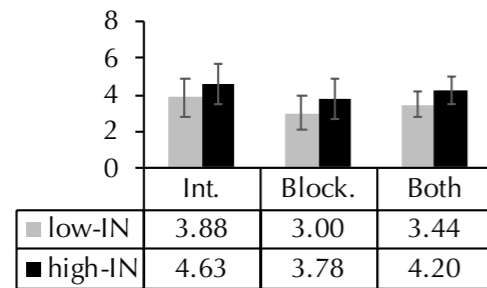


(n) Clicks w/o bookmarks

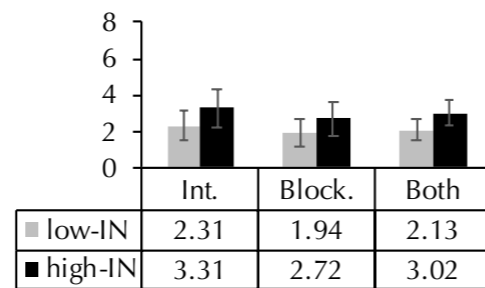


(o) Completion time

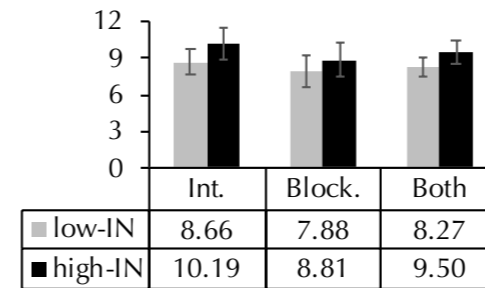
RQ3 Results: Inhibition on Search Behaviors



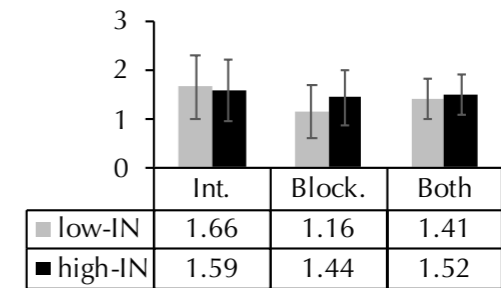
(a) Queries w/o bookmarks



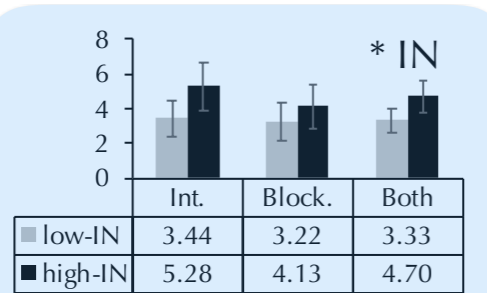
(b) Repeated Intent Queries



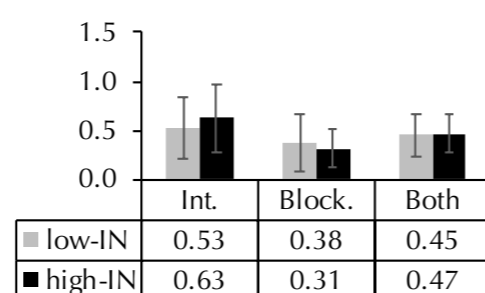
(c) Queries



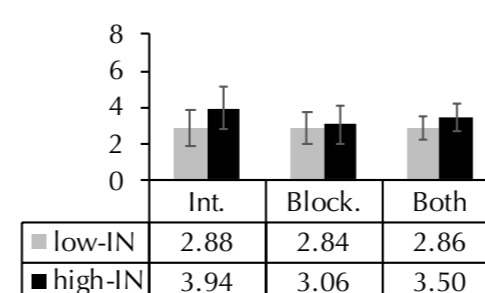
(d) Queries w/o Clicks



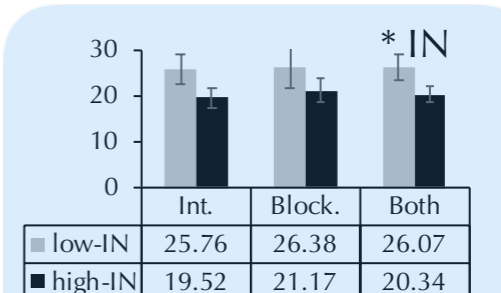
(e) Quick Reformulations



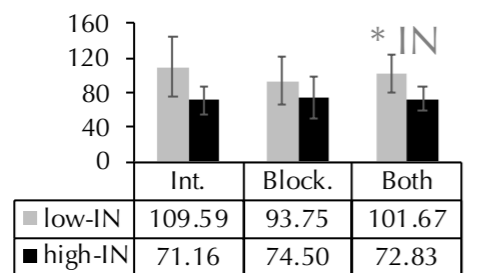
(f) Queries w/o mouseovers



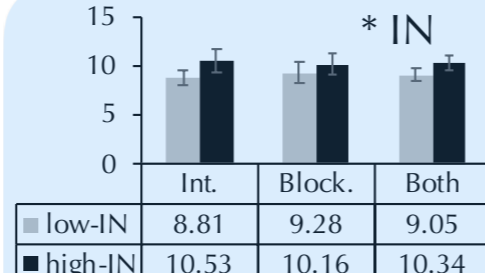
(g) Queries w/o scrolls



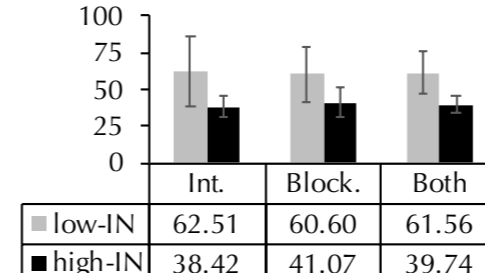
(h) Time b/w events



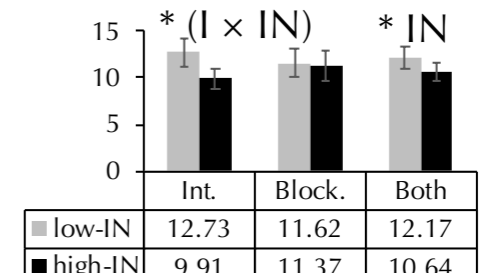
(i) First bookmark time



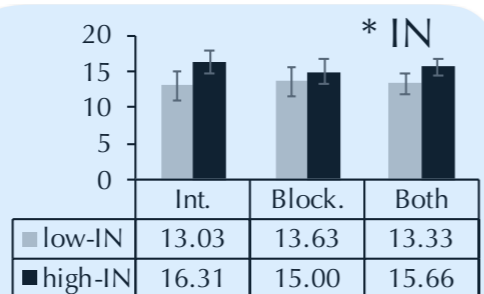
(j) Bookmarks



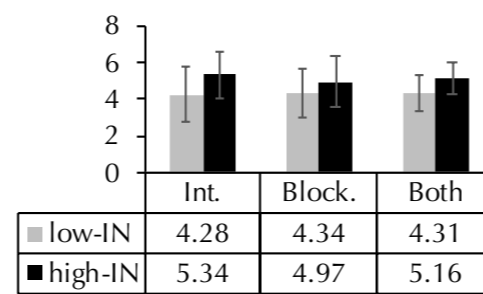
(k) Click-to-bookmark time



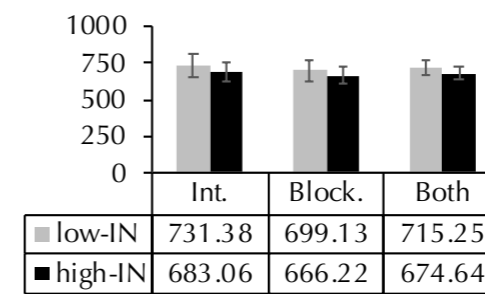
(l) Query-to-click time



(m) Clicks

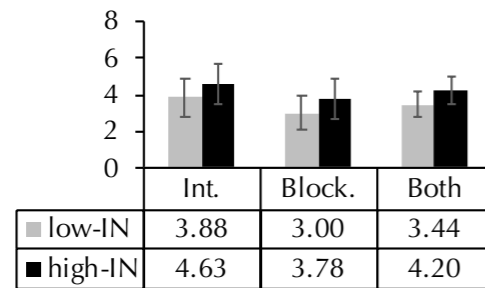


(n) Clicks w/o Bookmarks

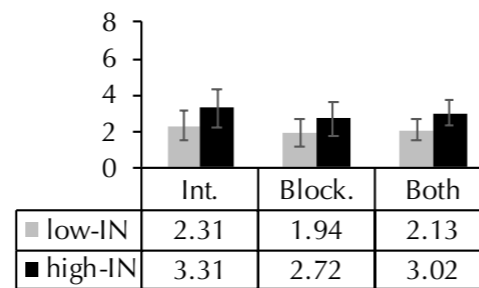


(o) Completion time

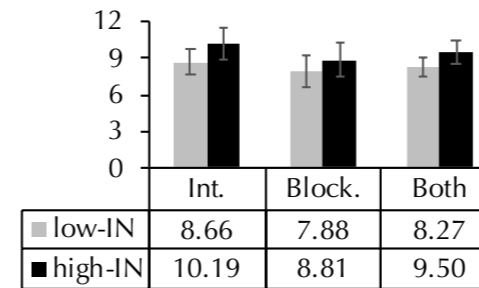
RQ3 Results: Inhibition on Search Behaviors



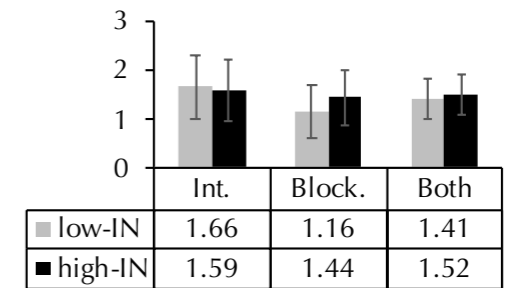
(a) Queries w/o bookmarks



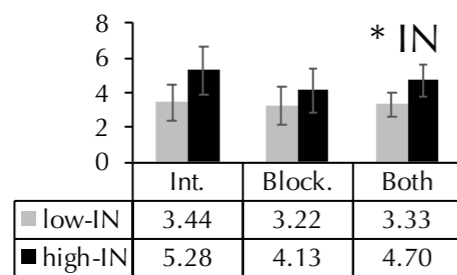
(b) Repeated Intent Queries



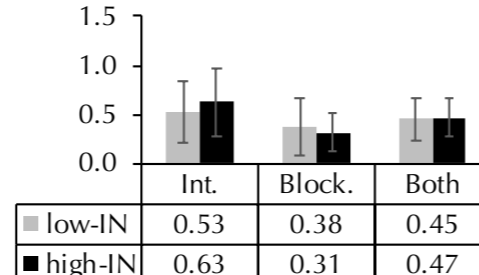
(c) Queries



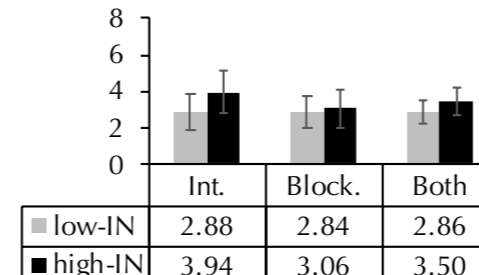
(d) Queries w/o Clicks



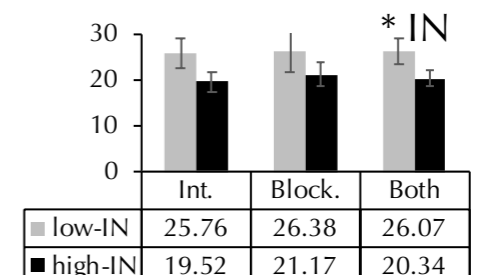
(e) Quick Reformulations



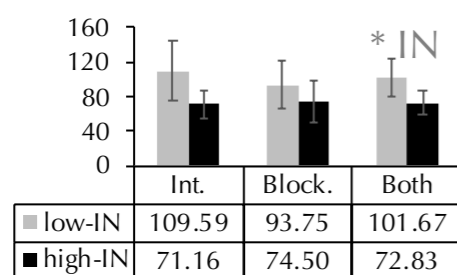
(f) Queries w/o mouseovers



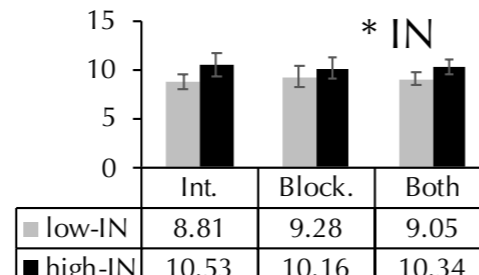
(g) Queries w/o scrolls



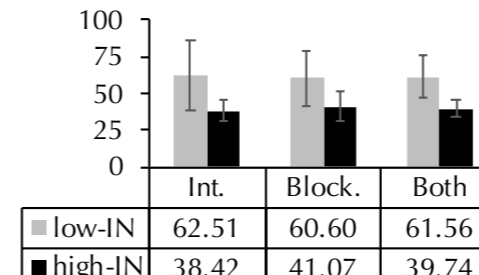
(h) Time b/w events



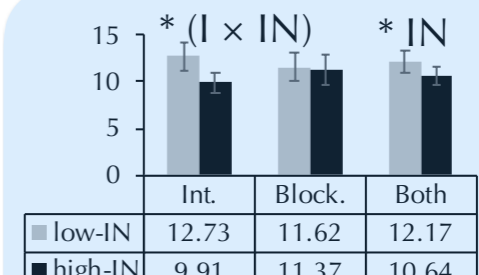
(i) First bookmark time



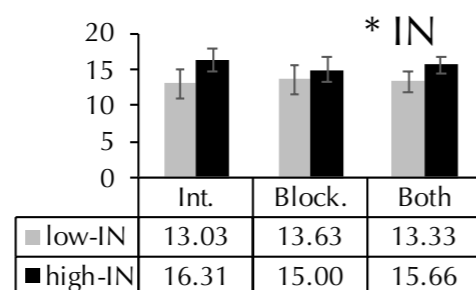
(j) Bookmarks



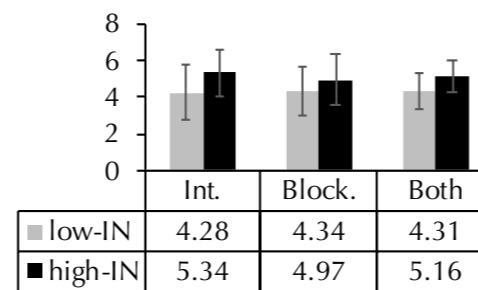
(k) Click-to-bookmark time



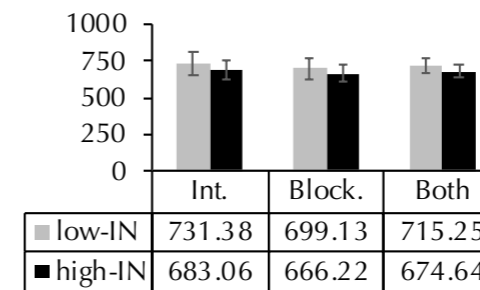
(l) Query-to-click time



(m) Clicks



(n) Clicks w/o Bookmarks



(o) Completion time

Studies

- The effects of working memory, perceptual speed, and inhibition in aggregated search
- The effects of working memory during search tasks of varying complexity

Research Questions

- The effects of working memory and task complexity on:

RQ1: workload

RQ2: satisfaction

RQ3: search behaviors

RQ4: outcomes

Task Complexity Manipulation

(2 x 2) vs. (4 x 4)

- Evaluate tasks:
 - ▶ compare N alternatives along M criteria
 - ▶ complete N x M spreadsheet (as needed)
 - ▶ make a selection
 - ▶ write a justification
- Simple tasks: 2 alternatives, 2 criteria
- Complex tasks: 4 alternatives, 4 criteria

User Study

(N=24)

- 2 search tasks (1 simple, 1 complex)
- 2 post-task questionnaires (workload, satisfaction)
- (Short break)
- 1 post-study psychometric test

RQ3: Search Behaviors

Factor Analysis

- 3-factor solution explained 82% of variance

	Factor 1	Factor 2	Factor 3
queries	0.941	0.247	-0.144
queries without scrolls	0.915	0.209	-0.199
clicks	0.921	0.024	-0.119
completion time	0.807	-0.075	0.530
quick query reformulations	0.755	0.392	-0.327
queries without clicks	0.155	0.890	0.035
queries without mouseovers	0.145	0.875	-0.009
time between events	-0.036	-0.142	0.911
query-to-click time	-0.213	0.160	0.543

RQ3: Search Behaviors

Factor Analysis

- 3-factor solution explained 82% of variance

	Factor 1	Factor 2	Factor 3
queries	0.941	0.247	-0.144
queries without scrolls	0.915	0.209	-0.199
clicks	0.921	0.024	-0.119
completion time	0.807	-0.075	0.530
quick query reformulations	0.755	0.392	-0.327
queries without clicks	0.155	0.890	0.035
queries without mouseovers	0.145	0.875	-0.009
time between events	-0.036	-0.142	0.911
query-to-click time	-0.213	0.160	0.543

RQ3: Search Behaviors

Factor Analysis

- 3-factor solution explained 82% of variance

	Factor 1	Factor 2	Factor 3
queries	0.941	0.247	-0.144
queries without scrolls	0.915	0.209	-0.199
clicks	0.921	0.024	-0.119
completion time	0.807	-0.075	0.530
quick query reformulations	0.755	0.392	-0.327
queries without clicks	0.155	0.890	0.035
queries without mouseovers	0.145	0.875	-0.009
time between events	-0.036	-0.142	0.911
query-to-click time	-0.213	0.160	0.543

RQ3: Search Behaviors

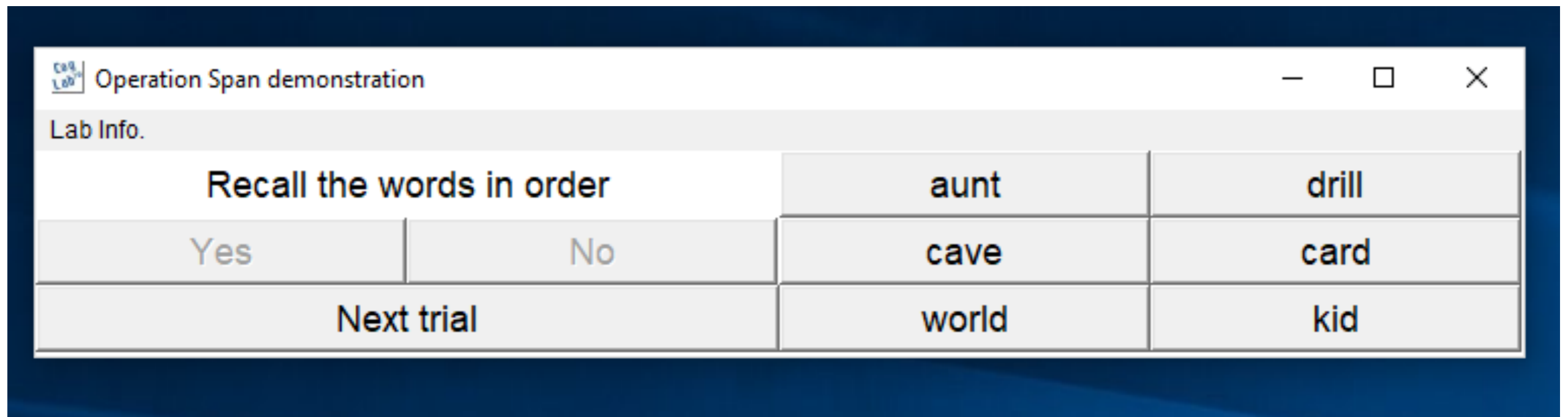
Factor Analysis

- 3-factor solution explained 82% of variance

	Factor 1	Factor 2	Factor 3
queries	0.941	0.247	-0.144
queries without scrolls	0.915	0.209	-0.199
clicks	0.921	0.024	-0.119
completion time	0.807	-0.075	0.530
quick query reformulations	0.755	0.392	-0.327
queries without clicks	0.155	0.890	0.035
queries without mouseovers	0.145	0.875	-0.009
time between events	-0.036	-0.142	0.911
query-to-click time	-0.213	0.160	0.543

Psychometric Test

Working Memory: Operation Span Task



The screenshot shows a software window titled "Operation Span demonstration". Below the title bar is a "Lab Info." section containing a table. The table has three rows of words and two columns of response options ("Yes" and "No"). The words are arranged in a grid: "aunt" and "drill" in the first row, "cave" and "card" in the second row, and "world" and "kid" in the third row. The "Next trial" button is located below the "Yes" and "No" options.

Recall the words in order		aunt	drill
Yes	No	cave	card
Next trial		world	kid

Psychometric Test

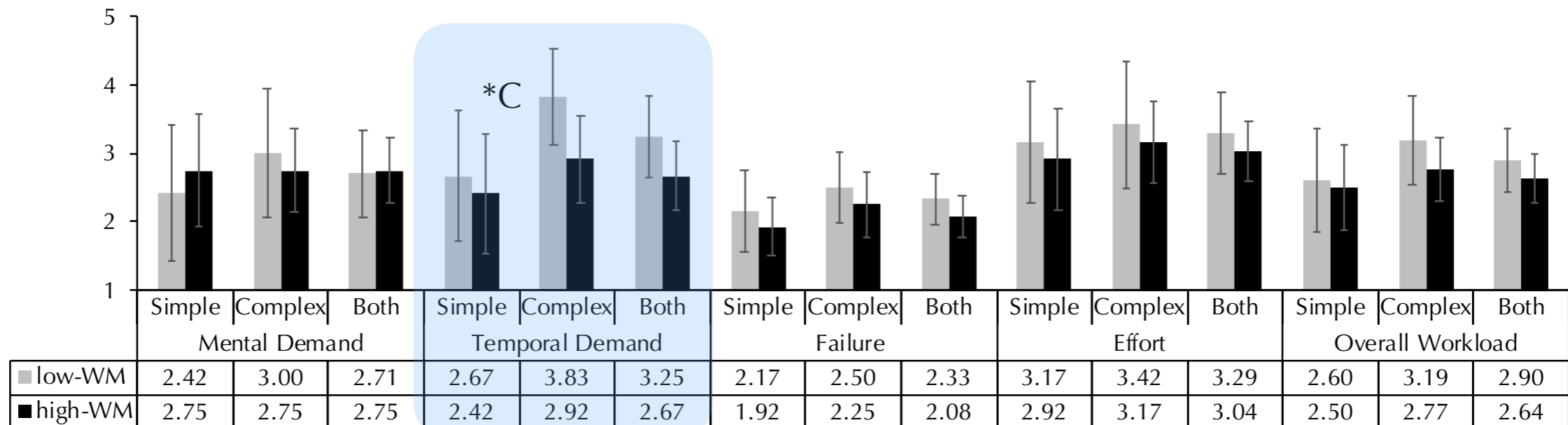
Working Memory: Operation Span Task

The screenshot shows a software window titled "Operation Span demonstration" with a "Cog Lab" logo. The window contains a table for a psychometric test trial. The table has three rows and two columns. The first row contains the question "is (8 x 1) + 5 = 13?". The second row contains the response options "Yes" and "No". The third row contains a "Next trial" button. The table is styled with a light gray background and black borders.

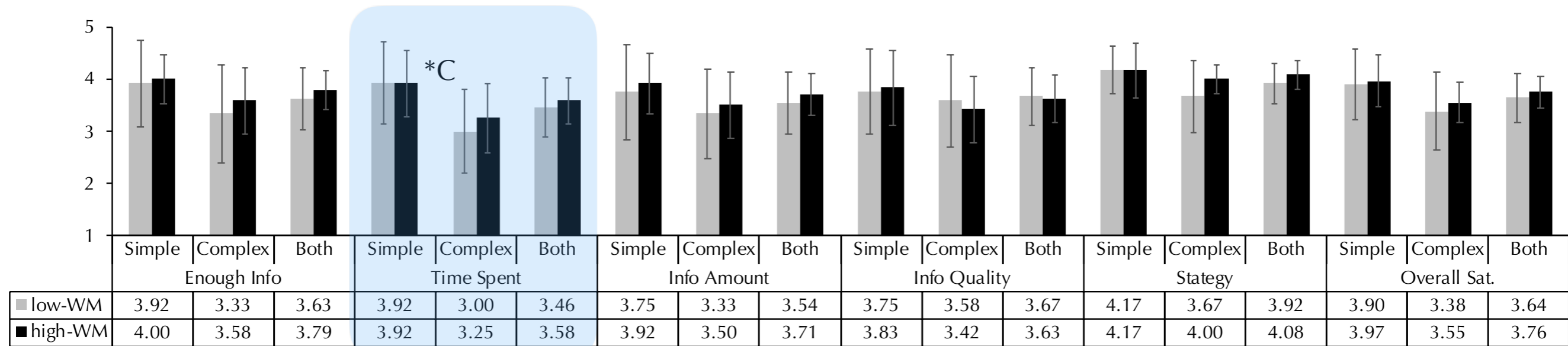
Lab Info.	
is $(8 \times 1) + 5 = 13?$	
Yes	No
Next trial	

Results

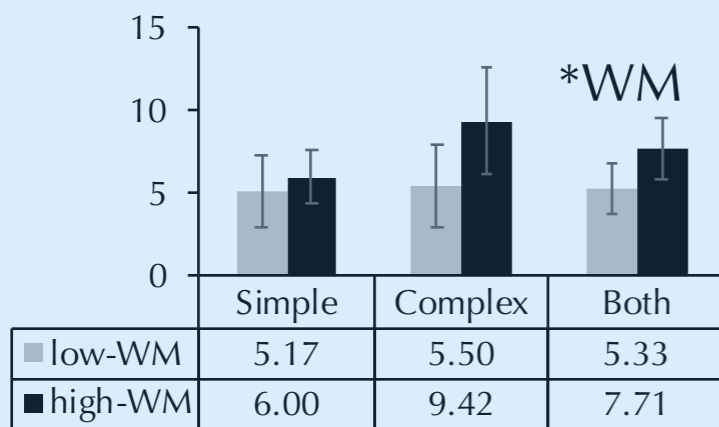
RQ1 Results: Workload



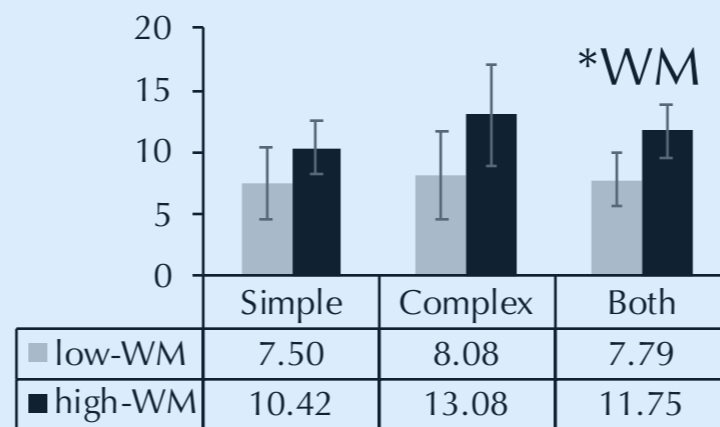
RQ2 Results: Satisfaction



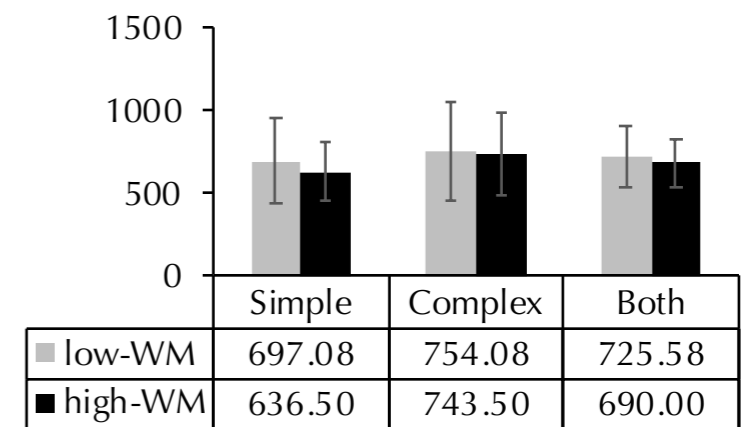
RQ3 Results: Search Behaviors



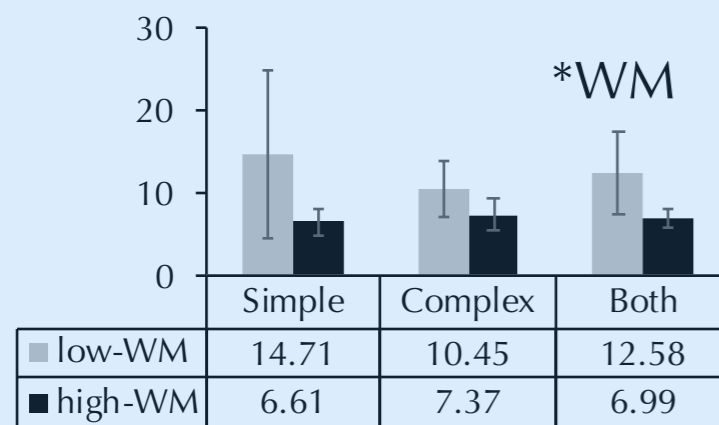
queries



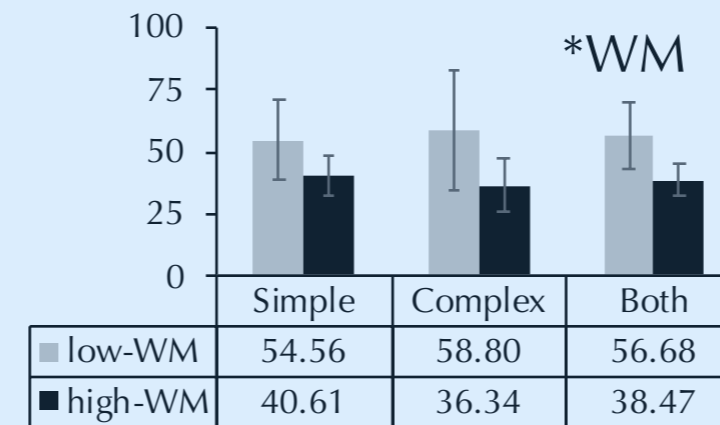
clicks



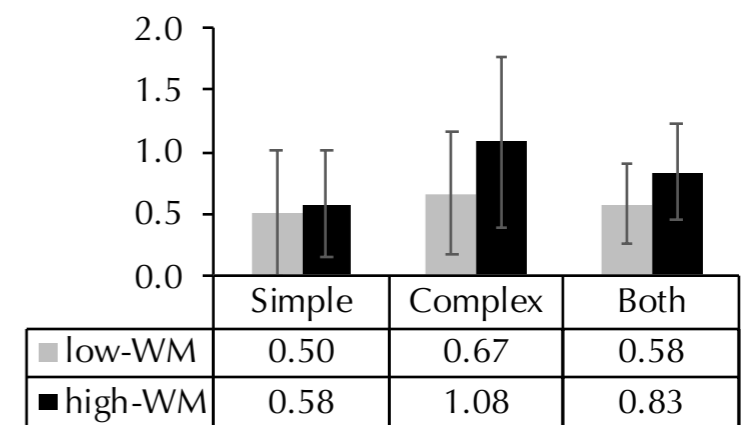
completion time



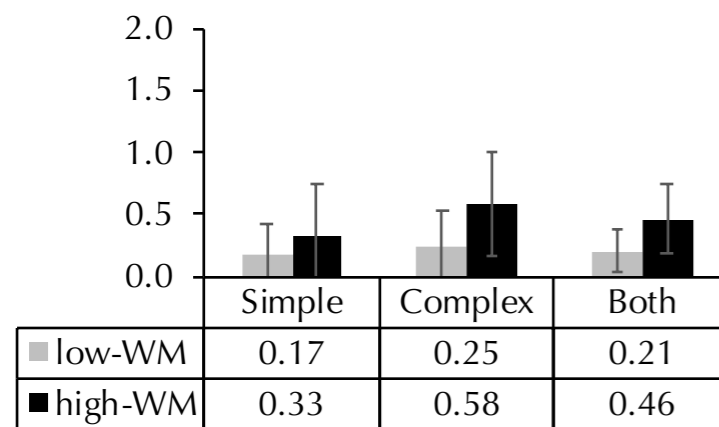
query-to-click time



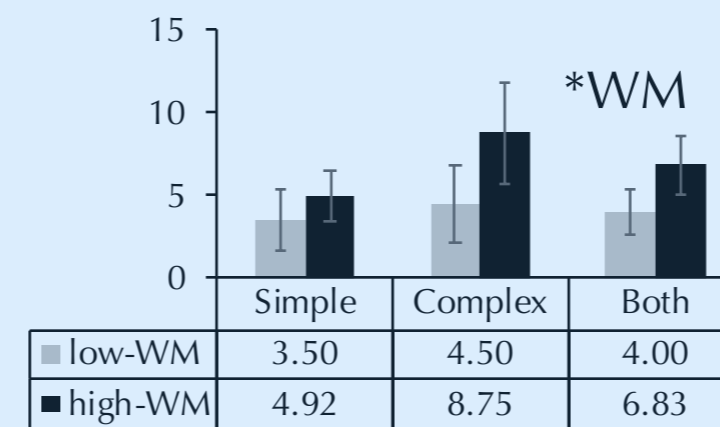
time between events



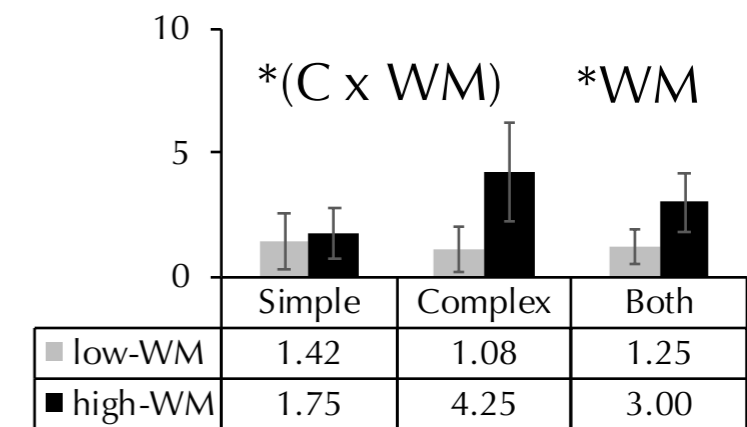
queries w/o clicks



queries w/o mouseovers

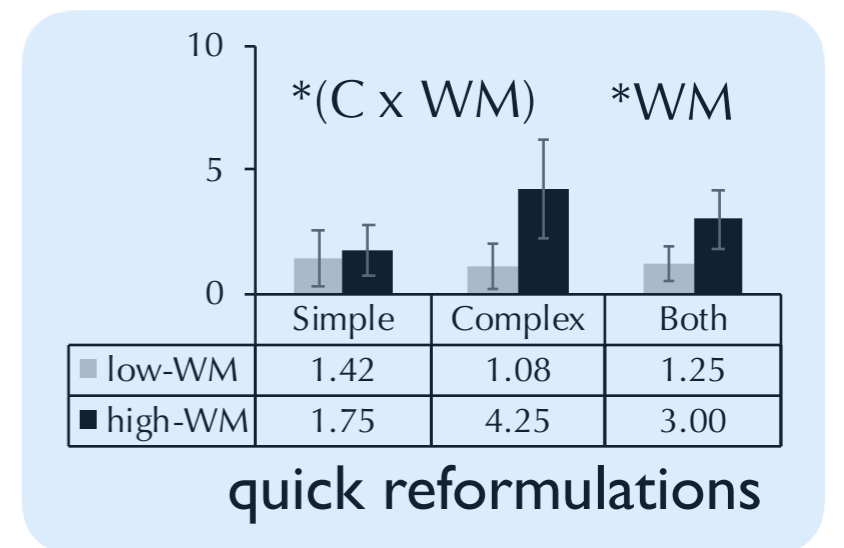
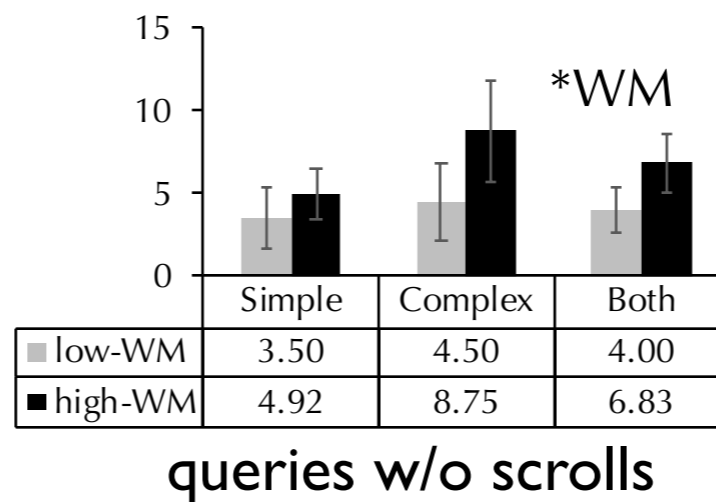
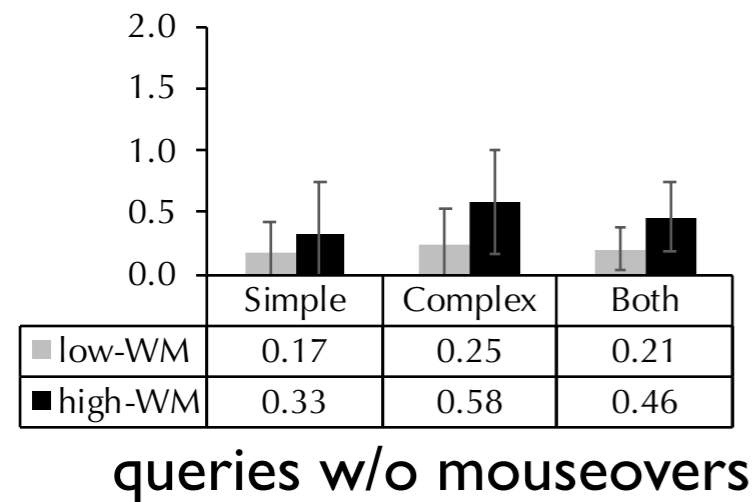
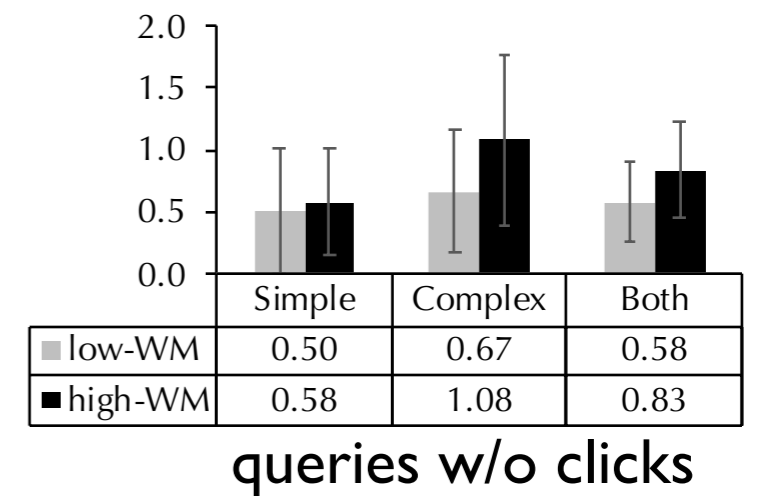
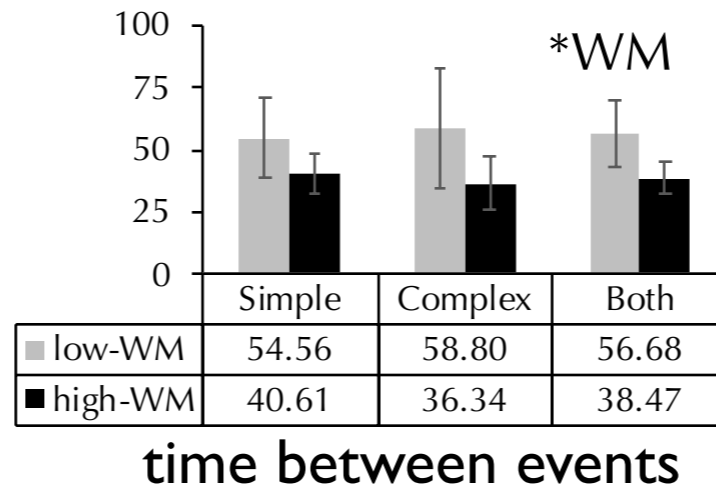
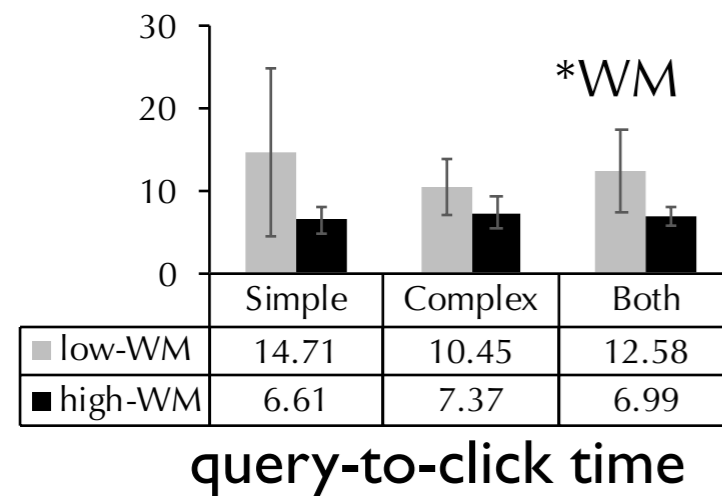
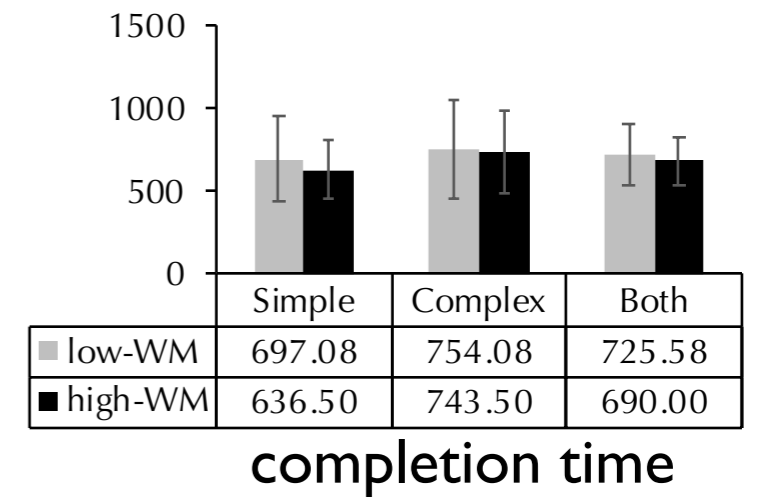
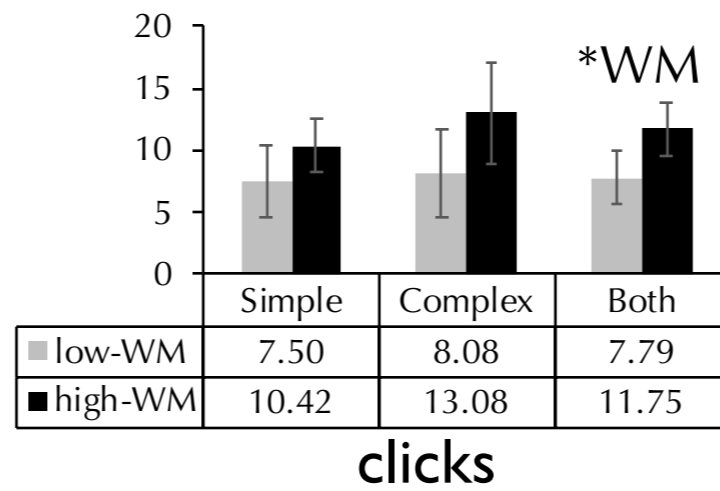
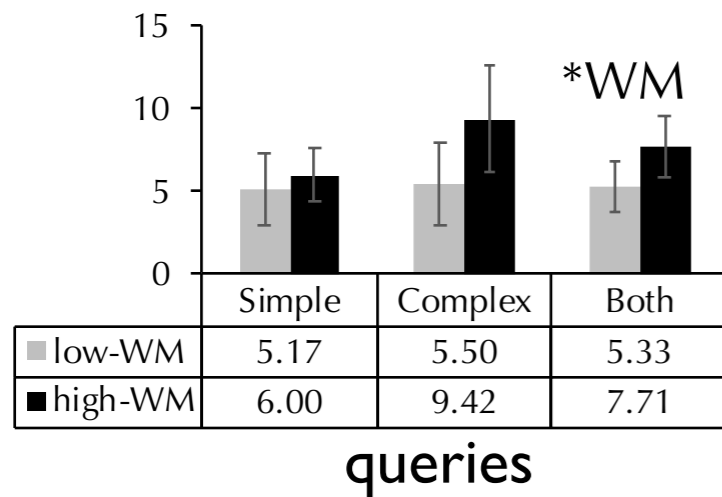


queries w/o scrolls

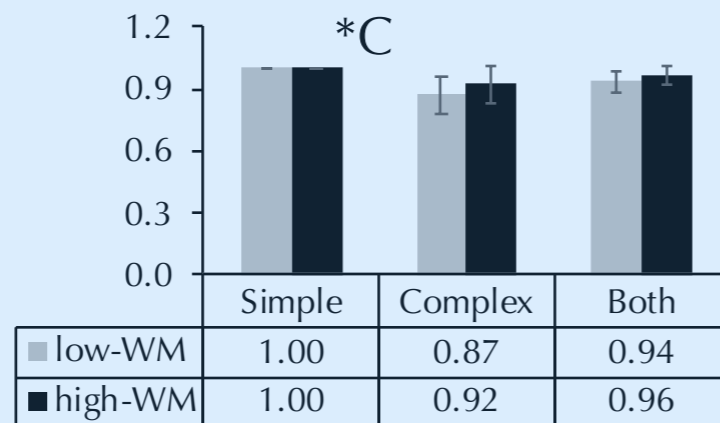


quick reformulations

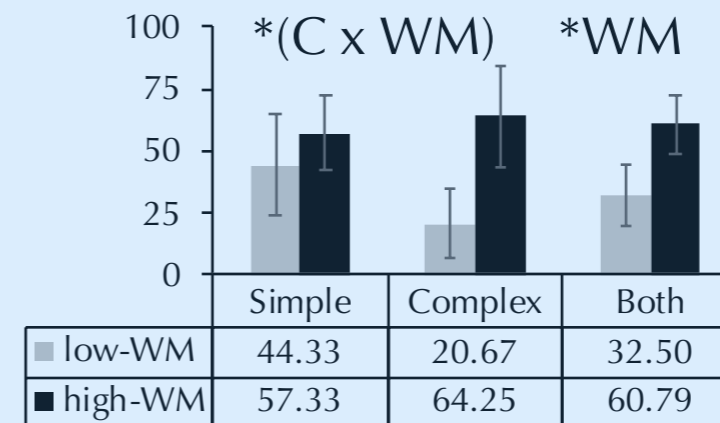
RQ3 Results: Search Behaviors



RQ4 Results: Search Outcomes



coverage



Justification length