

IT UNIVERSITY OF COPENHAGEN



PIONEER CENTRE FOR
ARTIFICIAL INTELLIGENCE

FROM QUERIES TO CANDIDATES: EXPLORING THE SEARCH AND SOURCE INTERACTION BEHAVIOR OF RECRUITERS

Toine Bogers (IT University of Copenhagen / Pioneer Centre for AI)

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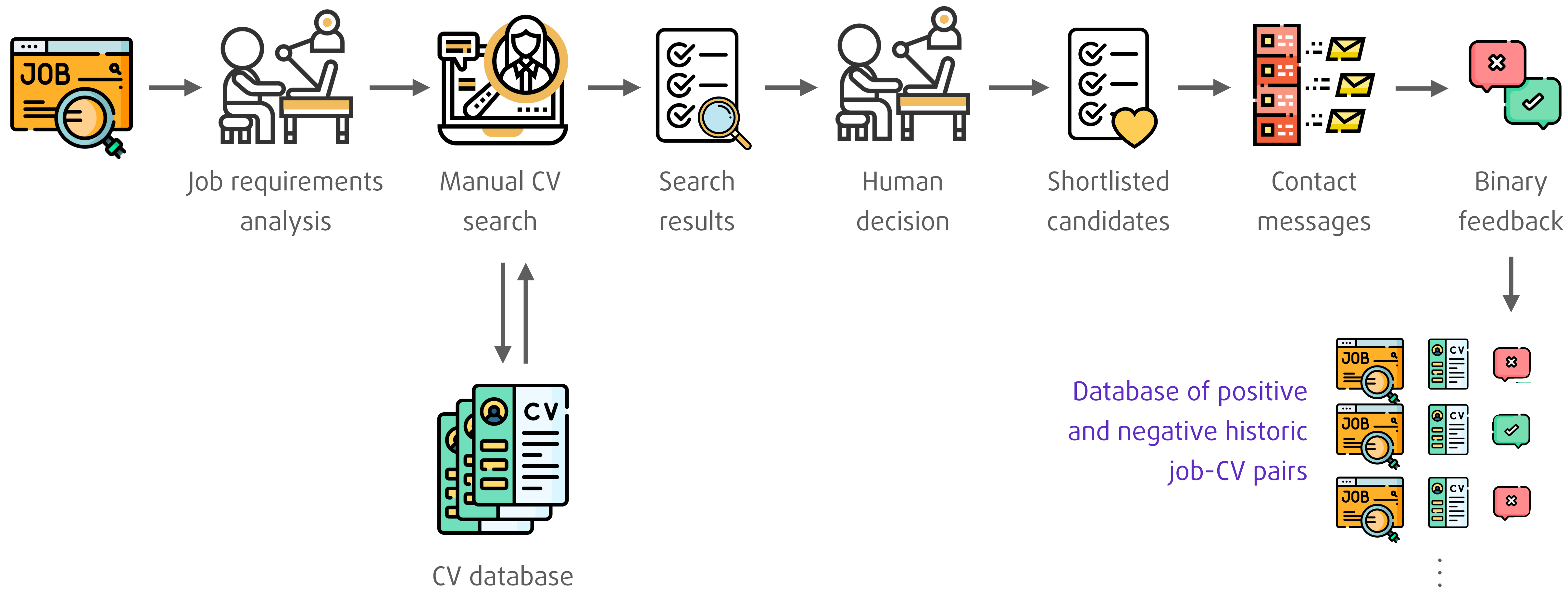
Maria Gäde (Humboldt Universität zu Berlin)

- ▶ **Recruitment** consists of **identifying relevant candidates for an open position** by assessing their education level, their knowledge, skills, abilities, their work experience and their interests
 - As a professional search domain, recruiting has been largely **overlooked** in IR research
 - Estimates on the number of recruiters range from **1 to 3.5 million**
 - Better support of recruiters could have a big impact on job seekers, companies and society as a whole



- ▶ Academic-industrial collaboration with **Jobindex**
 - Denmark's biggest job portal (>30K job postings, >120K resumés, >600K unique users)
- ▶ Focus of this talk is on characterizing recruiters' search behavior
 - **RQ1:** How is **search behavior** impacted by **task type**?
 - **RQ2:** How is **search behavior** impacted by **task complexity**?
 - **RQ3:** Which search behavior leads to the **identification of successful matches**?

HOW DO JOBINDEX RECRUITERS WORK?



CV SEARCH ENGINE

► CV search engine

– Search bars

- Four different bars

- ★ Free-text

- ★ Location

- ★ Job title

- ★ Category (automatically assigned)

- Recruiters can save previously successful queries

– Filters

– Search results

Search in CVs

[See manual ?](#)

Filter your search

Following company

☐ Testfirma

Education level

At least

Maximum

Work experience (years)

10

Maximum

Management experience (years)

5

Maximum

Salary expectations

40,000 kr.

60,000 kr.

Tags

Advanced

Language skills

× English

Minimum language proficiency

Notice period

1 month notice

Found 1,845 users.

Contact CVs

Clear CVs

Sent messages

Language skills

English

Management experience

5–

Notice period

1 month notice

Salary expectations

40,000 kr.–60,000 kr.

Search among

Online CVs + followers

Search term

sales supply chain

Special groups

Full-time

Work experience

10–

Create CV Agent

Experienced Supply Chain Management Professional

Job wishes:

Supply Chain Director, Category Manager, COO, Director and 6 others

Geography:

Salary expectations:

DKK 40-50,000

Conditions of employment:

Full-time and temp

Latest job:

Owner and founder

Education:

Graduate Diploma in Business Administration) – HD 2. Supply Chain Management

Work experience:

24 years

Management experience:

20 years

Experienced Supply Chain Management Professional – with extensive international leadership experience from Strategic Sourcing, Procurement, Supply Chain Management, Product Portfolio Management, Business & Product Development and leading global international teams.

... one of the best managers within Supply Chain and Procurement in Denmark ...

... PROFILE I am an Experienced Supply Chain Management Professional with a solid ...

supply shipment

Experienced Supply Chain Management Professional

Global Supply Chain Jobs

ABC

+ 134 others

★ ★ ★

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📄

Add tag

Add comments

► CV search engine

- **Search term highlighting** is an important tool in relevance assessment
- Recruiters can **shortlist** relevant candidates
- Shortlisted candidates can be **contacted** all at once or in batches

Search in CVs

Filter your search

Following company

☐

 Testfirma

Education level

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Language skills	English
Management experience	5–
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Search among	Online CVs + followers
Search term	sales supply chain
Special groups	Full-time
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Create CV Agent

☐

Experienced Supply Chain Management Professional

1

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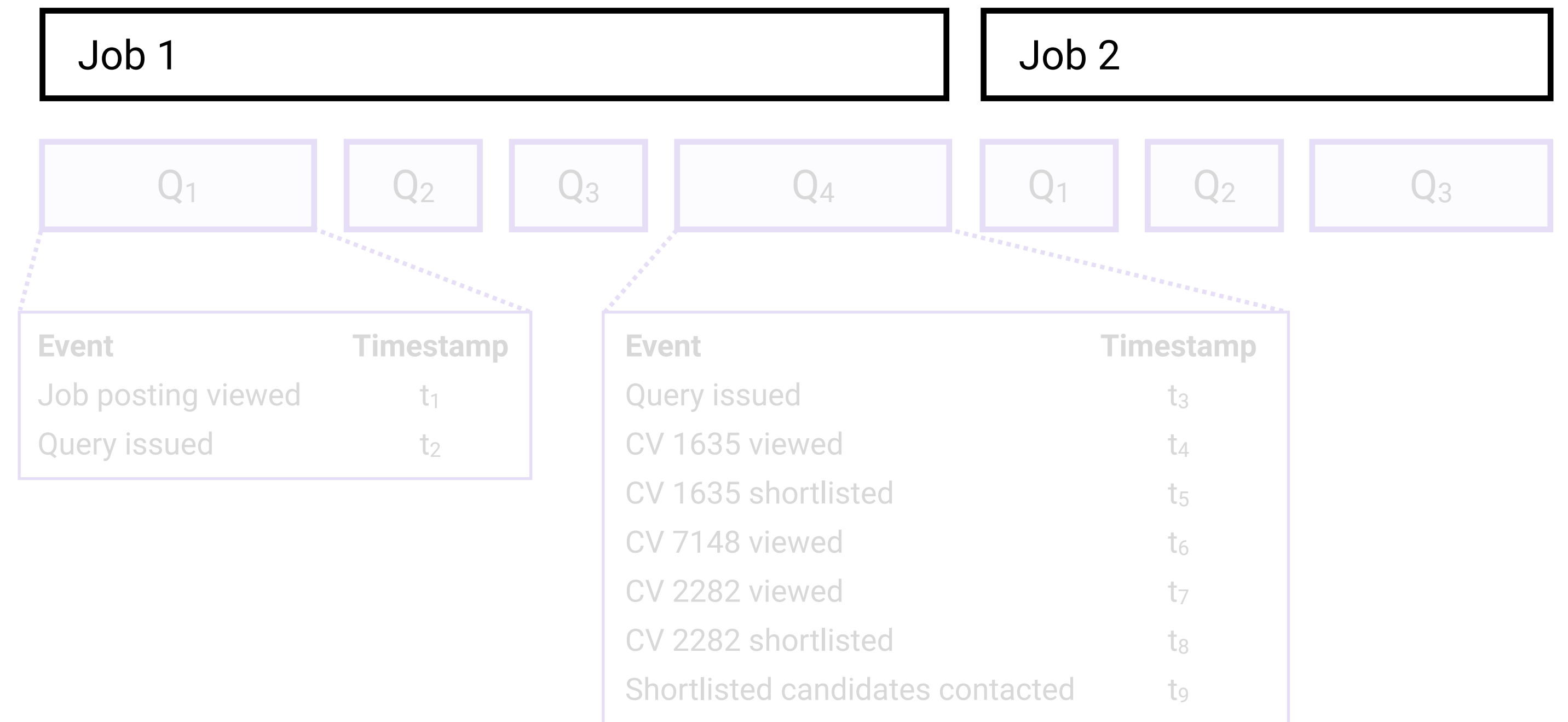
ABC

+ 134 others

★ ★ ★ ✎ 📎 J Add tag Add comments

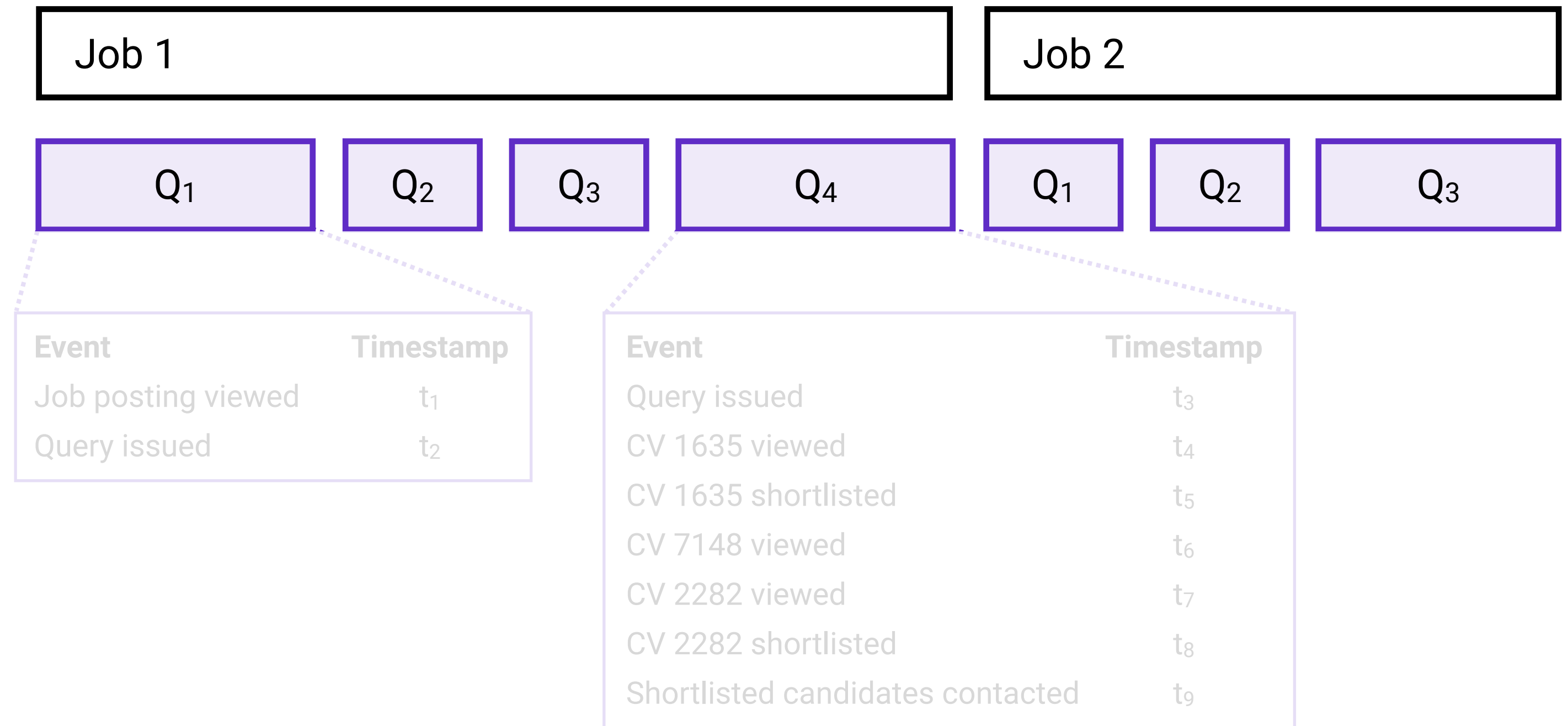
► Definitions

- Each **job** processed by a recruiter counts as a **task**
- Each **task** corresponds to a single **session**
 - A session starts when a job is **selected from the queue** and ends when all shortlisted candidates have been **contacted**
 - ★ More complex session definitions did not result in a meaningful increase in the number of sessions
 - Recruiters previously reported working **sequentially** on a job until done



► Definitions

- Each **job** processed by a recruiter counts as a **task**
- Each **task** corresponds to a single **session**
- A **session** consists of **multiple queries**
 - A query consists of the four search bar inputs and the selected filters

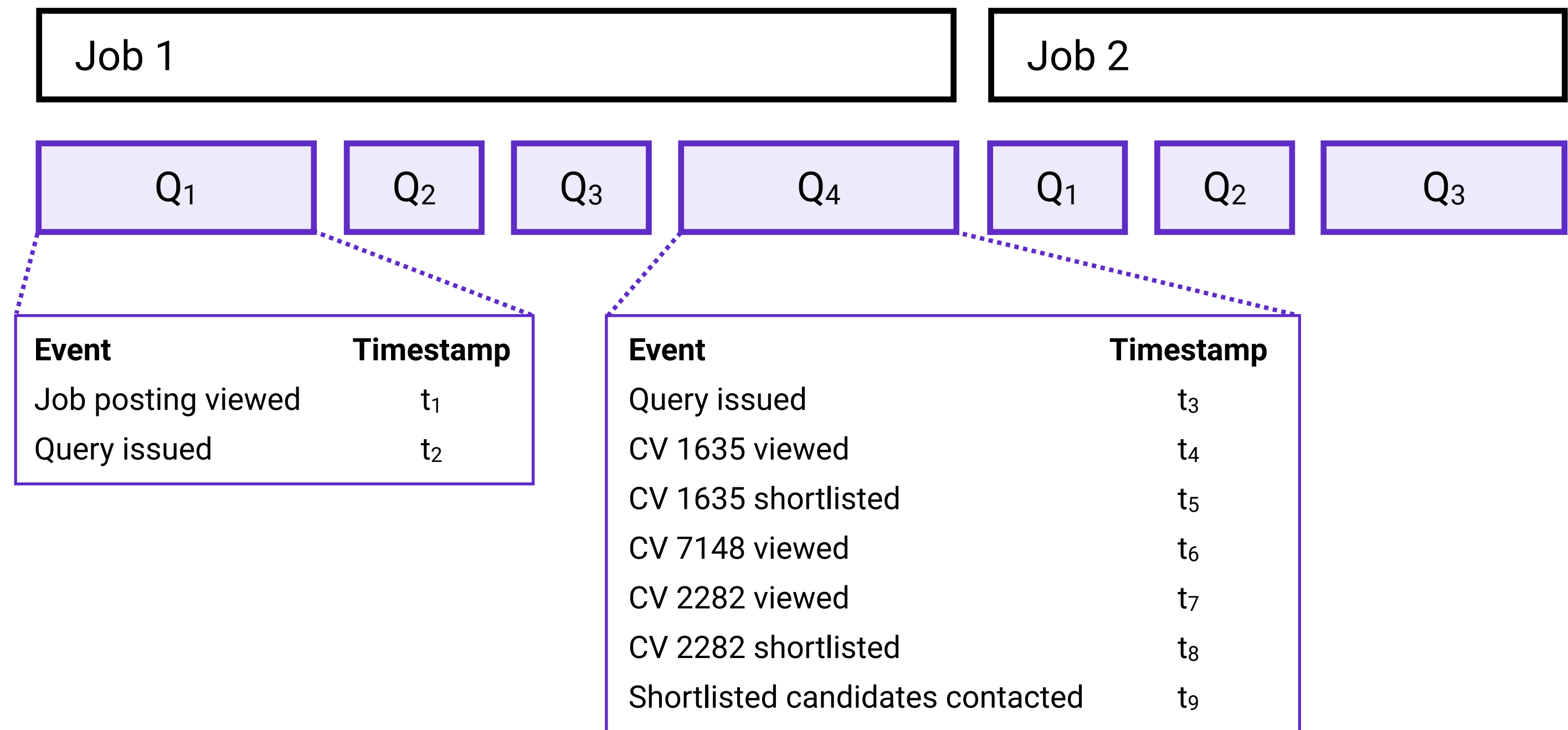


► Definitions

- Each **job** processed by a recruiter counts as a **task**
- Each **task** corresponds to a single **session**
- A **session** consists of **multiple queries**
- Each **query** has an associated **event log**
 - There are 10 different event types

Possible events

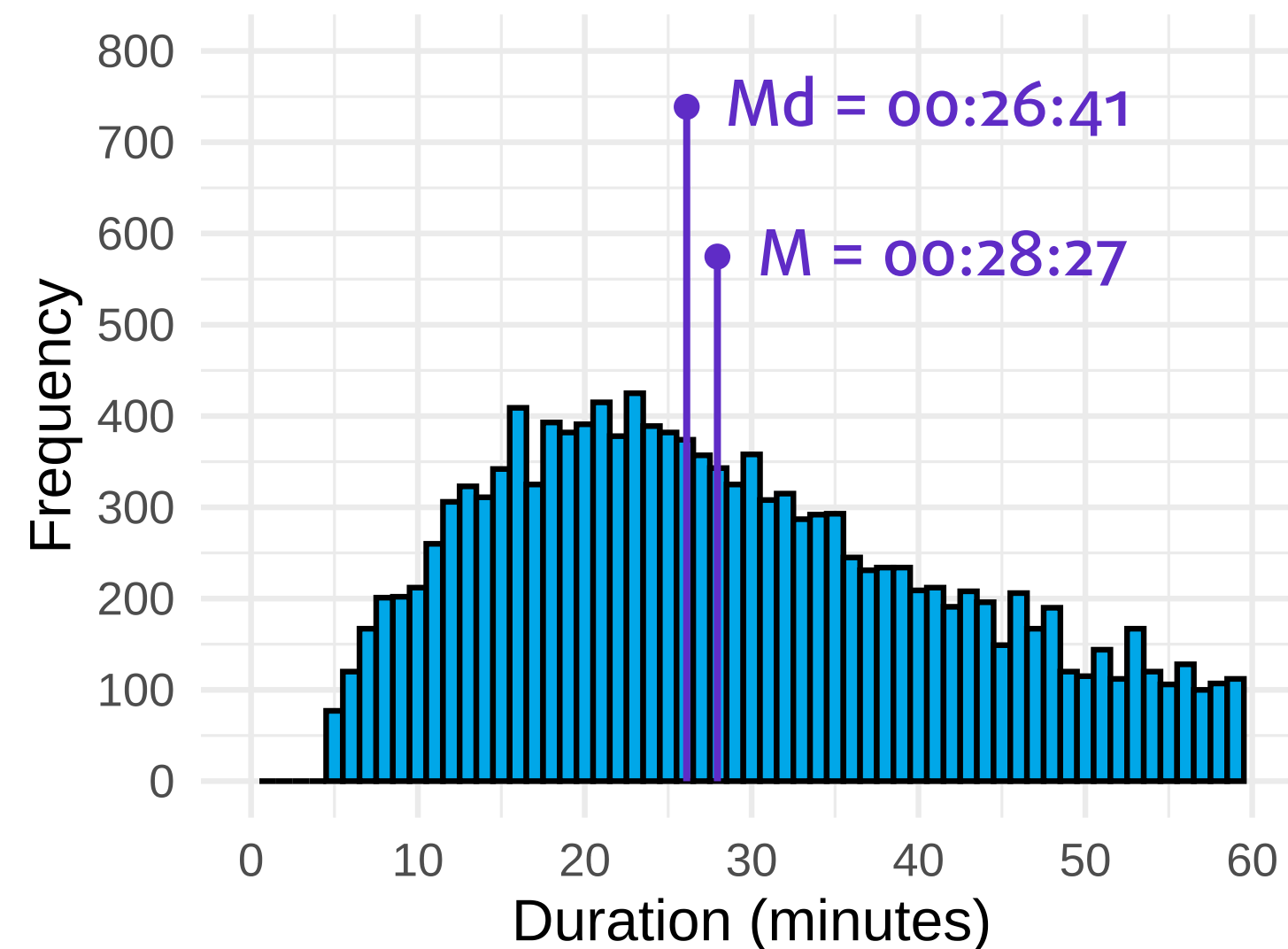
- Job posting viewed
- Query issued
- CV viewed
- CV clicked
- CV shortlisted
- CV removed from shortlist
- Shortlisted candidates contacted
- Shortlist cleared
- Task in focus
- Task out of focus



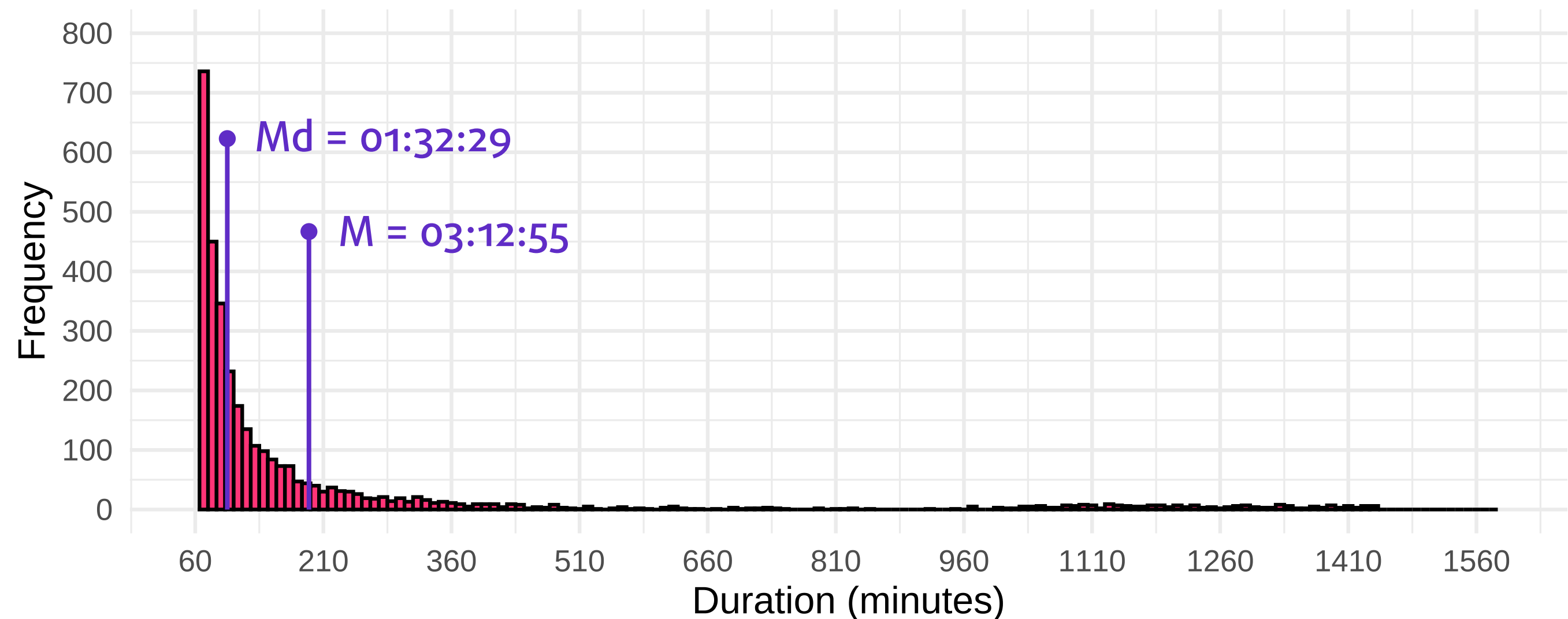
► Task type

- Defined by the **two types of paid services** offered by Jobindex
 - **Matching**, where recruiter spend **at most 60 minutes**
 - **Recruiting**, where recruiters typically (but not always) spend **3-4 hours**

(a) Matching tasks (N = 13,718)



(b) Recruiting tasks (N = 3,761)



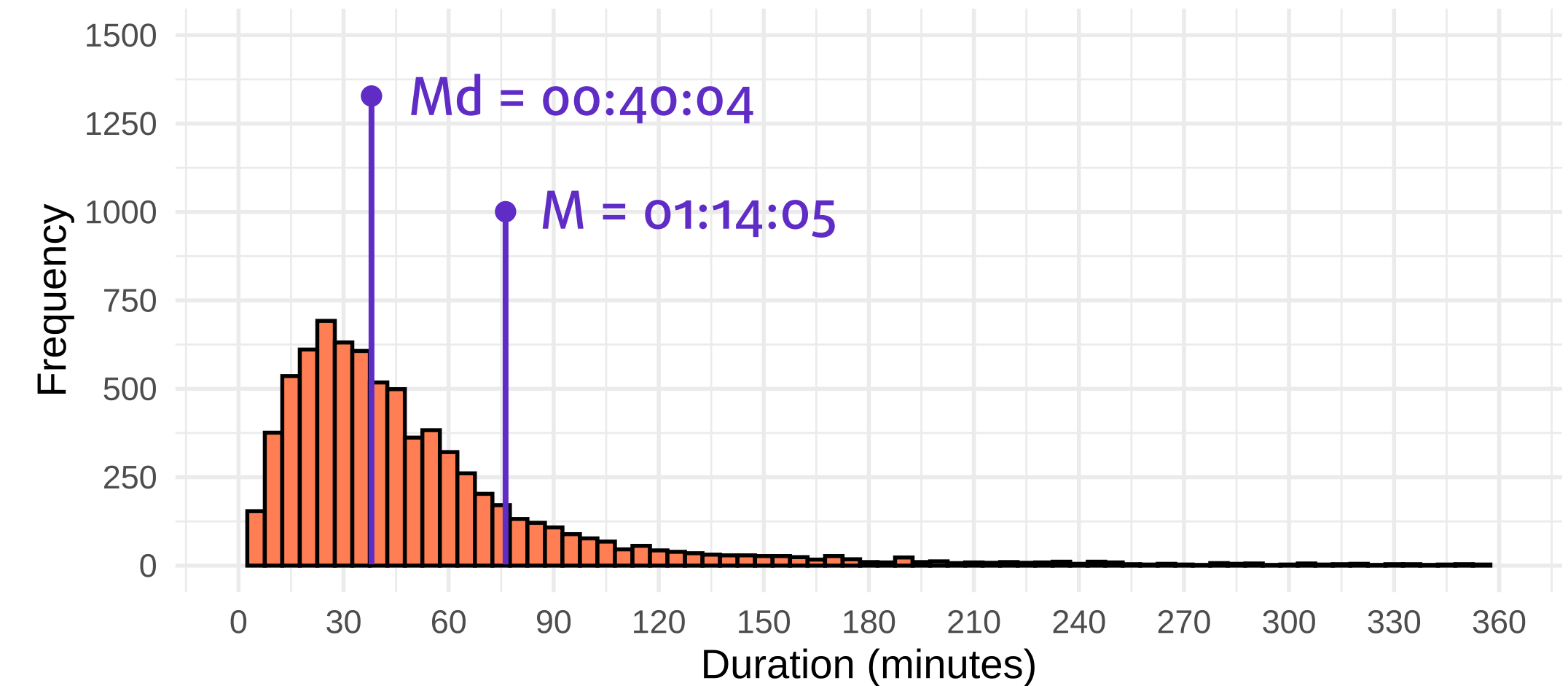
► Task complexity

- **Two classes of complexity** defined by senior expert recruiters at Jobindex
 - **Complex** jobs, which are more difficult to find relevant candidates for
 - **Standard** jobs, which are easier to find relevant candidates for

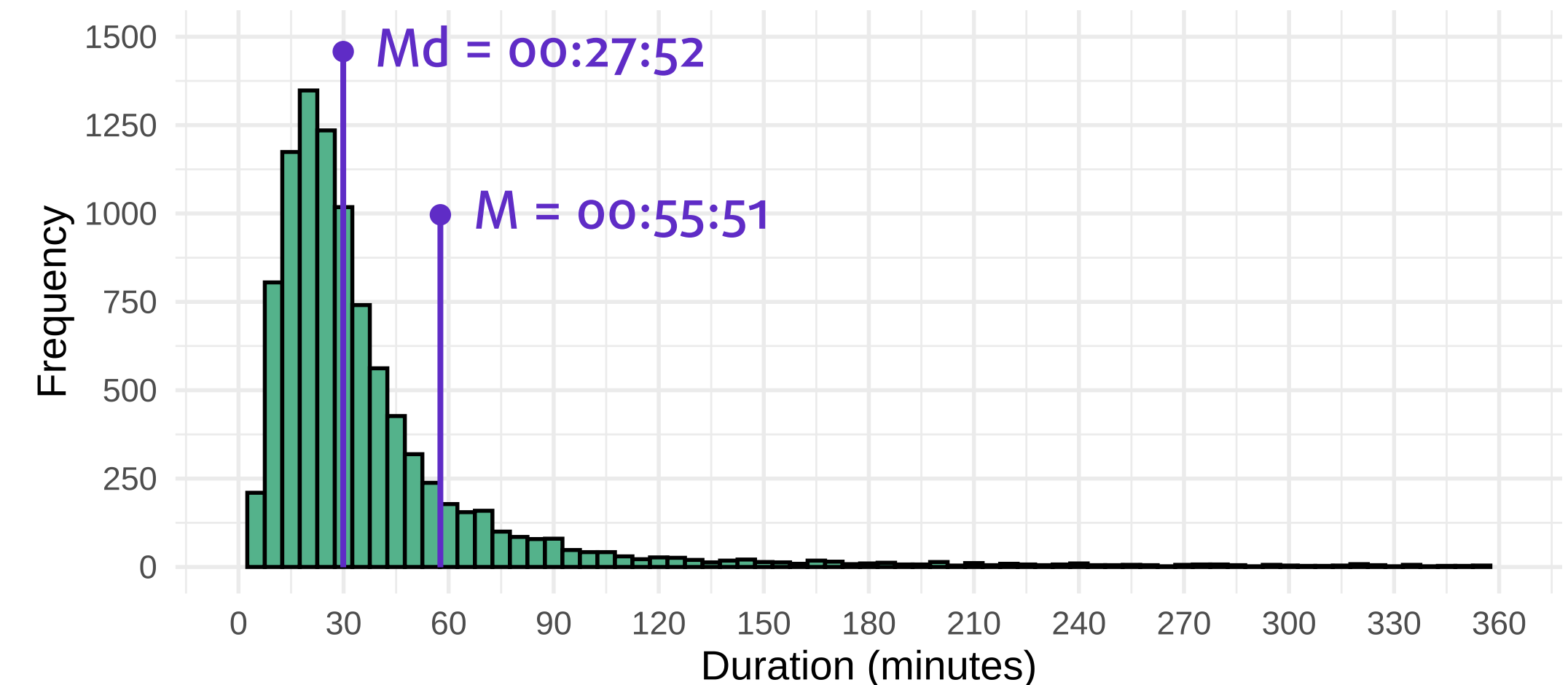
► Search success

- Mean number of contacted candidates is 20.5 (Md = 20) with a typical range of **15-30 candidates**
- **Positively responding** candidates = **success**

(a) Complex tasks (N = 7,783)



(b) Standard tasks (N = 9,696)



► Filtering

- Each job is associated with **a single recruiter** (3.1% of jobs are cases where the recruiter is replaced by another)
- **Only Danish jobs** were retained (31.2% are in English, Norwegian or Swedish)
- **Outlier jobs were removed** with a duration of <5 minutes or >24 hours (12.6% of all tasks)

► Final dataset contains **17,479 tasks, 195,370 queries** and **4,078,447 events** spanning **564 days**

		Complexity		
		Complex	Standard	Total
Task type	Matching	5,550 (31.8%)	8,168 (46.7%)	13,718 (78.5%)
	Recruiting	2,233 (12.8%)	1,528 (8.7%)	3,761 (21.5%)
	Total	7,783 (44.6%)	9,696 (55.4%)	17,479 (100%)

60% of **matching** jobs are **standard**

60% of **recruiting** jobs are **complex**

► How did we characterize **search behavior**?

– **Search formulation**

- Query counts
- Query length and term re-use
- Query operators
- Filters

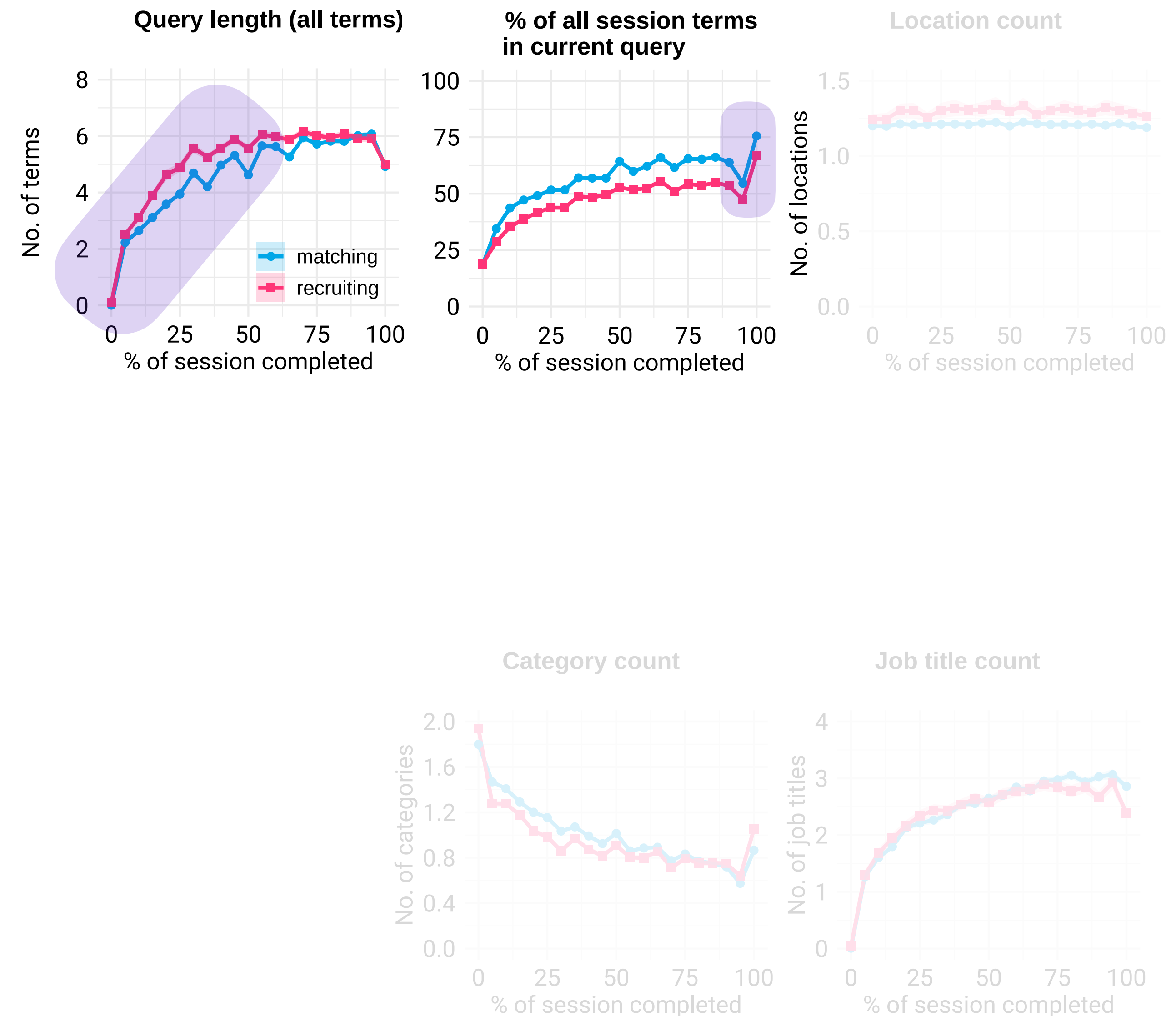
– **Source selection & interaction**

- Viewed, clicked and contacted candidates

► Search formulation

– Query length and term re-use

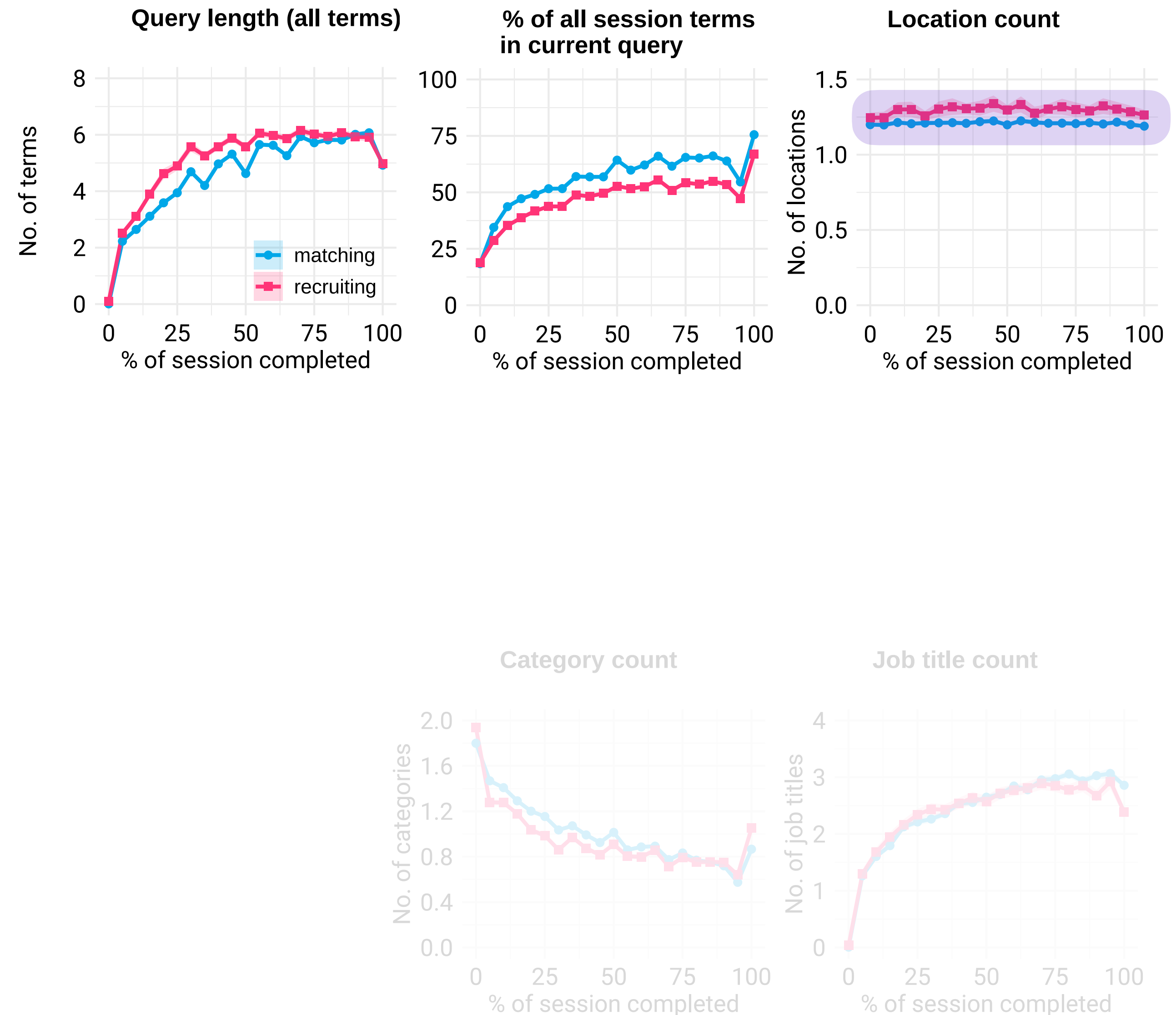
- Queries **increase in length** during the **first half** of the sessions
- **Reformulating** and **removing** unsuccessful query terms happens more during the **second half**
- ★ Only **75%** of all of a session's query terms are part of the **final** query



► Search formulation

– Query length and term re-use

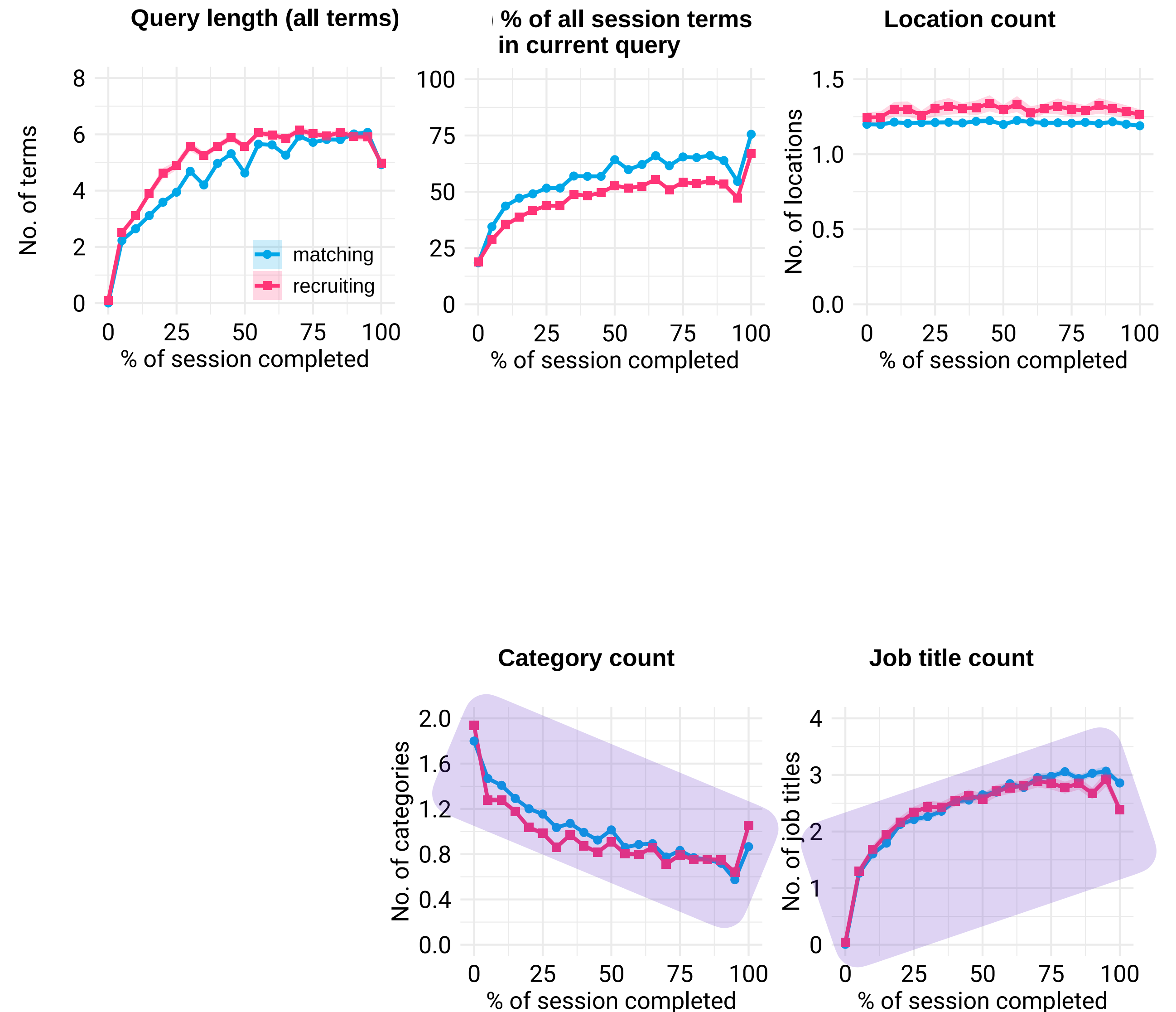
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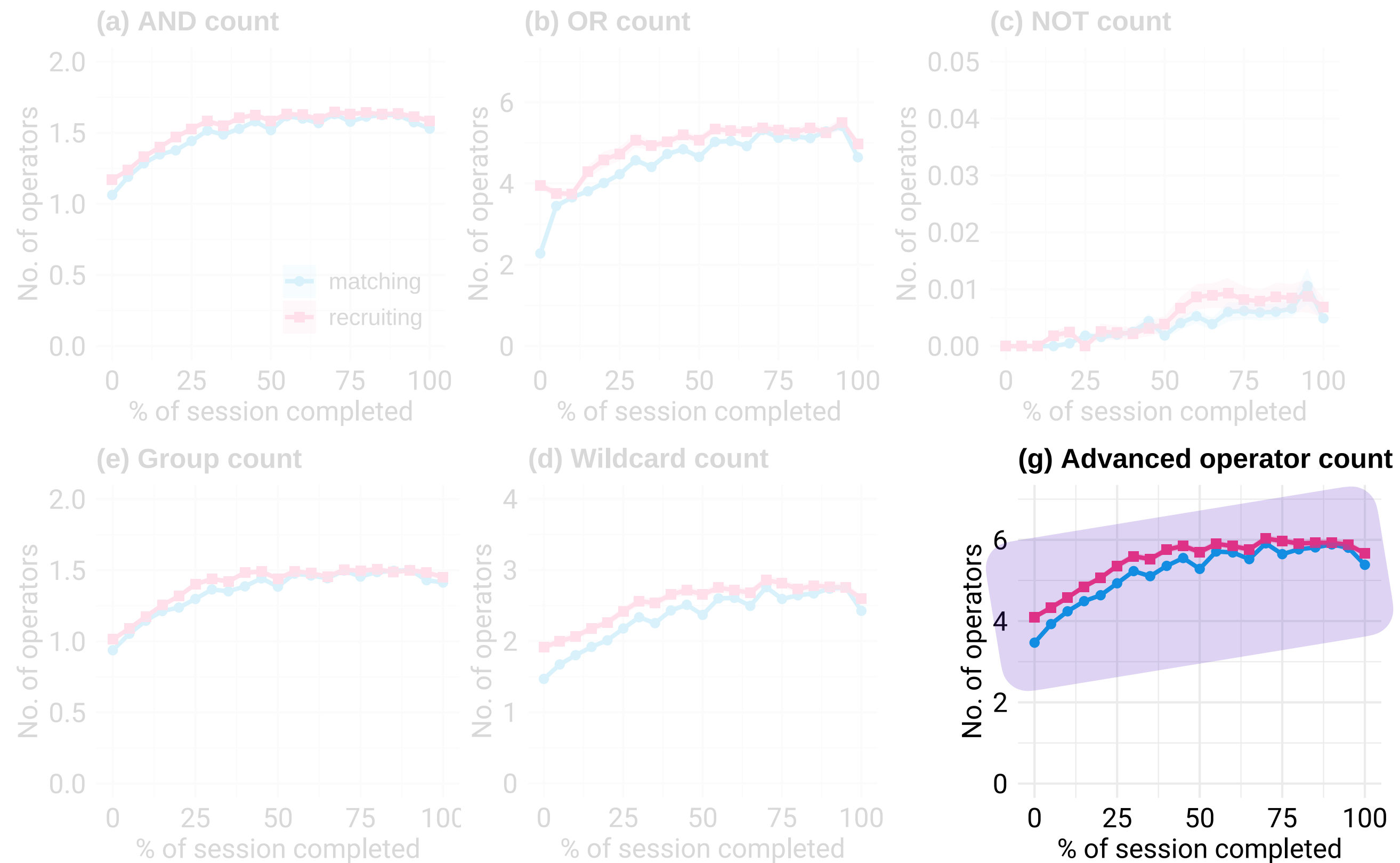


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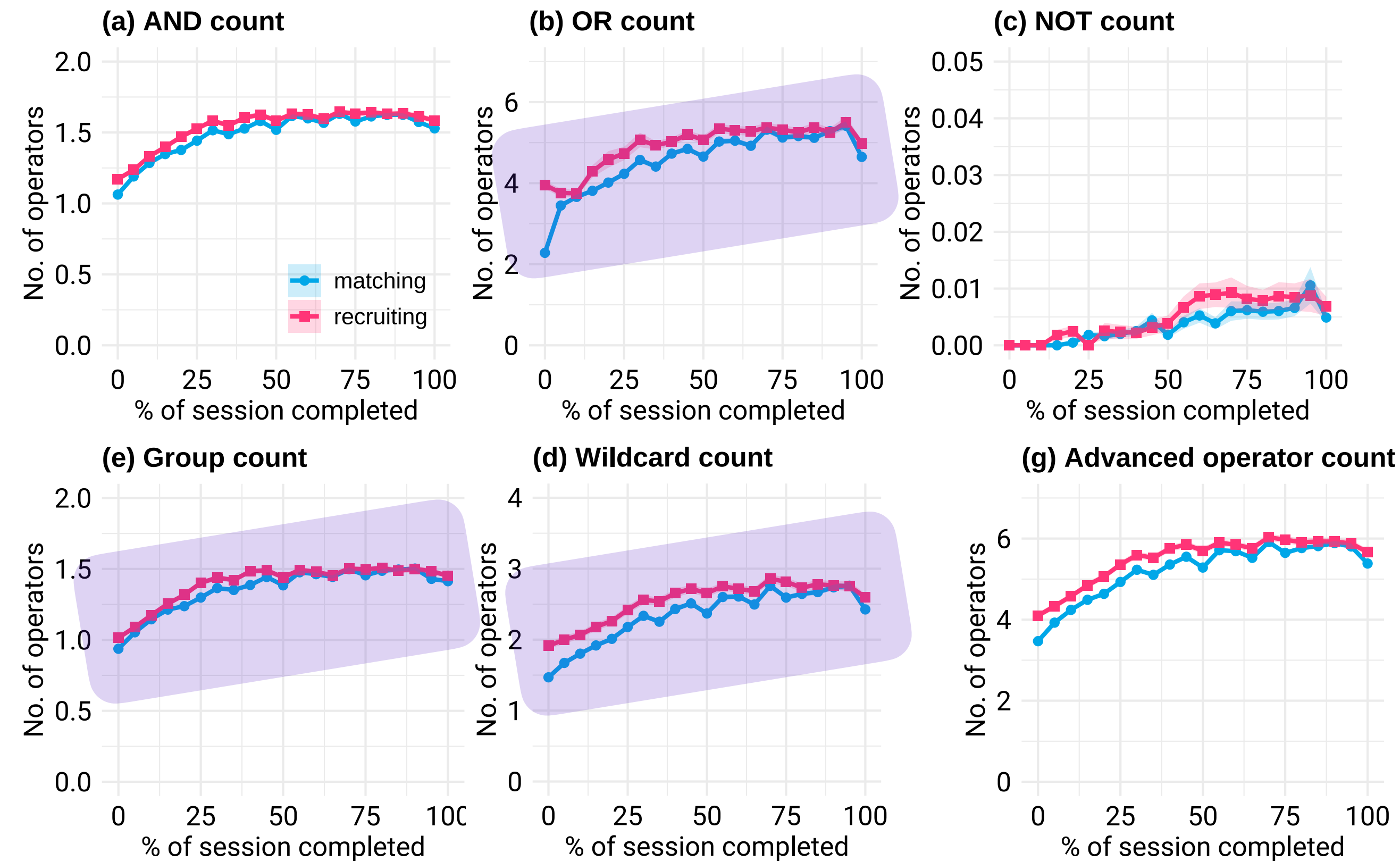
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- Location filter is **rarely removed**
- Having experience from **similar jobs** is more important than experience from the **same industry**





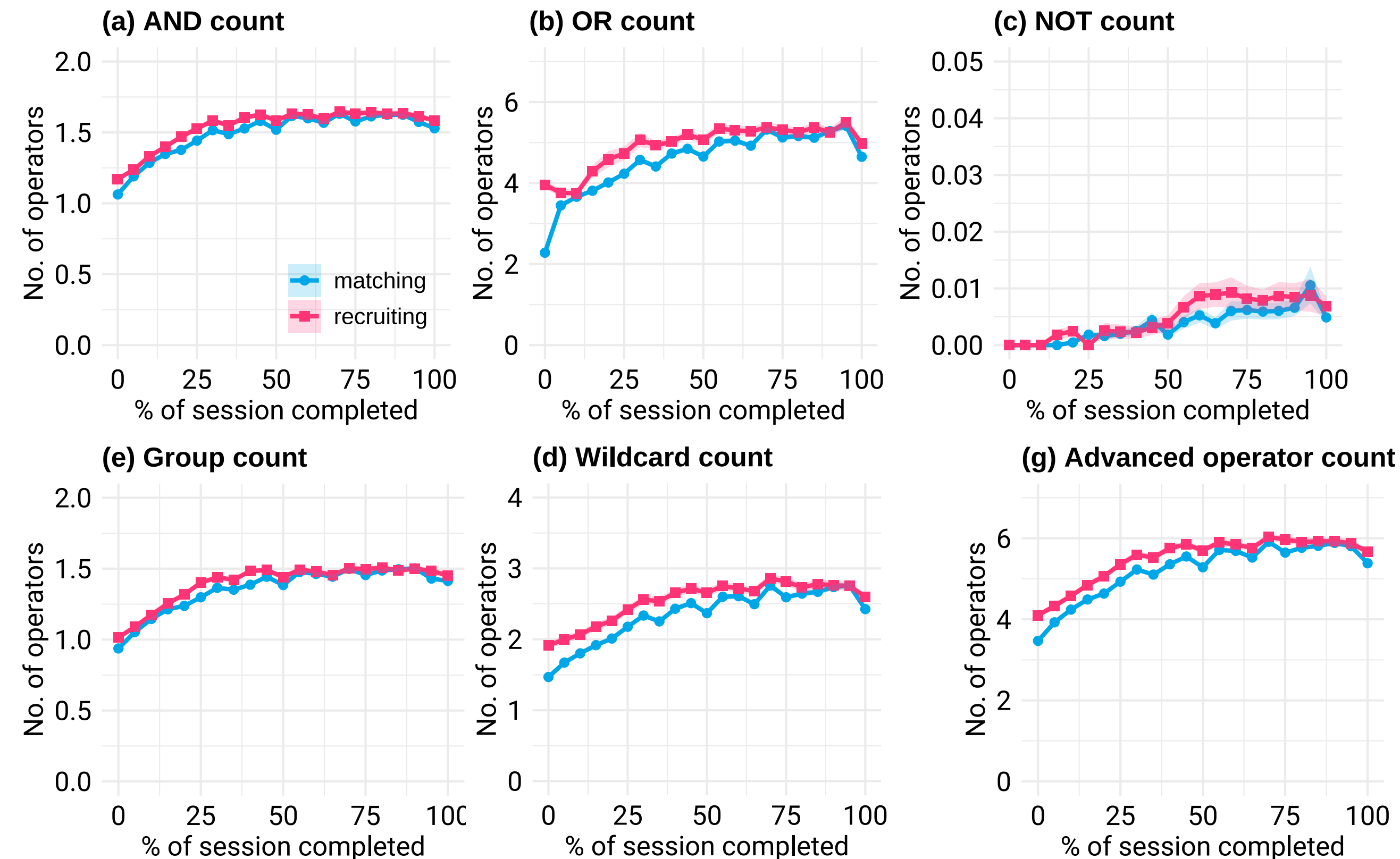
– Query operators

- Queries become **more complex** (in terms of query operators) as the session progresses



– Query operators

- Queries become **more complex** (in terms of query operators) as the session progresses
- **Wildcard** operators and **building block** operators (OR and grouping) are important tools for recruiters



building block 1

building block 2

– Query operators

- Queries become **more complex** (in terms of query operators) as the session progresses
- **Wildcard** operators and **building block** operators (OR and grouping) are important tools for recruiters
- Example:

```
+(innovatio* innovati*  
specialkonsulent) +(kliniske-  
forsøg life-science vaccin*  
sundheds* medic* medico*  
folkesundhe* lægemid* medicinsk-  
udstyr pharma* farma* hospital*  
*hospitalet sygehus)
```


– Filters

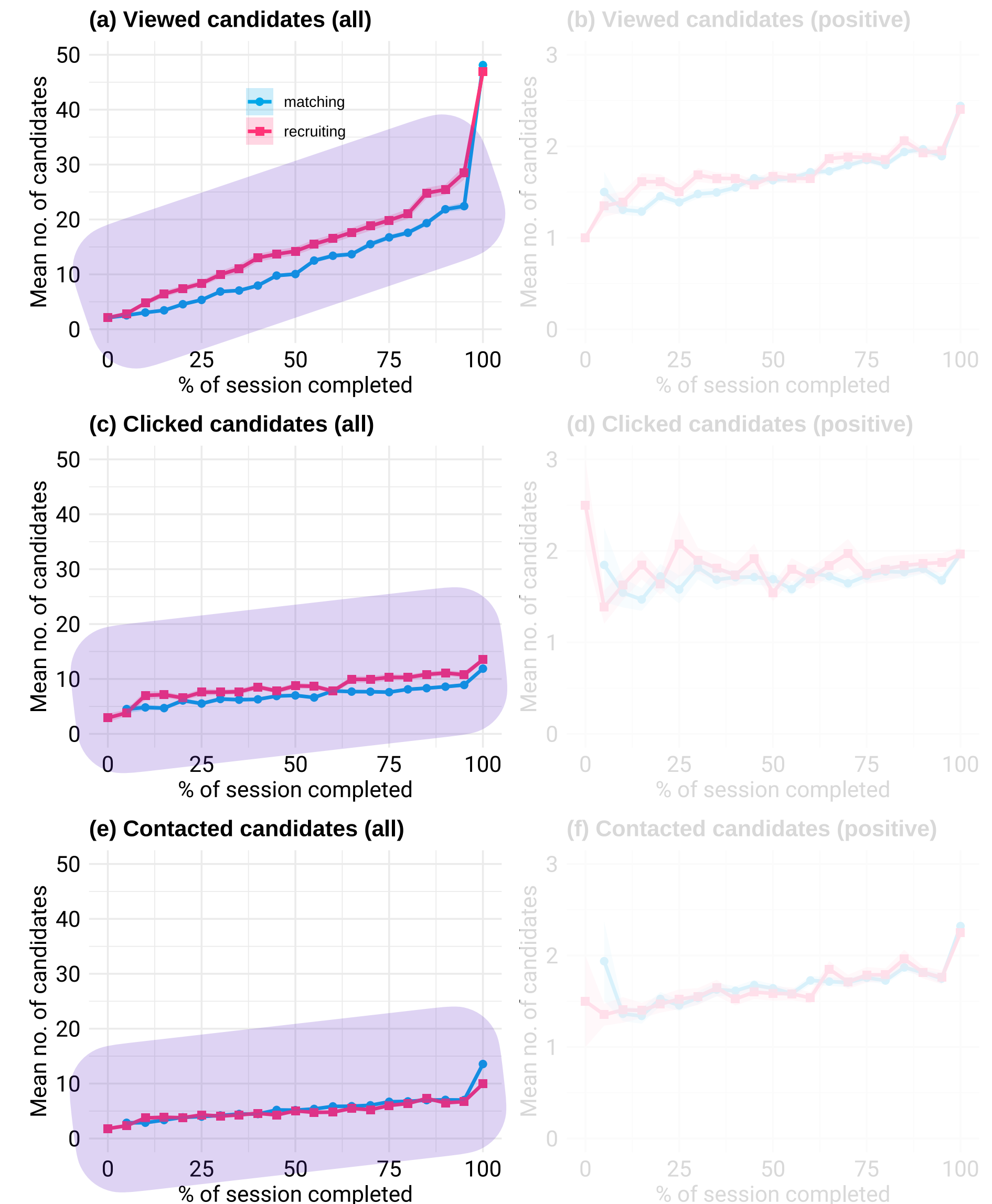
- Commonly used filters include (1) **work experience**, (2) **management experience**, (3) desired **salary**, (4) **language** skills & level, (5) **employment groups** (e.g., full-time, part-time)

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► Source selection & interaction

- Number of CVs a recruiter interacts with **increases steadily over the course of a session**
- Number of **viewed CVs increases more rapidly** than clicked or shortlisted → due to recruiters having to scroll past CVs they already encountered earlier

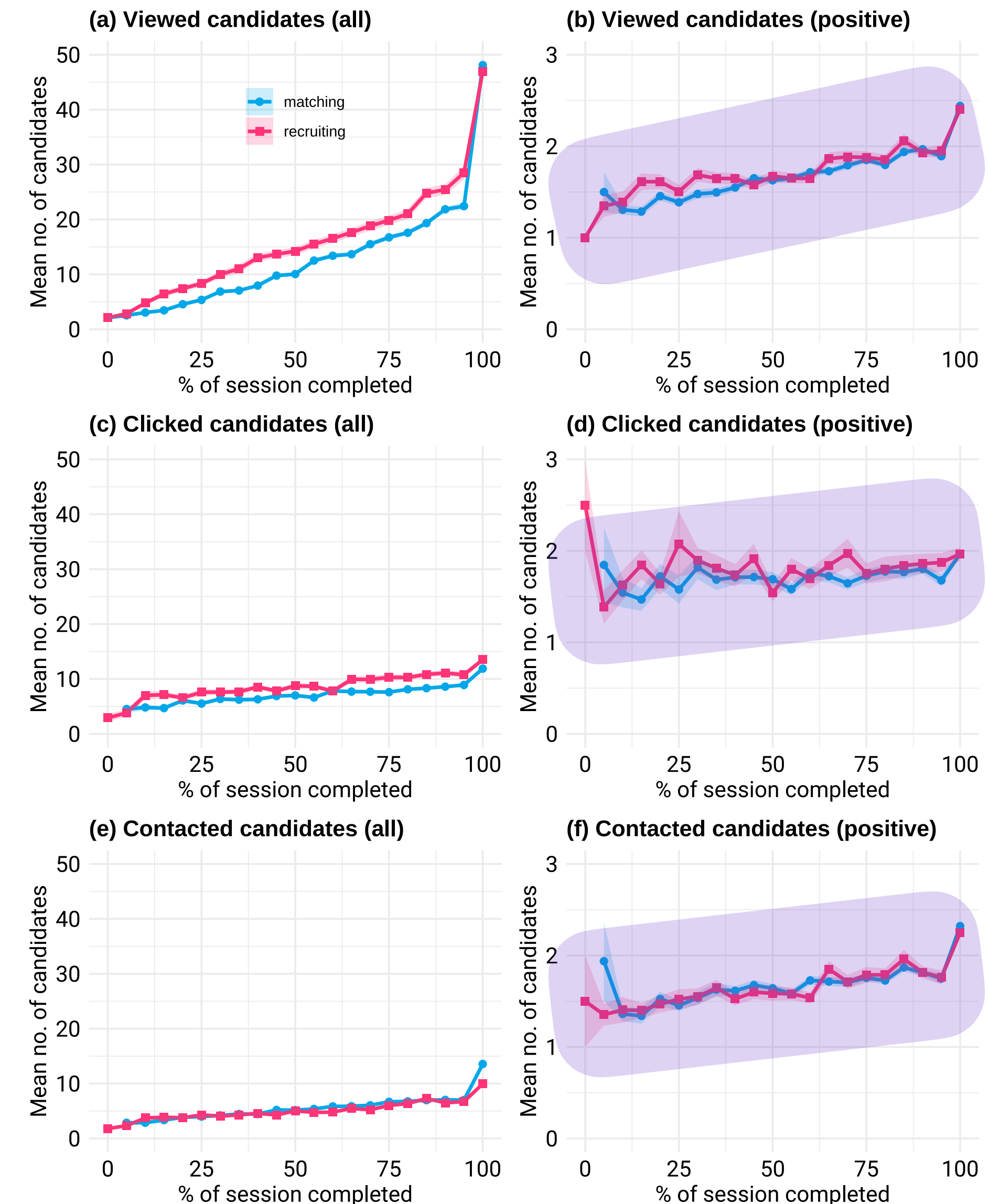


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► Source selection & interaction

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- Number of **viewed CVs increases more rapidly** than clicked or shortlisted → due to recruiters having to scroll past CVs they already encountered earlier
- Number of **positive interacted CVs does not increase at the same rate**



- ▶ Differences between **matching** (5-60 mins) & **recruiting** (1-4 hrs) tasks
 - **Query counts**
 - **Matching** tasks contain fewer queries on average (**10.2**) than **recruiting** tasks (**15.6**)
 - Not commensurate with **tripling** of average session length, so **recruiters spend more time per query** too
 - **Query length & term re-use**
 - Final queries are the same length across **matching** and **recruiting** tasks
 - Recruiters **construct complex queries earlier** in **recruiting** sessions
 - **Recruiting** tasks see more reformulations and removal of terms (during the second half)
 - **Query operators / Filters**
 - **Recruiting** tasks use **more advanced query operators** and **filters** than **matching** tasks

- ▶ Differences between **complex** and **standard** tasks
 - **Query counts**
 - **Complex** tasks require more queries on average (**12.7**) than **standard** tasks (**10.5**)
 - Recruiters spend **only around 10% more time per query** for **complex** tasks
 - **Query length & term re-use**
 - **Complex** tasks require longer queries
 - **Complex** tasks build on relevant job titles much more early than **standard** tasks

- Query operators
 - **Complex** tasks use **more advanced query operators** than **standard** tasks
- Filters
 - **Work & management experience** and **education** filters are used more often in **complex** tasks
 - The **employment group** filter is more common for **standard** tasks (as these are more often not full-time)

- ▶ We trained a regression model to predict **which actions influence search success**
 - Longer queries (based on term count)
 - More **job titles** selected
 - No. of **OR** operators used
 - No. of **Generalization** actions
 - No. of **Reformulation** actions

- ▶ Recruitment search shows **complex** patterns of search behavior
 - Recruiters grow their queries in the first half but reformulate and optimize in the second half
 - **More time for a task** (recruiting vs. matching) results in **more time spent per query** (inspecting candidates and (**re**)formulating queries)
 - **Candidate quota** seems to influence their search behavior
- ▶ **From earlier qualitative work**
 - Recruiters search for skills, occupations and industries
 - Recruiters assess relevance by education, most recent work experience (max 5 yrs), salary and work/management experience
 - Recruiters rely heavily on search term highlighting for relevance assessment

► Future work

- What does this mean for **designing a recommender system** to support the recruiters?
- Should we **rethink features and default search options** (e.g., inclusion of industry category)?
- How does the addition of a recommender system **change** their search behavior?





QUESTIONS?