

Designing Information Gathering Robots for **Human-Populated Environments**



Mike Chung Andrzej Pronobis Maya Cakmak Dieter Fox Rajesh Rao

UNIVERSITY OF WASHINGTON

Hello there

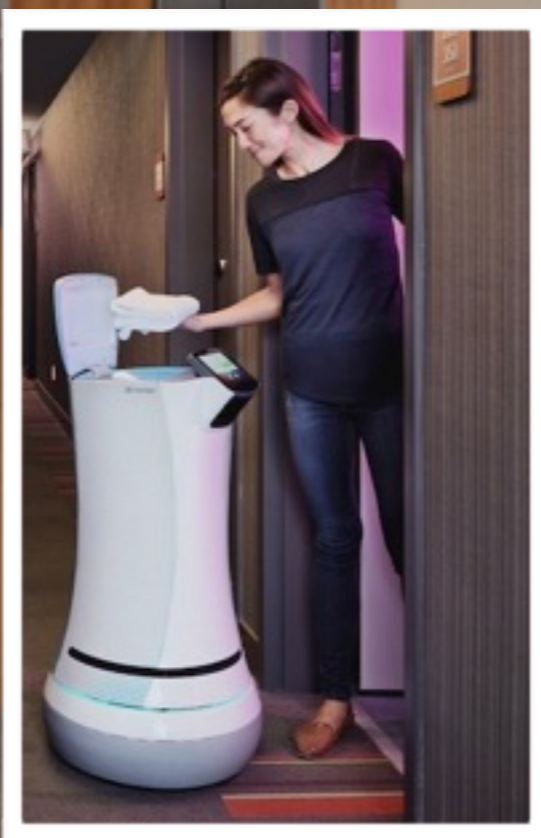




CMU Cobots



Aethon TUG



Saviioke Relay

Is my advisor in her office?

Can you find me an empty study lounge?

Let me know when my advisor becomes available

What was your day like?

Hello there



INFOBOTS

- Information gathering agents in human populated environments

We seek to better understand the value of the services that InfoBots can provide

TASK TYPES FOR INFOBOTS

Is my advisor in
her office?

Checking

Can you find
me an empty
study lounge?

Searching

Let me know
when my advisor
becomes available

Monitoring

What was your
day like?

Summarizing

TASK TYPES FOR INFOBOTS

**Is my advisor in
her office?**

Checking

Can you find
me an empty
study lounge?

Searching

Let me know
when my advisor
becomes available

Monitoring

What was your
day like?

Summarizing

STUDY DESIGN

Study 1: A User Survey

- to determine types of useful information
- to identify constraints and requirements

Study 2: Deployment

- to study practical usage of the service

STUDY DESIGN

Study 1: A User Survey

- to determine types of useful information
- to identify constraints and requirements

Study 2: Deployment

- to study practical usage of the service

Q1. Is John in his office?

Q2. How many people are in the lounge

Q3. Are there any empty tables in the study
room?

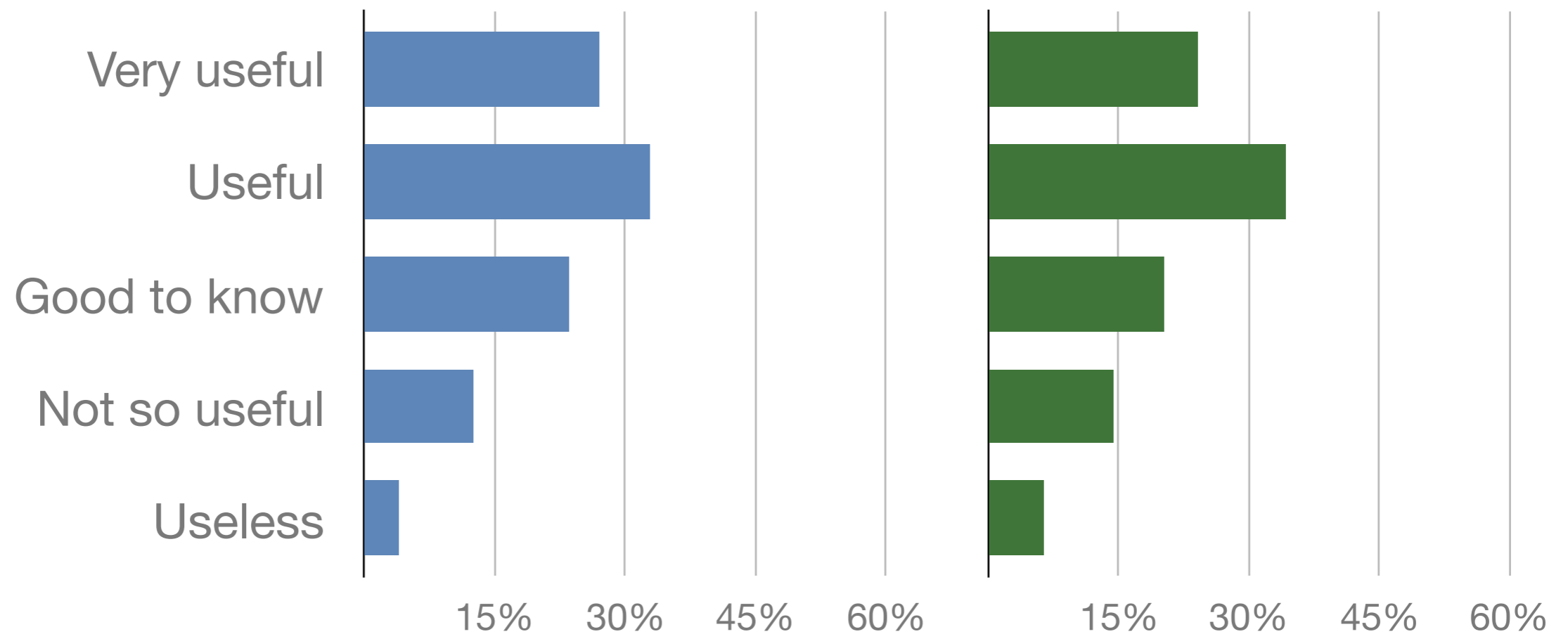
Q4. Are there any bagels at the coffeeshop?

Q5. Is there free food in the kitchen?

Q6. Is the conference room occupied?

FINDINGS: USEFULNESS

■ CS ■ LAW Average % of responses over 6 questions

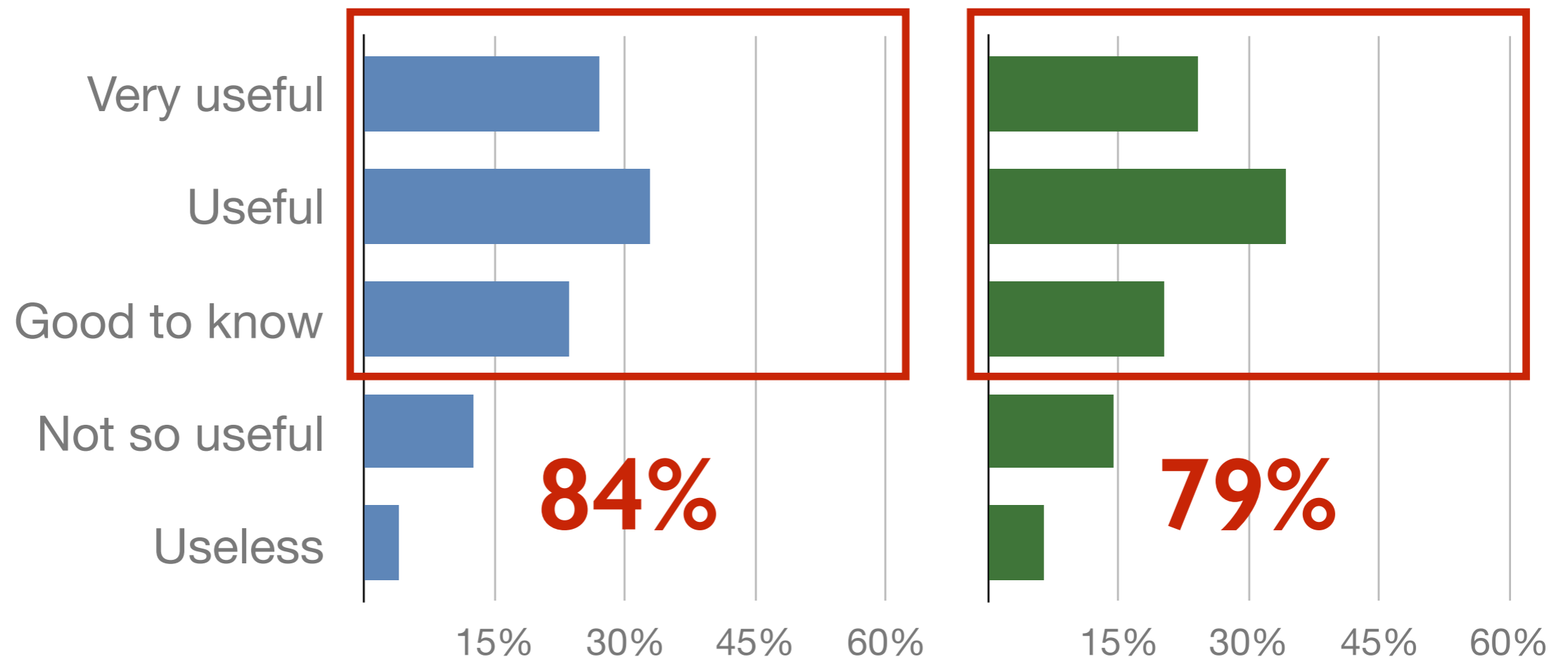


The ability to ask this type of question would be

FINDINGS: USEFULNESS

■ CS ■ LAW

Average % of responses over 6 questions



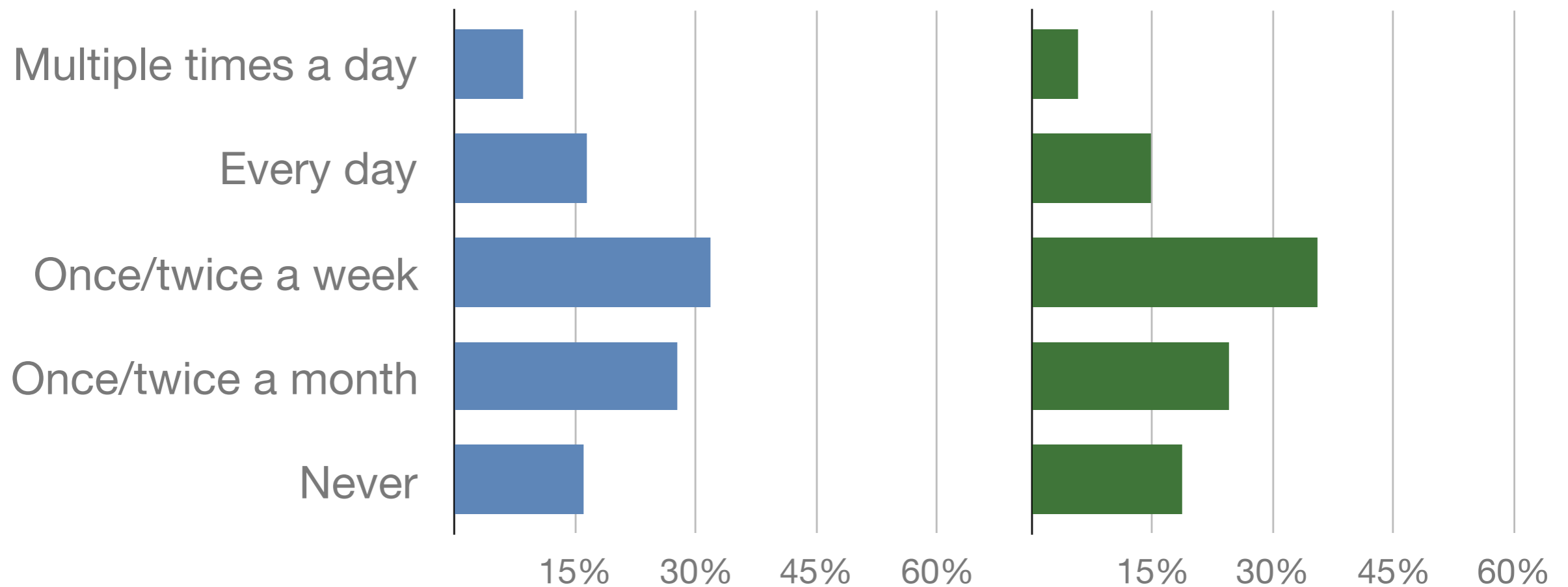
The ability to ask this type of question would be

People think InfoBots can be useful

FINDINGS: USAGE FREQUENCY

■ CS ■ LAW

Average % of responses over 6 questions



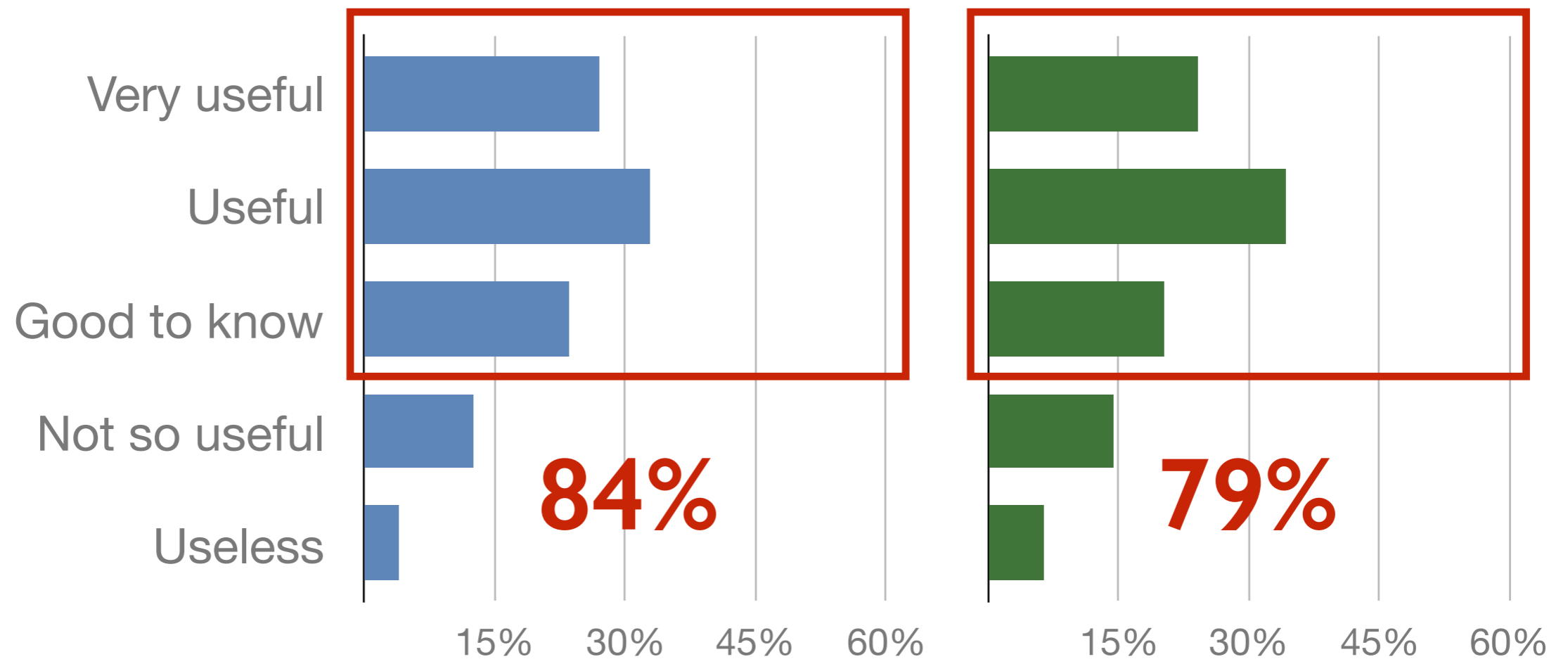
I would ask this type of question

People will not ask questions frequently

FINDINGS: USEFULNESS

■ CS ■ LAW

Average % of responses over 6 questions



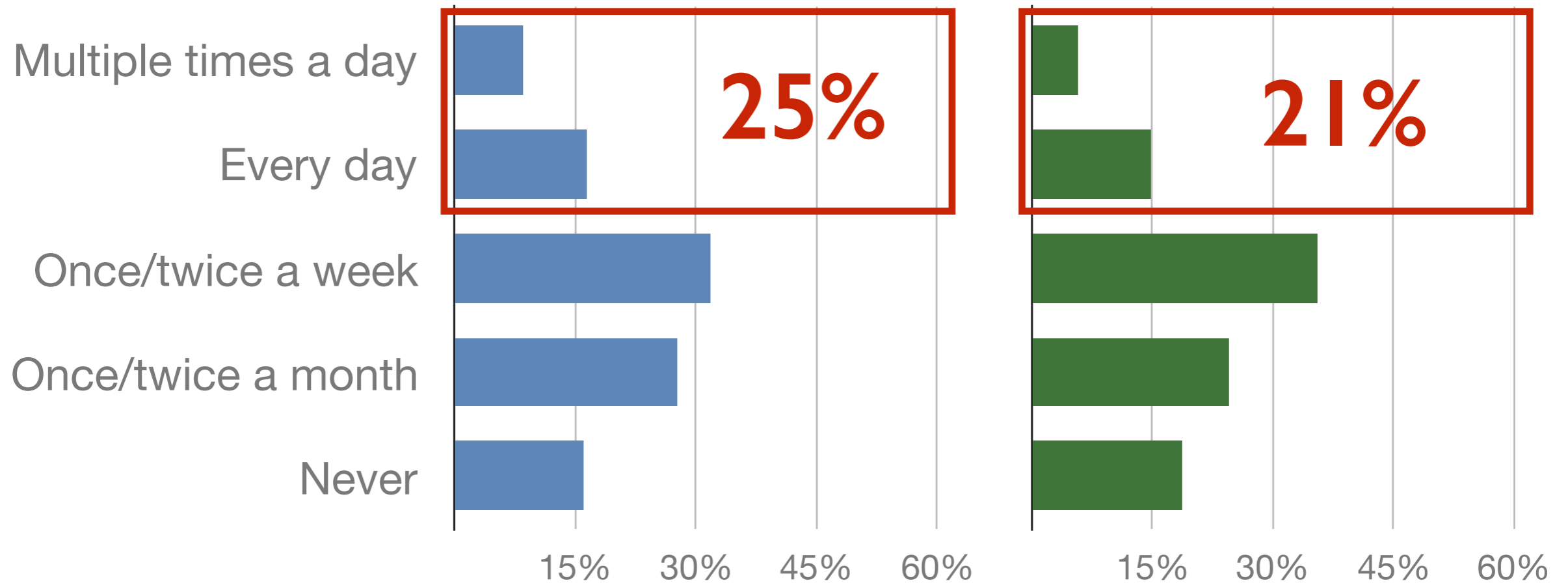
The ability to ask this type of question would be

People think InfoBots can be useful

FINDINGS: USAGE FREQUENCY

■ CS ■ LAW

Average % of responses over 6 questions



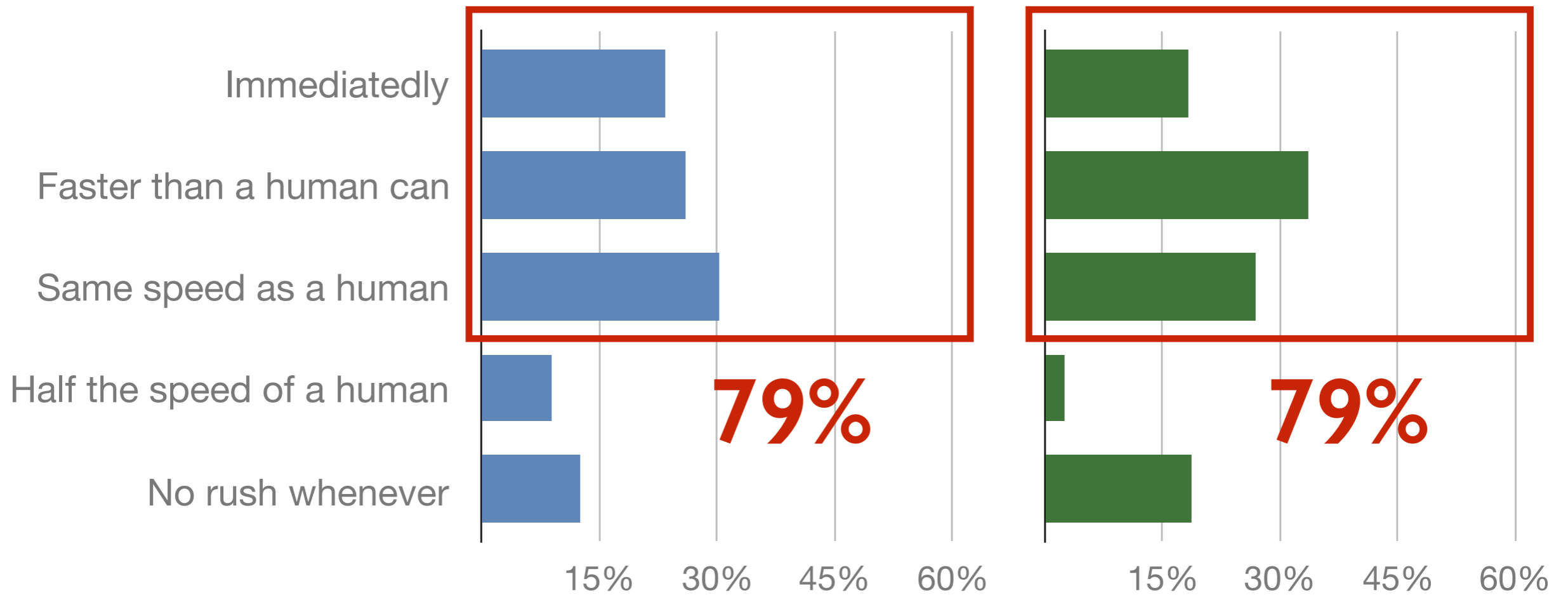
I would ask this type of question

People will not ask questions frequently

FINDINGS: TIME CONSTRAINT

■ CS ■ LAW

Average % of responses over 6 questions



I would require a response

High expectation

STUDY DESIGN

Study 1: A User Survey

- to determine types of useful information
- to identify constraints and requirements

Study 2: Deployment

- to study practical usage of the service

Your Questions

Everyone's Questions

Signed in as Michael Jae-Yoon Chung

Type question here

Make Public



Email Notification



Deadline

10/01/2014 8:46 PM



Submit



Type question here

Make Public



Email Notification



Deadline

10/01/2014 8:46 PM



Submit

Michael Jae-Yoon Chung Today at 8:39 am

Cancel

private

email

deadline today at 9:30 am

Is there any free food in the lunchroom?

DUB-E Today at 8:39 am

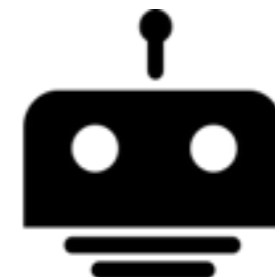
Received your question.

In Queue

Write a comment...

Post

Thank You DUB-E ❤️ 0



Type question here

Make Public



Email Notification



Deadline

10/01/2014 8:46 PM



Submit

Michael Jae-Yoon Chung Today at 8:39 am

Cancel

private

email

deadline today at 9:30 am

Is there any free food in the lunchroom?

DUB-E Today at 8:39 am

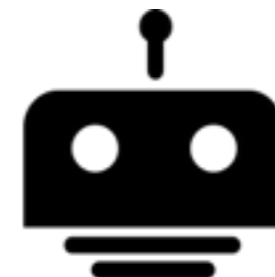
Received your question.

In Queue

Write a comment...

Post

Thank You DUB-E ❤️ 0



Type question here

Make Public



Email Notification



Deadline

10/01/2014 8:46 PM



Submit

~~Michael Jae-Yoon Chung~~ Today at 8:39 am

Cancel

private

email

deadline today at 9:30 am

Is there any free food in the lunchroom?

DUB-E Today at 8:39 am

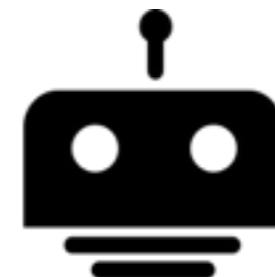
Working on your question!

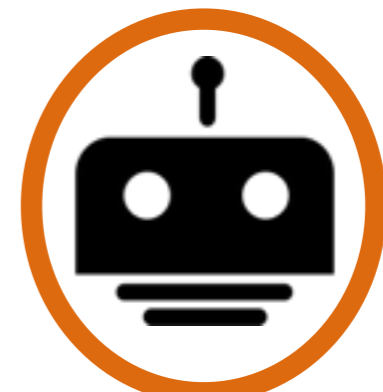
Running

Write a comment...

Post

Thank You DUB-E ❤️ 0





Your Questions | Everyone's Questions | Signed in as Michael Jae-Yoon Chung

Type question here

Make Public Email Notification Deadline 10/01/2014 8:46 PM


████████████████████ Today at 8:39 am

private email deadline today at 9:30 am

Is there any free food in the lunchroom?

DUB-E Today at 8:39 am
95 % confidence

Yes.



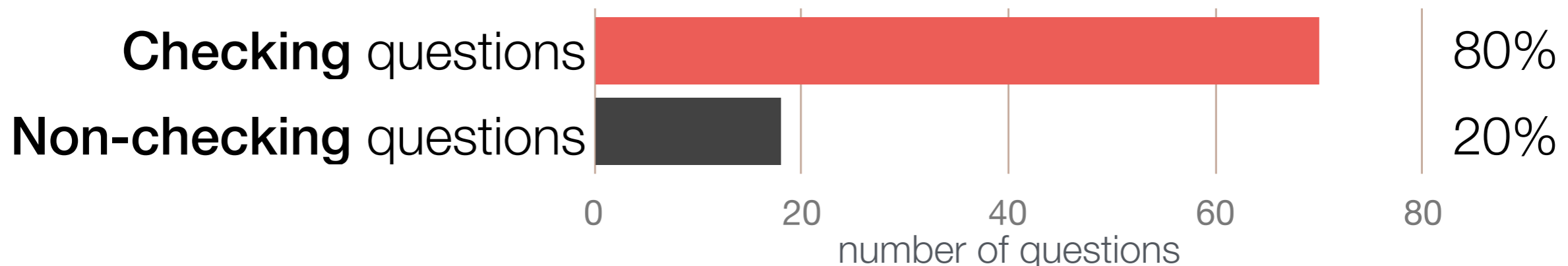
Success :)

Write a comment... Thank You DUB-E ❤️ 0



FINDINGS: QUESTION TYPES

<i>Is there anyone in {location}?</i>	checking
<i>Is {person} in his/her office?</i>	checking
<i>Is there any food in the downstairs kitchen?</i>	checking
<i>Is there anything in my mailbox?</i>	checking
<i>Does {name}'s office have a sofa?</i>	checking
<i>Is the reception still open?</i>	checking
<i>Who let the dogs out? :)</i>	non-checking
<i>Has {person} arrived yet today in the {} building?</i>	non-checking
<i>Which meeting room has the best visibility of the {landmark} today?</i>	non-checking

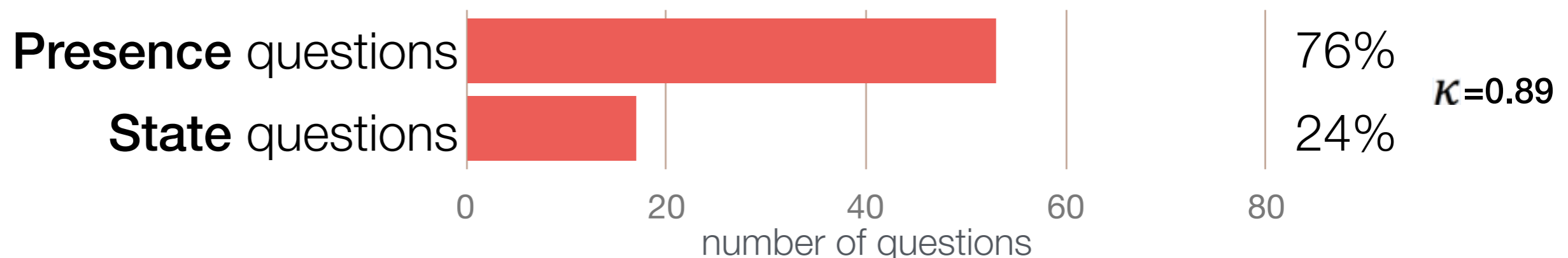


FINDINGS: CHECKING SUBTYPES

<i>Is there anyone in {location}?</i>	presence
<i>Is {person} in his/her office?</i>	presence
<i>Is there any food in the downstairs kitchen?</i>	presence
<i>Is there anything in my mailbox?</i>	presence
<i>Does {name}'s office have a sofa?</i>	presence
<i>Is the reception still open?</i>	state

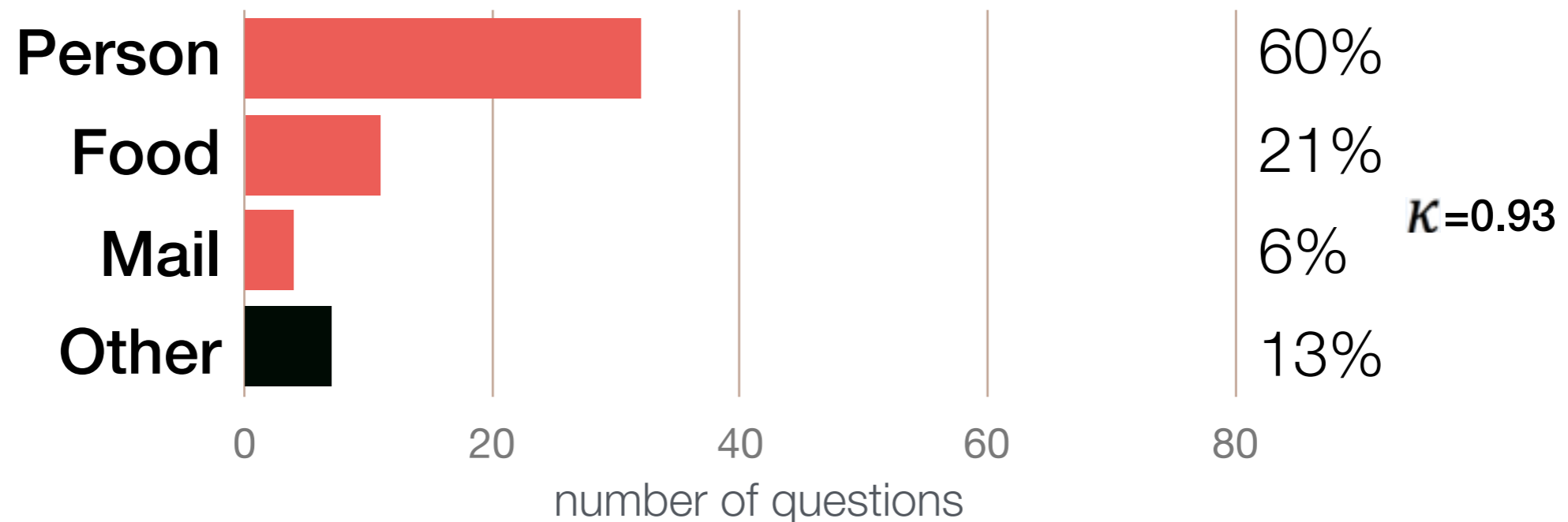
presence: e.g. Is {object} in {location}?

state: e.g. Is {location} {state}?



FINDINGS: TARGET OBJECTS

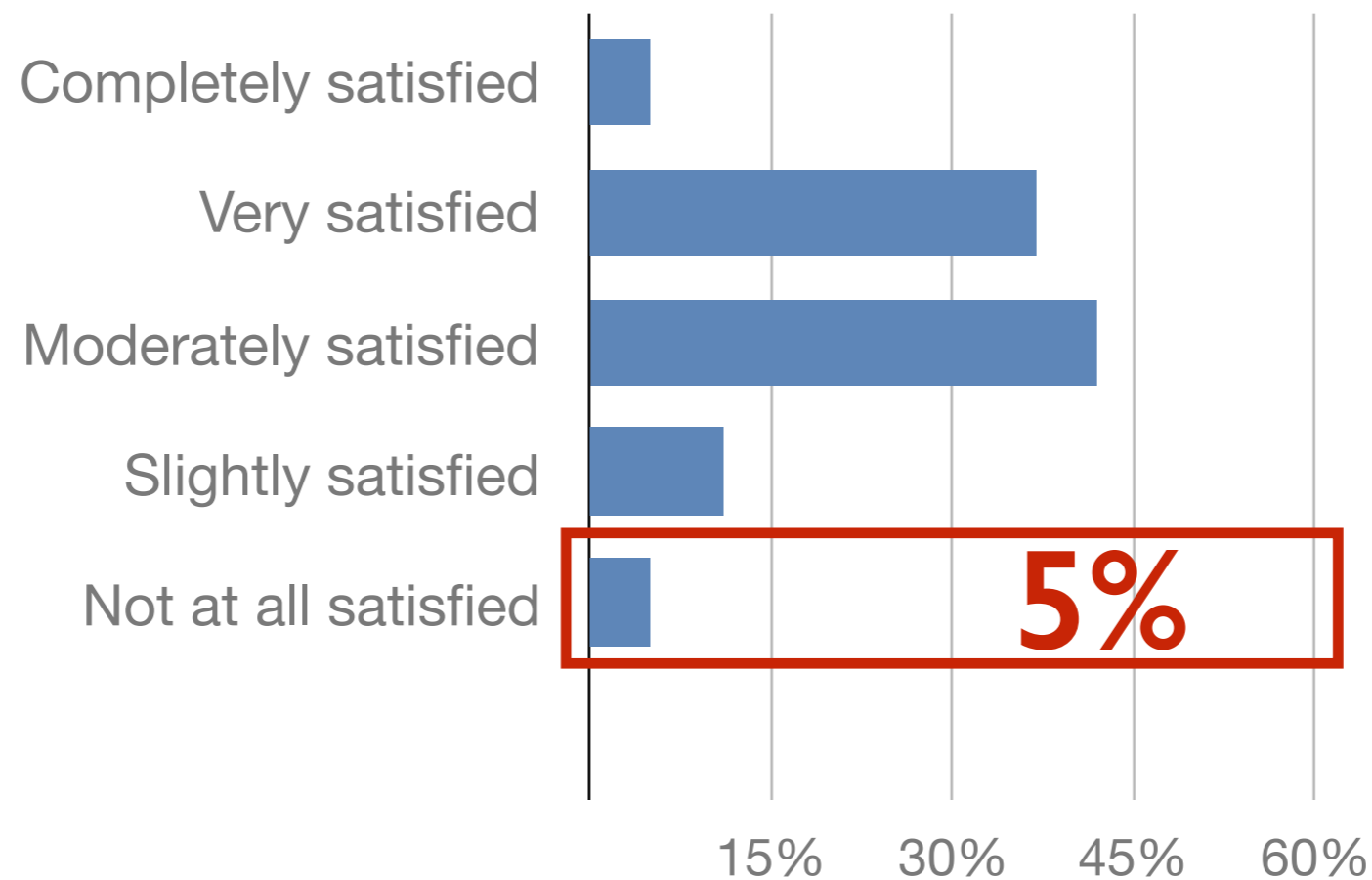
<i>Is there anyone in {location}?</i>	person
<i>Is {person} in his/her office?</i>	person
<i>Is there any food in the downstairs kitchen?</i>	food
<i>Is there anything in my mailbox?</i>	mail
<i>Does {name}'s office have a sofa?</i>	other



Long tailed distribution

POST-DEPLOYMENT SURVEY

*Please rate how satisfied you were with InfoBot's *speed* in answering your question.*



Despite initial high expectation, only 5% was “Not at all satisfied”.

PROGRESS ON AUTONOMOUS INFOBOTS

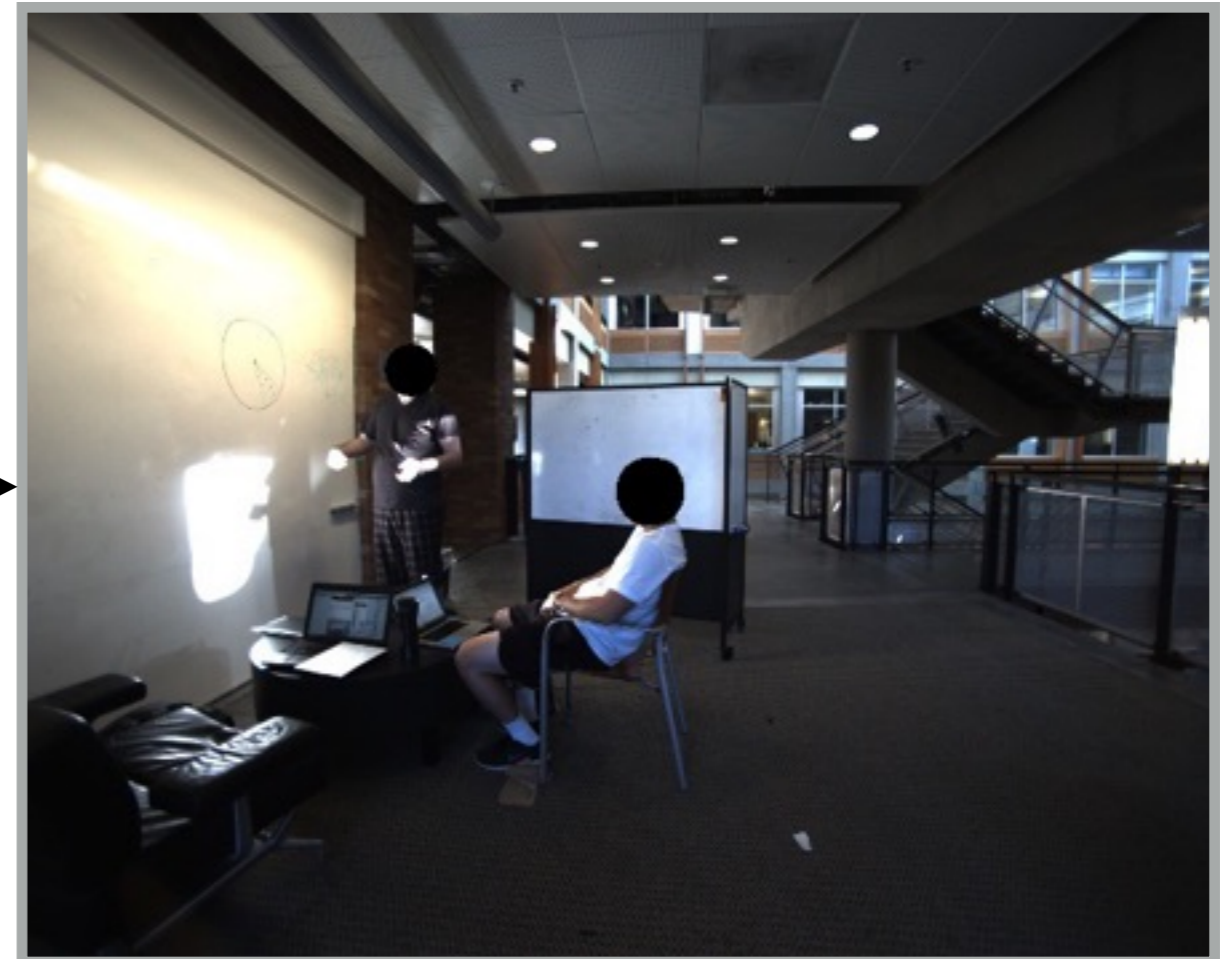
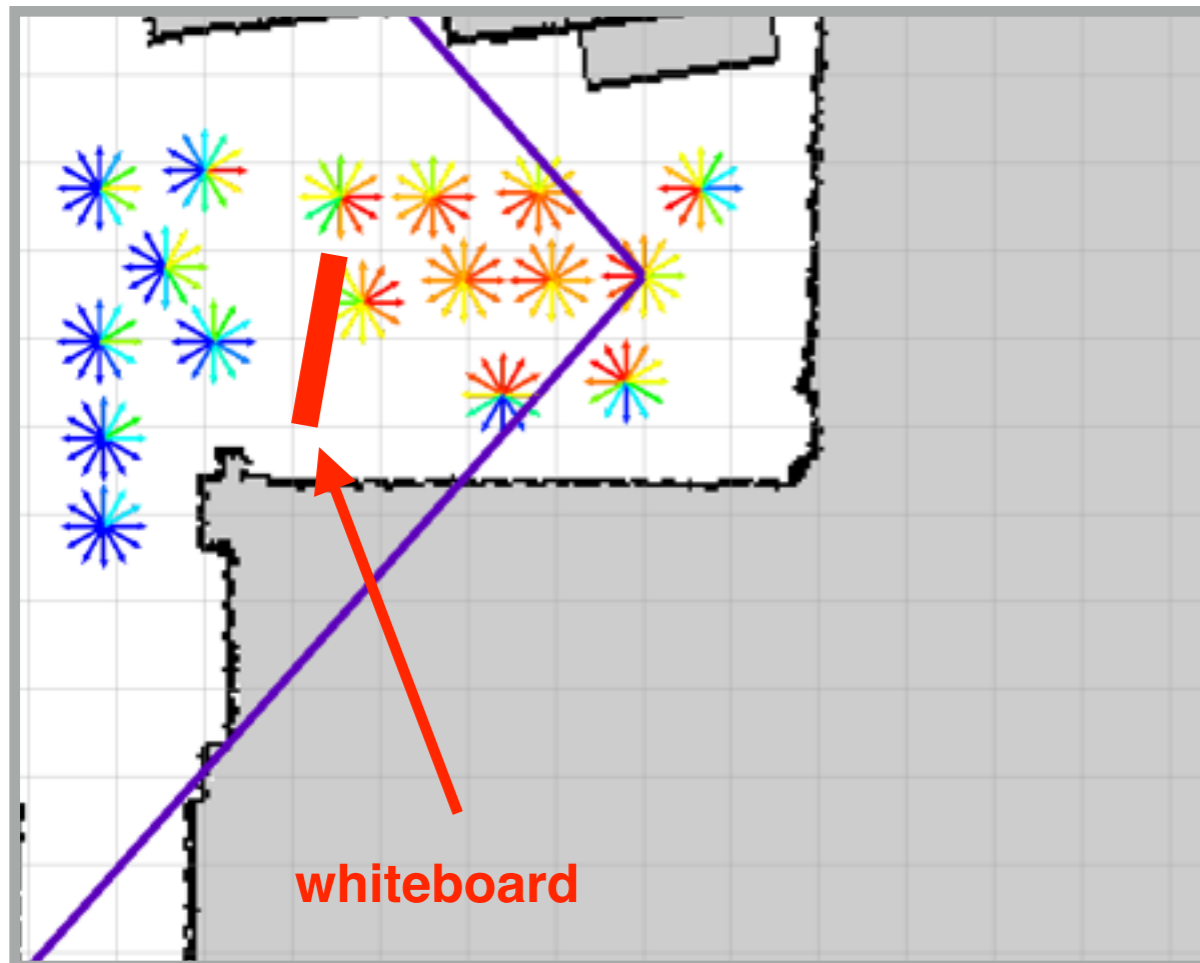
Input: Q . Is there breakout area occupied?

language parsing ↓

$\text{presence}(cse400, person)$

viewpoint estimation

Output:



Submitted to ICRA2016

CONTRIBUTIONS

1. Categorization of InfoBots' task types
2. Findings on people expected InfoBot usage
3. Findings on actual InfoBot usage

Thank you!

