Why Am I Not Seeing It? Understanding Users' Needs for Counterfactual Explanations in Everyday Recommendations

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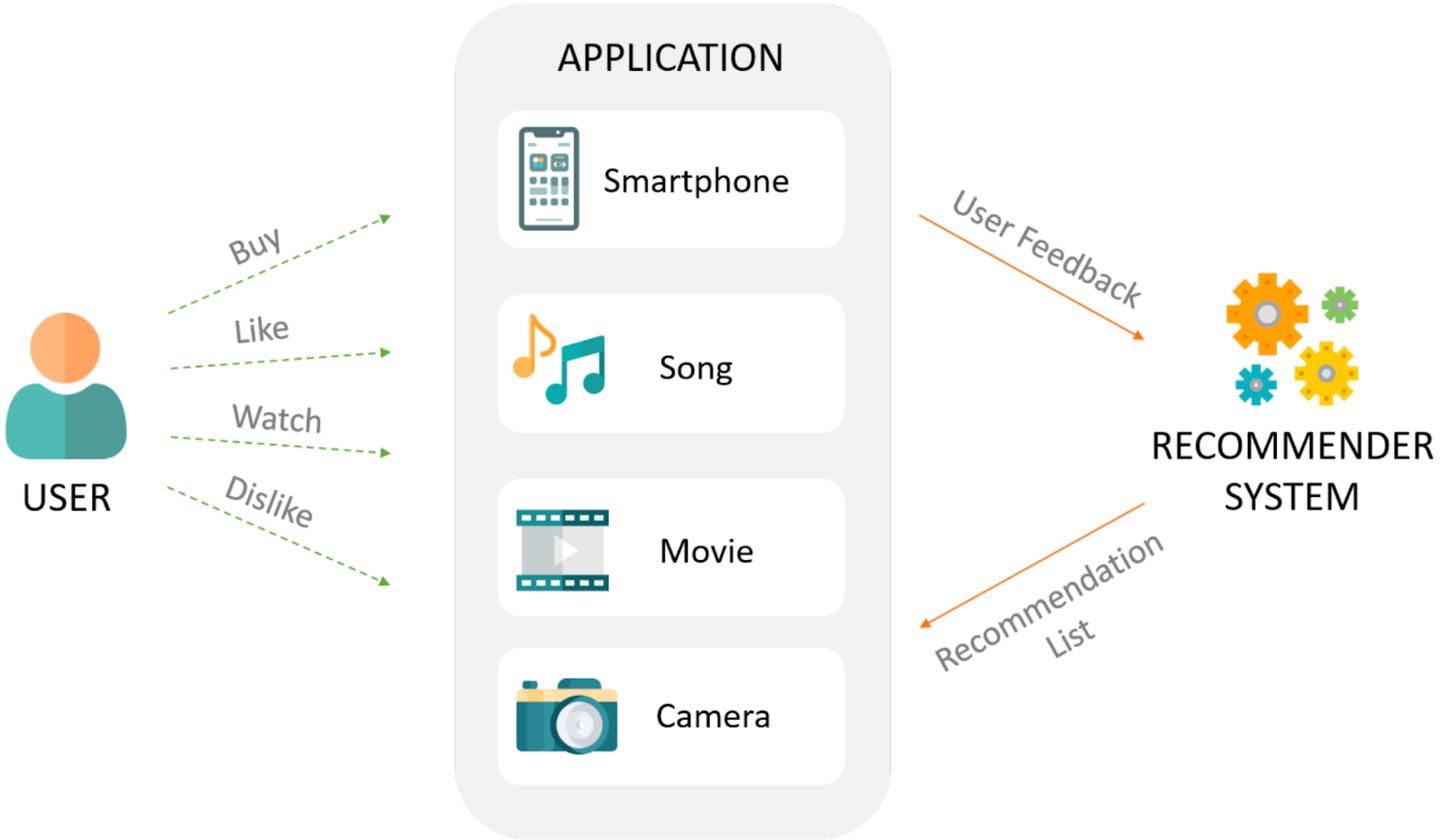
HUMAN CENTERED DESIGN & ENGINEERING
UNIVERSITY of WASHINGTON

DESIGN
USE
BUILD

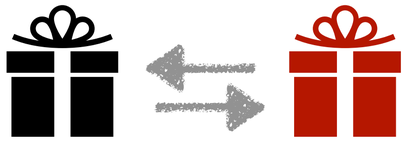
Background

Recommender Systems (RS)



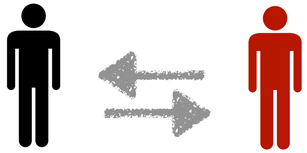
Adopted from Ferreira, Diana, et al. Recommendation system using autoencoders."

Examples of explanations in everyday applications



Item-based explanation

Recommended based on the similar items



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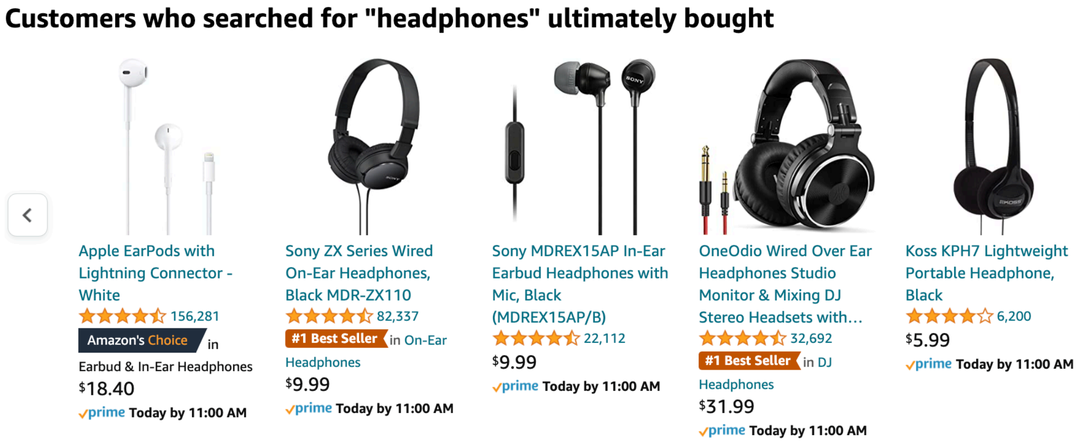

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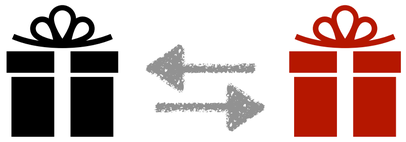

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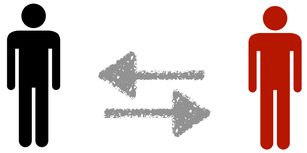

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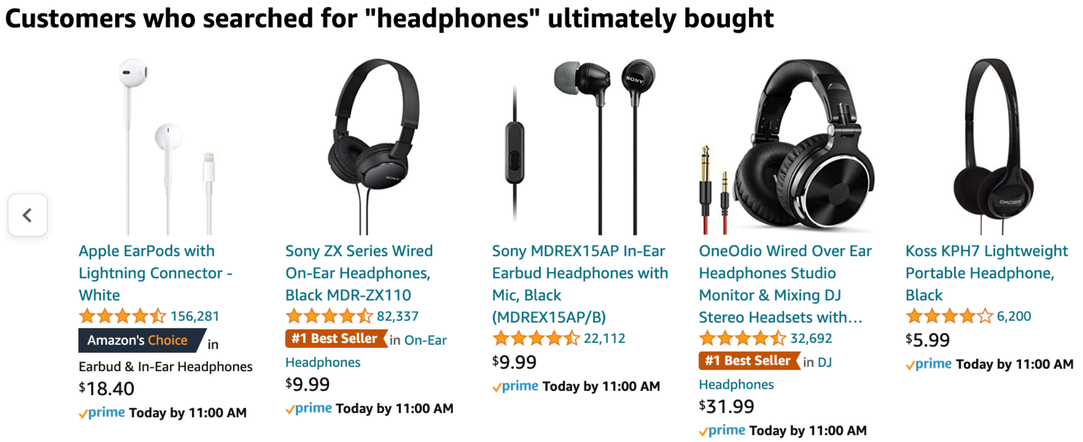

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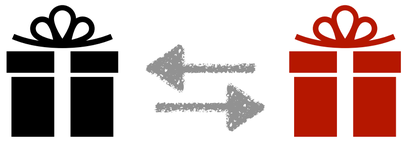

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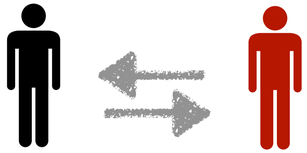

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Why-not explanations

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  Why did P happen? <—> Why did P happen rather than Q?

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Why-not explanations

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  Why did P happen? <—> Why did P happen rather than Q?

- Useful in high-stakes algorithmic decision-making such as denying loan application, rejecting job application, prescribing life-altering medication

- Useful in low-stake domains such as recommender systems or chat-based interactive systems to enhance explainability, trust, and the personalized experience

Question-driven approach

- Counterfactual explanation <—> Answer to a *why not* question
  - *Why* the system does *not* recommend other relevant items that you might be interested in?

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  - *Why* the system does *not* recommend other relevant items that you might be interested in?
- Counterfactual explanation <—> *Why not* explanations

Current Landscape

- Limited understanding of *why not* explanation needs for low-stake algorithmic decision making in everyday tasks

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- Insufficient prior empirical work with in-the-wild use contexts

Research Question

When do people need counterfactual explanations when interacting with recommended content in everyday intelligent applications?

Study Overview

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Study 1
Preliminary Survey

N = 91
Amazon MTurk

Retrieve initial insights on people's general explanation needs for everyday recommendations

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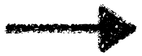

Study 2
Interview

N = 12
Social media, Slack, snowball sampling

Retrieve initial insights on people's general explanation needs for everyday recommendations

Understand what is missing from existing explanations and what triggers people to ask why not questions

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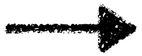

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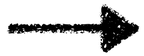

Study 3
Quantitative Survey

N = 89
Amazon MTurk

Test a hypothesis on decision making utility based on the interview findings

Preliminary Survey

Why do users want explanations?

Overview

- Surveyed 91 participants on MTurk who reside in the US (avg. age = 36.2)
- 3 scenario-based questions on whether and how explanations were used

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Findings

- Generally high interest in using explanations, especially in e-commerce
- Most common reason for desiring explanations is effectiveness (making better decisions)

Interview Study

Interview Research Questions

- How do people interact with existing explanations in RS?
- What is lacking in existing explanatory information?
- Whether and how why not explanations are going to be desirable for users?
- What might trigger them to ask *why not* questions and seek *why not* explanations?

Recruitment

- Recruited via Slack channels, social media, and snowball sampling
- 12 participants
- Semi-structured
- 45 ~ 60 minutes conducted on Zoom
- All participants consented to be recorded and were compensated with a $10 Amazon gift card at the end of the interview

Experiences with existing explanations

Existing explanations are **not actively noticed**

It's like now that you've pointed it out, I'm just realizing that there are already explanations on that I just usually just skip over. […] There are actual explanations, but I never paid attention to. (P10)

I always see them just passively. It's just kind of built in. You almost don't even notice it. (P4)

Experiences with existing explanations

Lack of relevant details in existing explanations

When I click on “Why are you seeing this ad?" […] The explanation is super vague. I'm like, okay, this is a lie. They're not targeting any random person who lives in the United States. (P8)

Experiences with existing explanations

Why not explanations would appear desirable **if there were significant perceived benefits or costs** associated with the decision-making

The process of looking at different why not explanations feels like it would take a long time. […] If I'm making like a pretty big decision out of it, I think buying stuff or like watching a really like long running show, more consequential than like listening to a single song. I don't think I've cared too much about exploring that for Spotify necessarily. (P3)

Takeaways

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- Participants generally expressed a need for **more relevant and detailed explanatory information** to aid their decision-making process
- **Perceived utility** associated with decision-making is **a major factor** affecting users' needs for *why not* explanations

Survey Study

Decision-making from behavioral economics

Utilities associated with decision-making (Dean et al., Vasconcelos et al.)

Decision Utility

Perceived during at the point of choice to guide the decisions

Experience Utility

The endpoint of a decision process after the person attains the outcome of that decision

Survey Research Question

How does **utility associate with decision-making** affect **users' needs for *why not* explanations** when choosing from a list of recommended items?

Within-subjects design with two different scenarios

Imagine a time when you are using an application with point-of-interest recommendations (e.g. Yelp, Google Maps, OpenTable, etc.)...

You search on the application and scroll down to choose from the list of recommended restaurants.

Measures

Independent Variables

Decision Utility

Experience Utility

Pos. Experience Utility

Neg. Experience Utility

Dependent Variables

Understand What (asking what's missing)

Understand Why (asking why items are missing)

User Action (take action, such as filtering)

Explanation Need (how desirable are explanations)

t-test results

Table 2. t-test results for each variable

Variable	Mean in S_s (Variance)	Mean in S_c (Variance)	Difference in Mean
Decision Utility	4.11 (0.72)	3.35 (0.78)	0.76 ***
Experience Utility (negative)	3.10 (1.0)	2.40 (0.77)	0.70 ***
Experience Utility (positive)	3.64 (0.28)	3.37 (0.42)	0.27 ***
User Action	3.52 (0.46)	3.18 (0.60)	0.34 ***
Understand What	2.93 (0.97)	2.61 (0.95)	0.32 **
Understand Why	2.76 (0.84)	2.47 (0.87)	0.29 **
Explanation Need	3.61 (1.4)	3.15 (1.5)	0.46 ***

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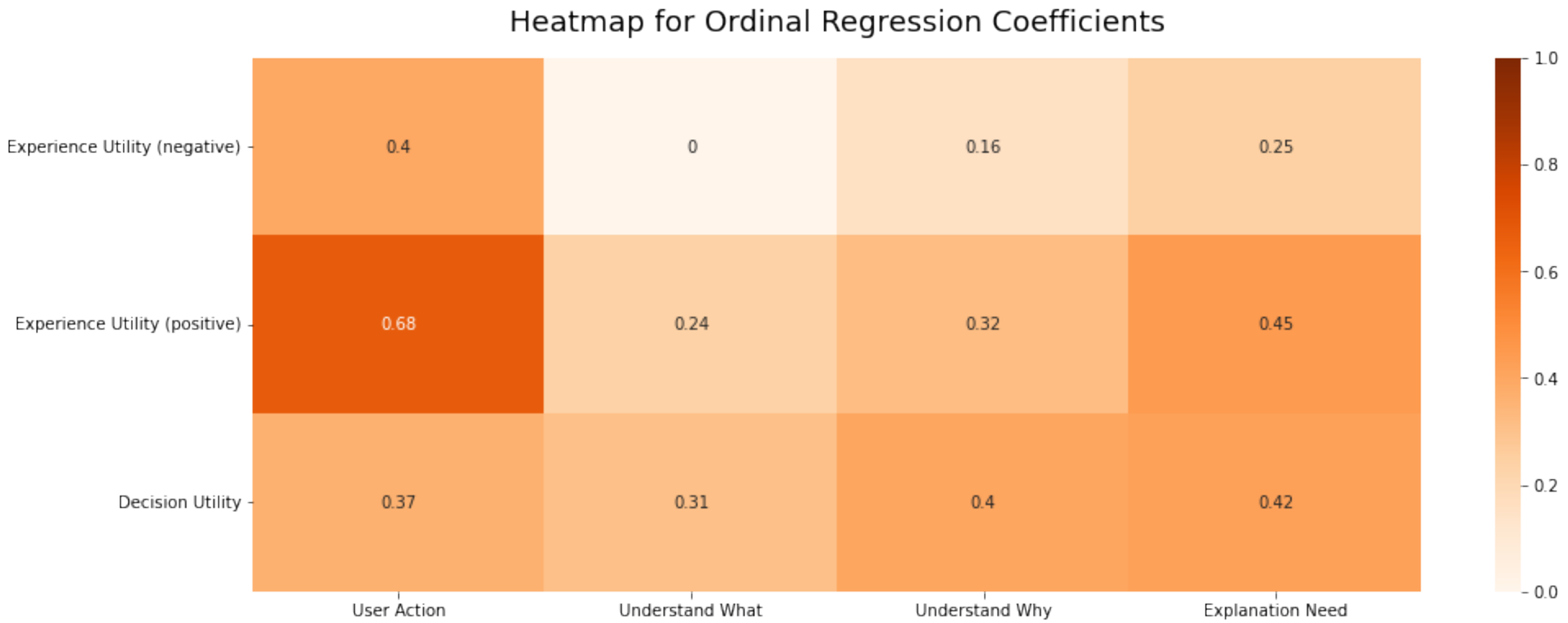

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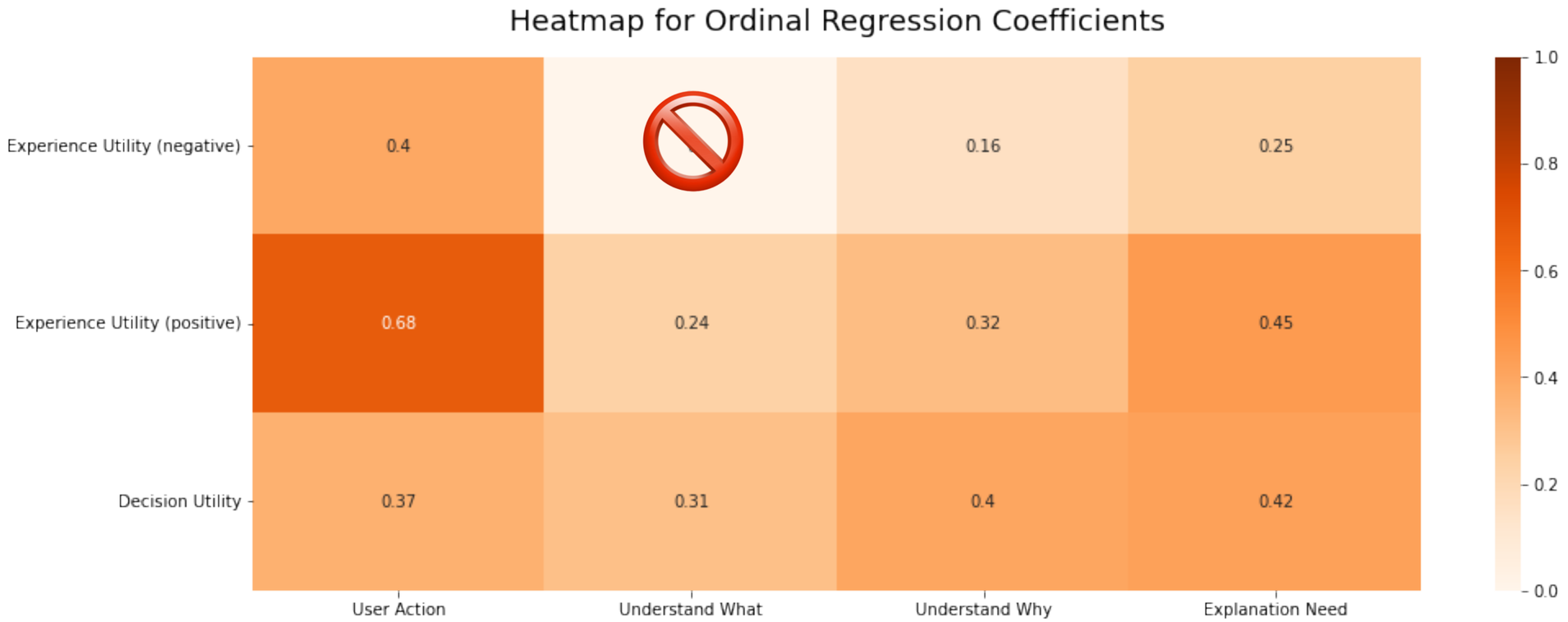

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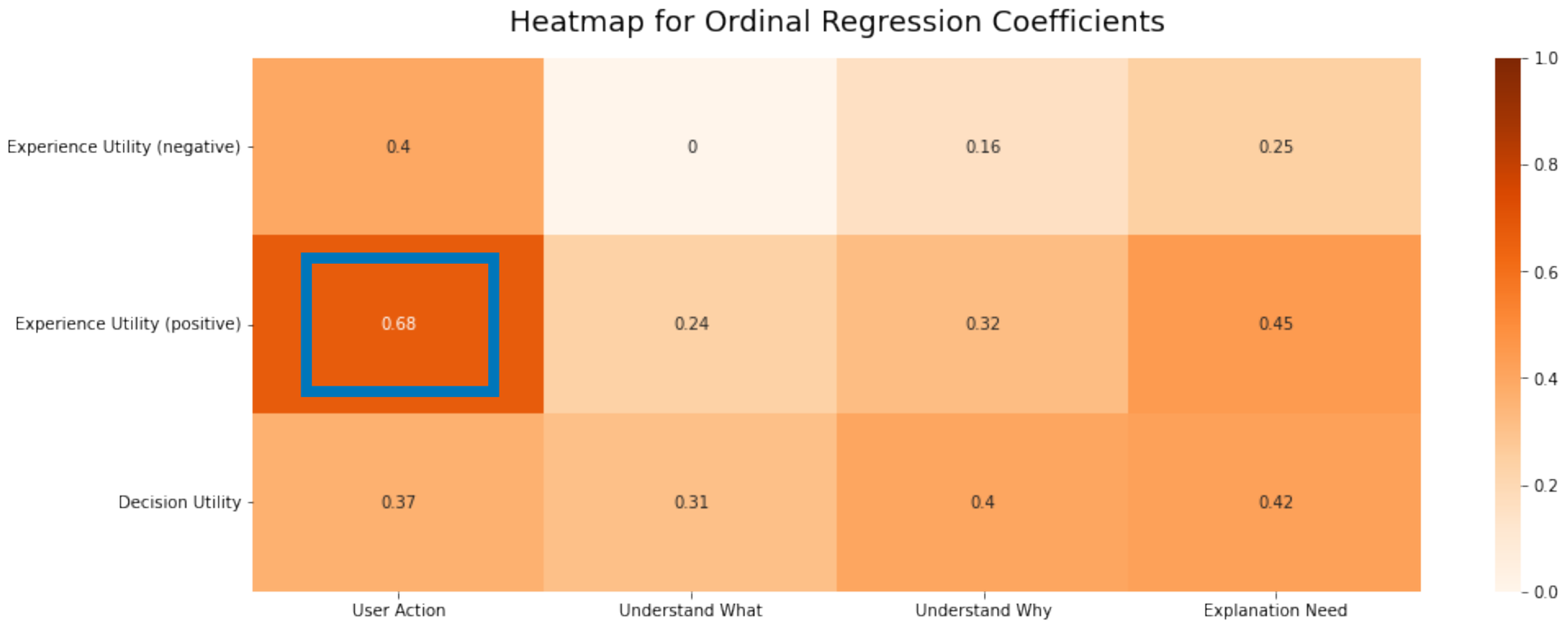

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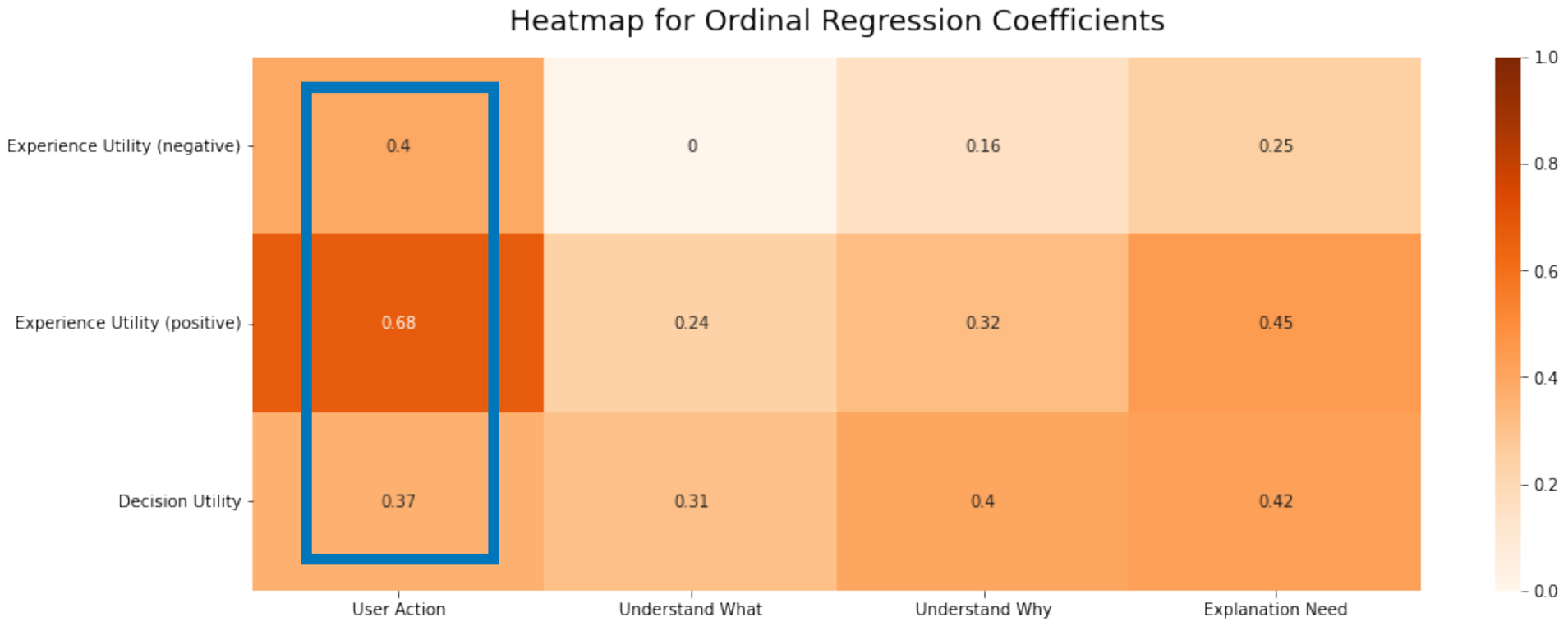

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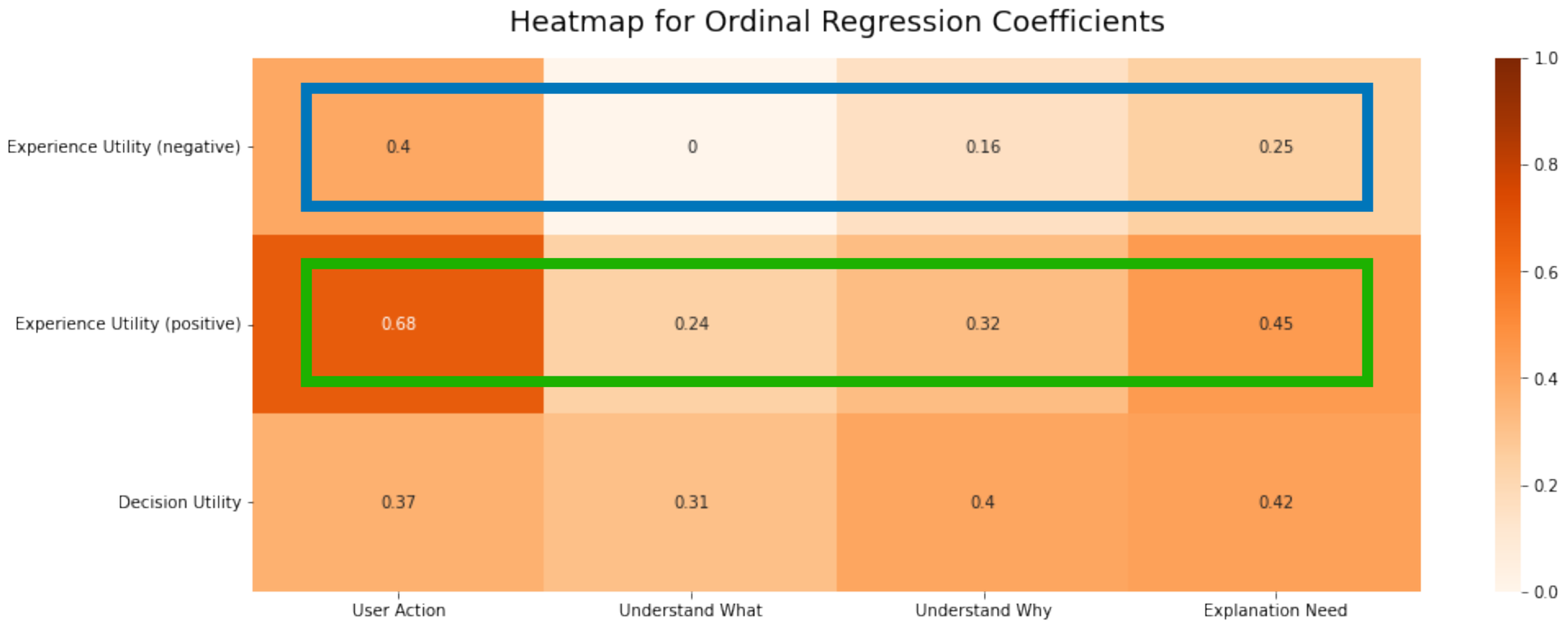

Overall relationship between utility associated with decision-making and *why not* explanation needs

- Significant and positive correlation between utility associated with decision making and why not explanation needs
  - This resonates with the prior work on users' perception of the cost-benefit trade-off of attending to explanations (Kuleza et al., Bunt et al.)

Effects of different types of decision-making utility

- Asymmetric correlational effects of positive experience utility and negative experience utility on *why not* explanation needs
  - Interactions are optimized for short-term euphoria (Panek)
  - Reward and risk motivate people to behave differently (Schultz)

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- Asymmetric correlational effects of positive experience utility and negative experience utility on *why not* explanation needs
  - Interactions are optimized for short-term euphoria (Panek)
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- Taking actions to refine search results **might be more desirable than reading explanations**

Wrapping up

Looking ahead

- How to effectively *present* counterfactual explanations to users?

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- Counterfactual explanations may result in higher cognitive load. How can systems *balance load and uncertainty* to preserve user trust?
- How to design decision *utility-aware* recommenders systems in everyday applications?

Thanks!

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