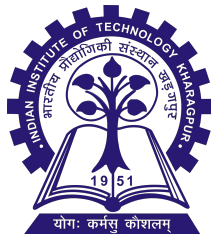


# Alexa, in you, I trust!

## Fairness and Interpretability Issues in E-commerce Search through Smart Speakers



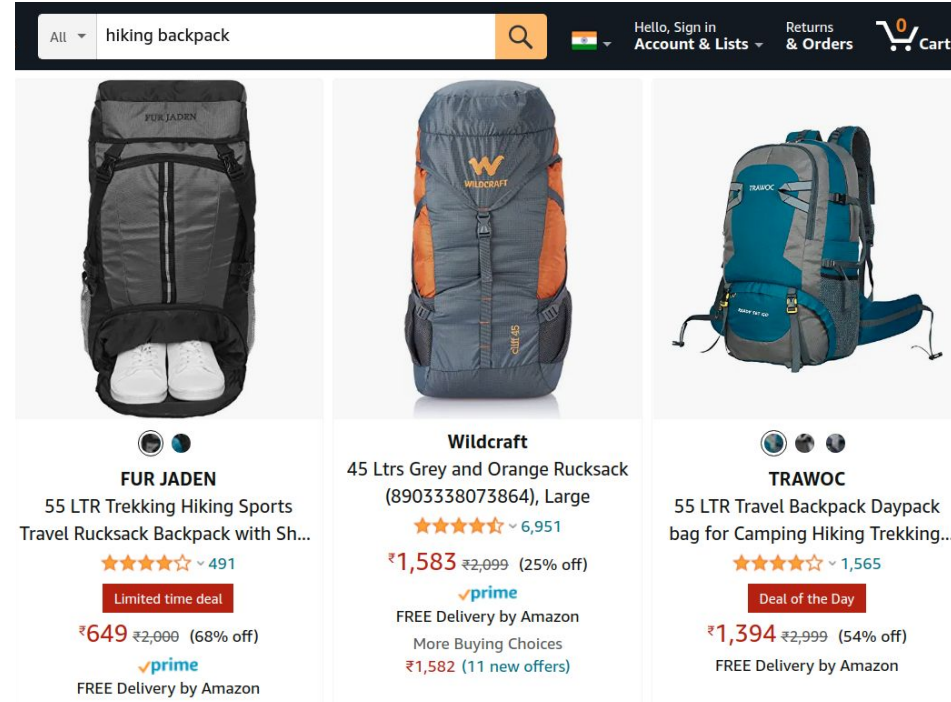
**Abhisek Dash**, Abhijnan Chakraborty, Saptarshi Ghosh,  
Animesh Mukherjee, Krishna P. Gummadi



MAX PLANCK INSTITUTE  
FOR SOFTWARE SYSTEMS

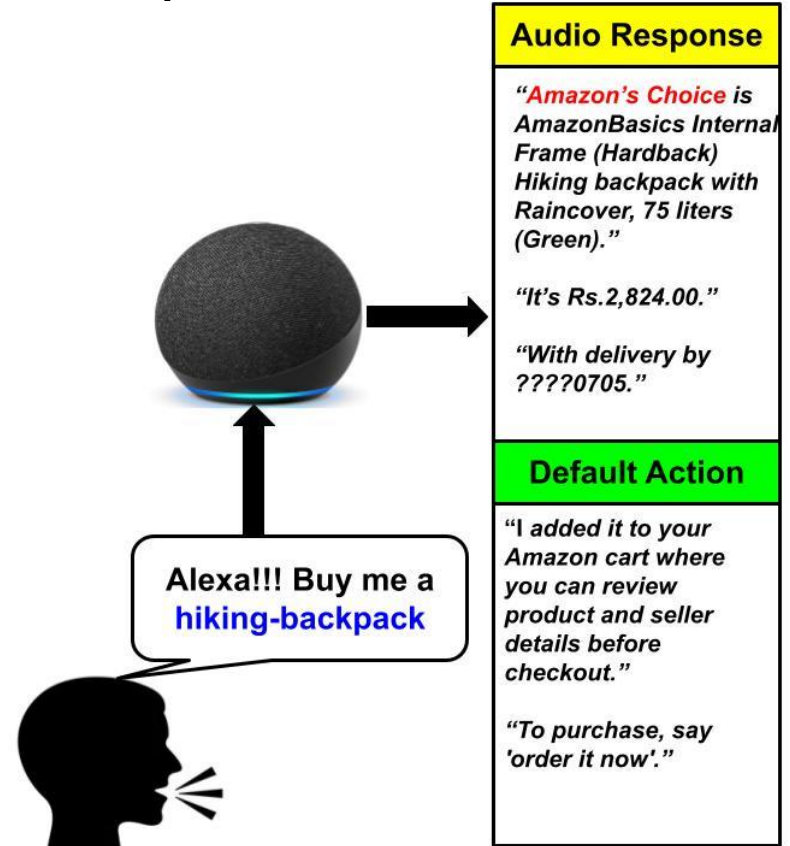
# Traditional e-commerce search

- Customers enter query strings
- A ranked **list of products** appear
  - ◆ Decreasing order of relevance
  - ◆ Metadata of the products shown
- Customers have multiple options to choose from



# E-commerce search through Smart Speakers

- Smart speakers are powered by voice assistants (VAs)
- Customers utter a query string
- The details of a **single product** is told
  - ◆ Audio response with a brief explanation
  - ◆ Default action of adding the product to cart



# Audio responses from Alexa

*"buy me a hiking backpack"*

*"Amazon's Choice is AmazonBasics Internal Frame  
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*"It's Rs.2,824.00."*

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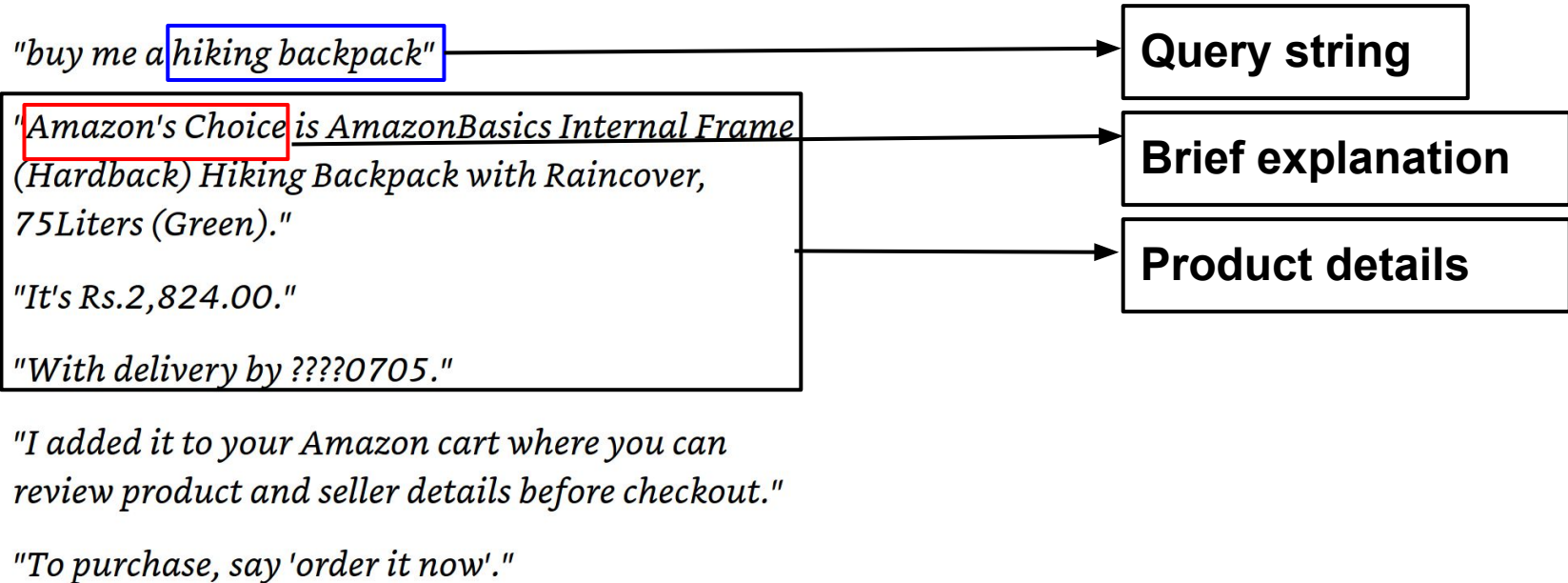
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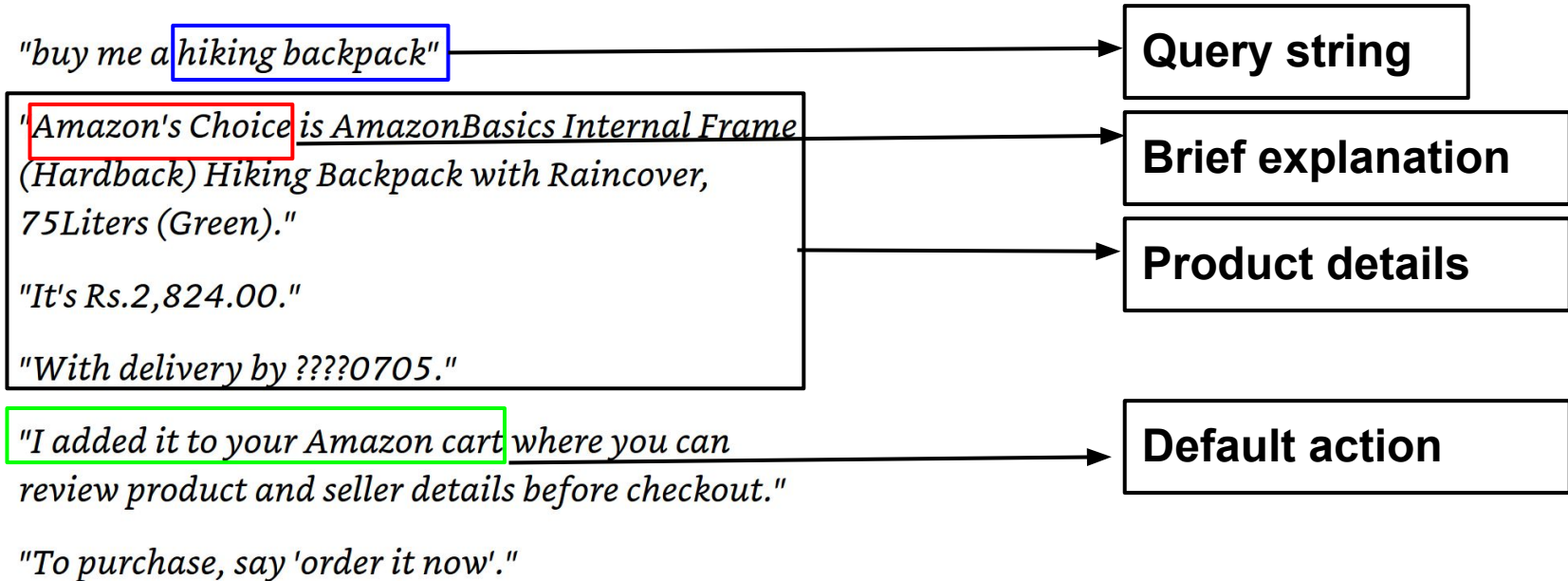
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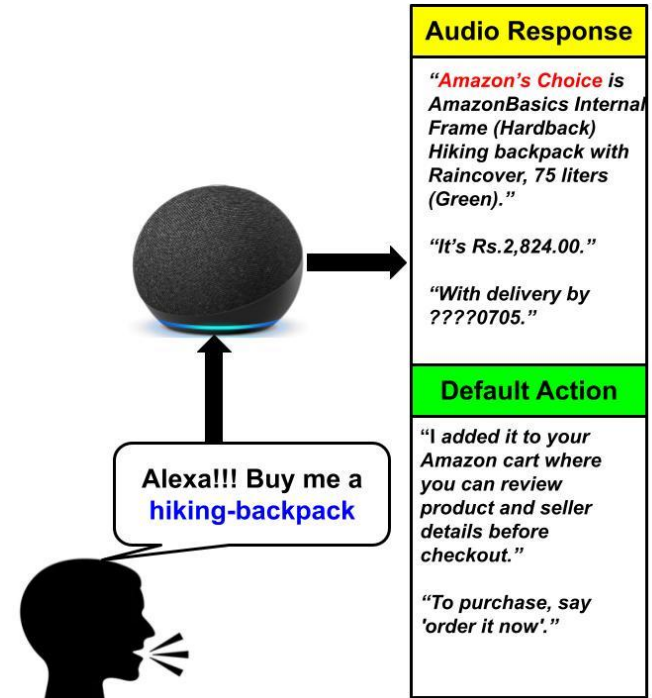
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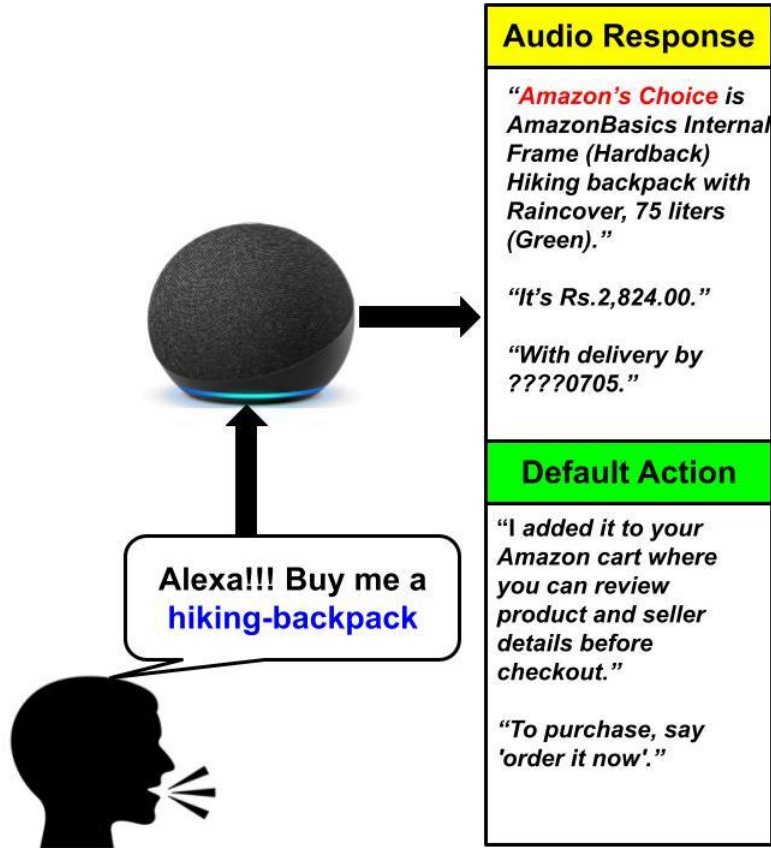


# E-commerce search through Smart Speakers

- Smart speakers are powered by voice assistants (VAs)
- Customers utter a query string
- The details of a **single product** is told
  - ◆ Audio response with a brief explanation
  - ◆ Default action of adding the product to cart
- Unlike traditional product search, customers do not have many options to choose from.



# In this paper



***RQ 1: How do customers interpret the explanations given in the audio response by the VA?***

***RQ 2: How fair is the default action by the VA?***

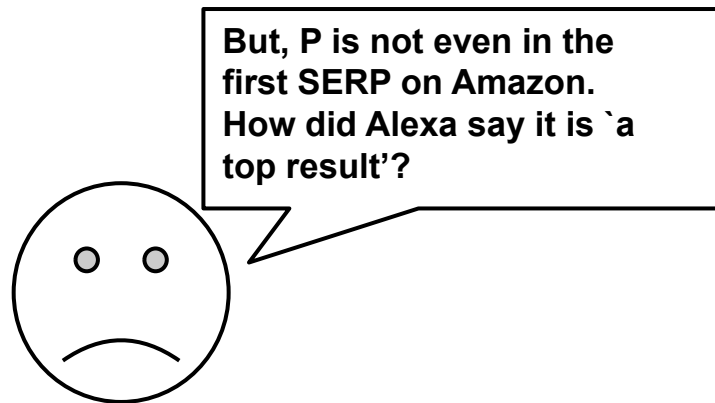
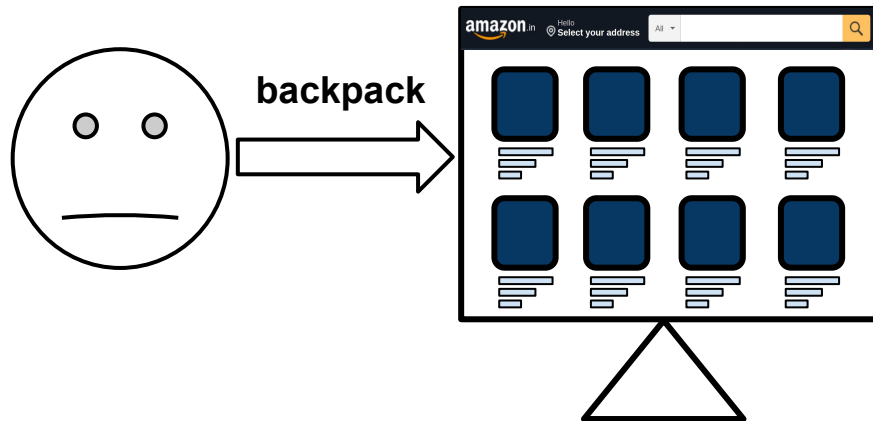
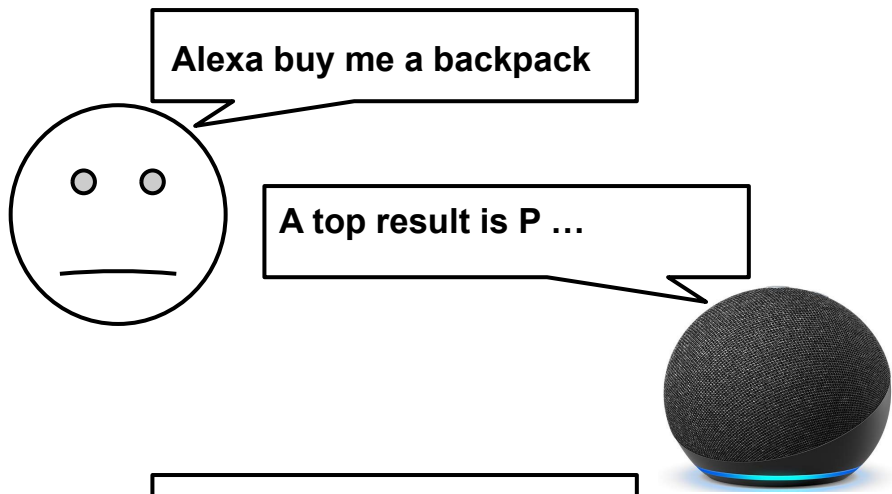
Why are these  
questions important?

# Gap in explanation and Interpretation of customers

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# Fairness in the default action by VA

- VA selects one specific product as part of its default action
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  - Hence, likelihood of choosing / purchasing the default option is generally high.
- 
- Non-selection of the most relevant product as the default choice
    - ◆ may deny its producers sales and revenue opportunities
    - ◆ may mislead customers to (possibly) less relevant products



# Research questions



***RQ 1: How do customers interpret the explanations given in the audio response by the VA?***

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# Challenges in understanding customers interpretation

- These explanations have several semantics and nuances attached
- Customers are more conversant with traditional mediums e.g., Desktop e-commerce search.

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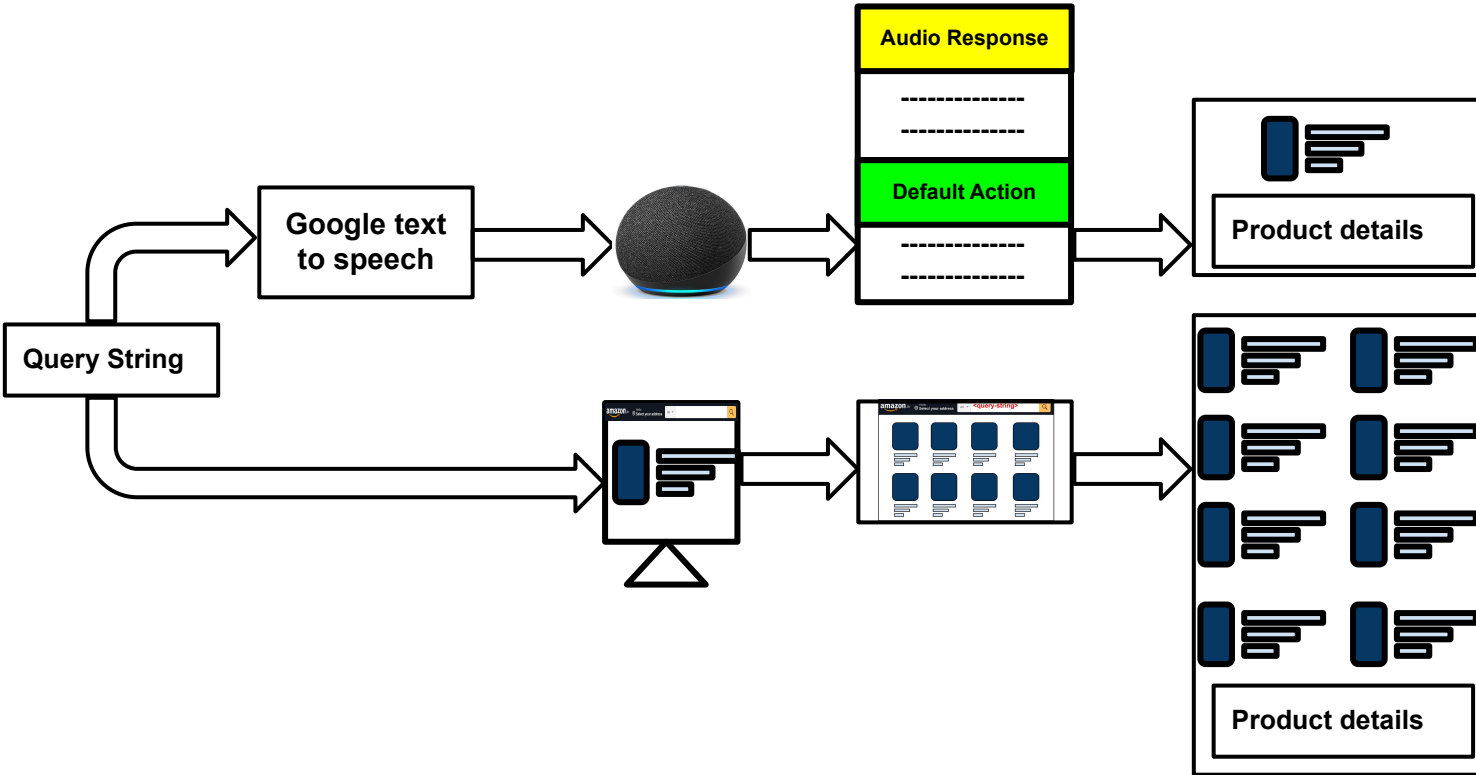
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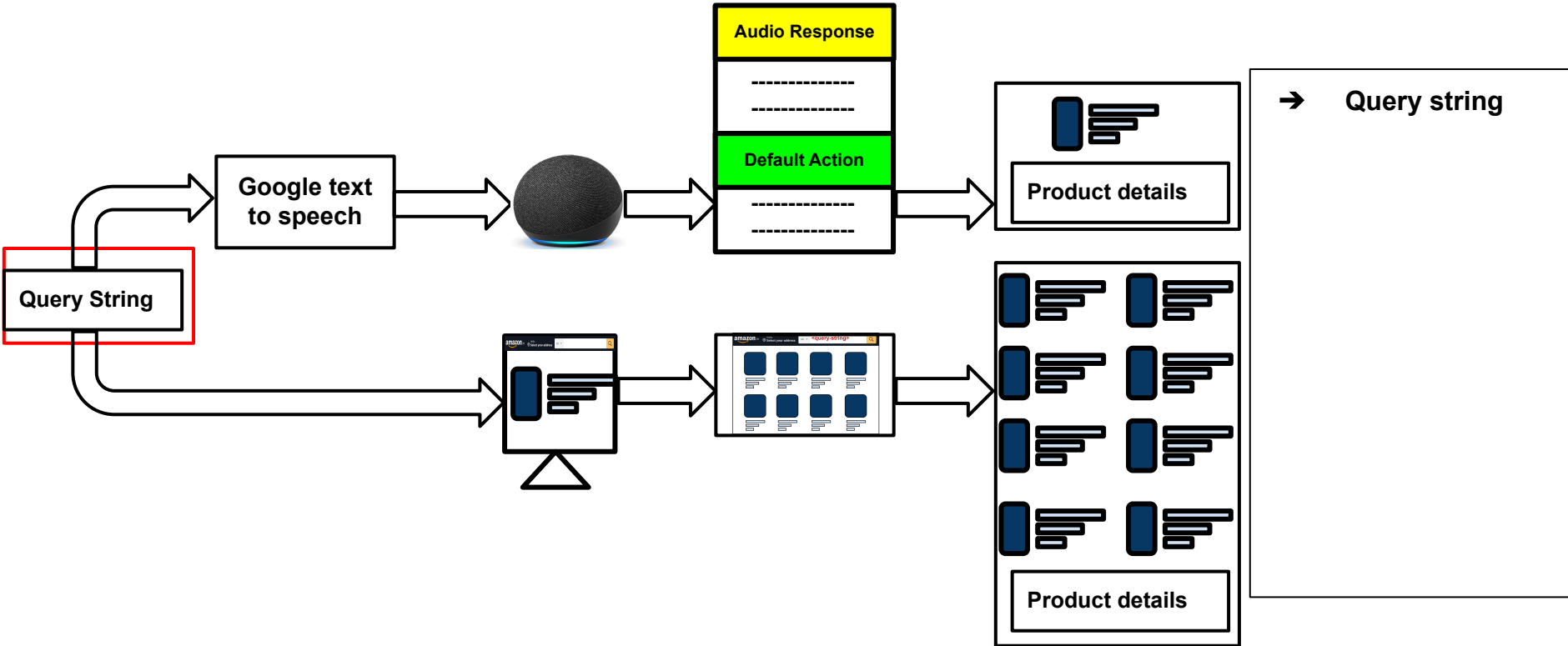
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**How to design an effective data collection framework for such analysis?**

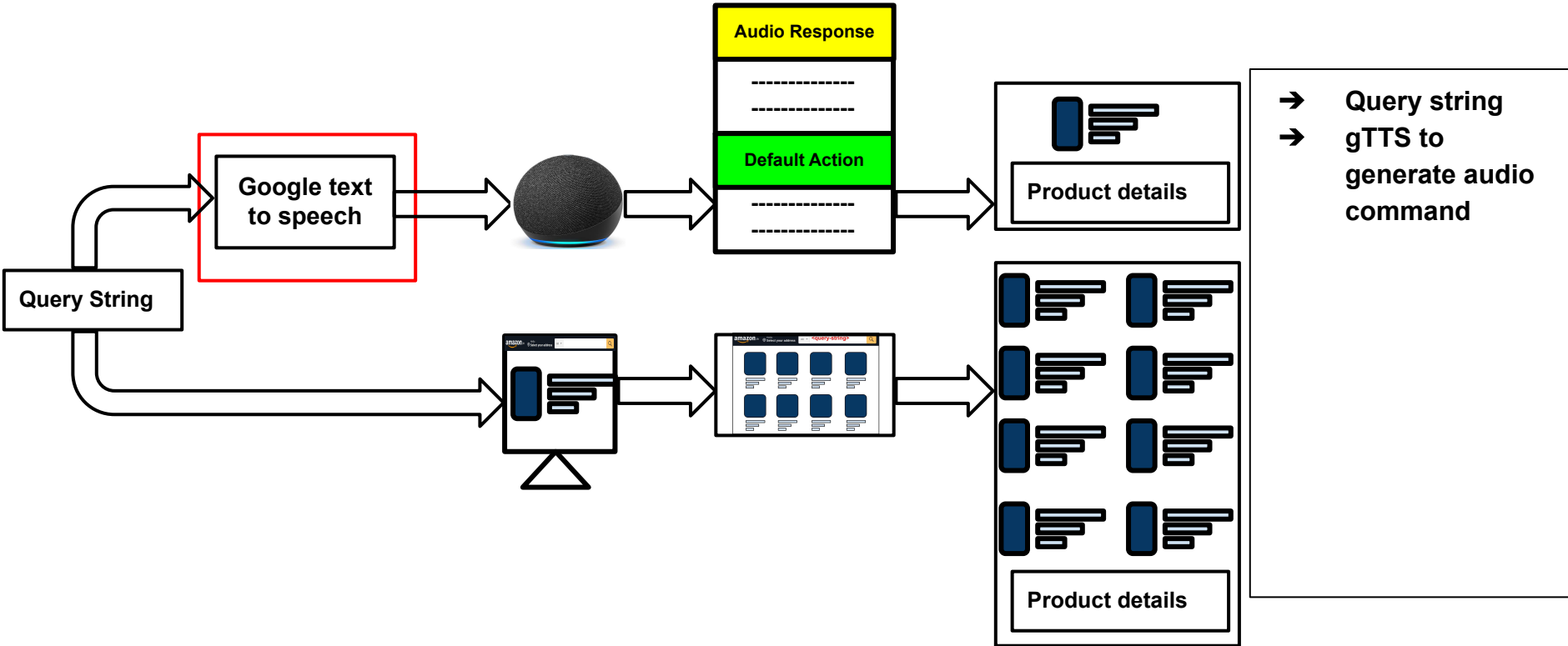
# Data collection for a meaningful comparison



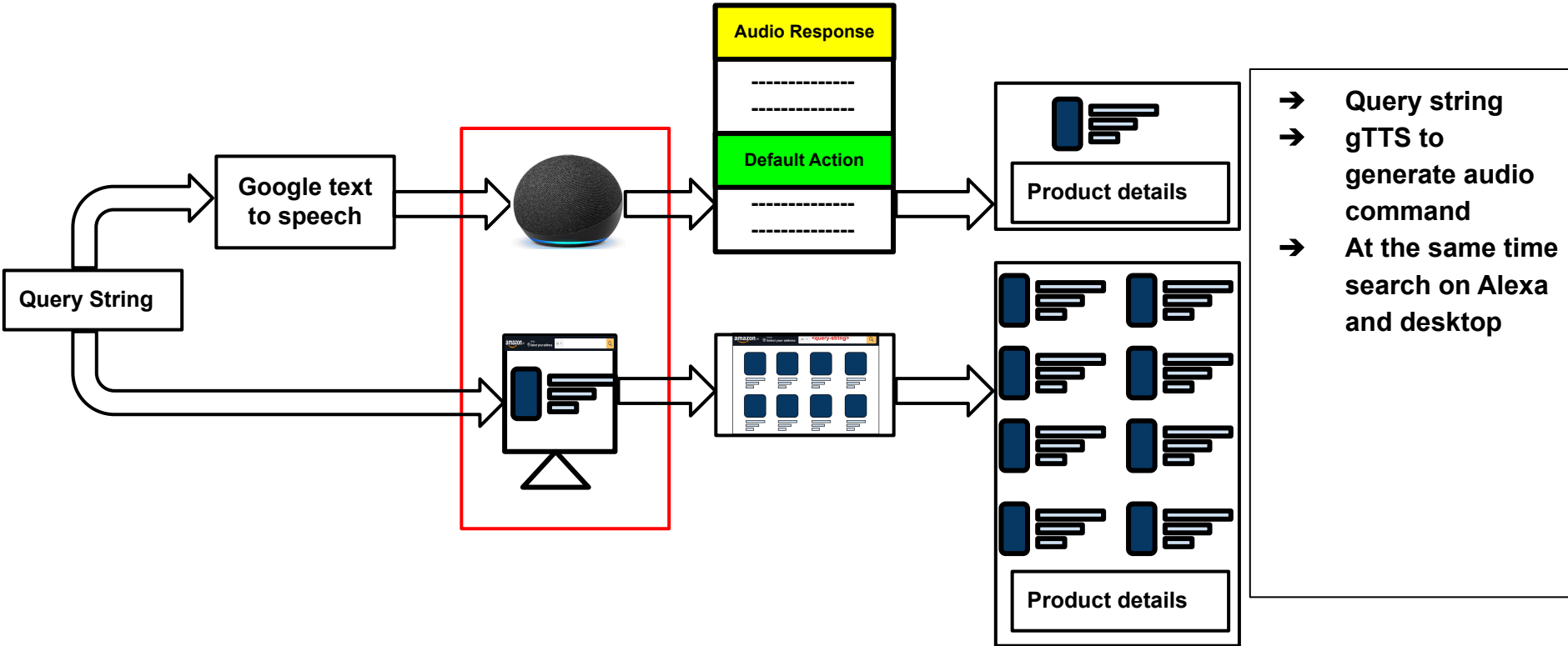
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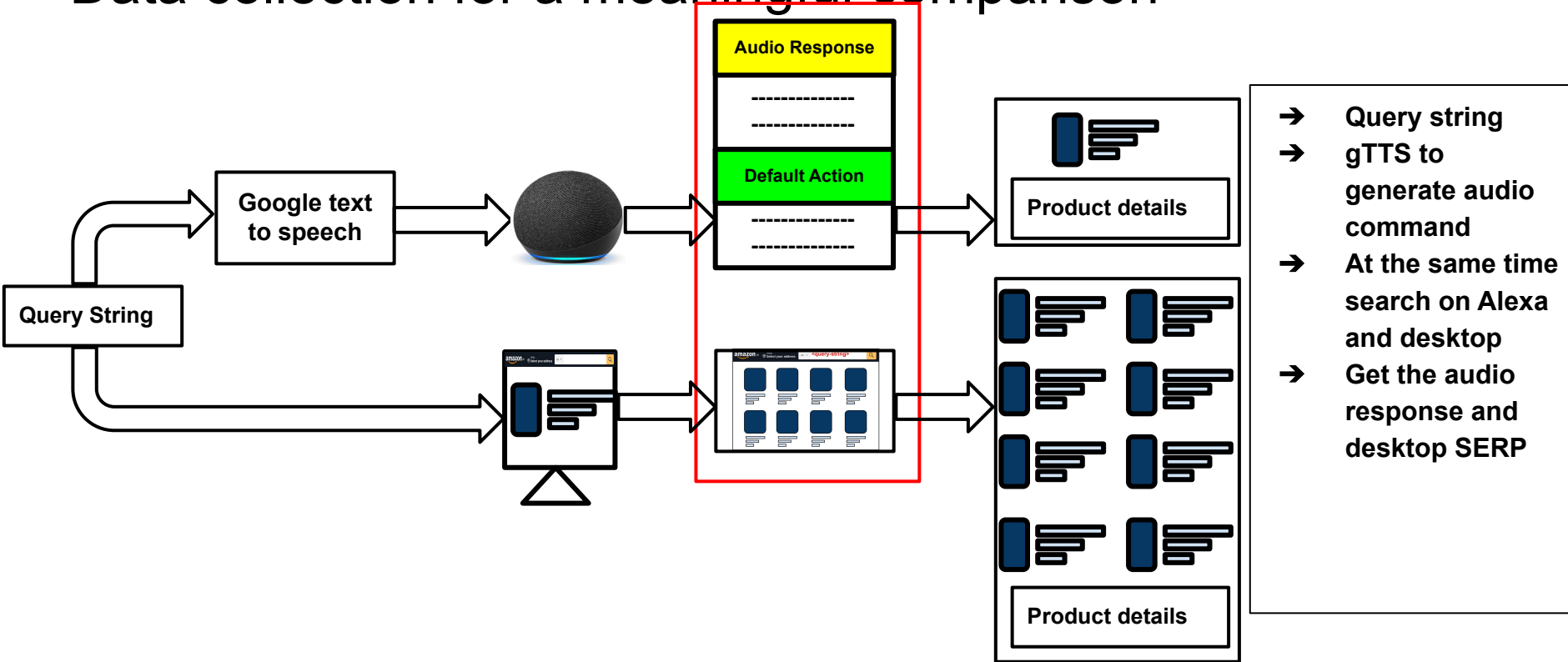


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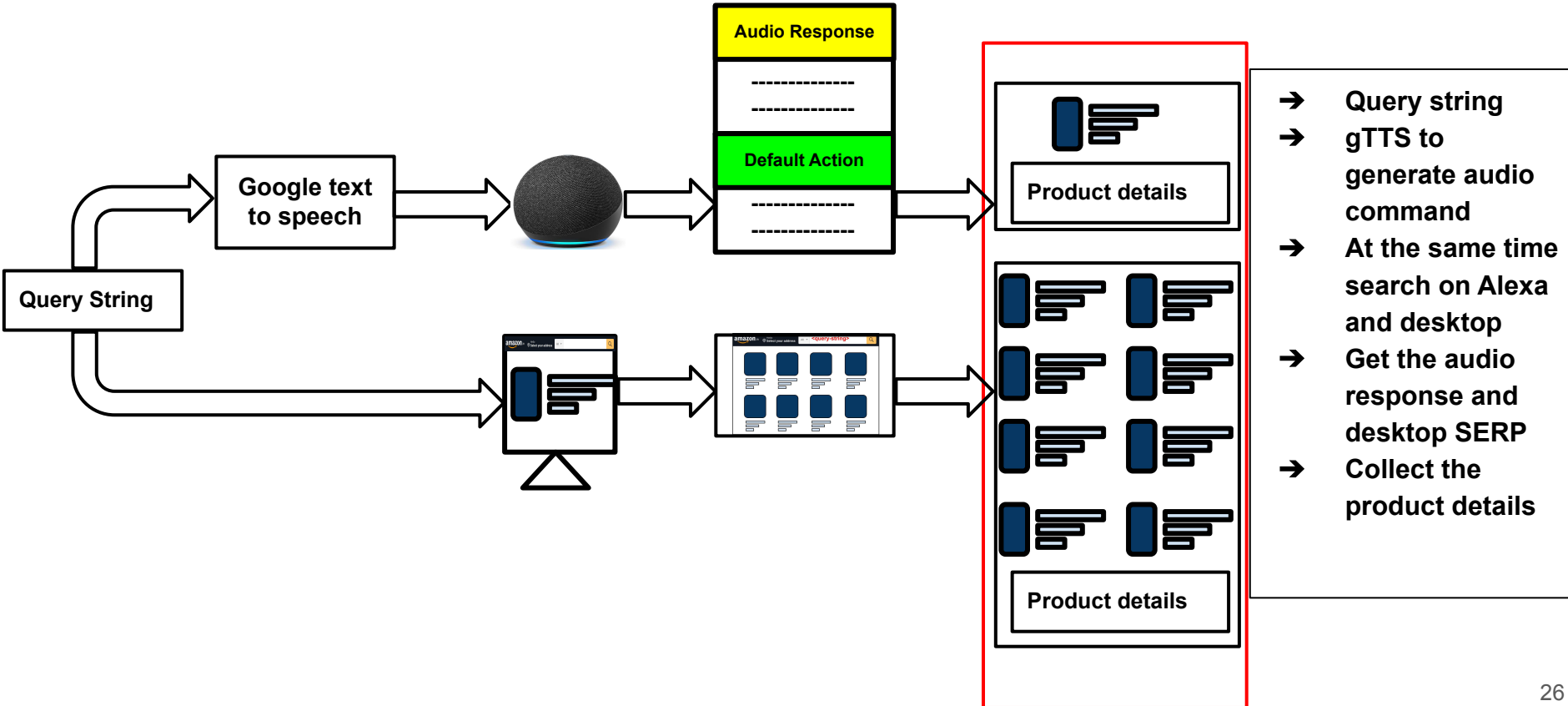




# Data collection for a meaningful comparison



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## Some statistics of the dataset collected

- We collected data for 1000 query strings on Amazon.
- The queries cover 10 popular product categories on Amazon.
- We also collected 14 temporal snapshots for top-100 queries on Amazon.

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For access to dataset, please refer to the form at this link: <https://forms.gle/aEG2n84Ay82QkVD19>

# Most prevalent explanations

*"buy me a hiking backpack"*

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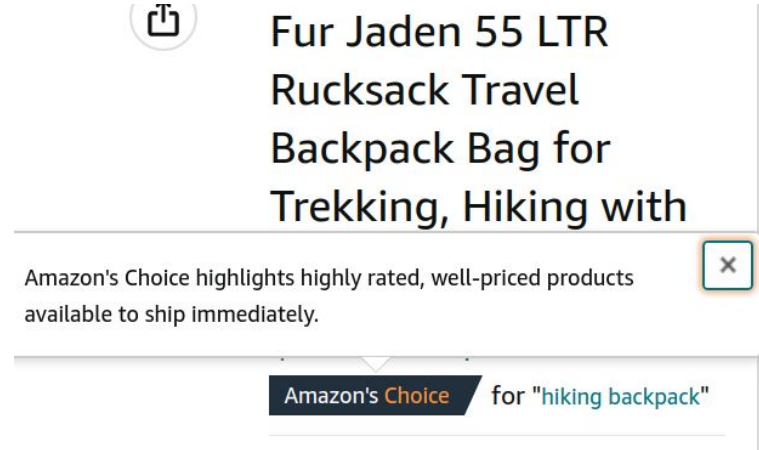
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Amazon's choice highlights **highly rated, well-priced** products available to ship immediately.

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- We conducted a survey among 100 participants.
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- We conducted a survey among 100 participants.
- Most of them are conversant with Amazon platform.
- We asked them different questions pertaining to
  - ◆ What do customers interpret by 'highly rated' (or 'well priced') products?
  - ◆ Where do customers expect Amazon's Choice products to appear?
  - ◆ How likely are you to buy the product which is explained as "Amazon's Choice"?



# What do customers interpret by `highly rated' product?

- According to 59% respondents, a product with avg. rating greater than 4.0 out of 5.0 can be considered highly rated.

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- According to 59% respondents, a product with avg. rating greater than 4.0 out of 5.0 can be considered highly rated.
- In all the 662 queries, the product selected with Amazon's choice explanation has an average rating greater than 4.0.

# What do customers interpret by 'well priced' product?

- 61% respondents consider a product with price among the least 5 prices among all the products shown in SERP to be well priced.

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- 61% respondents consider a product with price among the least 5 prices among all the products shown in SERP to be well priced.
- In merely 23% cases, product added to cart adhered to the most common interpretation as mentioned above.

## Where do customers expect Amazon's Choice products to appear?

- 54% respondents expect them to appear in top-5 positions; while 30% respondents expect them to appear as the top search result.

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## Where do customers expect Amazon's Choice products to appear?

- 54% respondents expect them to appear in top-5 positions; while 30% respondents expect them to appear as the top search result.
- In 74% cases, Amazon's Choice product appeared in the top-5 positions.
- The contribution from position 1 is merely 39%.
- Worse, nearly 8% of the times, it does not even appear in the first SERP.

# Major takeaways from the survey

Explanation type	Statement	Interpretation	Match	
<b>Amazon's Choice</b>	Highly rated	Avg. user rating $\geq 4.0$	✓ (100%)	✗ (00%)
	Well priced	Least-5 price	✓ (23%)	✗ (77%)
	Expected position	Top-5 in SERP	✓ (74%)	✗ (26%)
<b>A top result</b>	Expected position	Top result (position 1)	✓ (19%)	✗ (81%)



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**Respondents' interpretations of the VA's explanation do not align with observations from desktop search results in majority of the cases.**

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**Respondents' interpretations of the VA's explanation do not align with observations from desktop search results in majority of the cases.**

Additionally, 56% customers answered that they are likely or very likely to purchase products with such explanations.

# Research questions



***RQ 1: How do customers interpret the explanations given in the audio response by the VA?***

***RQ 2: How fair is the default action by the VA?***

# (Un)Fairness toward producers

- Exposure due to Alexa:
  - ◆ 1 if product is added to cart, 0 otherwise
- Exposure due to ranked results of desktop search
  - ◆ Can be evaluated using any standard attention distribution mechanism
  - ◆ We assume attention / exposure are distributed geometrically
- **Exposure bias** is the difference between the two exposures
  - ◆ Ideally, Exposure bias  $\approx 0$ .

# Observation

In 68% of all 1000 queries, exposure bias is non-zero → most relevant product according to desktop search was **not** added to cart by Alexa.

# Observation

**Less relevant products were added to cart; thus, depriving producers of more relevant products an opportunity to potential sales and revenue.**

# (Un)Fairness toward customers

- Is the product added to cart by Alexa also preferred by customers?
- We conducted a user survey among the same 100 respondents
- We showed the customers:
  - ◆ Product that was added to cart by Alexa
  - ◆ Product that appeared as the top result in the corresponding desktop search
- Which of the following two products would you prefer to buy?

# Observation

- For 22 out of the 30 queries (73.3%), the majority preference of respondents did not match with the products selected by Alexa.
- Out of the 1000 evaluations, we find that in 73.2% cases, respondents preferred the top desktop search result to the product selected by Alexa.



# Observation

→ For 22 out of the 30 queries (73.3%), the majority preference of respondents

**These observations further underpin the potential unfairness and customer dissatisfaction concerns due to default product selection of Alexa.**

preferred top of desktop search result to product selected by Alexa.

# Conclusion


- There exists significant gap in customers' interpretation of Alexa's explanations and observation in traditional desktop search.
- The default product selection of Alexa has potential unfairness concerns for both customers and producers / sellers.
- Since customers cede complete autonomy to smart speakers (and the VAs therein), VAs should be more responsible during such interactions.

# Acknowledgements

- ERC Advanced Grant
- TCS Research Fellowship
- CNeRG Lab, IIT Kharagpur

# Thank You

For dataset please fill up: <https://forms.gle/PQdTghzynxQiuw4h6>

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