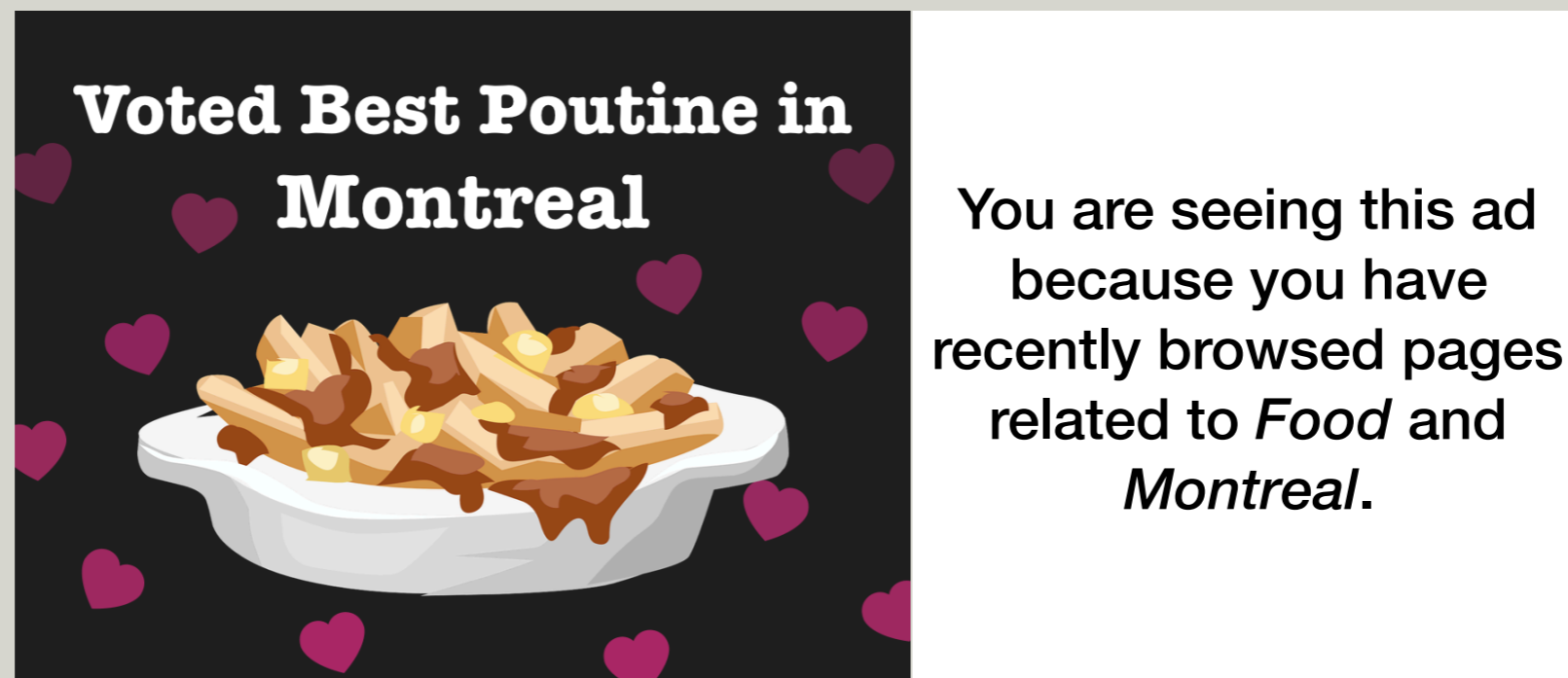


Unpacking Perceptions of Data-Driven Inferences Underlying Online Targeting and Personalization



Voted Best Poutine in Montreal

You are seeing this ad because you have recently browsed pages related to *Food* and *Montreal*.

The advertisement features a central image of a white bowl filled with poutine (fries, cheese curds, and gravy) set against a dark background with scattered pink hearts. The text is presented in a clean, sans-serif font.

Claire Dolin, Ben Weinshel,

Shawn Shan, Chang Min Hahn, Euirim Choi,

Michelle L. Mazurek, Blase Ur



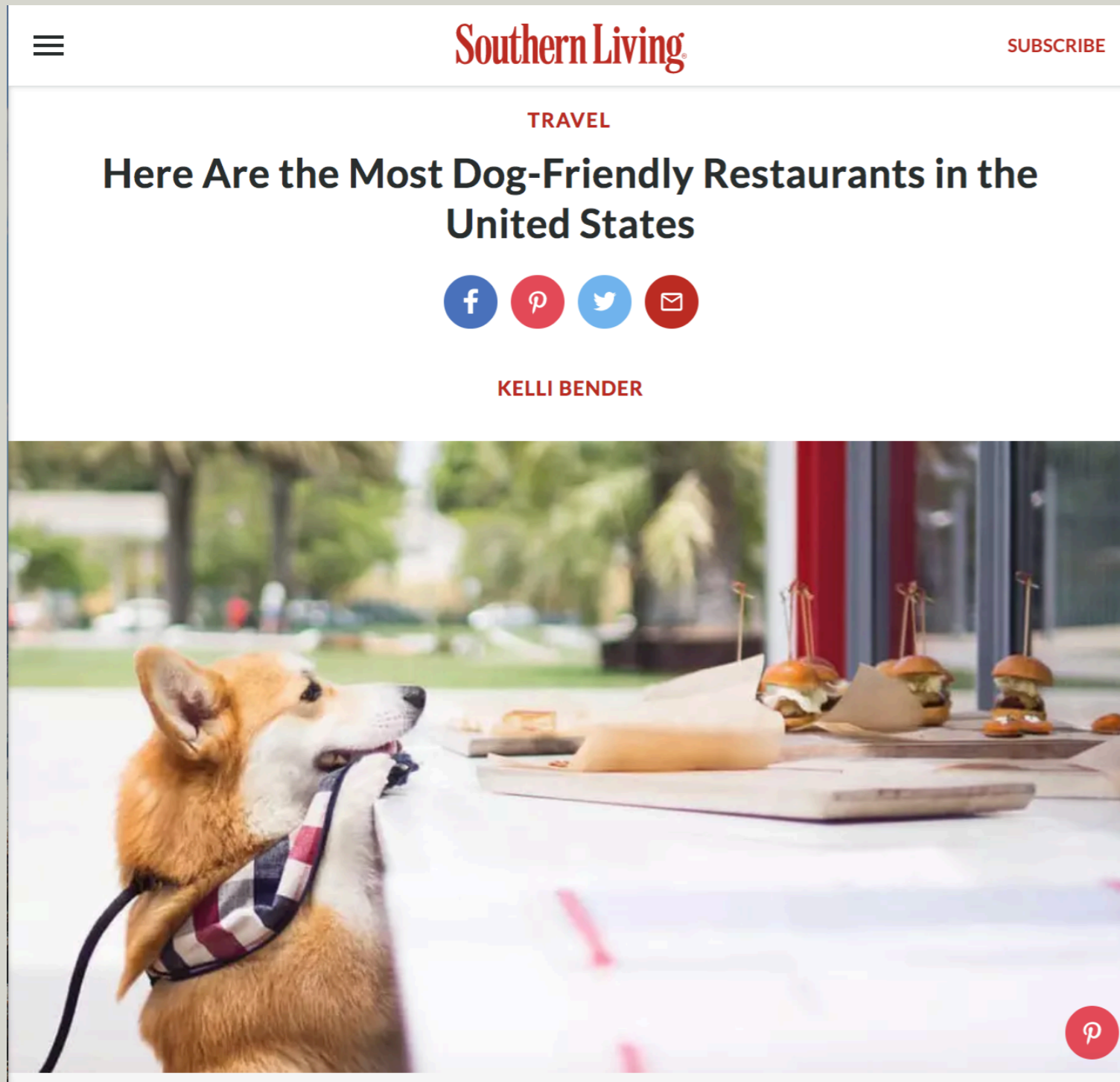
THE UNIVERSITY OF
CHICAGO



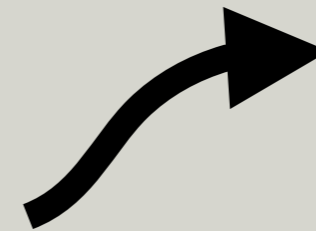
UNIVERSITY OF
MARYLAND



Advertisers use web activity to make inferences...



The screenshot shows the top portion of a web page from Southern Living. At the top left is a hamburger menu icon. The page title "Southern Living" is in a red serif font, and "SUBSCRIBE" is in a red sans-serif font to its right. Below the title, the word "TRAVEL" is centered in red. The main headline reads "Here Are the Most Dog-Friendly Restaurants in the United States" in a bold black font. Underneath the headline are four circular social media icons: Facebook (blue), Pinterest (red), Twitter (blue), and Email (red). Below the icons, the author's name "KELLI BENDER" is written in red. The main image of the article shows a small dog sitting at a restaurant table with food. A small red Pinterest icon is visible in the bottom right corner of the image area.



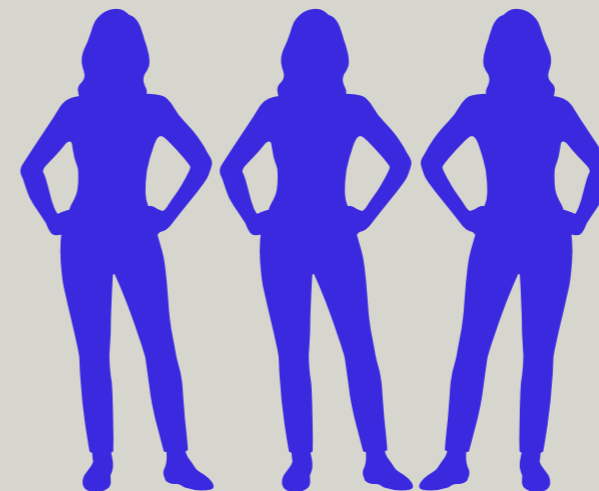
You might like dogs!

...which advertisers can use to target ads

Interests & remarketing

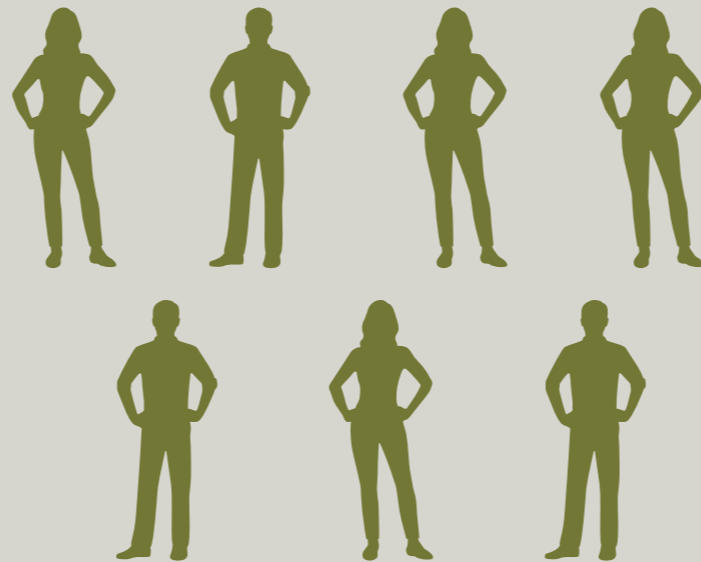
Affinity audiences

- Music Lovers >>
- News Junkies >>
- Nightlife Enthusiasts >>
- Outdoor Enthusiasts >>
- Pet Lovers >>



Research Questions

How does the **method of targeting** impact privacy attitudes?



How do the **interests that are inferred** and the **accuracy of these inferences** impact privacy attitudes?

Research Questions

How does the **method of targeting** impact privacy attitudes?

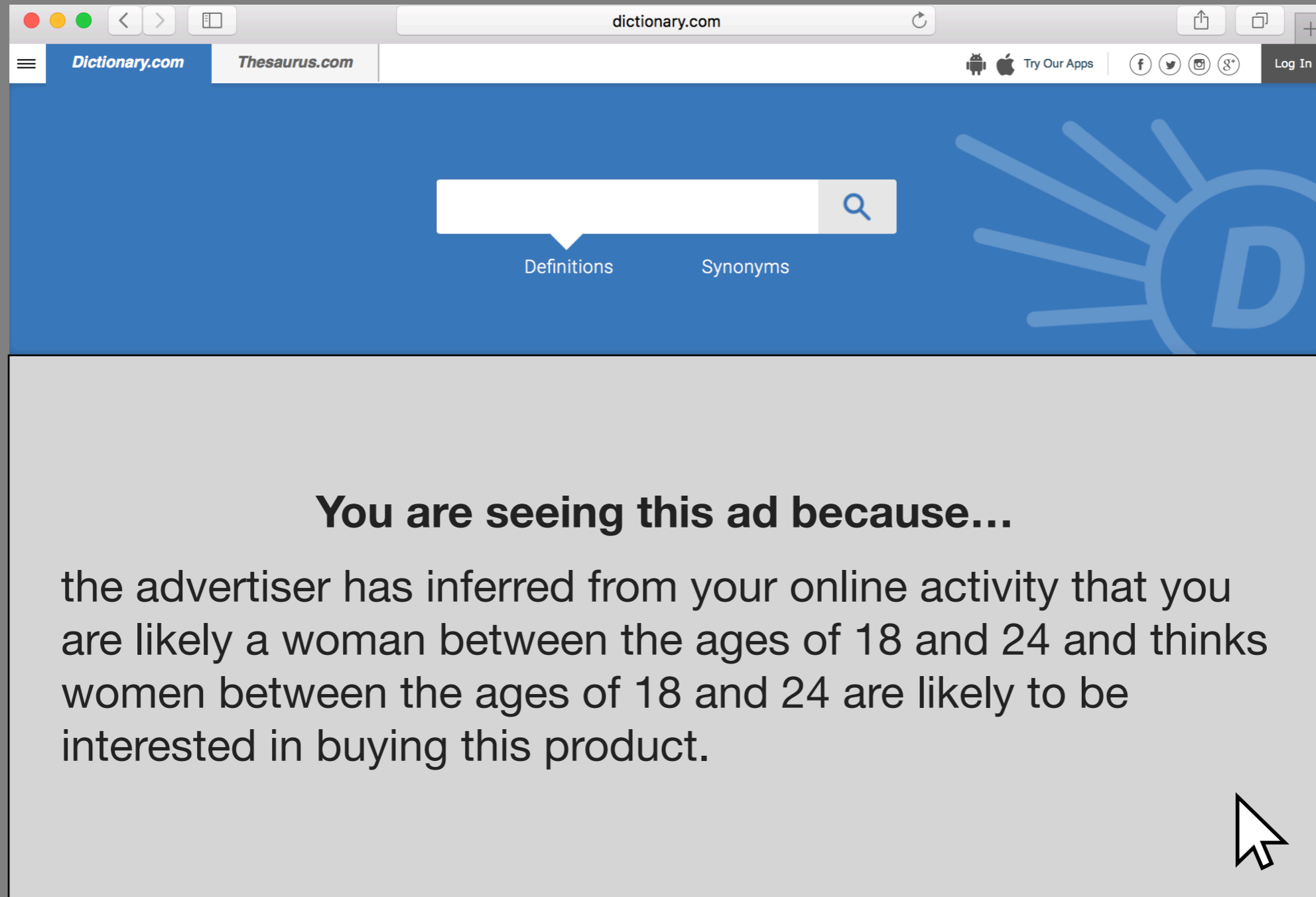


How do the **interests that are inferred** and the **accuracy of these inferences** impact privacy attitudes?

Study Setup: Simulated Ad

The image shows a simulated advertisement on the dictionary.com website. The browser address bar displays "dictionary.com". The website header includes "Dictionary.com" and "Thesaurus.com" tabs, along with social media icons and a "Log In" link. A search bar is visible with a magnifying glass icon. Below the search bar, the text "Definitions" and "Synonyms" is displayed. The advertisement itself features a large blue banner with the text "BEST PRICE" in white, slanted font. Below this banner, a brown dog is sitting in a brown, circular dog bed. To the right of the dog bed, a blue box contains the text "on dog beds and other pet supplies" in white.

Study Setup: Simulated Ad



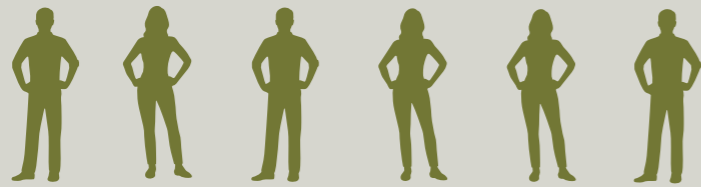
The image shows a simulated advertisement on the dictionary.com website. The browser's address bar displays "dictionary.com". The website's navigation bar includes "Dictionary.com" and "Thesaurus.com" tabs, along with social media icons and a "Log In" button. The main content area features a search bar with a magnifying glass icon and the words "Definitions" and "Synonyms" below it. A large, stylized blue "D" logo is visible on the right side of the page. The advertisement text is centered on a light gray background and reads:

You are seeing this ad because...

the advertiser has inferred from your online activity that you are likely a woman between the ages of 18 and 24 and thinks women between the ages of 18 and 24 are likely to be interested in buying this product.

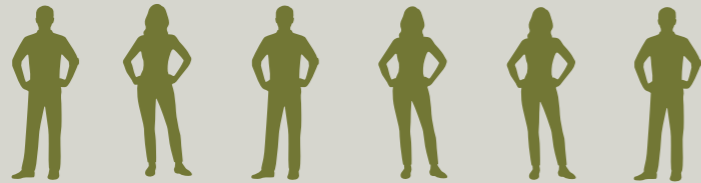
A mouse cursor is positioned in the bottom right corner of the advertisement area.

Targeting Explanations Reflect Prevalent Methods



Targeting Explanations Reflect Prevalent Methods

the advertiser has inferred that...

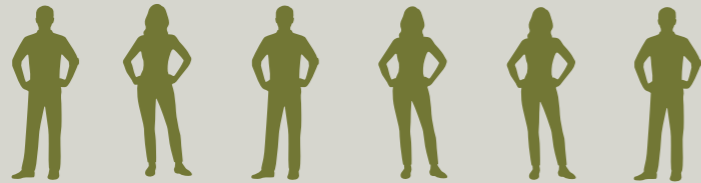


...visitors to this site... (Visitors)
...you... (You)



Targeting Explanations Reflect Prevalent Methods

the advertiser has inferred that...



...visitors to this site... (Visitors)
...you... (You)



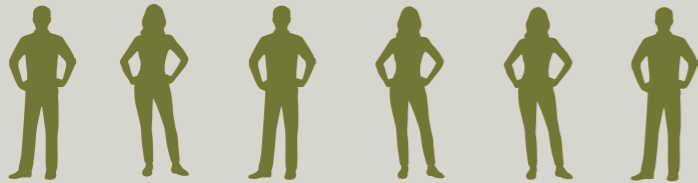
(Demographic)



Targeting Explanations Reflect Prevalent Methods

the advertiser has inferred that...

...visitors to this site... (Visitors)
...you... (You)



(Demographic)



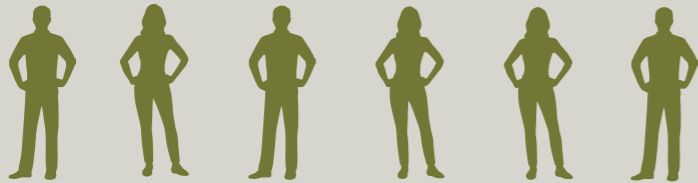
(Wrong Demographic)



Targeting Explanations Reflect Prevalent Methods

the advertiser has inferred that...

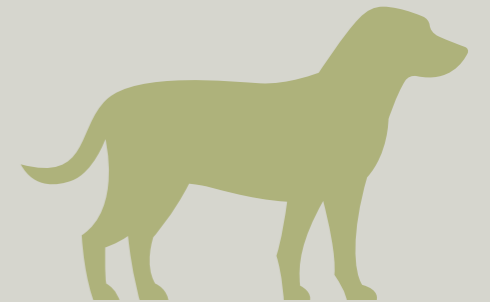
...visitors to this site... (Visitors)
...you... (You)



(Demographic)



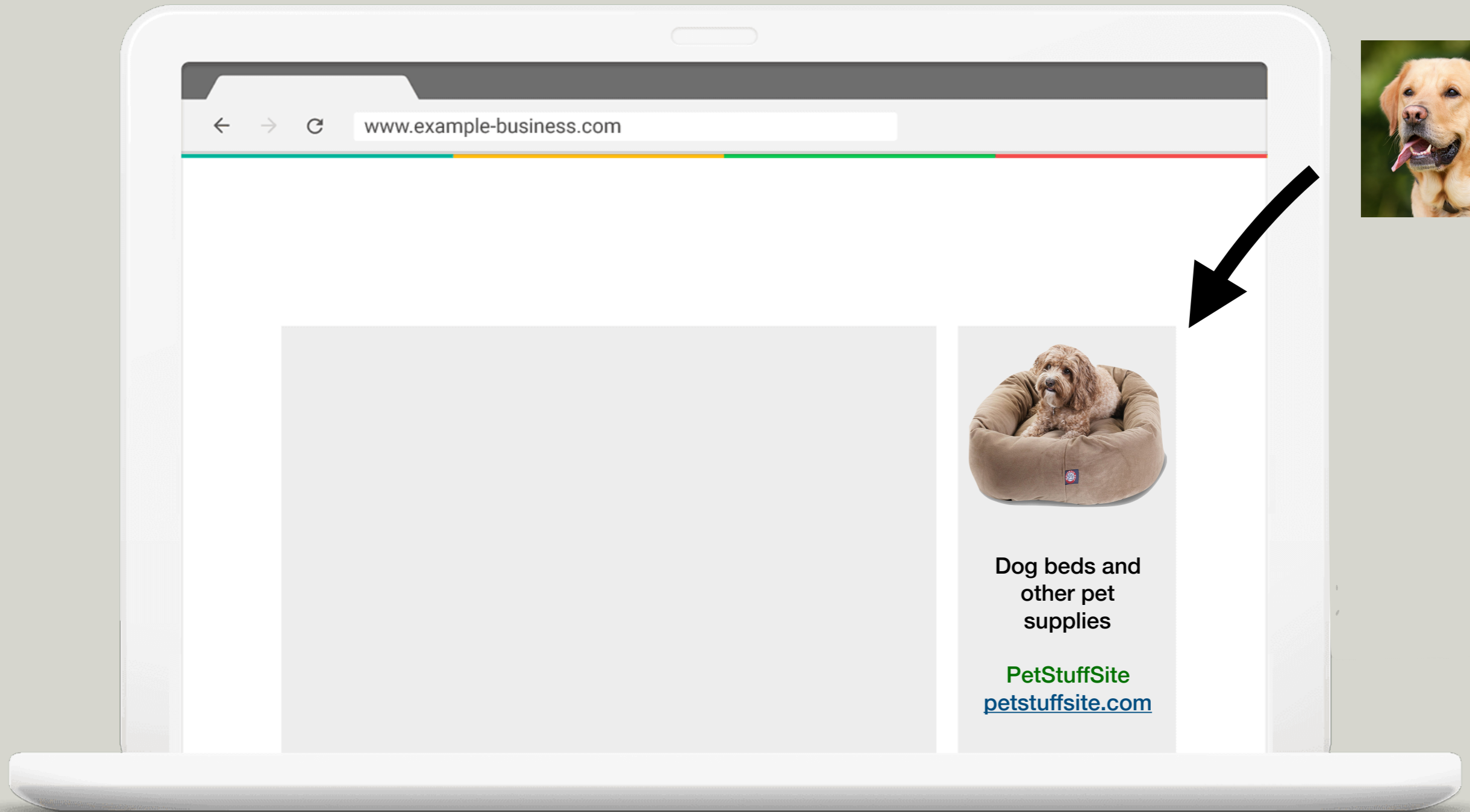
(Interest)



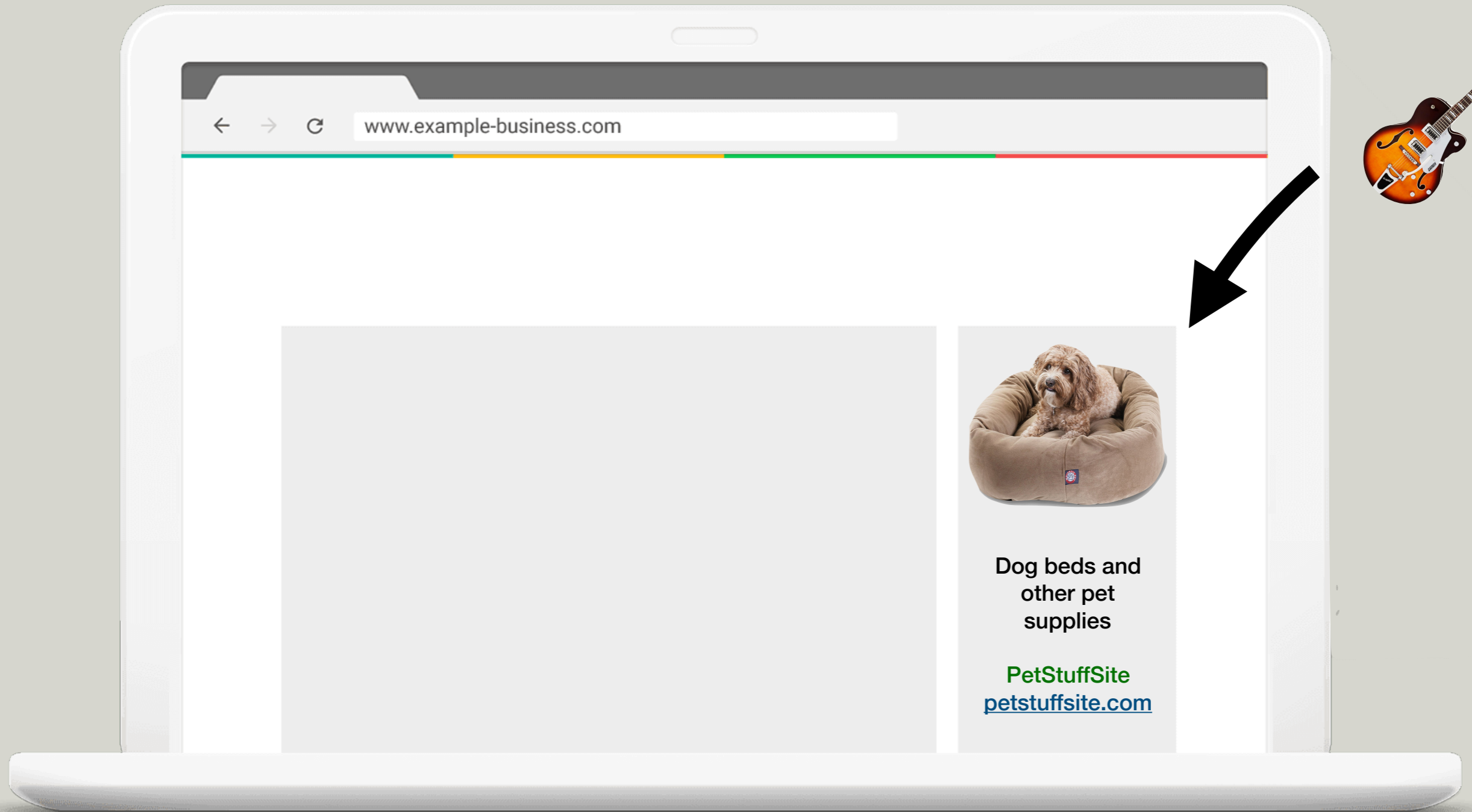
(Wrong Demographic)



Ads may be targeted by obvious connections



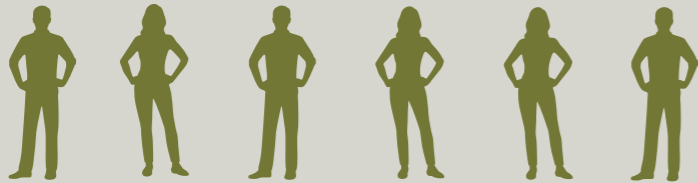
But algorithms can make unintuitive predictions



Targeting Explanations Reflect Prevalent Methods

the advertiser has inferred that...

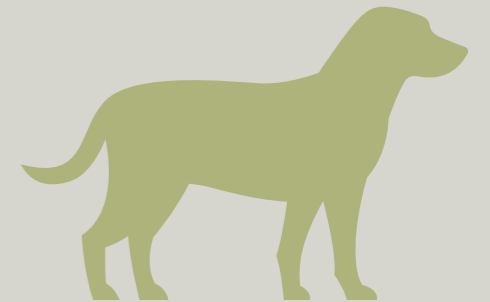
...visitors to this site... (Visitors)
...you... (You)



(Demographic)



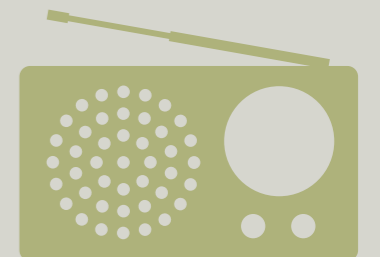
(Interest)



(Wrong Demographic)



(Unrelated Interest)



Targeting Explanations Reflect Prevalent Methods

...the advertiser decided to purchase an ad on this site. **(Control)**




...the advertiser's computer algorithms have determined that this ad would be effective. **(Algorithm)**



Reaction Statements—Likert Scale Responses

Reaction Statements—Likert Scale Responses

useful reason for
targeting




Reaction Statements—Likert Scale Responses

useful reason for
targeting


informative
notification

Reaction Statements—Likert Scale Responses


useful reason for
targeting



informative
notification



would **like to know**
when this targeting is
used



Reaction Statements—Likert Scale Responses

useful reason for
targeting

informative
notification

would **like to know**
when this targeting is
used

comfortable with
companies targeting
for this reason

Reaction Statements—Likert Scale Responses

useful reason for
targeting

informative
notification

would **like to know**
when this targeting is
used

comfortable with
companies targeting
for this reason

fair to target for this
reason

Reaction Statements—Likert Scale Responses

useful reason for
targeting

informative
notification

would **like to know**
when this targeting is
used

comfortable with
companies targeting
for this reason

fair to target for this
reason

fair to collect
information needed

Reaction Statements—Likert Scale Responses

useful reason for
targeting

informative
notification

would **like to know**
when this targeting is
used

comfortable with
companies targeting
for this reason

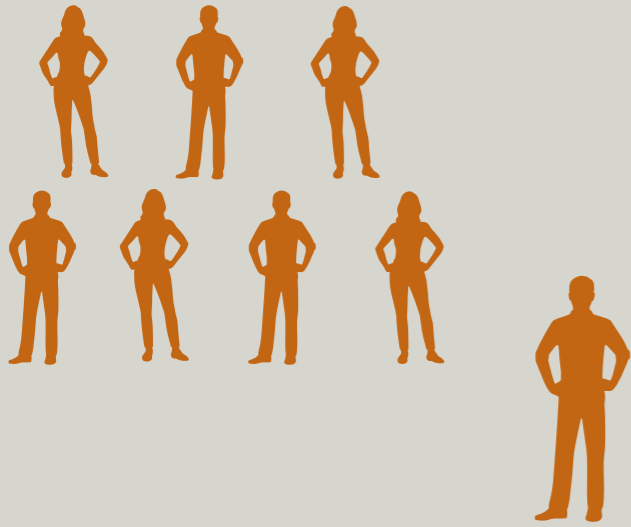
fair to target for this
reason

fair to collect
information needed

annoyed by this
type of targeting

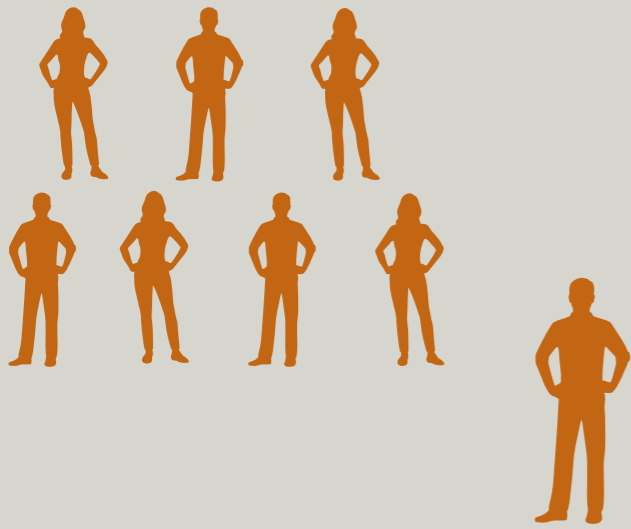
Planned Comparisons

Planned Comparisons



Visitors vs. You

Planned Comparisons

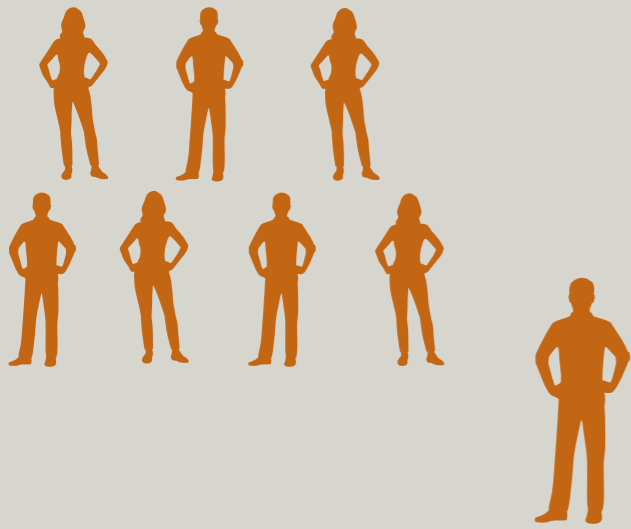


Visitors vs. You



Control vs. Algorithm

Planned Comparisons



Visitors vs. You

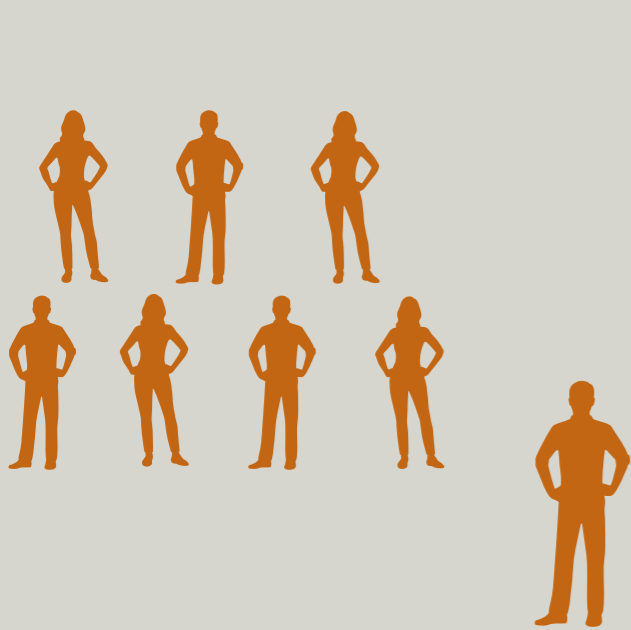


Control vs. Algorithm



Algorithm vs. Interest

Planned Comparisons



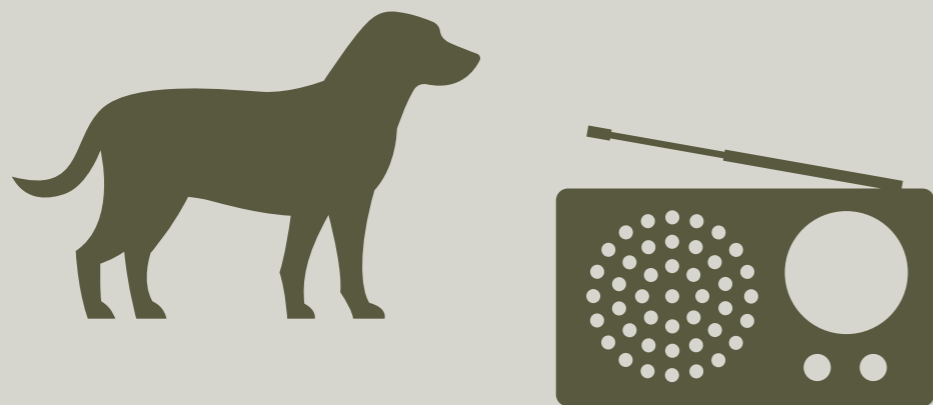
Visitors vs. You



Control vs. Algorithm

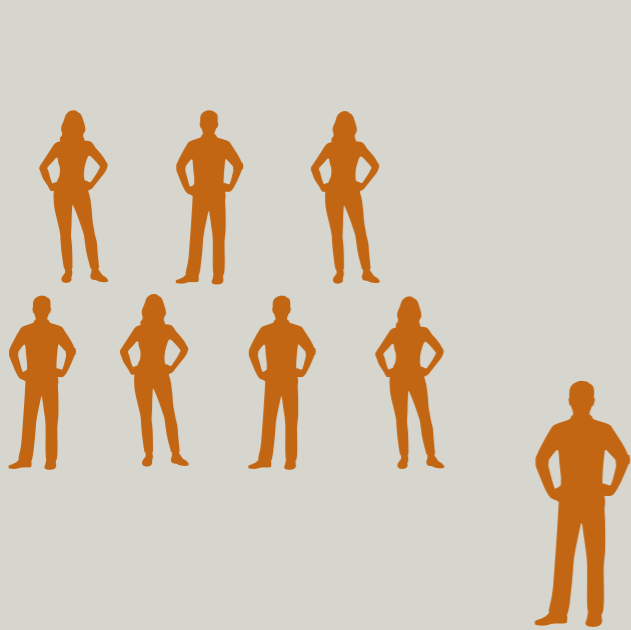


Algorithm vs. Interest



Interest vs. Unrelated Interest

Planned Comparisons



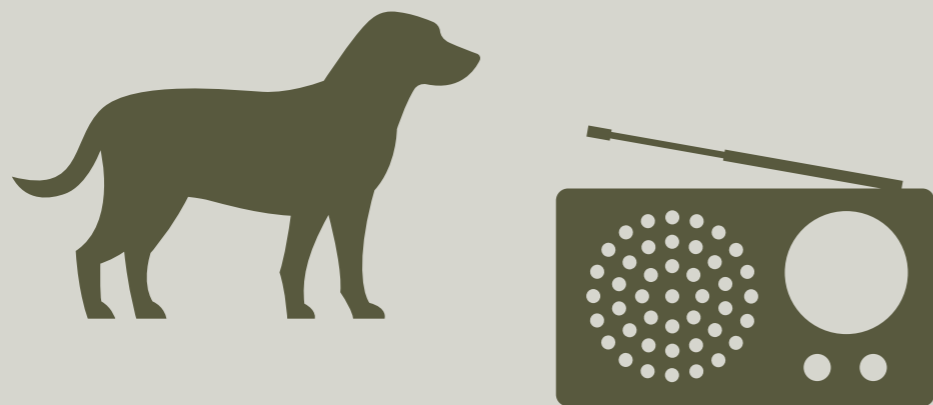
Visitors vs. You



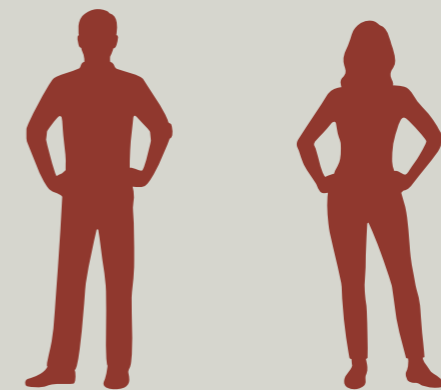
Control vs. Algorithm



Algorithm vs. Interest



Interest vs. Unrelated Interest

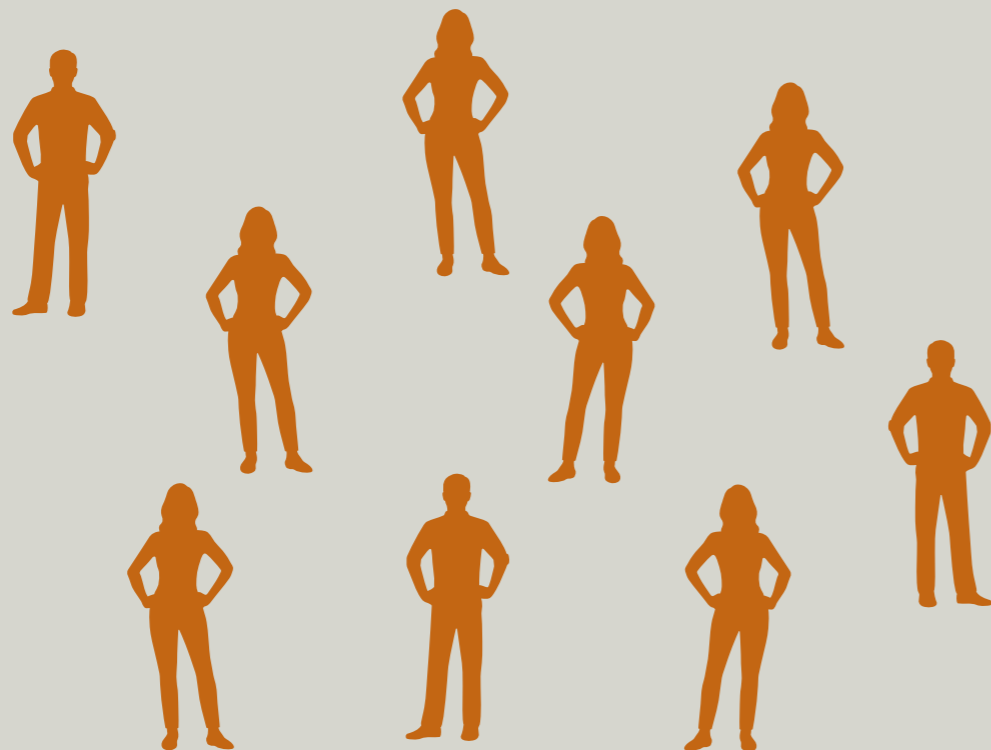


Demographic vs.
Wrong Demographic

More comfort with generalized targeting

Visitors

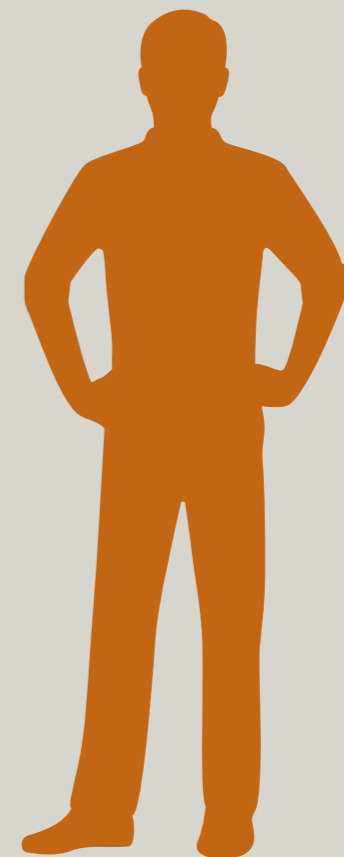
advertiser has inferred from general data that visitors to this site...



vs.

You

advertiser has inferred from your browsing data that you...



More comfort with generalized targeting

Visitors

vs.

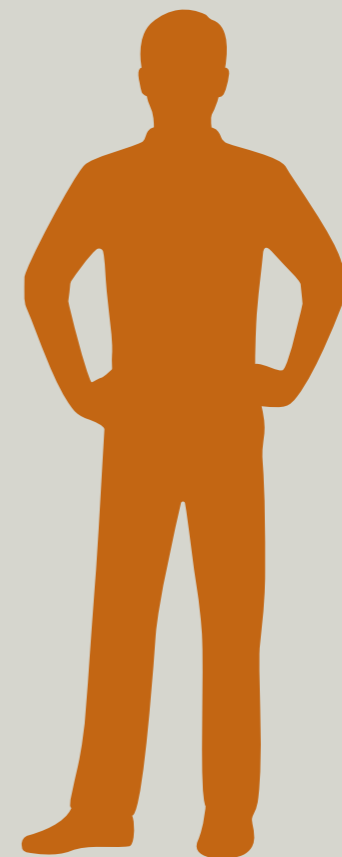
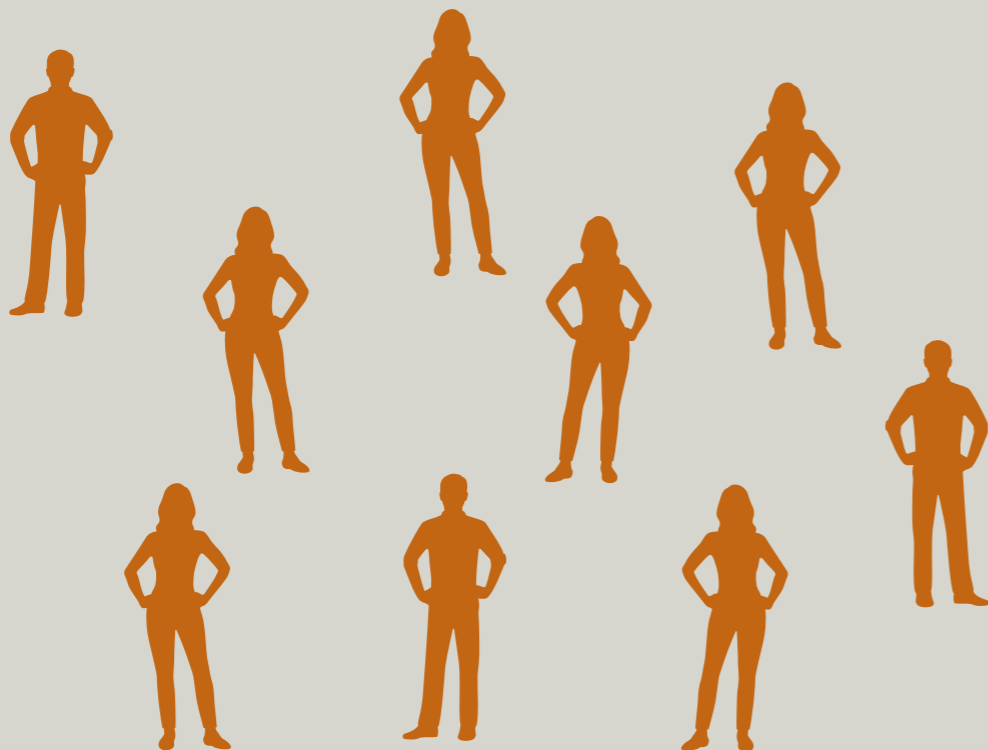
You

advertiser has inferred from general data that visitors to this site...

advertiser has inferred from your browsing data that you...

More Fair to Target

More Comfortable



Ads targeted by “algorithms” more useful but less fair

Control

advertiser decided to purchase an ad on this site



vs.

Algorithm

advertiser's computer algorithms determined this ad would be effective



Ads targeted by “algorithms” more useful but less fair

Control

advertiser decided to purchase an ad on this site

More Fair to Target



vs.

Algorithm

advertiser's computer algorithms determined this ad would be effective

More Useful



Notifications invoking your own activity more informative

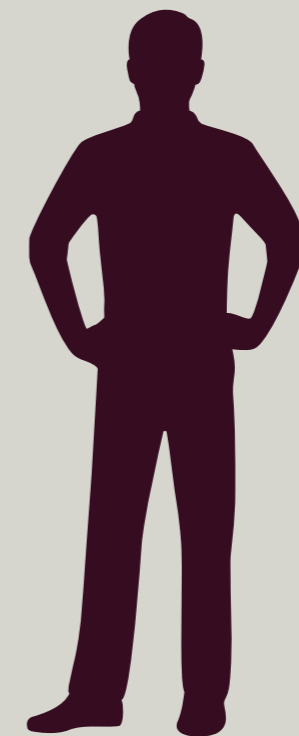
Algorithm

advertiser's computer algorithms determined this ad would be effective

vs.

Interest

advertiser thinks you are interested in dogs and therefore likely to buy this product



Notifications invoking your own activity more informative

Algorithm

advertiser's computer algorithms determined this ad would be effective

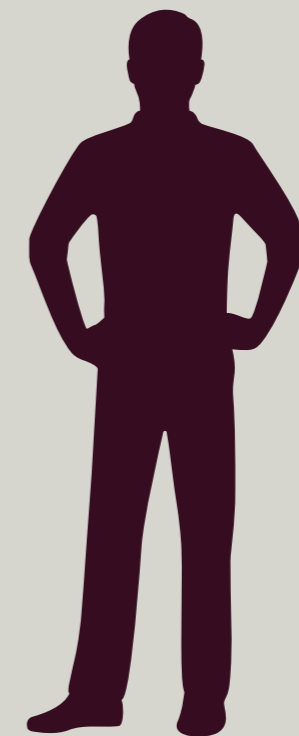


vs.

Interest

advertiser thinks you are interested in dogs and therefore likely to buy this product

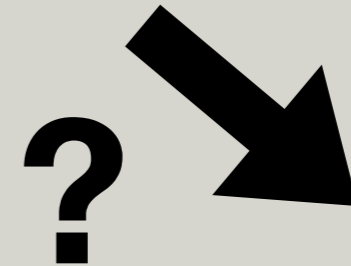
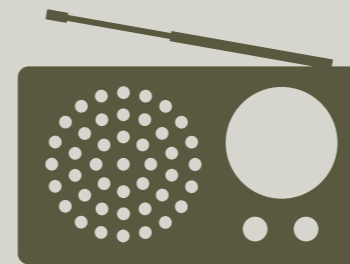
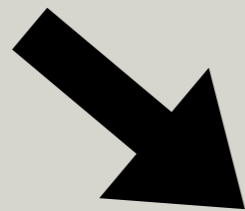
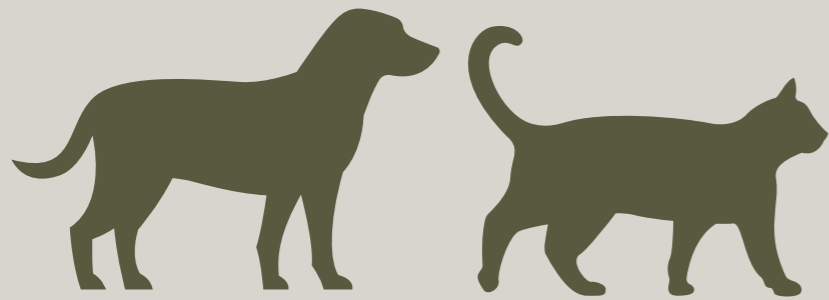
More Informative



Related interest-based targeting more useful

Interest

vs. Unrelated Interest



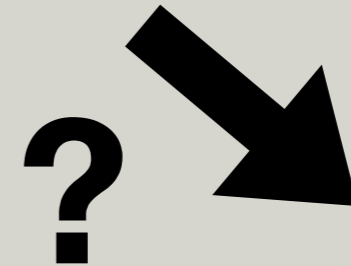
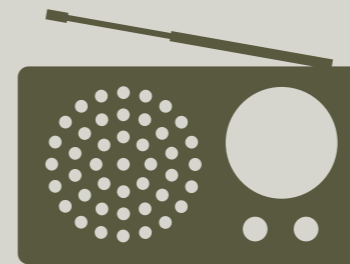
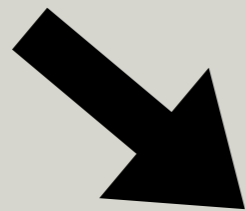
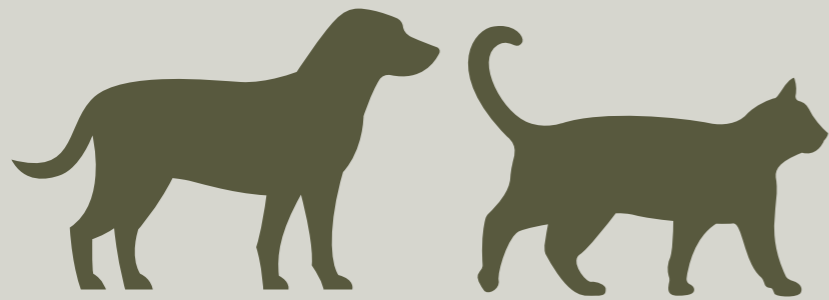
Related interest-based targeting more useful

Interest

vs. Unrelated Interest

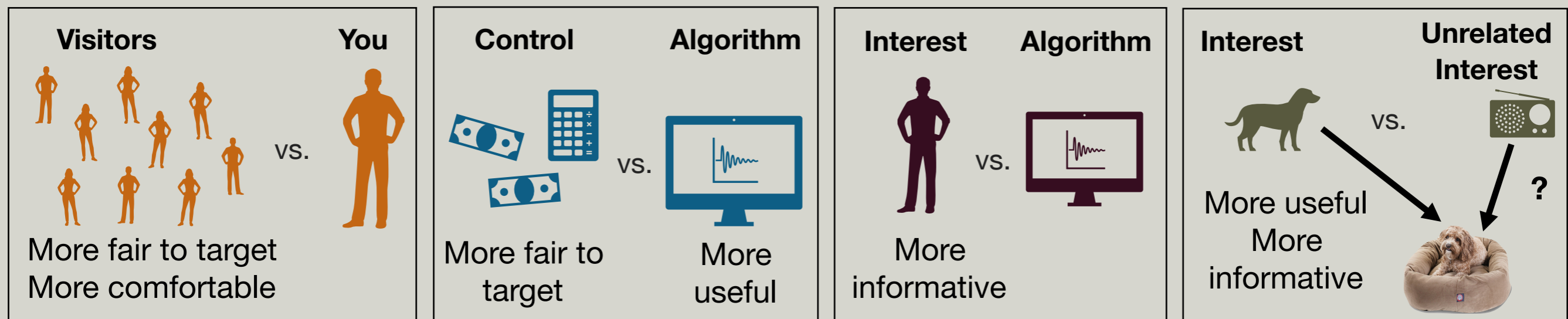
More Useful

More Informative



Summary: Privacy attitudes and targeting methods

Study 1



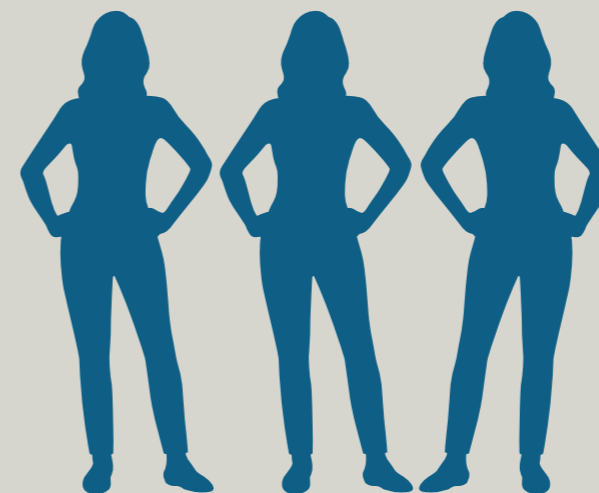
Next: How do particular inferences and the accuracy of these inferences impact privacy attitudes?

Advertisers can target ads based off of many interests

Interests & remarketing

Affinity audiences

- Music Lovers >>
- News Junkies >>
- Nightlife Enthusiasts >>
- Outdoor Enthusiasts >>
- Pet Lovers >>



Market leaders provide thousands of interests for advertisers to target

Arts & Entertainment

Arts & Entertainment>Celebrities & Entertainment News

Arts & Entertainment>Comics & Animation

Arts & Entertainment>Comics & Animation>Anime & Manga

Arts & Entertainment>Comics & Animation>Cartoons

Arts & Entertainment>Comics & Animation>Comics

Arts & Entertainment>Entertainment Industry

Arts & Entertainment>Entertainment Industry>Film & TV Industry

Arts & Entertainment>Entertainment Industry>Film & TV Industry>Film & TV Awards

Arts & Entertainment>Entertainment Industry>Film & TV Industry>Film & TV Production

Arts & Entertainment>Entertainment Industry>Recording Industry

Arts & Entertainment>Entertainment Industry>Recording Industry>Music Awards

Arts & Entertainment>Entertainment Industry>Recording Industry>Record Labels

Arts & Entertainment>Events & Listings

Arts & Entertainment>Events & Listings>Clubs & Nightlife

Arts & Entertainment>Events & Listings>Concerts & Music Festivals

Arts & Entertainment>Events & Listings>Film Festivals

Arts & Entertainment>Events & Listings>Live Sporting Events

Arts & Entertainment>Events & Listings>Movie Listings & Theater Showtimes

Arts & Entertainment>Events & Listings>Ticket Sales

Arts & Entertainment>Fun & Trivia

Arts & Entertainment>Fun & Trivia>Flash-Based Entertainment

Arts & Entertainment>Fun & Trivia>Fun Tests & Silly Surveys

Arts & Entertainment>Humor

Arts & Entertainment>Humor>Live Comedy

Arts & Entertainment>Humor>Political Humor

Arts & Entertainment>Humor>Spoofs & Satire

Arts & Entertainment>Movies

Arts & Entertainment>Movies>Action & Adventure Film

Market leaders provide thousands of interests for advertisers to target

Autos & Vehicles>Vehicle Brands>Mazda
Autos & Vehicles>Vehicle Brands>Mercedes-Benz
Autos & Vehicles>Vehicle Brands>Mercury
Autos & Vehicles>Vehicle Brands>Mini
Autos & Vehicles>Vehicle Brands>Mitsubishi
Autos & Vehicles>Vehicle Brands>Nissan
Autos & Vehicles>Vehicle Brands>Nissan>Infiniti
Autos & Vehicles>Vehicle Brands>Peugeot
Autos & Vehicles>Vehicle Brands>Pontiac
Autos & Vehicles>Vehicle Brands>Porsche
Autos & Vehicles>Vehicle Brands>Renault-Samsung
Autos & Vehicles>Vehicle Brands>Rolls-Royce
Autos & Vehicles>Vehicle Brands>Saab
Autos & Vehicles>Vehicle Brands>Saturn
Autos & Vehicles>Vehicle Brands>Subaru
Autos & Vehicles>Vehicle Brands>Suzuki
Autos & Vehicles>Vehicle Brands>Toyota
Autos & Vehicles>Vehicle Brands>Toyota>Scion
Autos & Vehicles>Vehicle Brands>Vauxhall-Opel
Autos & Vehicles>Vehicle Brands>Volkswagen
Autos & Vehicles>Vehicle Brands>Volvo
Autos & Vehicles>Vehicle Licensing & Registration
Autos & Vehicles>Vehicle Maintenance
Autos & Vehicles>Vehicle Parts & Accessories
Autos & Vehicles>Vehicle Parts & Accessories>Auto Exterior
Autos & Vehicles>Vehicle Parts & Accessories>Auto Interior
Autos & Vehicles>Vehicle Parts & Accessories>Engine & Transmission
Autos & Vehicles>Vehicle Parts & Accessories>Vehicle Fuels & Lubricants
Autos & Vehicles>Vehicle Parts & Accessories>Vehicle Wheels & Tires

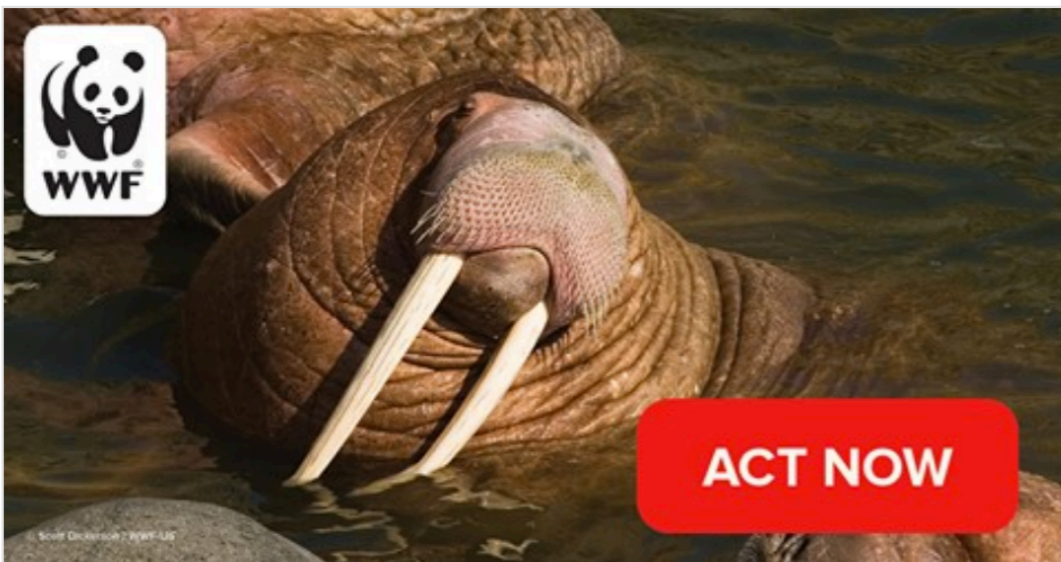
Targeting interests are sometimes revealed to users



Developers have proposed digging one of the world's largest pit mines in OUR Alaskan wilderness. Pebble Mine would:

- ✓ Devestate 3,000 acres of wetlands
- ✓ Destroy 21 miles of salmon streams
- ✓ Demolish 1,000 additional acres of wetlands...

[See More](#)



[Sign The Petition: Stop Pebble Mine](#)

Help us protect Alaskan fish and wildlife.

WORLDWILDLIFE.ORG/ACT

One reason you're seeing this ad is that **World Wildlife Fund** wants to reach people who like their page.

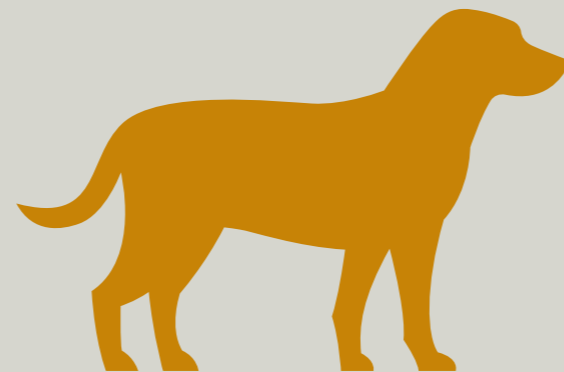
There may be other reasons you're seeing this ad, including that **World Wildlife Fund** wants to reach **people ages 18 and older who live in the United States**. This is information based on your Facebook profile and where you've connected to the internet.

Research Question

How do the **interests that are inferred** and the **accuracy of these inferences** impact privacy attitudes?

Survey Design

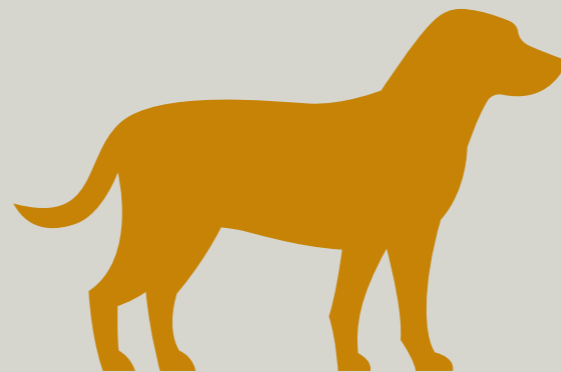
237 Mechanical Turk respondents



Survey Design

237 Mechanical Turk respondents

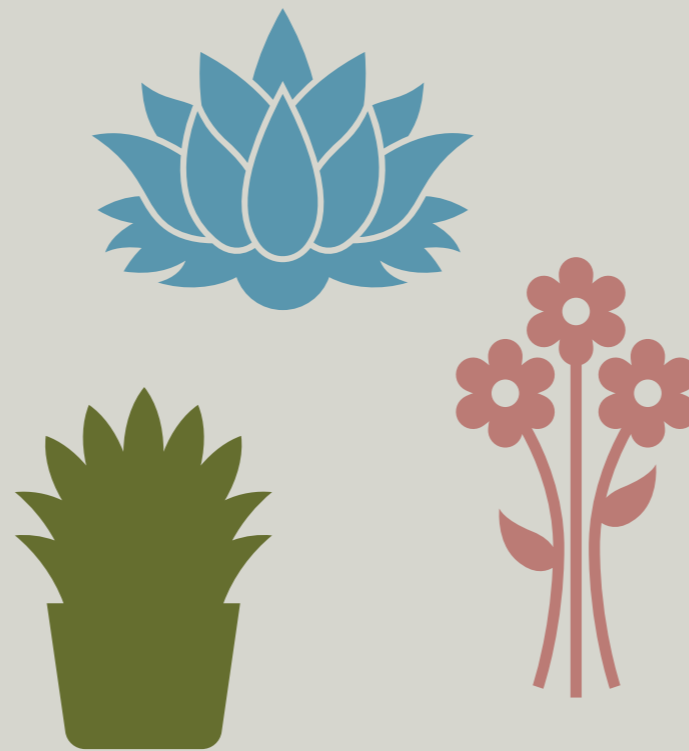
160 Google AdWords categories



Categories & Reaction Statements

Home & Garden

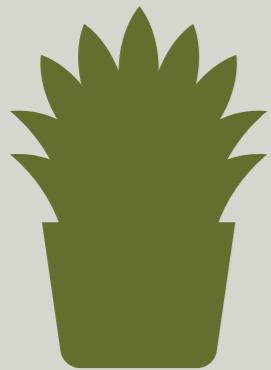
↳ Gardening & Landscaping



Categories & Reaction Statements

Home & Garden

↳ Gardening & Landscaping



accuracy of inference

comfortable with inference

usefulness of inference for
personalization

Interest in topic increases comfort

With increase in interest...

10x more likely to be **more comfortable**
with personalization

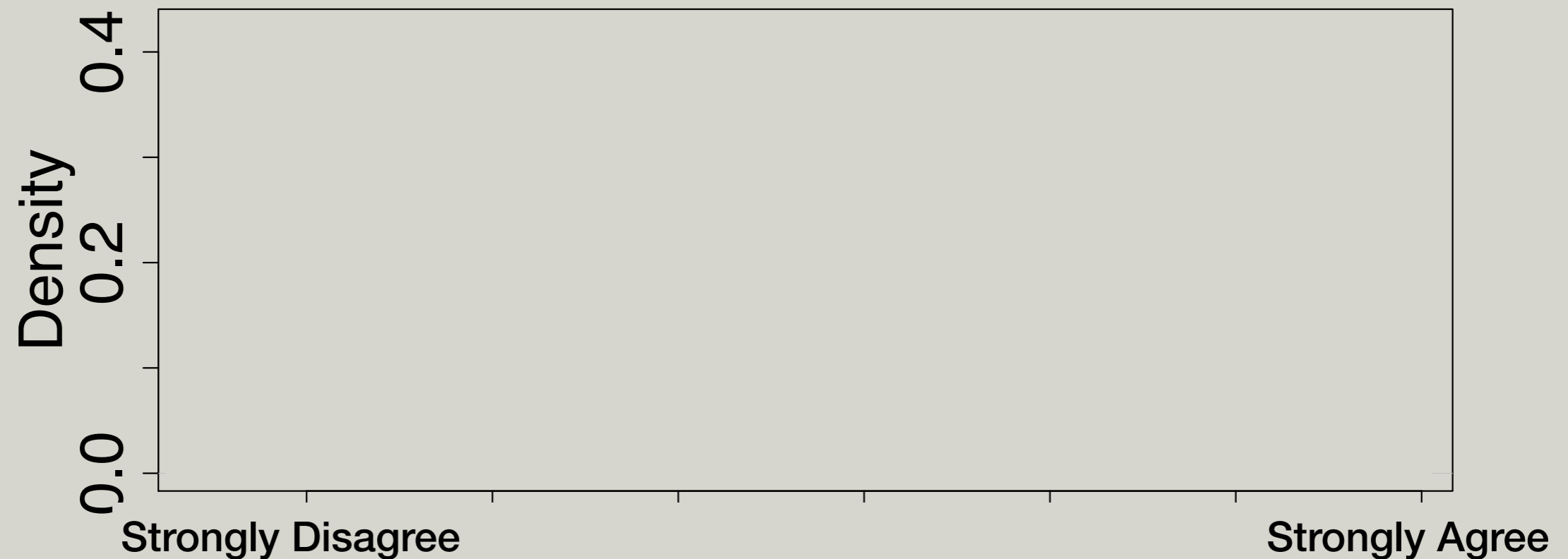
3x more likely to find personalization
more useful

Personalized advertising policy principles

Prohibited categories

- ✗ Personal hardships
- ✗ Alcohol
- ✗ Gambling
- ✗ Health
- ✗ Religious belief
- ✗ Sexual interests

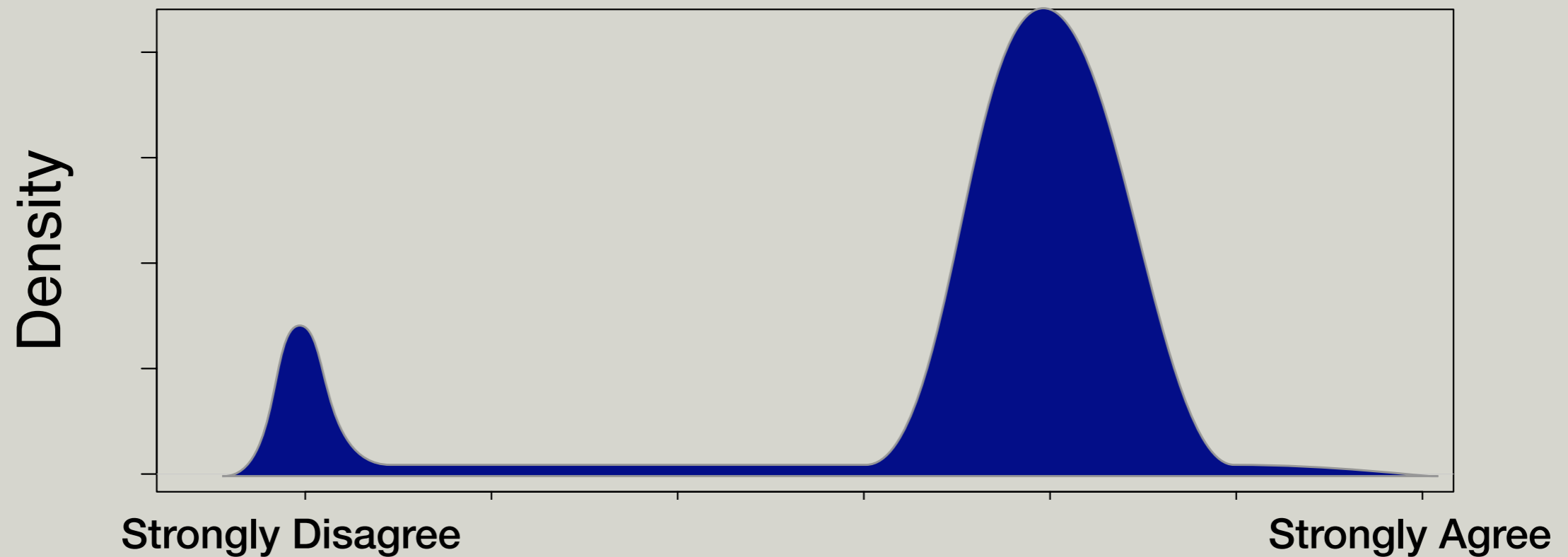
Distribution of comfort with personalization



I would be **comfortable with a company personalizing my web experience** based on an inference about my level of interest in *topic*.

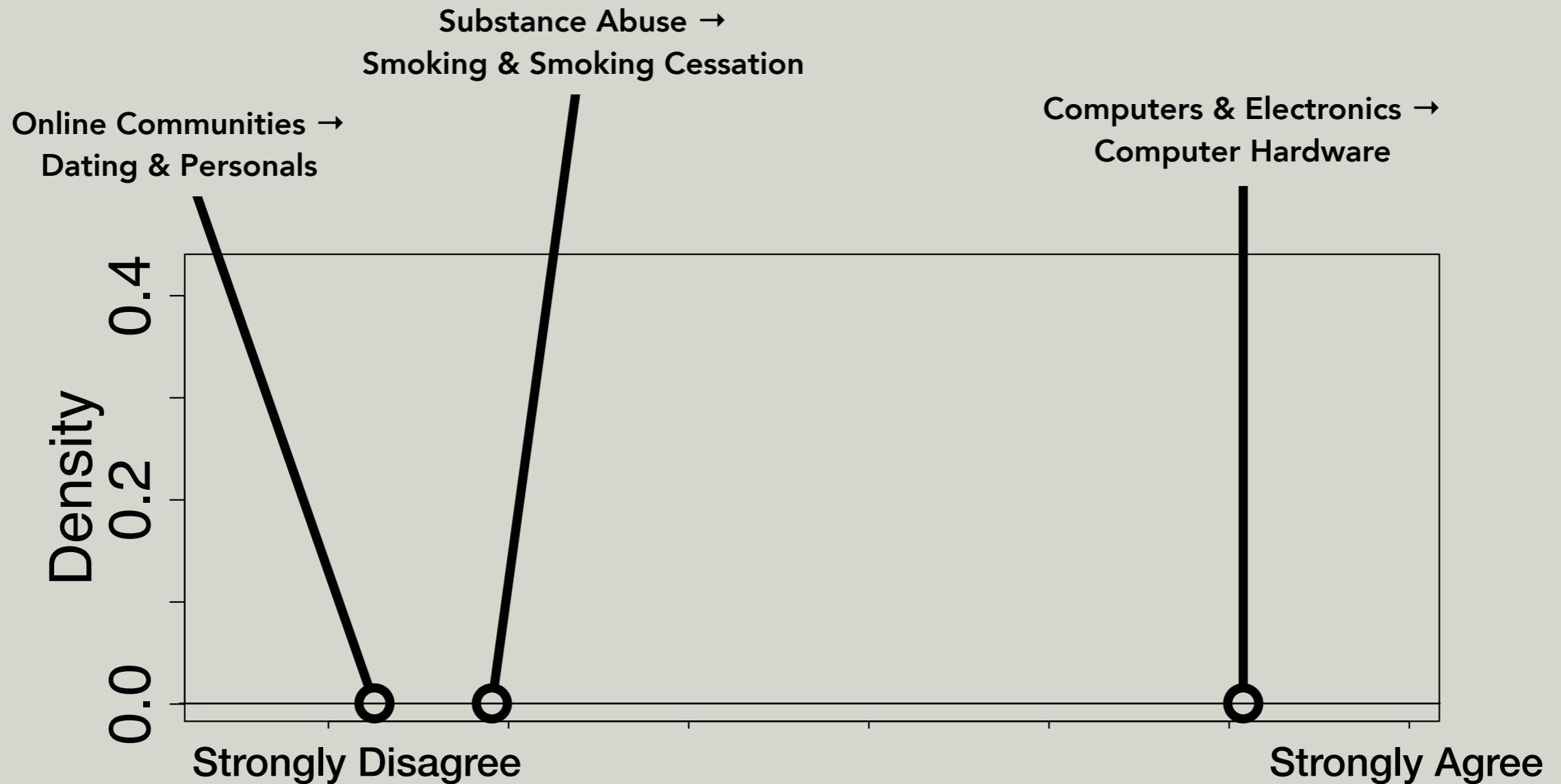
Practice suggests bimodal distribution

ANTICIPATED



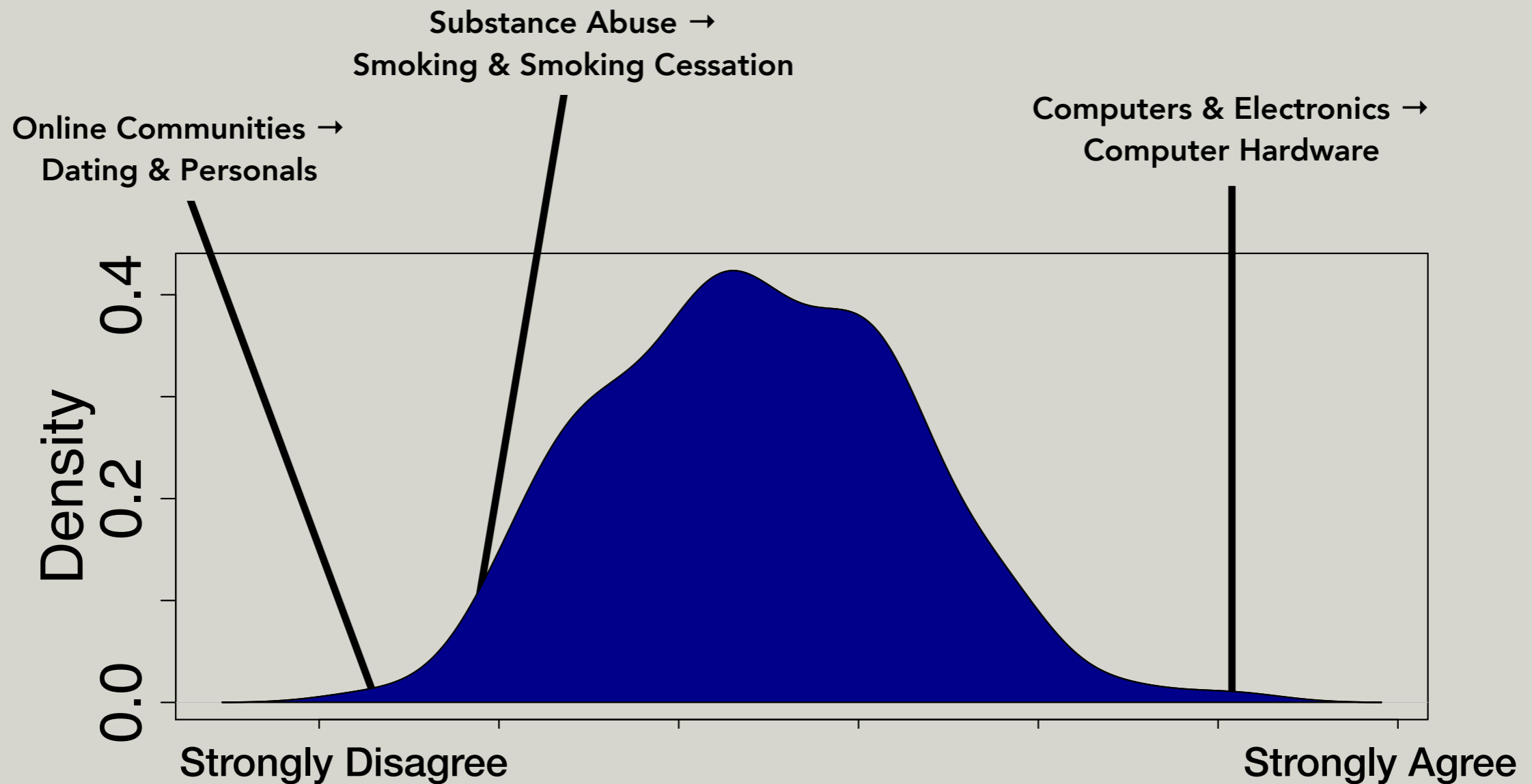
I would be **comfortable with a company personalizing my web experience** based on an inference about my level of interest in *topic*.

Some categories at extremes of comfort



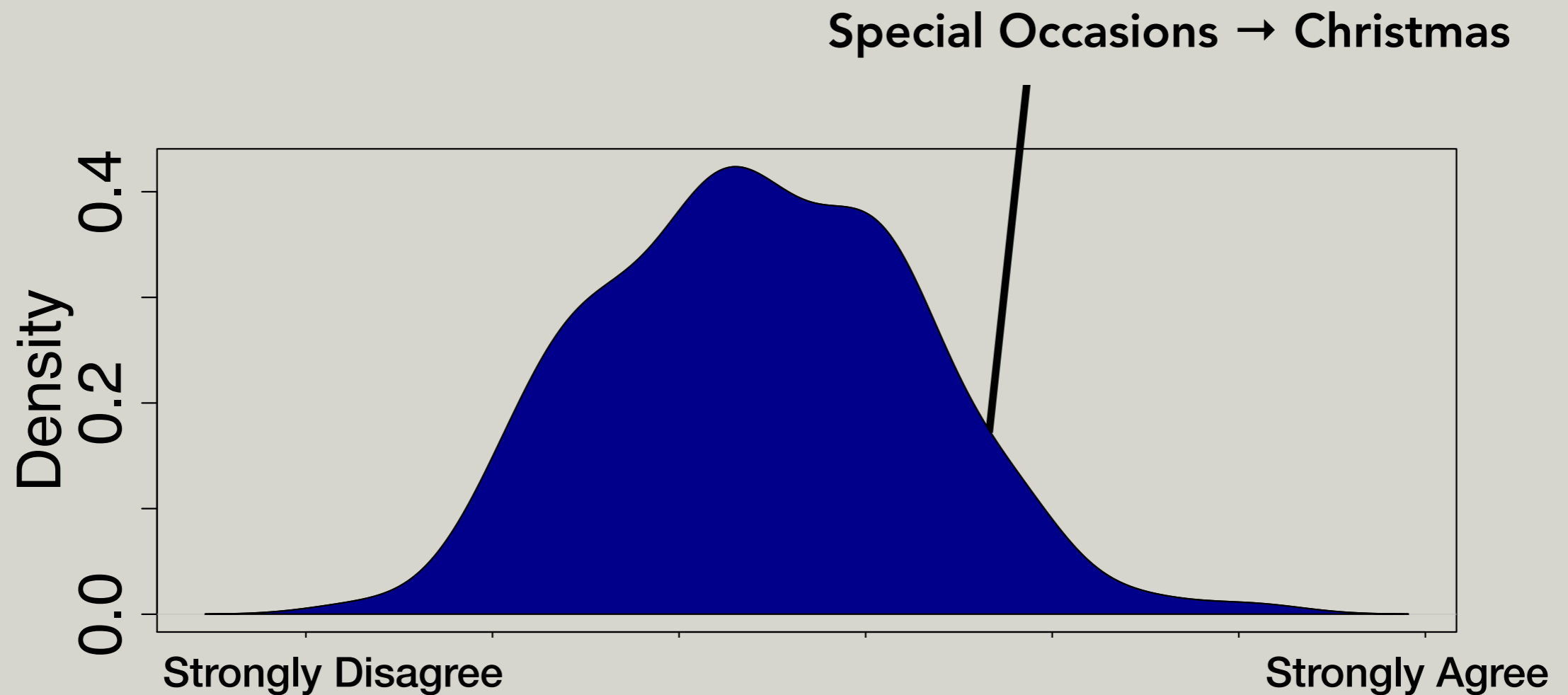
I would be **comfortable with a company personalizing my web experience** based on an inference about my level of interest in *topic*.

Broad spectrum of comfort across categories



I would be **comfortable with a company personalizing my web experience** based on an inference about my level of interest in *topic*.

Related categories can vary in sensitivity

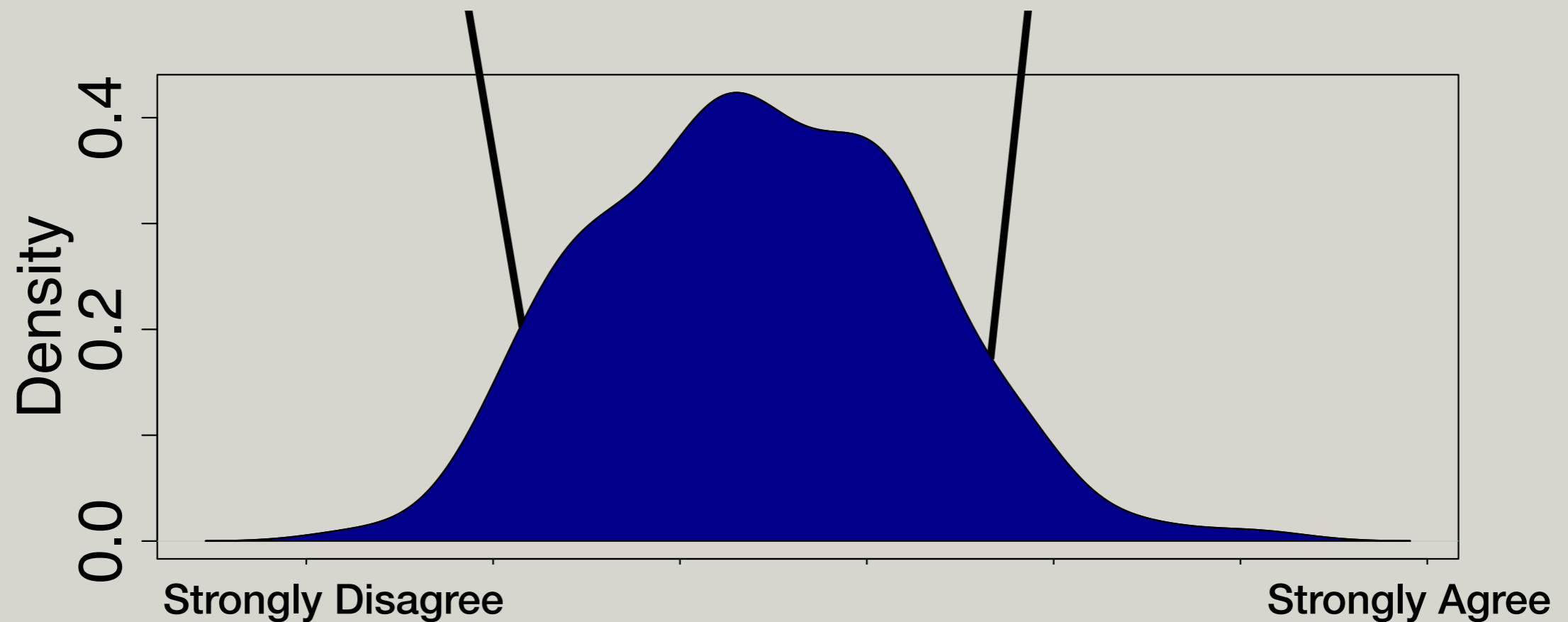


I would be **comfortable with a company personalizing my web experience** based on an inference about my level of interest in *topic*.

Related categories can vary in sensitivity

Religion & Belief → Christianity

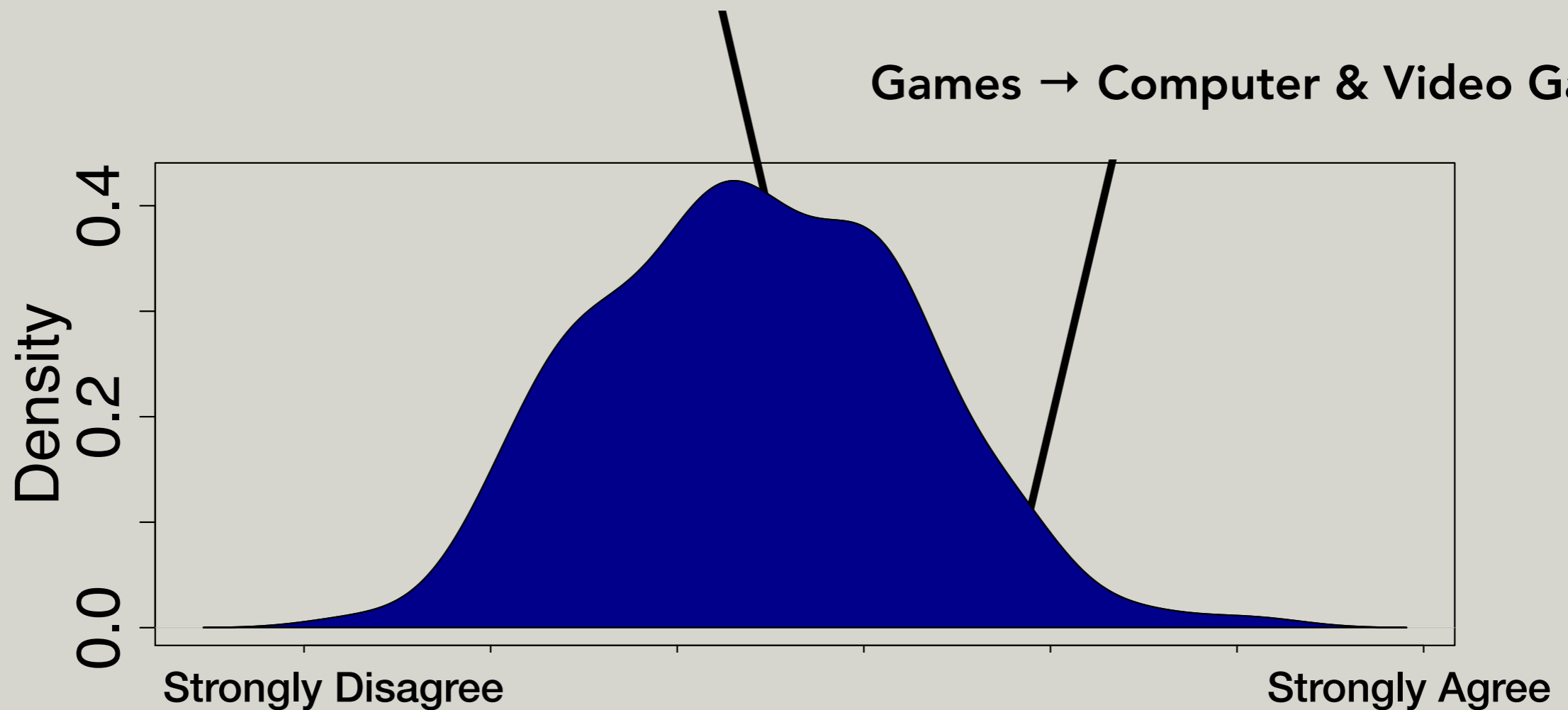
Special Occasions → Christmas



I would be **comfortable with a company personalizing my web experience** based on an inference about my level of interest in *topic*.

Related categories can vary in sensitivity

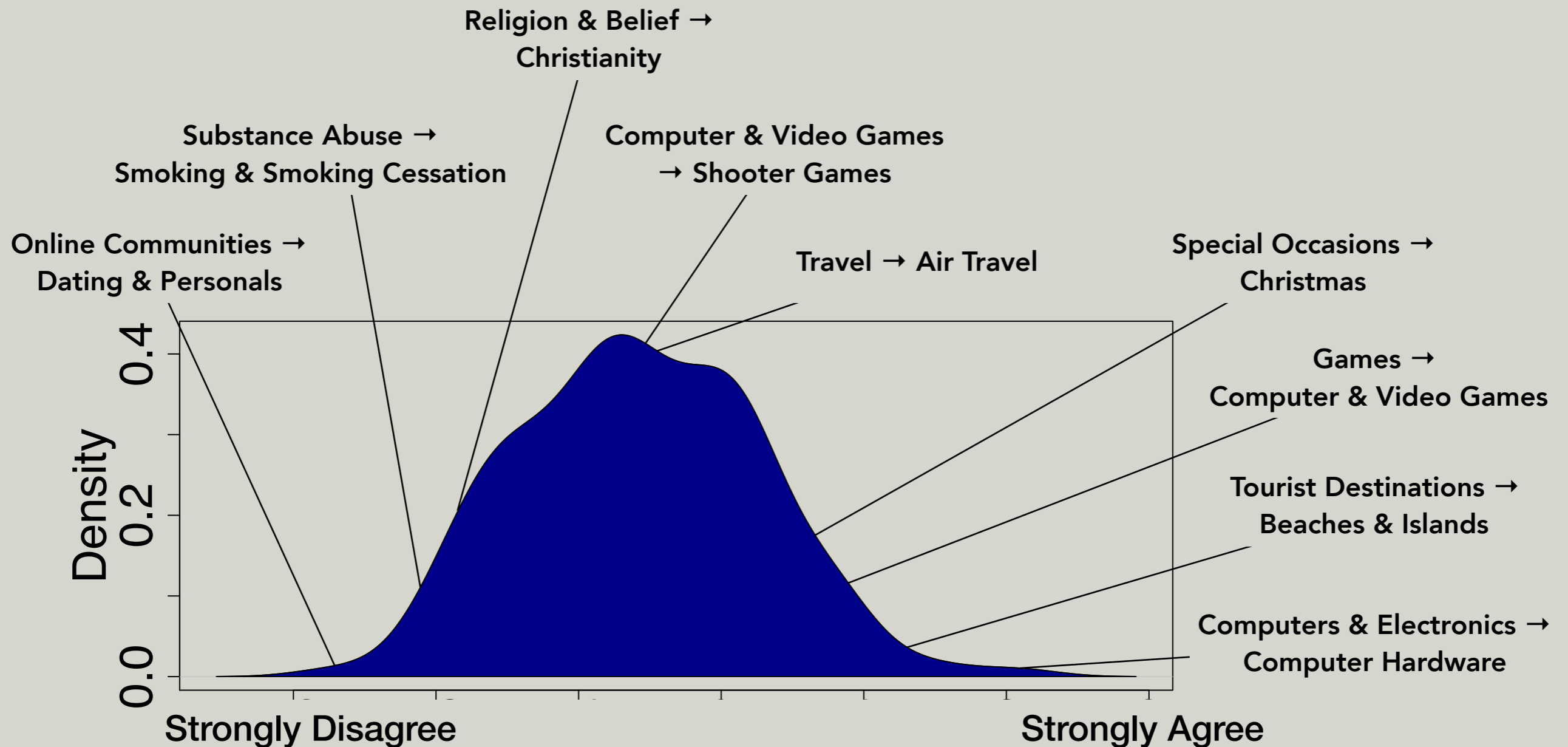
Computer & Video Games → Shooter Games



Games → Computer & Video Games

I would be **comfortable with a company personalizing my web experience** based on an inference about my level of interest in *topic*.

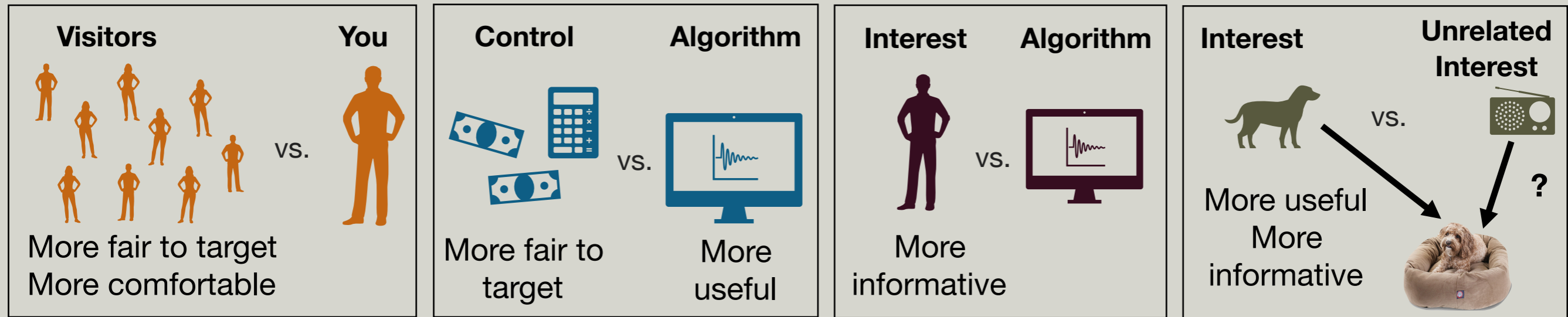
Broad spectrum of comfort across categories



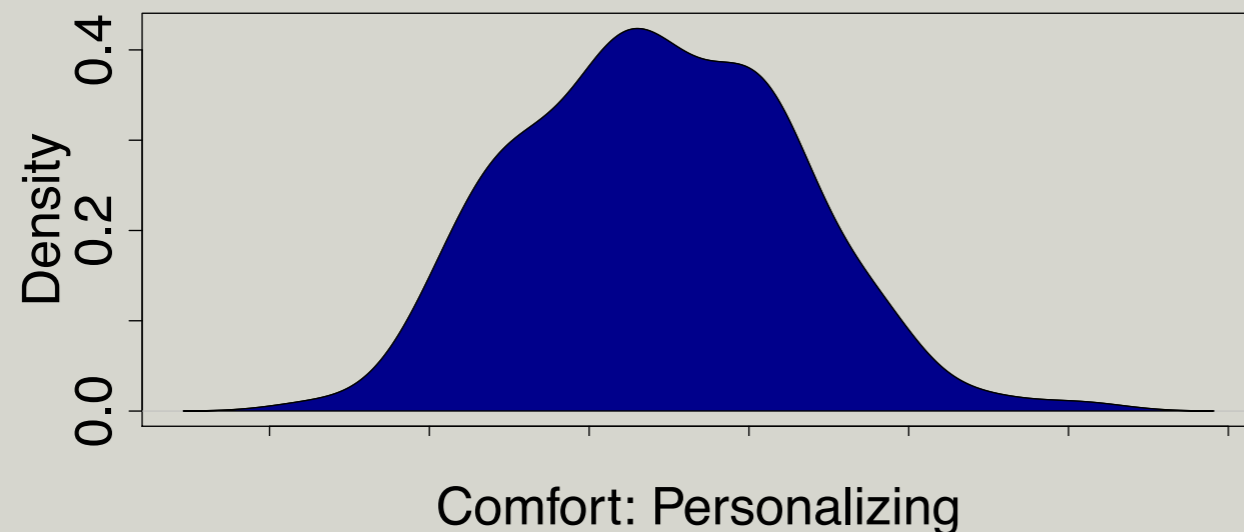
I would be **comfortable with a company personalizing my web experience** based on an inference about my level of interest in *topic*.

Results Summary

How does the method of targeting impact privacy attitudes?



How do particular inferences and their accuracy impact privacy attitudes?



Interest in topic →
Comfort with personalization
Perceived usefulness

Proposal: advertising network transparency

Your ad preferences

Learn what influences the ads you see and take control over your ad experience.



Your interests

Close ^

Business and industry

News and entertainment

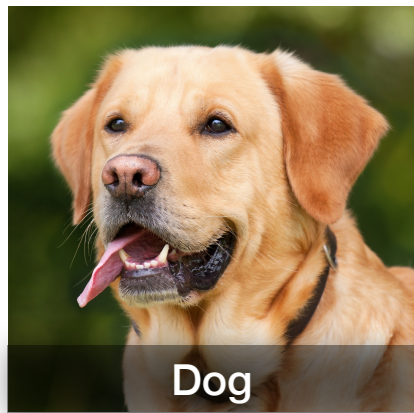
Technology

Travel, places and events

Hobbies and activities

More ▾

Choose an interest to preview examples of ads you might see on Facebook or remove it from your ad preferences.



Dog



Advertisers you've interacted with

Close ^

With your contact info

Whose website or app you've used

Whom you've visited

More ▾

Proposal: advertising network transparency

Your ad preferences

Learn what influences the ads you see and take control over your ad experience.



We inferred you are interested in **dogs** because you visited web pages related to this topic, including:

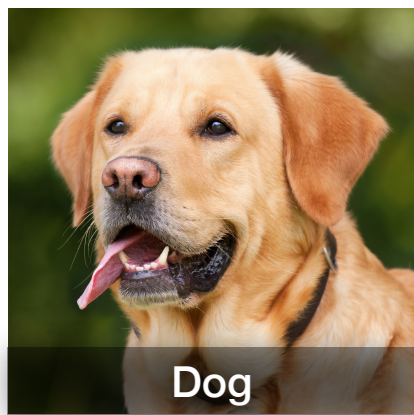
- “Here are the Most Dog-Friendly Restaurants in the United States” on Southern Living



Your interests

Business and industry

Choose an interest to preview



Dog

Close ^

nts Hobbies and activities More ▾

ad preferences.



Advertisers you've interacted with

With your contact info

Whose website or app you've used

Whom you've visited

More ▾

Close ^

Proposal: advertising network transparency



Developers have proposed digging one of the world's largest pit mines in OUR Alaskan wilderness. Pebble Mine would:

- ✓ Devestate 3,000 acres of wetlands
- ✓ Destroy 21 miles of salmon streams
- ✓ Demolish 1,000 additional acres of wetlands...

[See More](#)



[Sign The Petition: Stop Pebble Mine](#)

Help us protect Alaskan fish and wildlife.

WORLDWILDLIFE.ORG/ACT

You're seeing this ad because **World Wildlife Fund** chose to target this ad towards people who may be interested in **dogs**.

We inferred you are interested in **dogs** because you visited web pages related to this topic, including:

“Here are the Most Dog-Friendly Restaurants in the United States” on Southern Living

Proposal: ad targeting interface with sensitivity

The image shows a screenshot of an ad targeting interface. On the left, there is a search bar with the placeholder text "Search by word, phrase, or URL" and a magnifying glass icon. Below the search bar is a list of categories with checkboxes and expand/collapse arrows. The categories are: Online Communities (unchecked, expanded), Blogging Resources & Services (unchecked, collapsed), Dating & Personals (checked, expanded), Matrimonial Services (unchecked), Personals (unchecked), Photo Rating Sites (unchecked), Feed Aggregation & Social Bookmarking (unchecked), File Sharing & Hosting (unchecked), and Forum & Chat Providers (unchecked). On the right, there is a summary section showing "1 selected" and a "CLEAR ALL" button. Below this, the selected category "Dating & Personals" is listed with a red warning icon and a close button. A callout box with a red border points to the warning icon and contains the following text:

Users may be able to see that you are targeting to **dating and personals**.

We have found that users are **very uncomfortable** with this targeting, and recommend choosing a different category.

Recommendations: user-installed tools



Lightbeam for Firefox

DATA GATHERED SINCE NOV 27, 2014 YOU HAVE VISITED 1 SITE YOU HAVE CONNECTED WITH 100 THIRD PARTY SITES

Daily
GRAPH VIEW

TOGGLE CONTROLS

- Visited Sites
- Watched Sites
- Cookies
- Third Party Sites
- Blocked Sites
- Connections

FILTER

- Recent Site
- Last 10 Sites
- Daily
- Weekly

GHOSTERY

22 Trackers found on www.mynews.com

4 Blocked

Trust Site

Restrict Site

Pause Ghostery

Map these trackers

TRACKERS

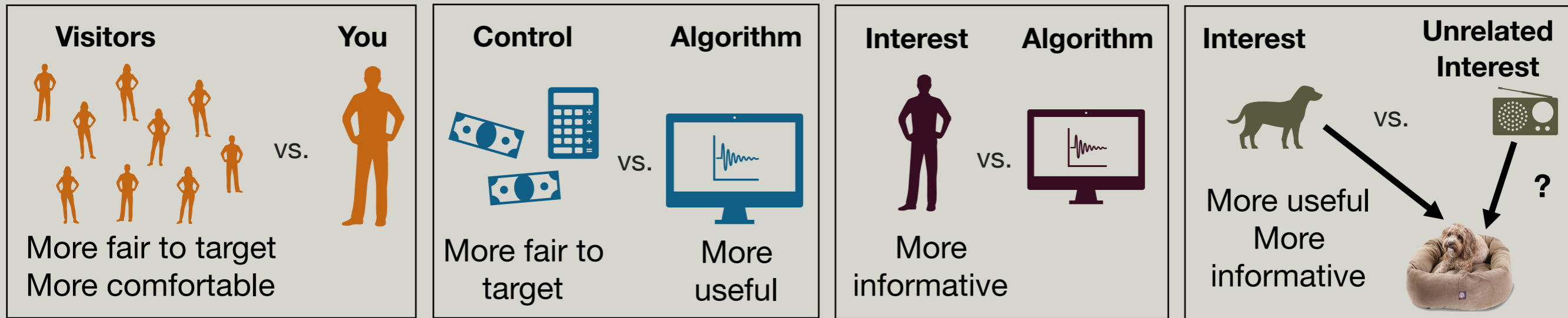
Block All

- Advertising (10 TRACKERS, 3 Blocked)
 - Advertising.com
 - DoubleClick
 - Google Adsense
 - Korrelate
 - Moat
 - NetRatings-Site-Center
 - Polar-Mobile
 - ScoreCard Research Beacon
 - Tacoda

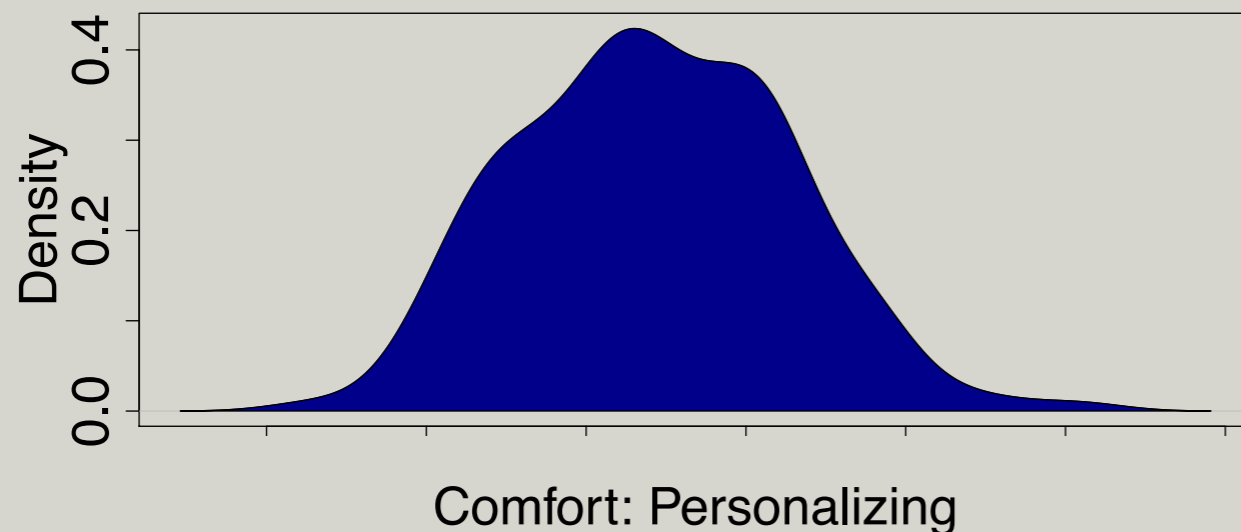
Unpacking Perceptions of Data-Driven Inferences Underlying Online Targeting and Personalization

Claire Dolin, Ben Weinshel, Shawn Shan, Chang Min Hahn, Euirim Choi, Michelle L. Mazurek, Blase Ur

How does the method of targeting impact privacy attitudes?



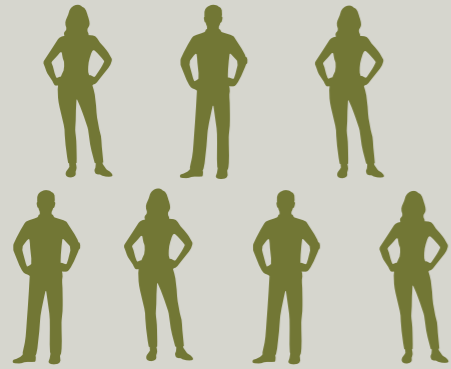
How do particular inferences and their accuracy impact privacy attitudes?



Interest in topic →
Comfort with personalization
Perceived usefulness

Extra Slides

Methodology: Ad Targeting Explanations



You are seeing this ad because the advertiser has inferred from general data that

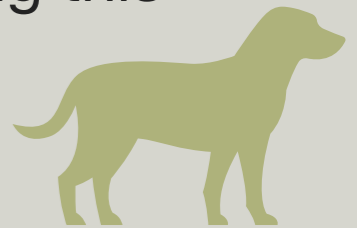
*visitors to this site... **(Visitors)**
you... **(You)***



...are likely a man ages 18-24 and thinks men ages 18-24 are likely to be interested in buying this product. **(Demographic)**



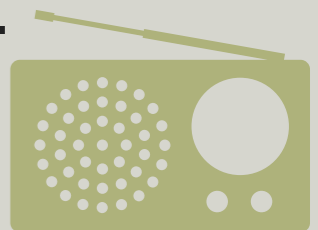
...are likely interested in dogs and thinks people interested in dogs are likely to be interested in buying this product. **(Interest)**



...are likely women ages 65-70 and thinks women ages 65-70 are likely to be interested in buying this product. **(Wrong Demographic)**

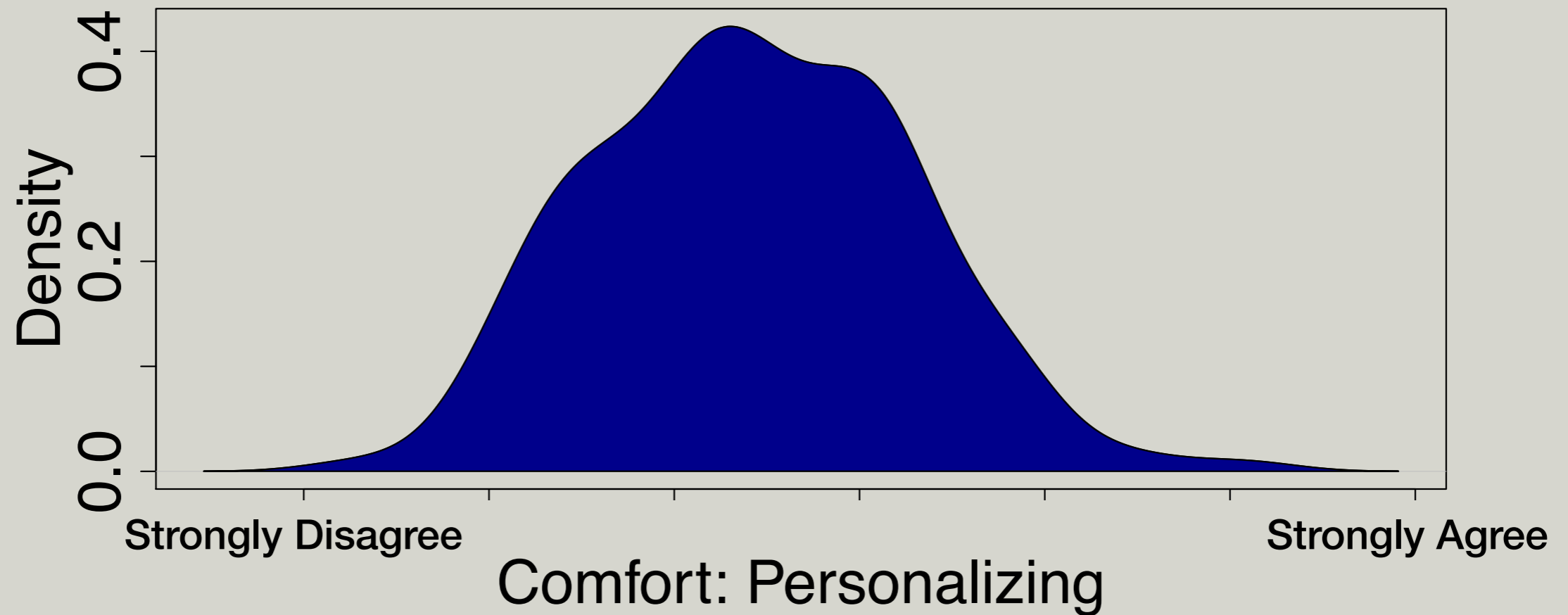


...are likely interested in Music Equipment & Technology and thinks people interested in Music Equipment & Technology are likely to be interested in buying this product. **(Unrelated Interest)**



Results

We would expect some categories to be clearly sensitive or non-sensitive...



Study 2: Inference Category Sensitivity

Methodology: Inference Categories

Arts & Entertainment>Celebrities & Entertainment News
Arts & Entertainment>Comics & Animation
Events & Listings>Clubs & Nightlife
Events & Listings>Live Sporting Events
Movies>Action & Adventure Films
Movies>Documentary Films
Movies>Romance Films
Music & Audio>Podcasting
Music & Audio>Christian & Gospel Music
Music & Audio>Rap & Hip-Hop
Performing Arts>Broadway & Musical Theater
TV & Video>TV Comedies
TV & Video>TV Soap Operas
Autos & Vehicles>Bicycles & Accessories
Autos & Vehicles>Hybrid & Alternative Vehicles
Autos & Vehicles>Motorcycles
Vehicle Parts & Accessories>Engine & Transmission
Autos & Vehicles>Vehicle Shopping
Cosmetic Procedures>Cosmetic Surgery
Face & Body Care>Make-Up & Cosmetics
Face & Body Care>Unwanted Body & Facial Hair Removal
Fitness>Bodybuilding
Hair Care>Hair Loss
...