

Dark Patterns at Scale

Findings from a Crawl of 11K Shopping Websites

Arunesh Mathur

Joint work with: Gunes Acar,
Michael Friedman, Elena Lucherini,
Jonathan Mayer, Marshini Chetty,
Arvind Narayanan

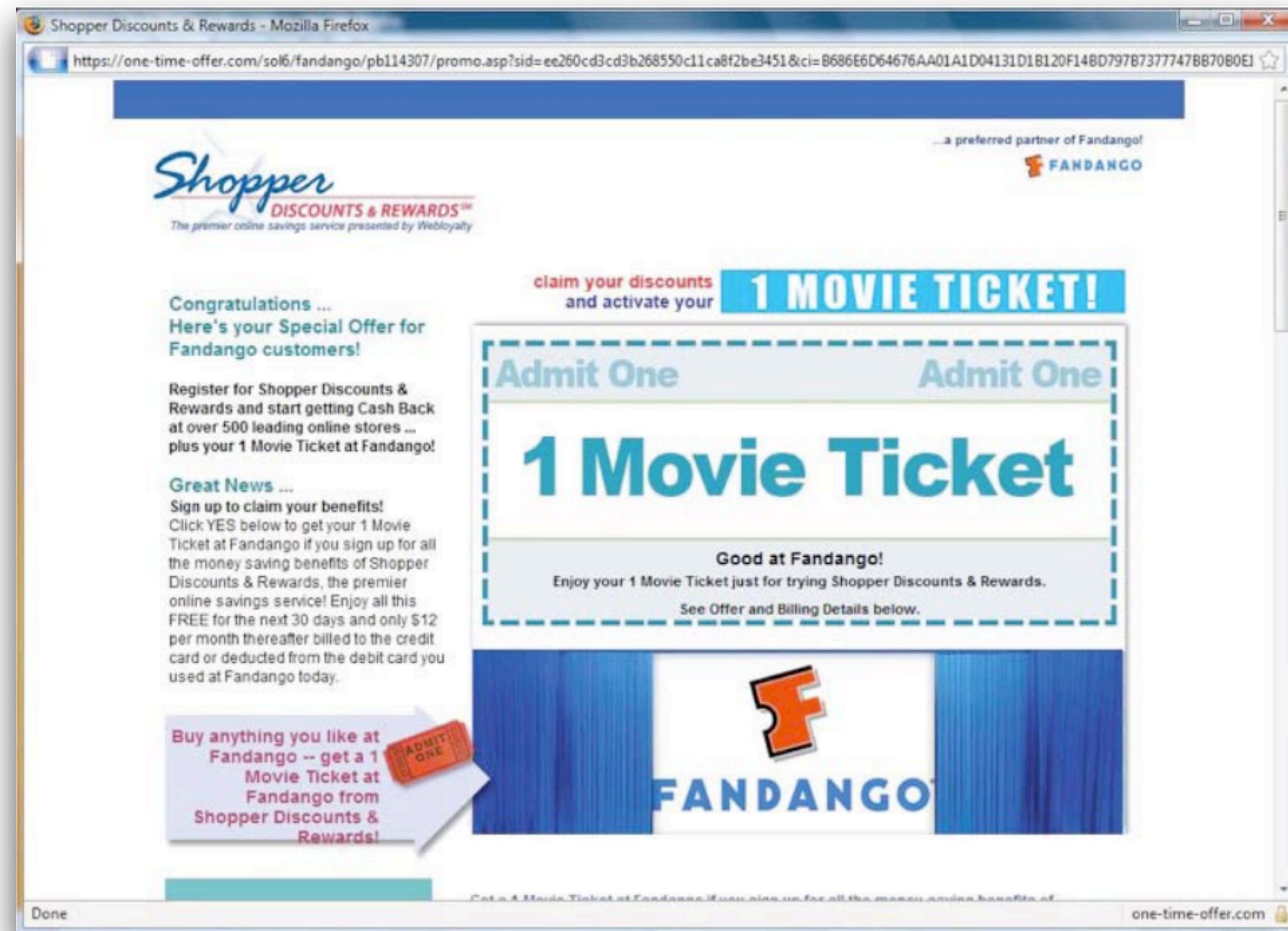


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POLICY
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Affinion Group Settlement (2010)



Affinion Group Settlement (2010)

The screenshot shows a Mozilla Firefox browser window with the title "Shopper Discounts & Rewards - Mozilla Firefox". The URL in the address bar is <https://one-time-offer.com/sol6/fandango/pb114307/promo.asp?sid=ee260cd3cd3b268550c11ca8f2be3451&ci=B686E6D64676AA01A1D04131D1B120F148D797B7377747887080EJ>. The page content is as follows:

Shopper DISCOUNTS & REWARDS™
The premier online savings service presented by Webloyalty

a preferred partner of Fandango
FANDANGO

Congratulations ...
Here's your Special Offer for Fandango customers!

Register for Shopper Discounts & Rewards and start getting Cash Back at over 500 leading online stores ... plus your 1 Movie Ticket at Fandango!

Great News ...
Sign up to claim your benefits! Click YES below to get your 1 Movie Ticket at Fandango if you sign up for all the money saving benefits of Shopper Discounts & Rewards, the premier online savings service! Enjoy all this FREE for the next 30 days and only \$12 per month thereafter billed to the credit card or deducted from the debit card you used at Fandango today.

claim your discounts and activate your **1 MOVIE TICKET!**

Admit One **Admit One**

1 Movie Ticket

Good at Fandango!
Enjoy your 1 Movie Ticket just for trying Shopper Discounts & Rewards.
See Offer and Billing Details below.

Buy anything you like at Fandango -- get a 1 Movie Ticket at Fandango from Shopper Discounts & Rewards!

Done

One Movie Ticket at Fandango if you sign up for all the money saving benefits of Shopper Discounts & Rewards

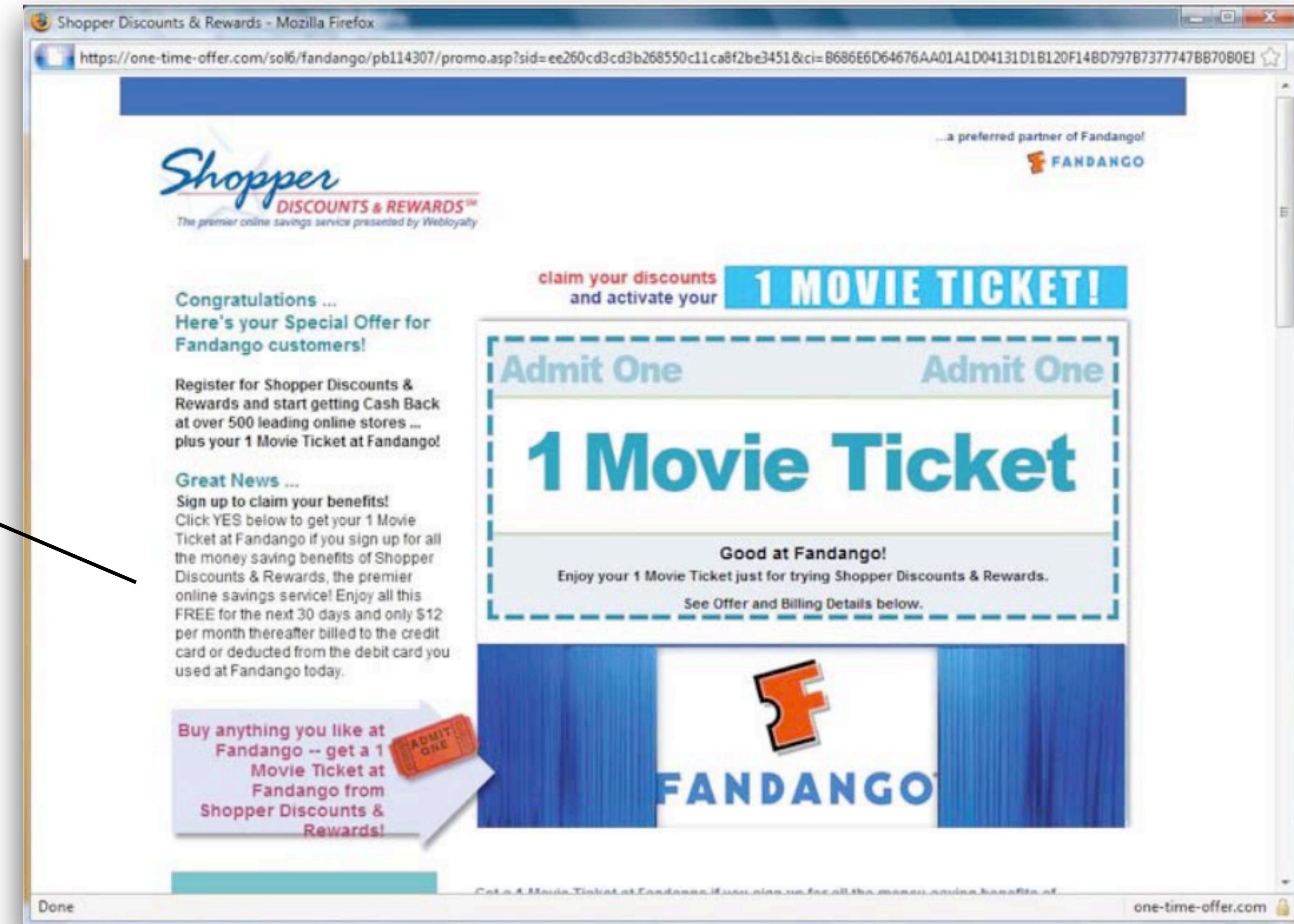
one-time-offer.com

Enjoy all this FREE
for the next 30 days
and only \$12 per
month thereafter...

Affinion Group Settlement (2010)

Enjoy all this FREE
for the next 30 days
and only \$12 per
month thereafter...

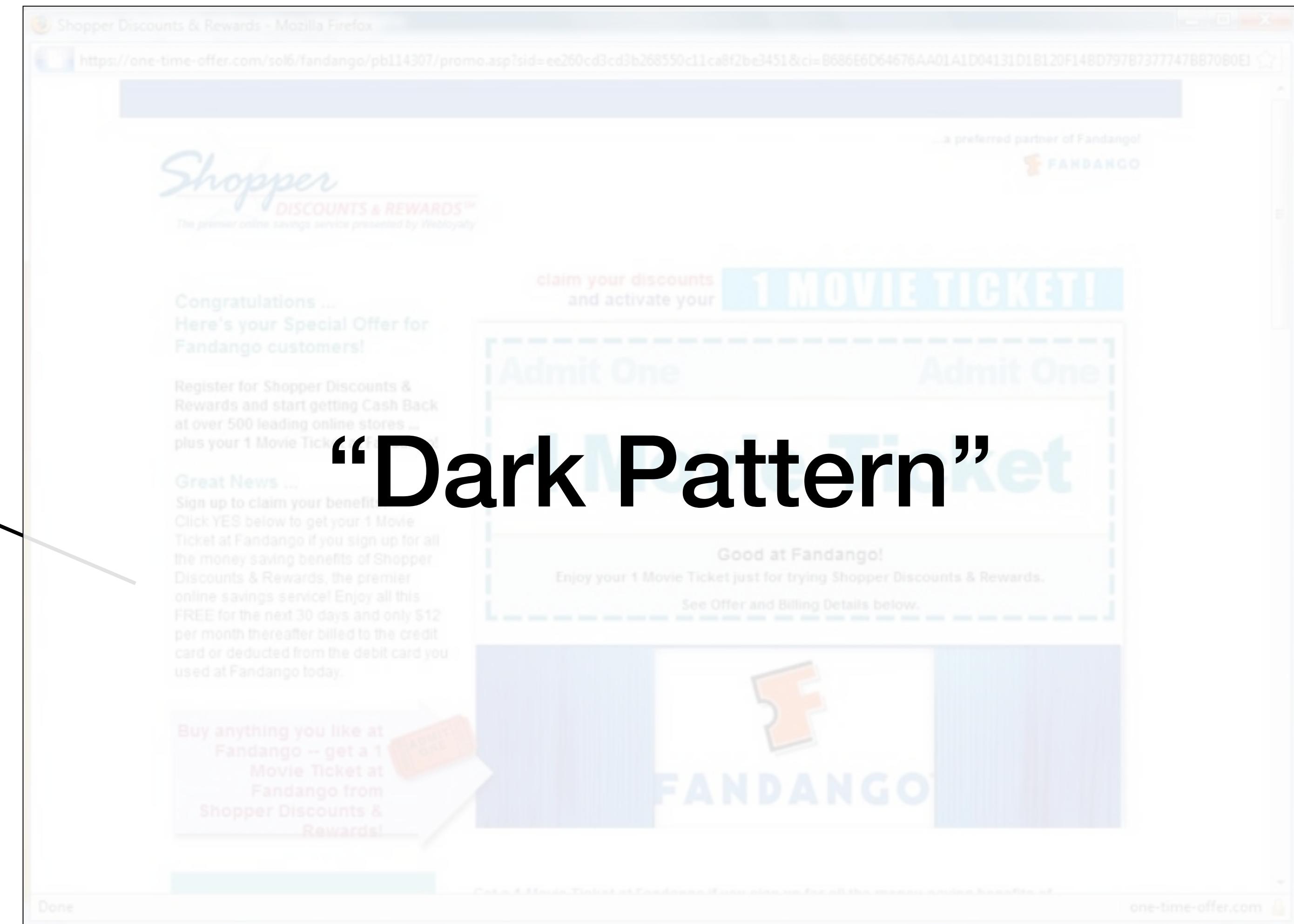
\$8 million settlement
with the New York
State Attorney General



Affinion Group Settlement (2010)

**Enjoy all this FREE
for the next 30 days
and only \$12 per
month thereafter...**

**\$8 million settlement
with the New York
State Attorney General**



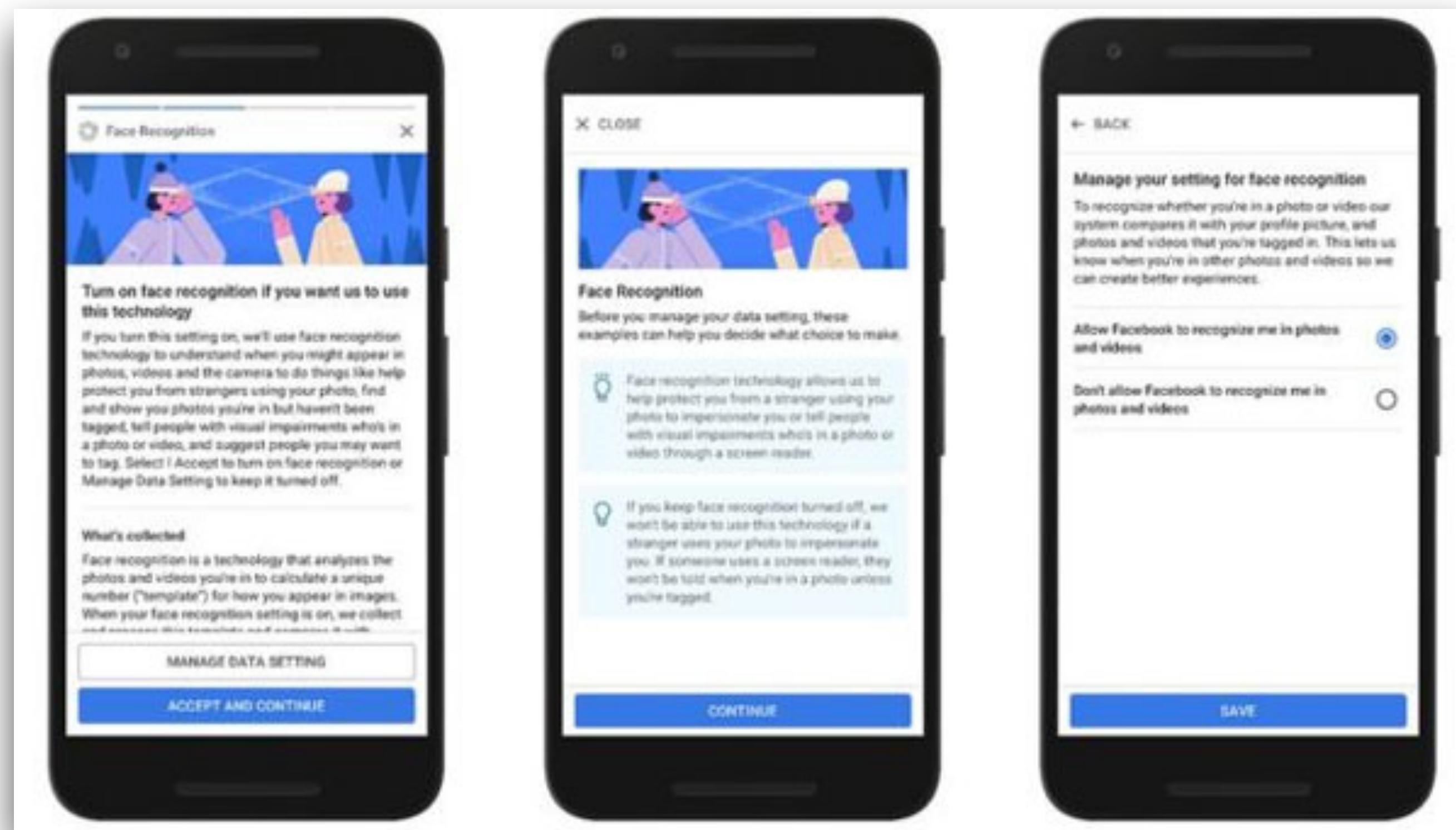
“**Dark patterns** are user interface design choices that benefit an online service by coercing, steering, or deceiving users into making decisions that — if fully informed and capable of selecting alternatives — they might not make.”

Instagram Ad

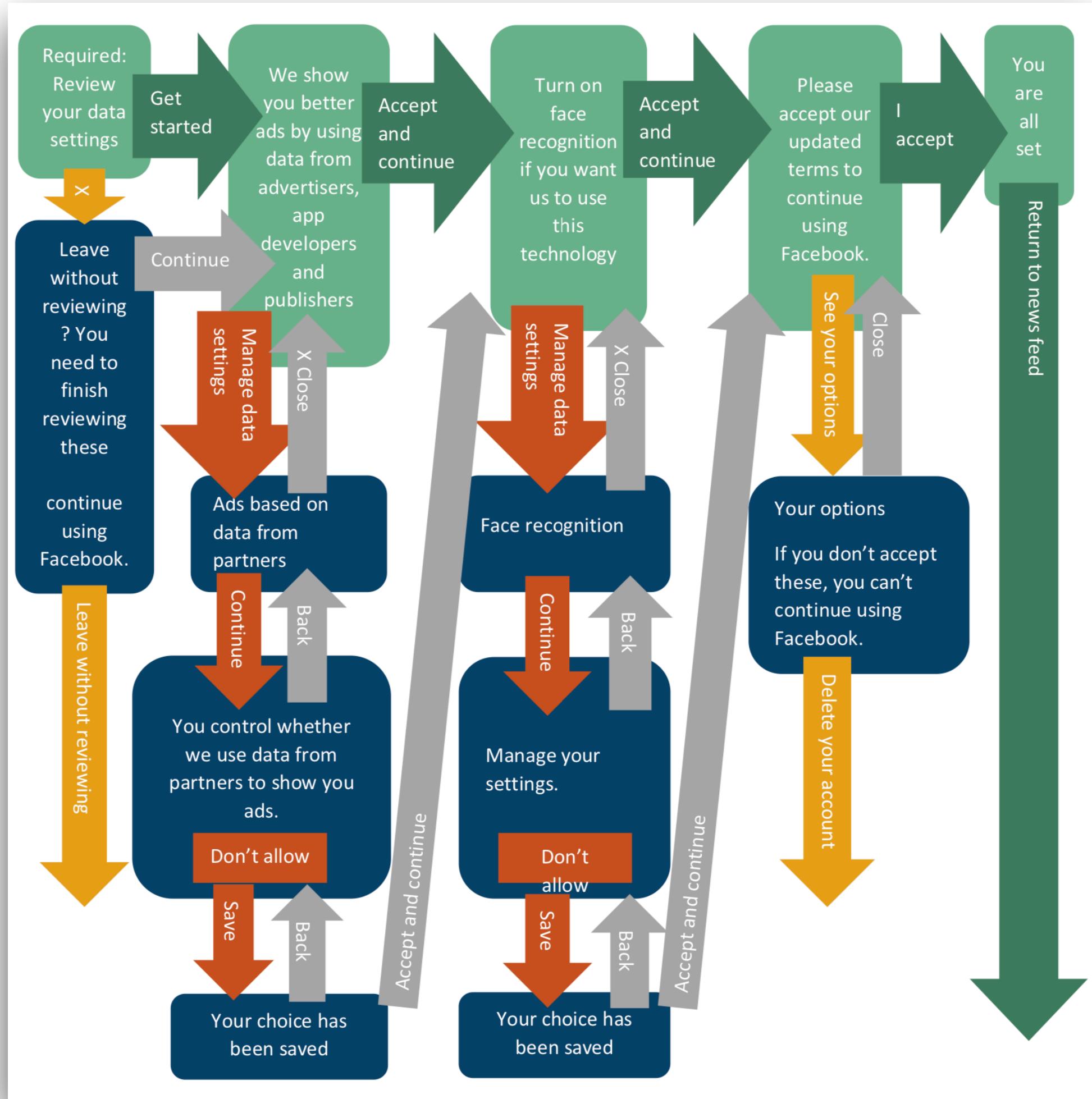


Not a real
strand of hair

Facebook Consent



Facebook Consent



3 clicks to provide consent
14 clicks to revoke consent

How can we identify and measure dark patterns on the web at scale?

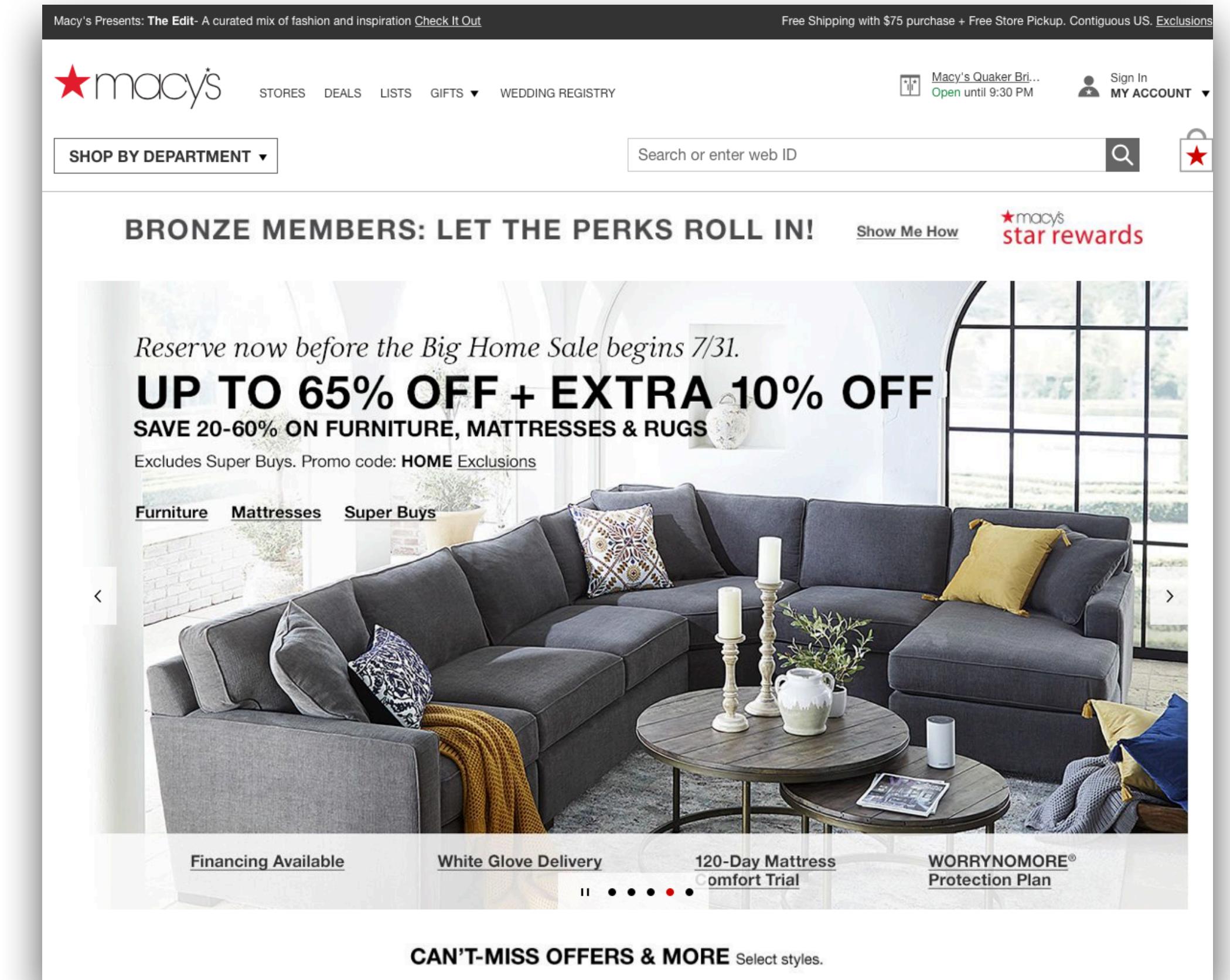


Why Measurement?

1. Document a wide variety of dark patterns
2. Measurement can be the basis of building defenses
3. Companies respond to public pressure; precedents include privacy & security measurement studies

Our study: Shopping Websites

1. Several anecdotes of dark patterns
2. Analyzed a corpus of 11K of the most popular shopping websites worldwide



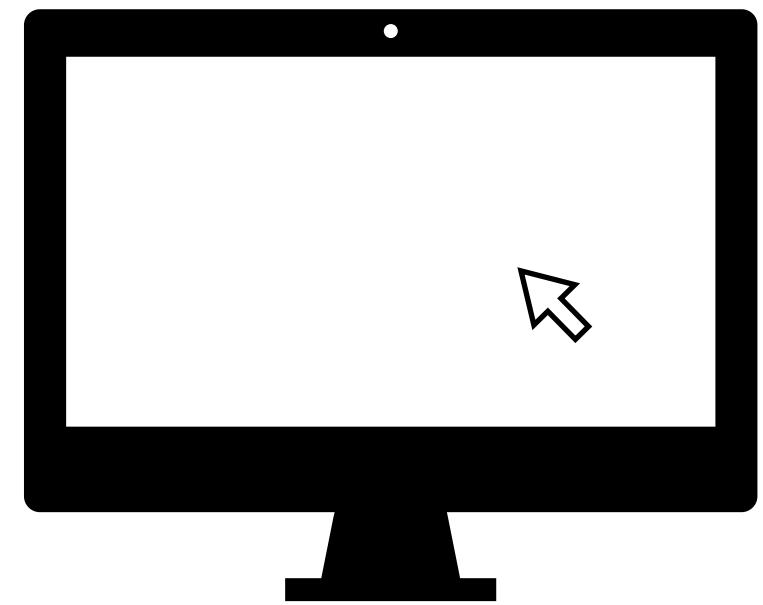
Contributions

1. Developed automated techniques to help experts identify dark patterns on the web at scale
2. Created a data set of 1,818 dark patterns on 1,254 shopping websites (~11.1%)
3. Documented the third-party entities that enable dark patterns on websites
4. Created a descriptive taxonomy that characterizes how dark patterns work

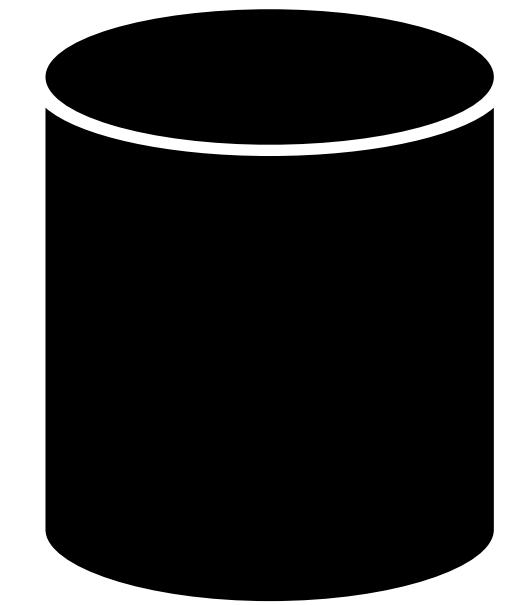
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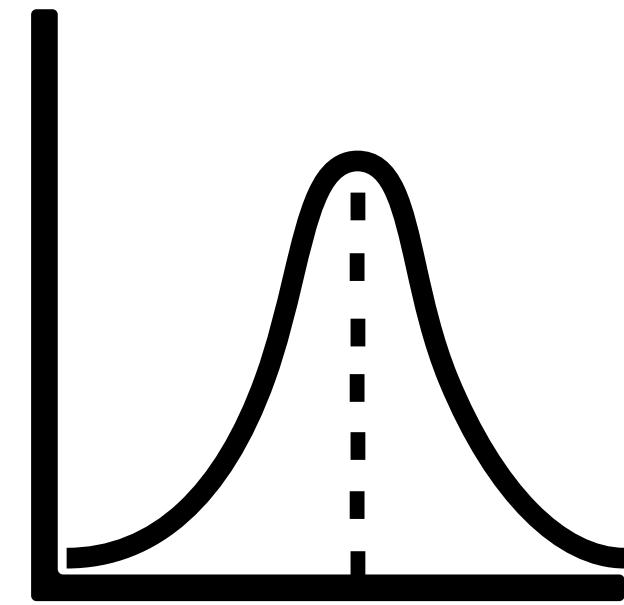
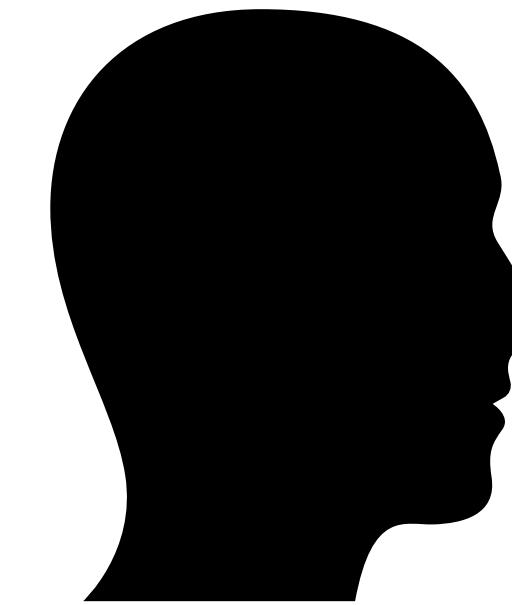
Method: Three Key Steps



Mimicking a real user
browsing websites

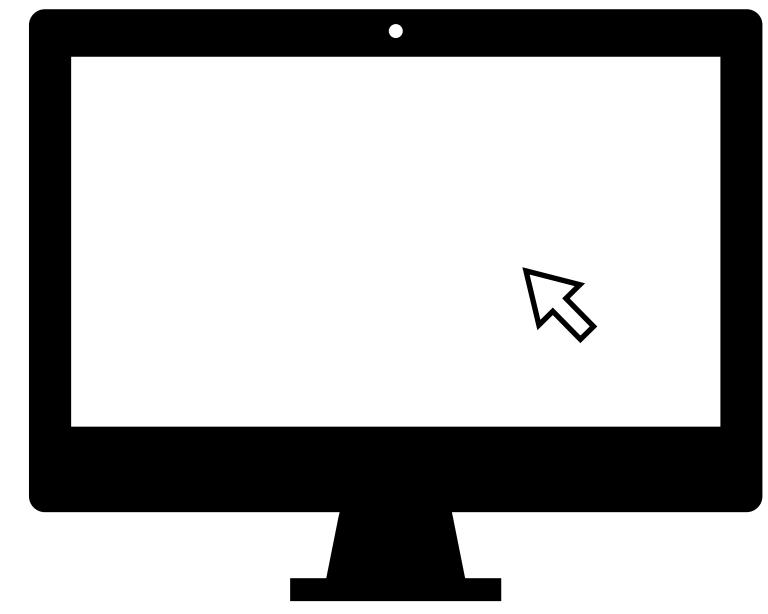


Collecting and storing
data from websites

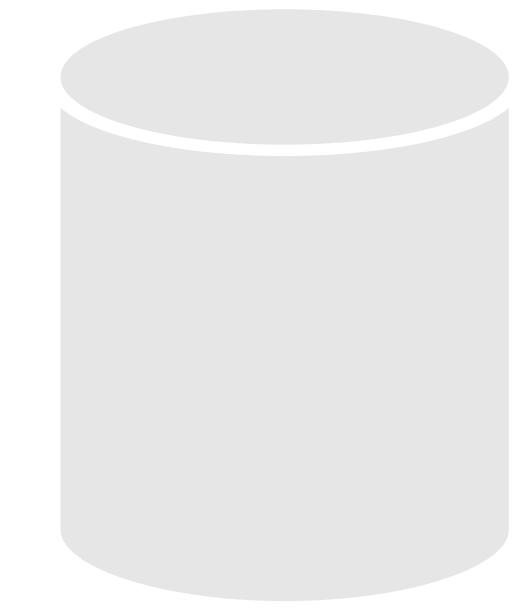


Analyzing collected
data

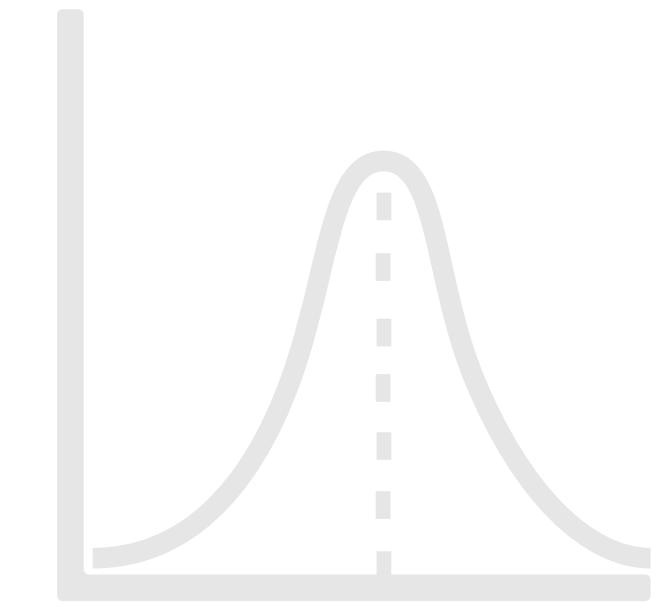
Method: Three Key Steps



Mimicking a real user
browsing websites



Collecting and storing
data from websites



Analyzing collected
data

Shopping Bot

American Rag Jamie T-Strap Platform Dress Sandals, Created for Macy's

105 Reviews

Limited-Time Special

\$59.50

Sale \$29.75 (50% off) Sale ends 7/30/19

Color: Tan

Find Your True Fit

Size: Please select | Size Chart

Qty: 1

ADD TO BAG

ADD TO LIST

Availability

Select a size above in order to view availability.

Product Details

American Rag's Jamie dress sandals take your style up a notch with a platform heel and T-strap design for a look that wows!

• 4-1/2" block heel 1-1/4" platform

customers also shopped

G by GUESS Shelli Sandals \$59.00 ★★★★ (2)

Jessica Simpson Jakayla We... Orig. \$79.00 Now \$36.13 ★★★★★ (1)

Call It Spring Acavie... Wed... Reg. \$50.00 Sale \$25.00

Shopping Bot

American Rag Jamie T-Strap Platform Dress Sandals, Created for Macy's

105 Reviews 2 Questions & 6 Answers

Limited-Time Special

\$59.50 Sale \$29.75 (50% off) Sale ends 7/30/19

Color: Red

Find Your True Fit

Size: Please select | Size Chart

5M 5.5M 6M 6.5M 7M See All Sizes

Qty: 1 - +

ADD TO BAG **ADD TO LIST**

Availability

Select a size above in order to view availability.

Product Details

American Rag's Jamie dress sandals take your style up a notch with a platform heel and T-strap design for a look that wows!

• 4-1/2" block heel 1-1/4" platform

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Call It Spring Acavie... Wed... Reg. \$50.00 Sale \$25.00

Shopping Bot

American Rag Jamie T-Strap P... X +
<https://www.macys.com/shop/product/american-rag-jamie-t-strap-platform-dress-sandals-created-for-macy's?ID=2603457&CategoryID=56172&swatchColor=Tan#fn=sp%3D1%26sp...> Incognito ☺ :

Macy's / Shoes / Sandals & Flip Flops

American Rag
Jamie T-Strap Platform Dress Sandals, Created for Macy's
★★★★★ 105 Reviews [2 Questions & 6 Answers](#)
Limited-Time Special
\$59.50
Sale \$29.75 (50% off) Sale ends 7/30/19

Color: Black Micro
See All Colors ▾
Find Your True Fit

Size: Please select | [Size Chart](#)
5M 5.5M 6M 6.5M 7M See All Sizes ▾

Qty: 1 - +

ADD TO BAG **ADD TO LIST**

Availability
Select a size above in order to view availability.

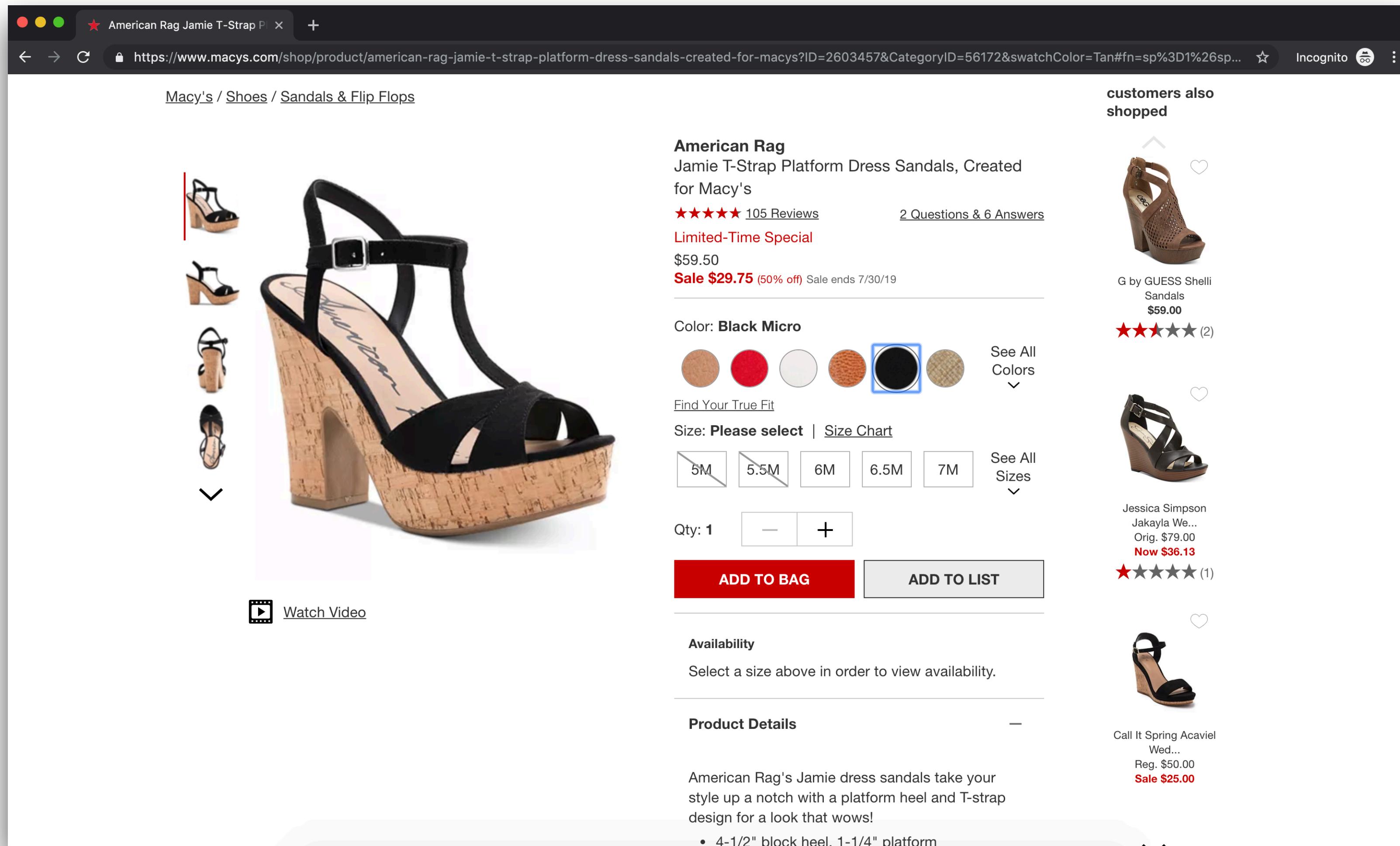
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★★★★★ (2)

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Now \$36.13
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Reg. \$50.00
Sale \$25.00



Shopping Bot

American Rag Jamie T-Strap P... X +
<https://www.macys.com/shop/product/american-rag-jamie-t-strap-platform-dress-sandals-created-for-macy's?ID=2603457&CategoryID=56172&swatchColor=Tan#fn=sp%3D1%26sp...> Incognito ☺ :

Macy's / Shoes / Sandals & Flip Flops



American Rag
Jamie T-Strap Platform Dress Sandals, Created for Macy's
★★★★★ 105 Reviews [2 Questions & 6 Answers](#)
Limited-Time Special
\$59.50 **Sale \$29.75 (50% off)** Sale ends 7/30/19

Color: Black Micro [See All Colors](#)
 Find Your True Fit

Size: 7M [Size Chart](#) [See All Sizes](#)
 5M 5.5M 6M 6.5M 7M

Qty: 1 [-](#) [+](#)

ADD TO BAG **ADD TO LIST**

Ship It
In stock: Usually ships within 3 business days.

Free Pickup In Store
[Check Availability In Stores](#)

Product Details —

American Rag's Jamie dress sandals take your style up a notch with a platform heel and T-strap

customers also shopped



G by GUESS Shelli Sandals \$59.00
★★★★★ (2)



Jessica Simpson Jakayla We...
Orig. \$79.00 Now \$36.13
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Shopping Bot

American Rag Jamie T-Strap Platform Dress Sandals, Created for Macy's

105 Reviews

Limited-Time Special

\$59.50

Sale \$29.75 (50% off) Sale ends 7/30/19

Color: Black Micro

Find Your True Fit

Size: 6.5M | Size Chart

Qty: 1

ADD TO BAG

ADD TO LIST

Ship It

In stock: Usually ships within 3 business days.

Free Pickup In Store

Check Availability In Stores

Product Details

American Rag's Jamie dress sandals take your style up a notch with a platform heel and T-strap

customers also shopped

G by GUESS Shelli Sandals \$59.00

Jessica Simpson Jakayla We... Orig. \$79.00 Now \$36.13

Call It Spring Acavie... Wed... Reg. \$50.00 Sale \$25.00

Shopping Bot

American Rag Jamie T-Strap P... X +

https://www.macys.com/shop/product/american-rag-jamie-t-strap-platform-dress-sandals-created-for-macys?ID=2603457&CategoryID=56172&swatchColor=Tan#fn=sp%3D1%26sp... Incognito

Macy's / Shoes / Sandals & Flip Flops

customers also shopped

American Rag Jamie T-Strap Platform Dress Sandals, Created for Macy's

1 item added to your bag

American Rag Jamie T-Strap Platform Dress Sandals, Created for Macy's

\$59.50
Sale \$29.75
You just saved \$29.75!

Color: Black Micro
Size: 6.5M

1 item(s) in bag subtotal: \$29.75
you saved: \$29.75

VIEW BAG & CHECKOUT

CONTINUE SHOPPING

You're **\$45.25** away from **Free Shipping**. Excludes furniture, mattresses & other exclusions apply.

Customers who bought this also shopped...

G by GUESS Shellie Sandals \$59.00 ★★★★★ (2)	Call It Spring Acavil Wed... Limited-Time Special Reg. \$50.00 Sale \$25.00 ★★★★★ (44)	American Rag Charlize Perf... Limited-Time Special Reg. \$59.50 Sale \$29.75 ★★★★★ (44)	Material Girl Bretta Wedge... LAST ACT Orig. \$59.50 Now \$29.63 coupon excluded ★★★★★ (36)	Material Girl Bretta Wedge... LAST ACT Orig. \$59.50 Now \$29.63 coupon excluded ★★★★★ (4)	American Rag Reeta Block-H... Reg. \$59.50 Sale \$49.99 ★★★★★ (141) ★
----------------------------------------------------	----------------------------------------------------------------------------------------------------	-----------------------------------------------------------------------------------------------------	------------------------------------------------------------------------------------------------------------	-----------------------------------------------------------------------------------------------------------	-----------------------------------------------------------------------------------

Shopping Bot

The screenshot shows a shopping bag containing one item: American Rag Jamie T-Strap Platform Dress Sandals. The item is listed at \$59.50 (Reg.) and \$29.75 (Sale). The total in the bag is \$29.75. The page includes options for shipping or pickup, a rewards section, and a checkout summary.

Macy's Presents: **The Edit**- A curated mix of fashion and inspiration [Check It Out](#)

Free Shipping with \$75 purchase + Free Store Pickup, Contiguous US. [Exclusions](#)

macy's STORES DEALS LISTS GIFTS ▾ WEDDING REGISTRY

Macy's Dulles Closed until 10 AM

Sign In MY ACCOUNT ▾

SHOP BY DEPARTMENT ▾

Search or enter web ID

1

Shopping Bag

Your Pickup Store
Macy's Dulles [Change Store](#)

American Rag
Jamie T-Strap Platform Dress Sandals,
Created For Macy's

Size: 6.5M
Color: Black Micro
Web ID: 2603457

Ship It.
 In Stock: Usually Ships Within 3 Business Days.

Pick Up In Store.
We Will Ship Your Item(S) To Macy's Dulles.
Ready In **6-9 BUSINESS DAYS**

[Move To List](#) [Remove](#)

Offers
Sorry, there are no offers that apply to the items in your bag.
To see if you have other offers, [sign in](#).

Enter Promo Code. Limit Of 1 Offer Per Order.

APPLY

You're **\$45.25** away from **Free Shipping!**
Excludes furniture, mattresses, and other items. [See Exclusions](#)

Subtotal \$29.75
Shipping ⓘ \$10.95

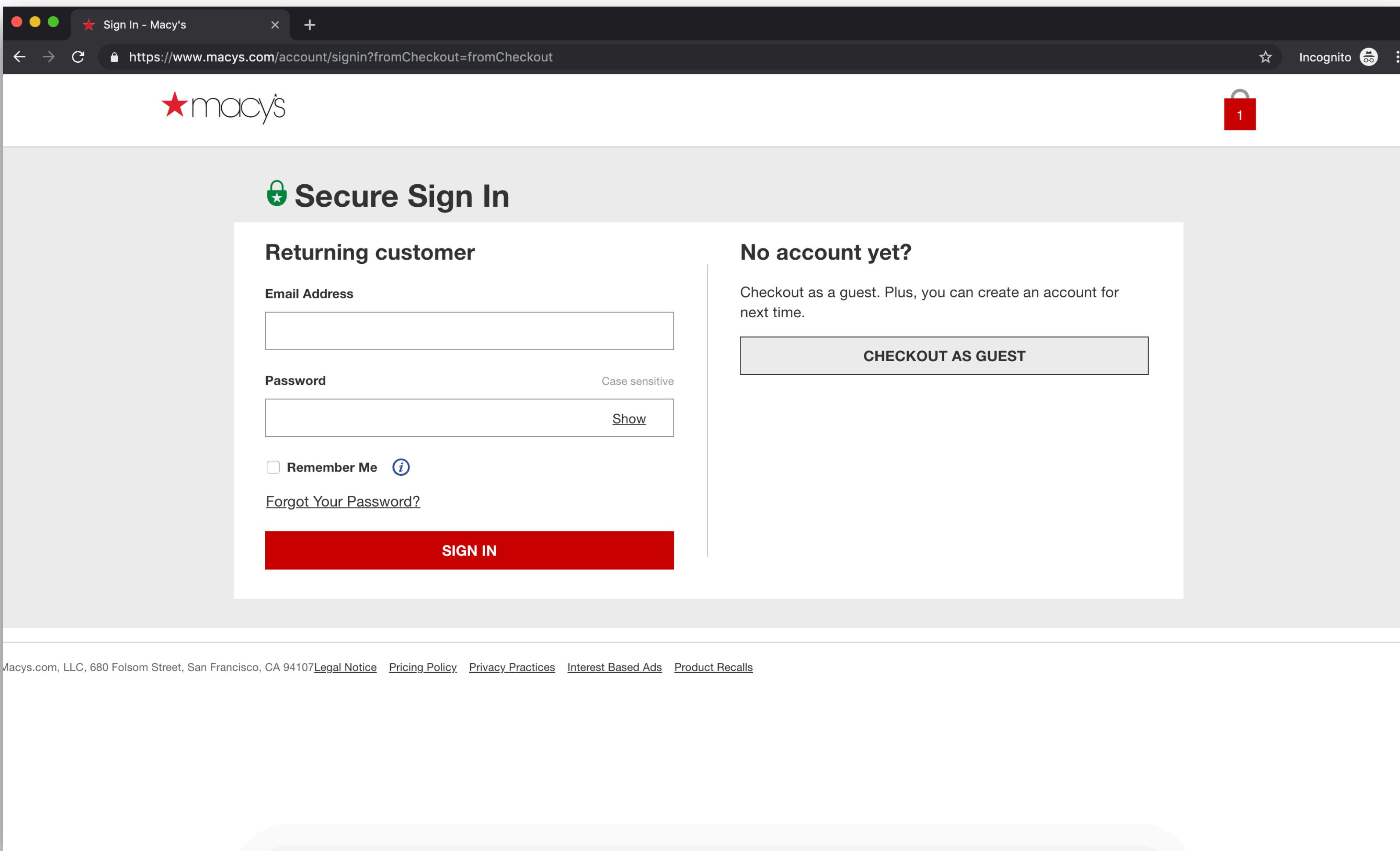
Pre-Tax Order Total \$40.70
You saved ⓘ \$29.75

PROCEED TO CHECKOUT

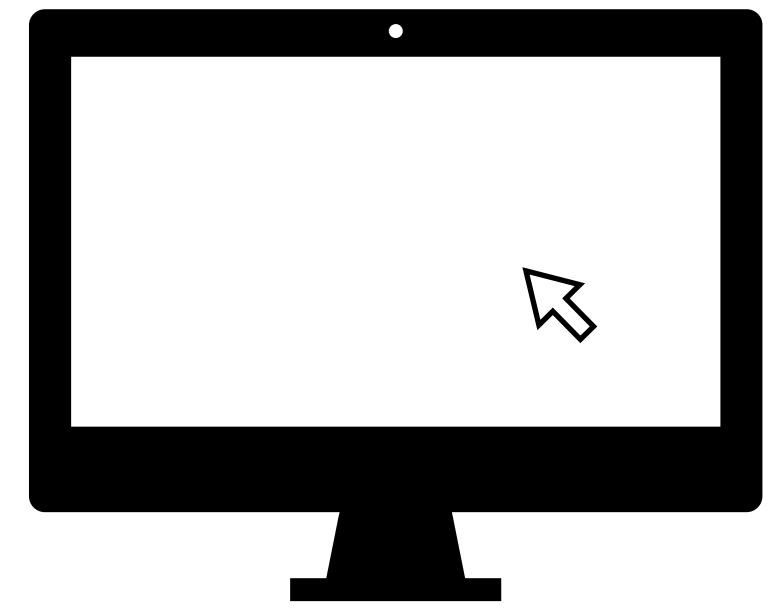
PayPal Check out

Get Better Benefits When You Shop With Star Rewards!

Shopping Bot



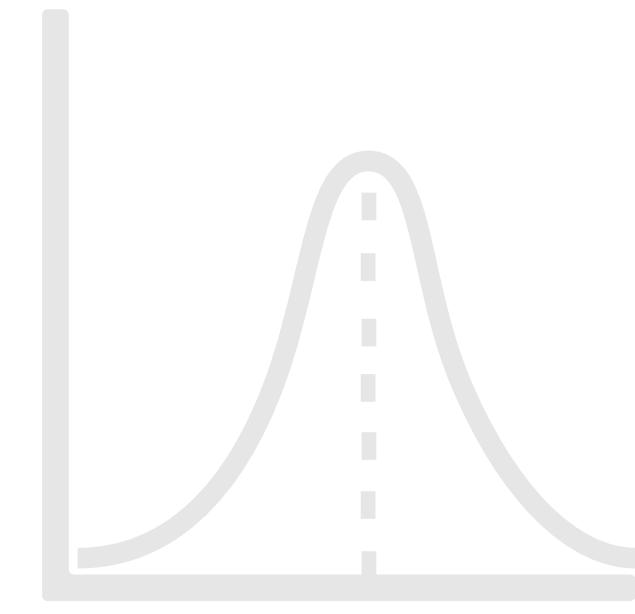
Method: Three Key Steps



Mimicking a real user
browsing websites



Collecting and storing
data from websites

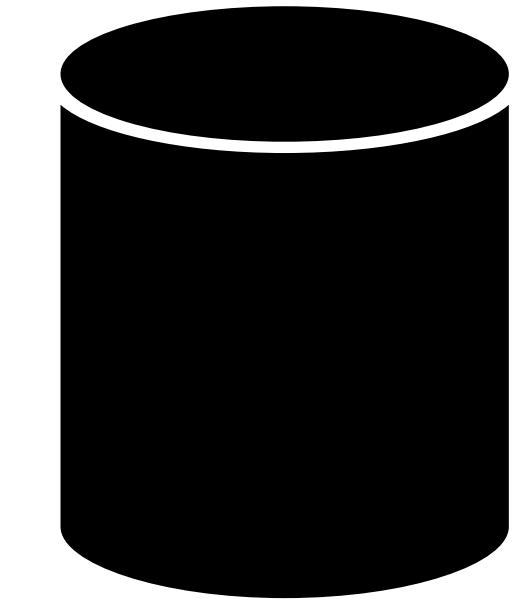


Analyzing collected
data

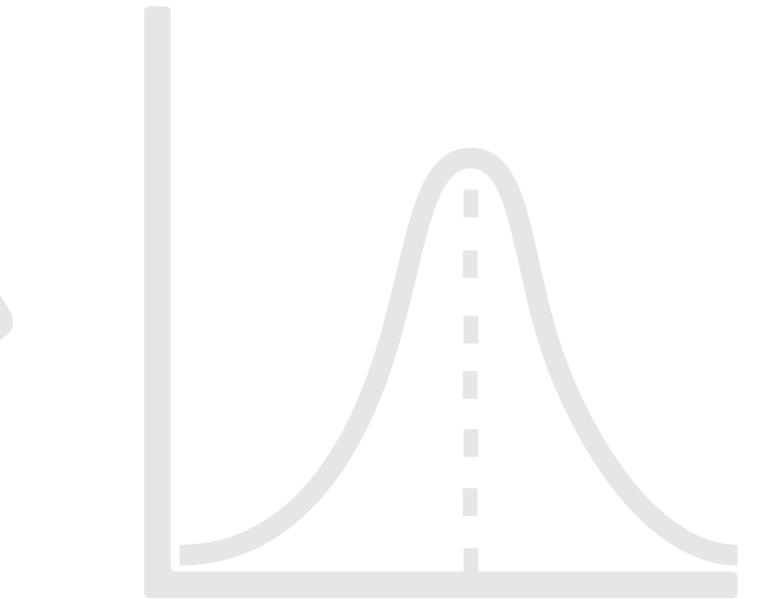
Method: Three Key Steps



Mimicking a real user
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Collecting and storing
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Analyzing collected
data

Page Segments

Macy's / Shoes / Boots



Sporto
Dana Boots
 76 Reviews
LAST ACT
\$79.00
Now \$39.13 (50% off)
coupon excluded [Details](#)

Color: **Black**
\$39.13
 \$25.03

Size: Please select | [Size Chart](#)

Qty: 1 - +

ADD TO BAG ADD TO LIST

Availability
Select a size above in order to view availability.

Product Details

Eastman Sporto's Dana boots feature modern lines with a hint of retro inspiration and plush faux fur for a

customers also shopped



Sporto Jenny Water-Resistant...
Orig. \$79.00
Now \$39.13
 (45)

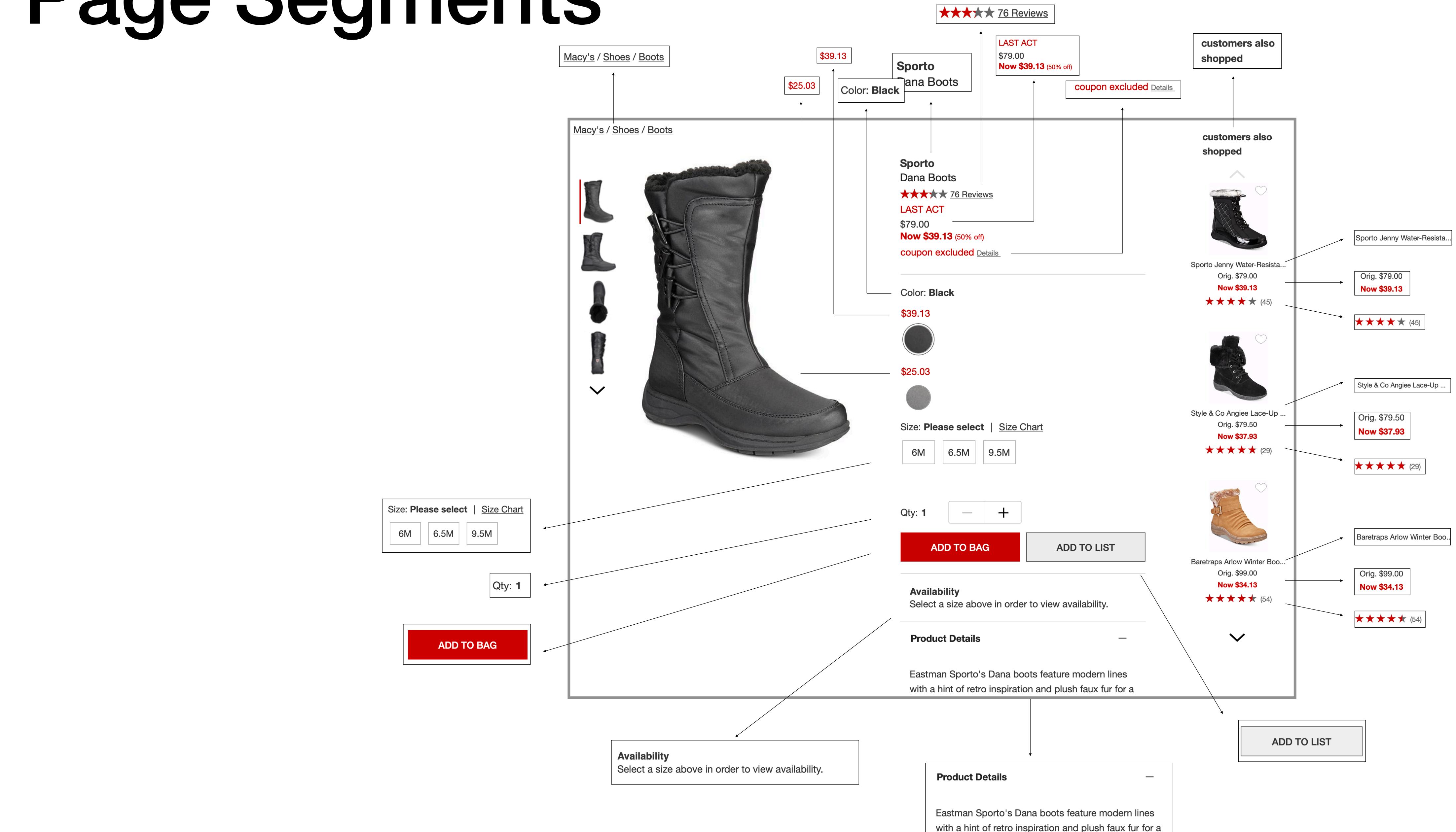


Style & Co Angie Lace-Up ...
Orig. \$79.50
Now \$37.93
 (29)



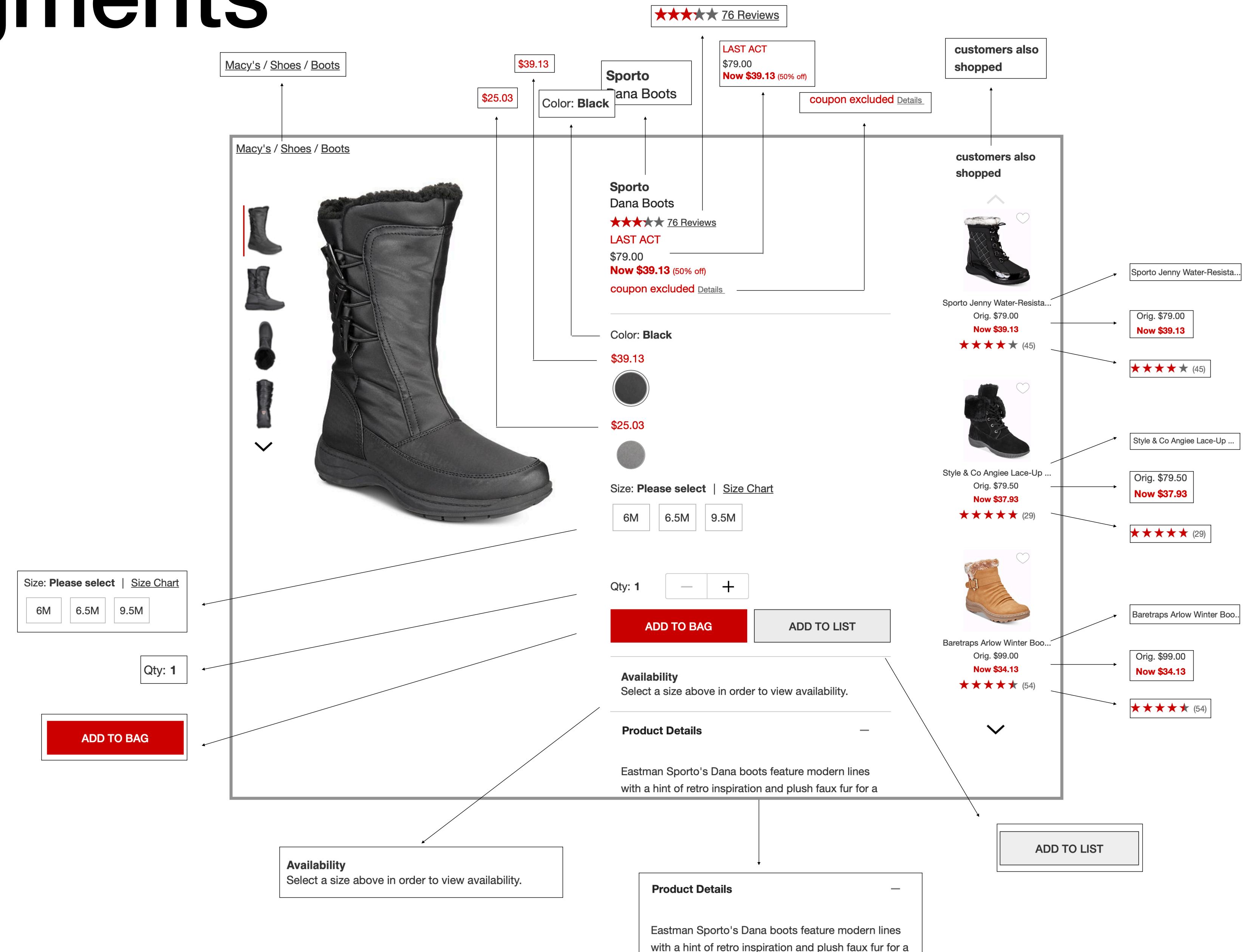
Baretraps Arlow Winter Boo...
Orig. \$99.00
Now \$34.13
 (54)

Page Segments



Page Segments

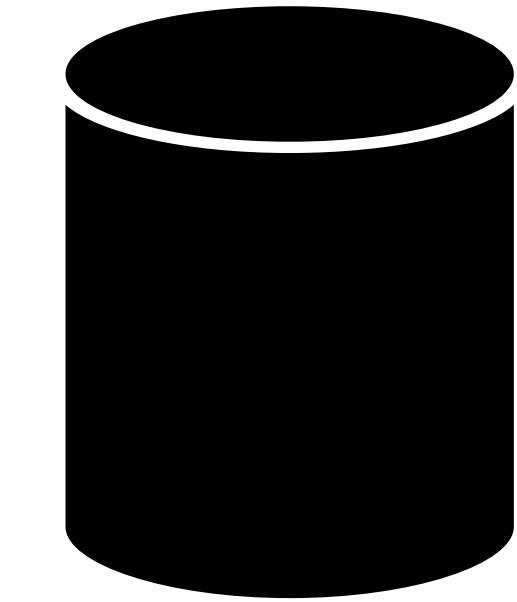
- HTML Sources
- HAR files
- Screenshots
- HTTP Requests
- HTTP Responses



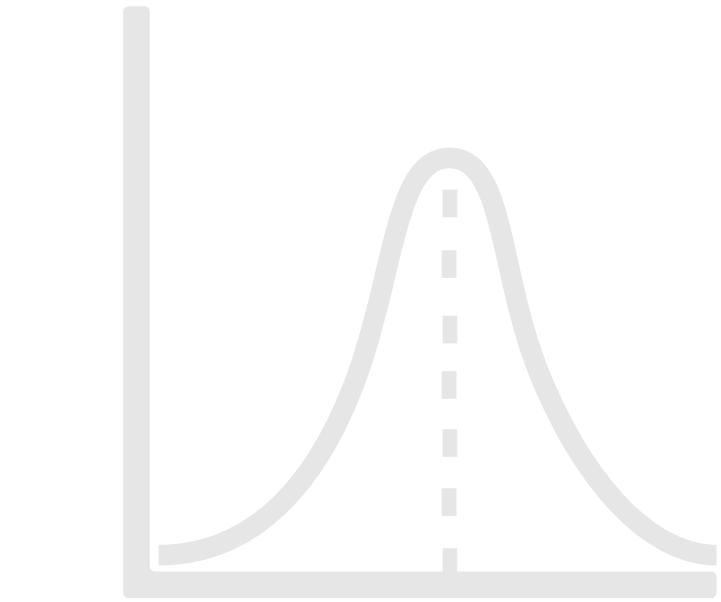
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Mimicking a real user
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Collecting and storing
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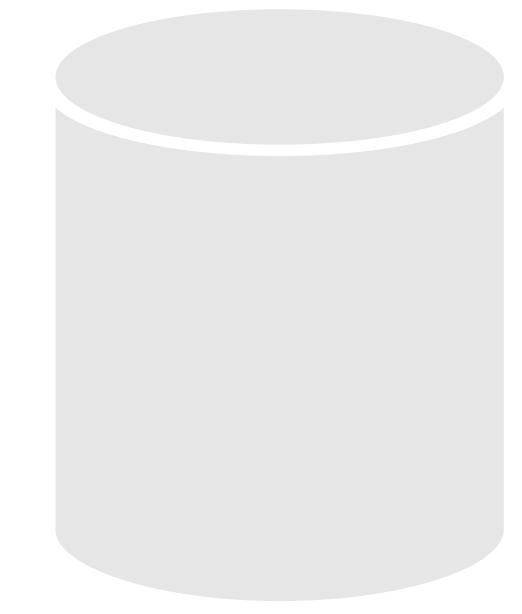


Analyzing collected
data

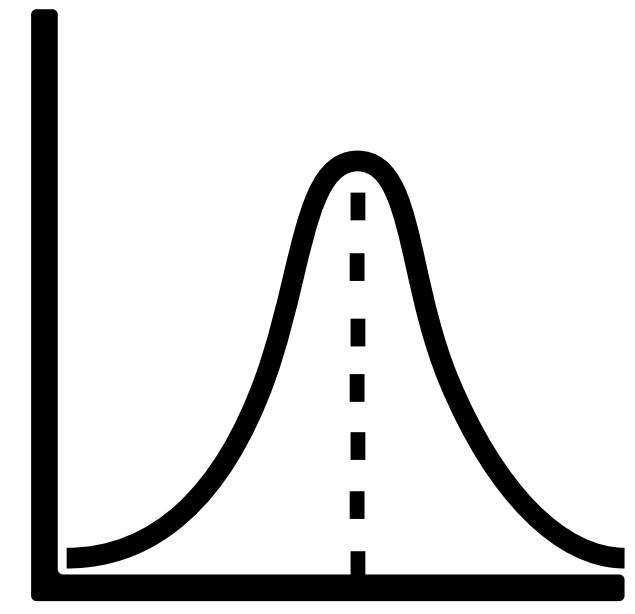
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Mimicking a real user
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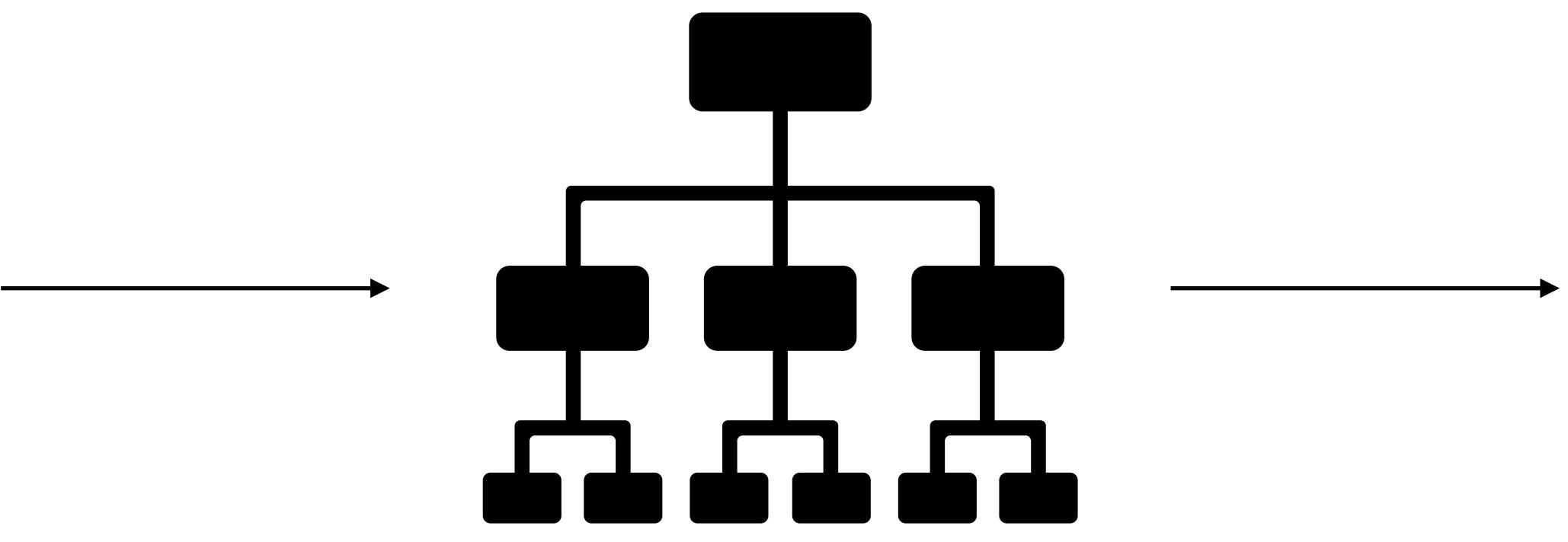
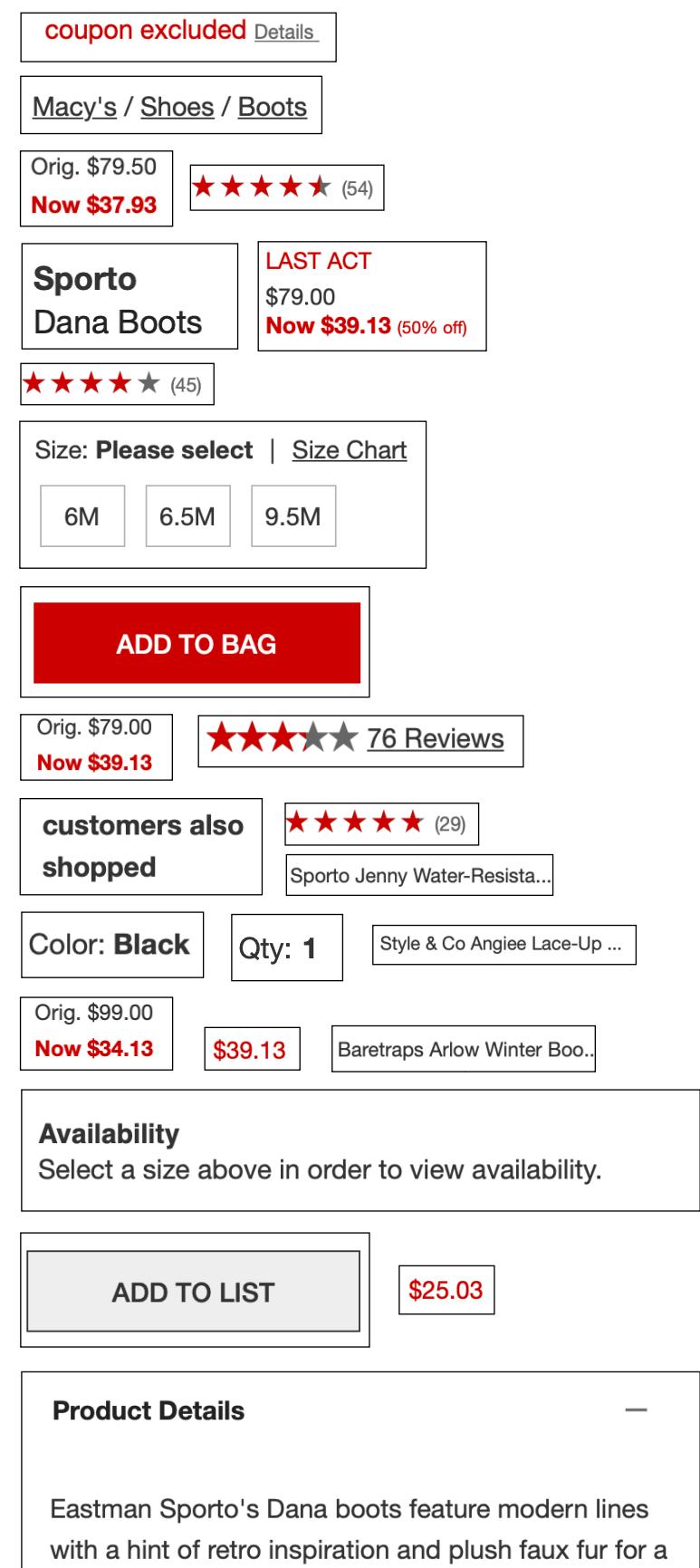


Collecting and storing
data from websites



Analyzing collected
data

Clustering Segments



Hierarchical
Clustering

Examine clusters
for dark patterns

Result: 15 Types, 7 Categories

Sneaking

- 1. Sneak into Basket
- 2. Hidden Costs
- 3. Hidden Subscription

Urgency

- 1. Countdown Timer
- 2. Limited-time Message

Scarcity

- 1. Low-stock Message
- 2. High-demand Message

Misdirection

- 1. Confirmshaming
- 2. Visual Interference
- 3. Trick Questions
- 4. Pressured Selling

Social Proof

- 1. Activity Messages
- 2. Testimonials of Uncertain Origin

Obstruction

- 1. Hard to Cancel

Forced Action

- 1. Forced Enrollment

Result: 15 Types, 7 Categories

Sneaking

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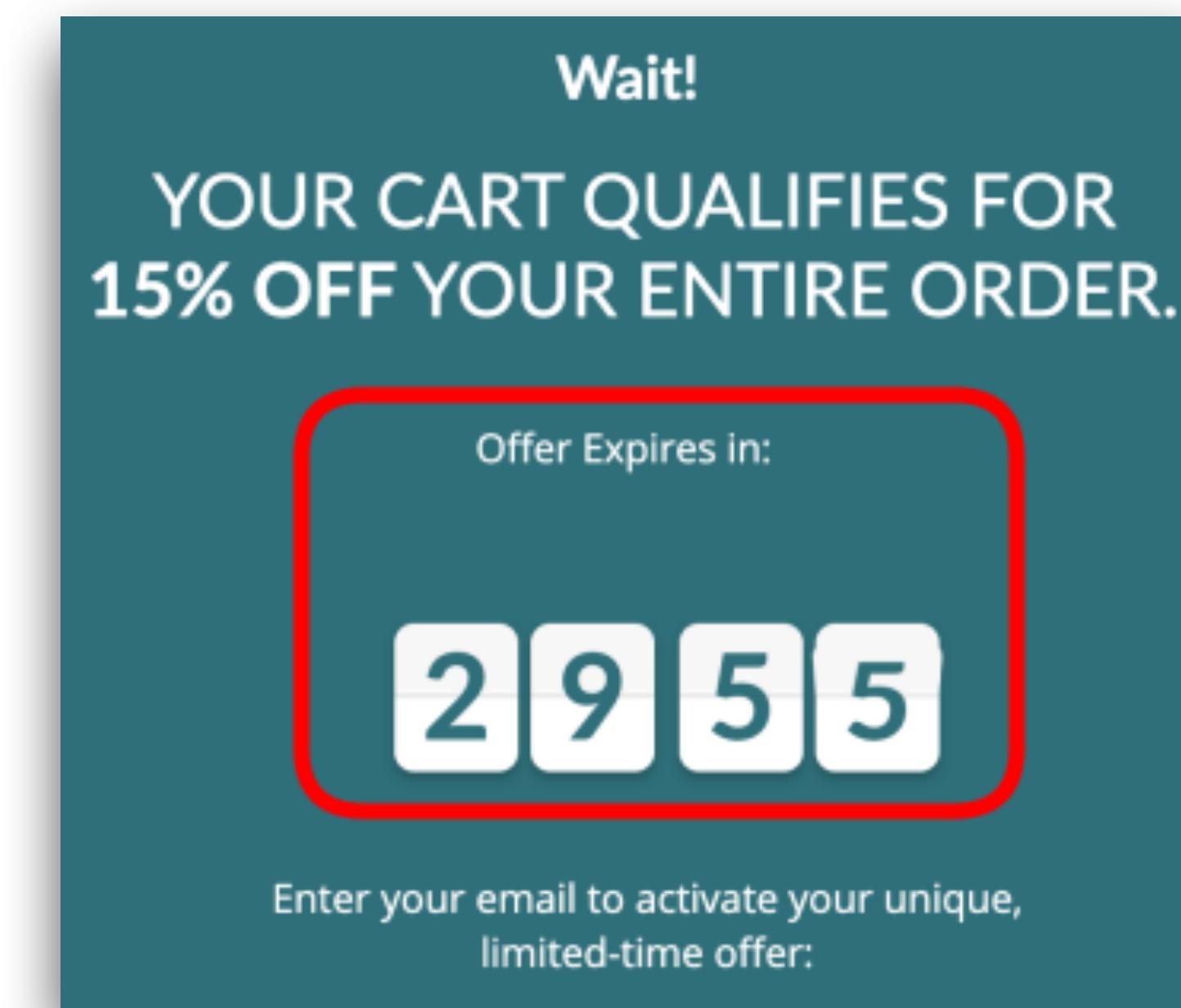
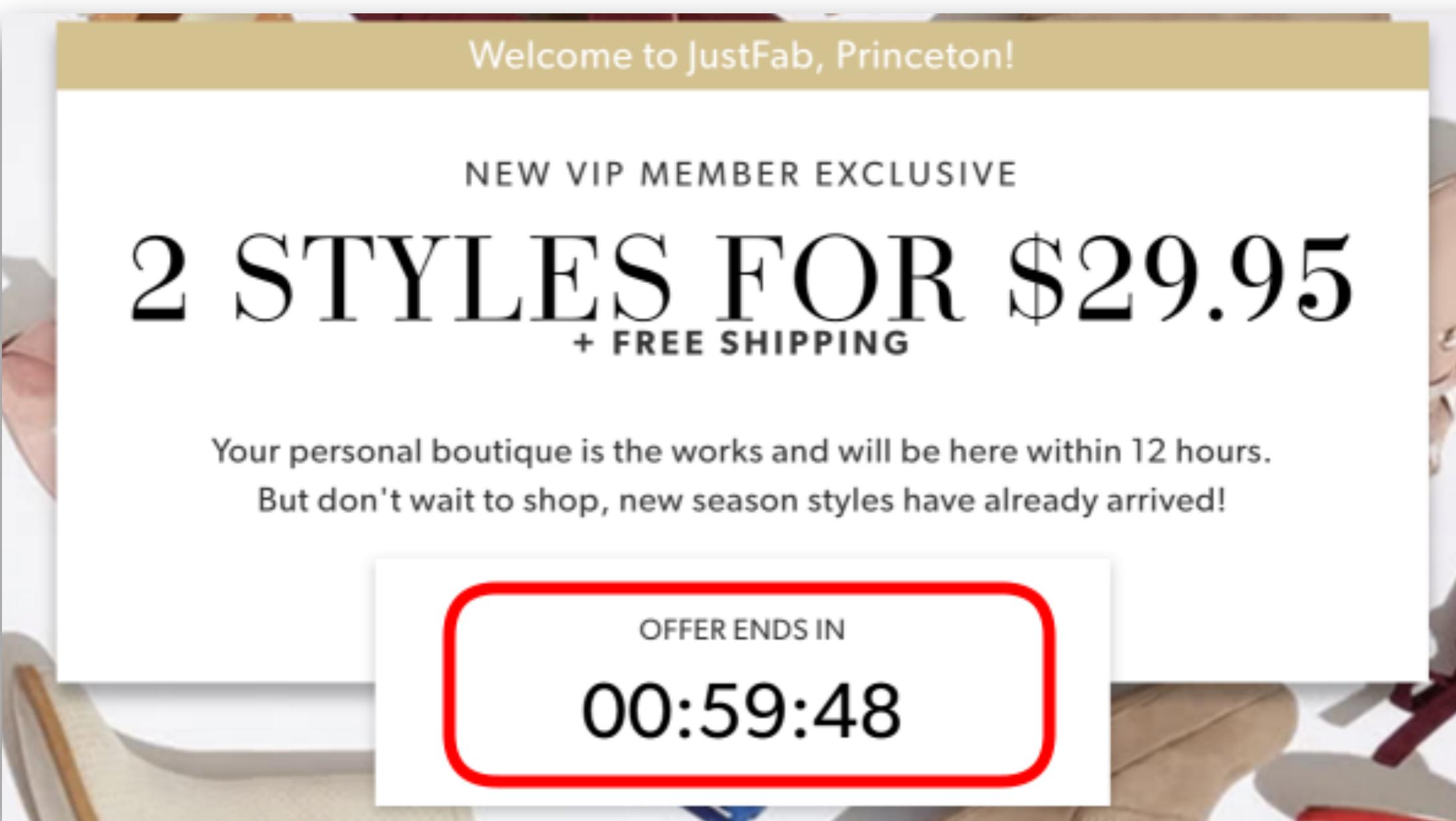
Obstruction

- 1. Hard to Cancel

Forced Action

- 1. Forced Enrollment

DP #1: Urgency – Timers



393 instances (157 deceptive)

DP #2: Sneaking – Sneak into Basket

TODAY'S SALE!- VALID ONLINE ONLY- *Up To 45% Off + Free Local Delivery

① Delivery Info ② Billing Info ③ Review & Place Order

Need assistance? We are here to help! Call us any time at **877-638-3303**

[Log in](#) to apply your points or discounts and earn even more points towards future purchases

SHOPPING CART

Item	Qty	Price	Subtotal
 Dreaming of Tuscany Selected: "As Shown" 2nd choice: similar as possible, same look and feel	1	\$52.99	\$52.99
 Greeting Card Service Selected: "STANDARD"	1	\$3.99	\$3.99

✓ In stock: [Ships today if ordered by 2pm EST!](#)

QTY: 1 **ADD TO MY CART** 

 LIFETIME Quality Assurance Warranty

 90 Day Return Policy

 110% Low Price Guarantee

Send me purchase updates on Messenger
 Send to  Messenger

 LG V40 ThinQ - Full Edge Tempered Glass Screen Protector, Black
\$19.99 **\$4.99**
 Add to my cart

7 instances

DP #3: Sneaking – Hidden Subscription

Case – SAVE over \$100 SALE

Collection
verage bottle rating i



15 bottles for JUST \$13.29 each

\$199.35
Reg. \$306.35
SAVE \$107.00

Shipping Rates

Enjoy **FREE shipping** with WSJwine Advantage [Learn More](#)

Add to Cart

Item No. A07897

VIP + rewards
YOU DESERVE OUR SPECIAL TREATMENT!



Start saving with the Ross-Simons VIP Rewards Club!
Annual benefits include:

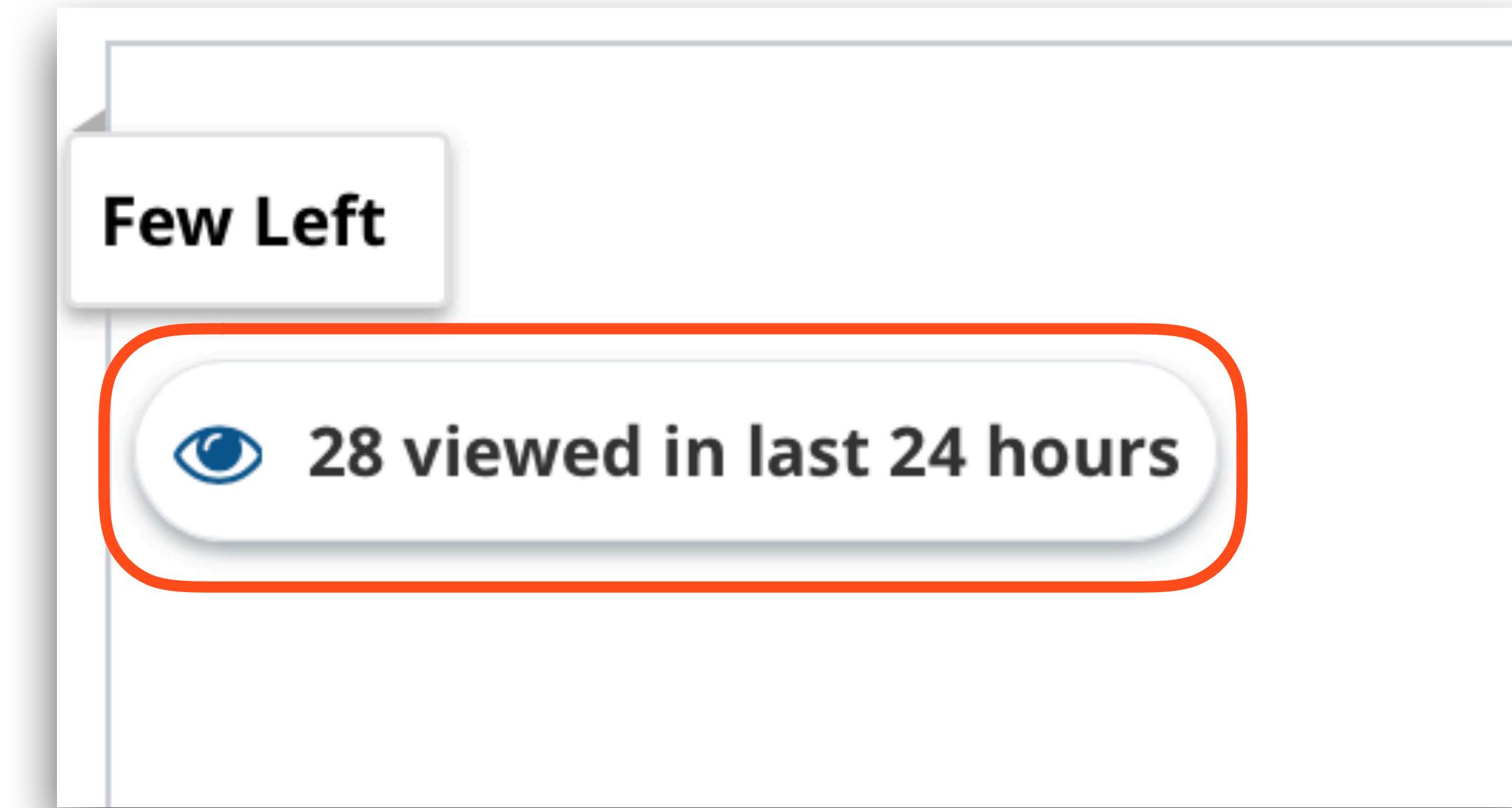
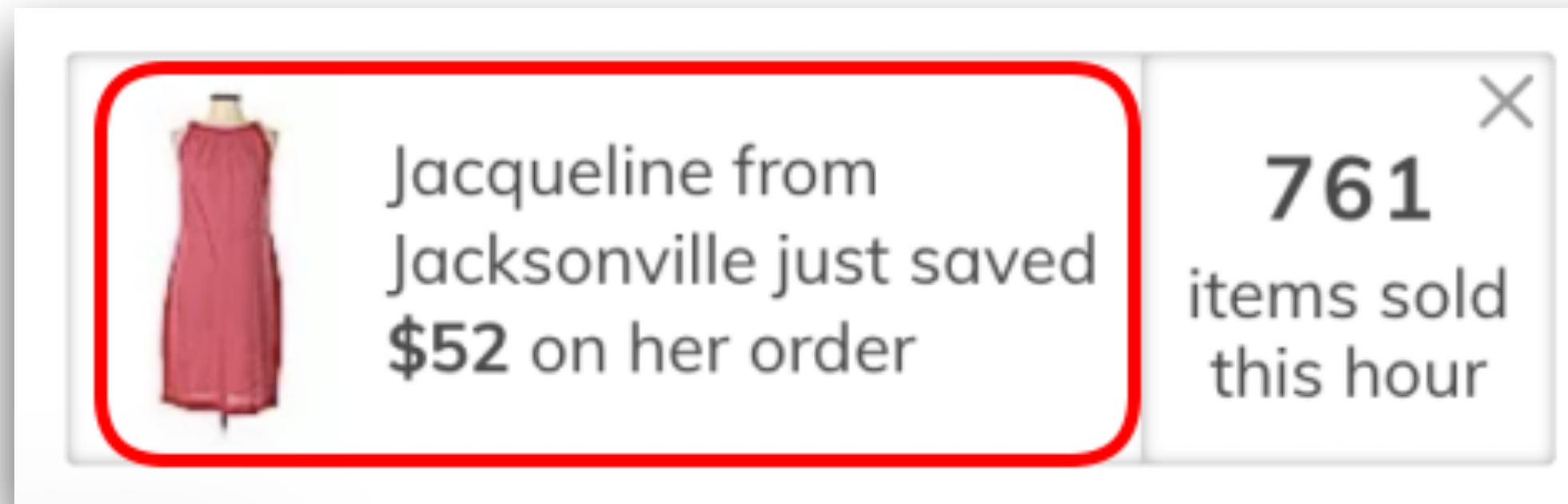
- Three \$50 gift coupons (\$150 total) to use on three distinct purchases – it more than pays for itself!
- Free 2-business-day domestic shipping.
- Free shipping on jewelry returns.
- Exclusive invitation-only savings events that you'll receive several times a year.
- Priority phone line answered by a dedicated VIP consultant to assist you.

Just \$95.00
JOIN TODAY

Already a member? [Sign In](#).
[Terms and conditions](#)

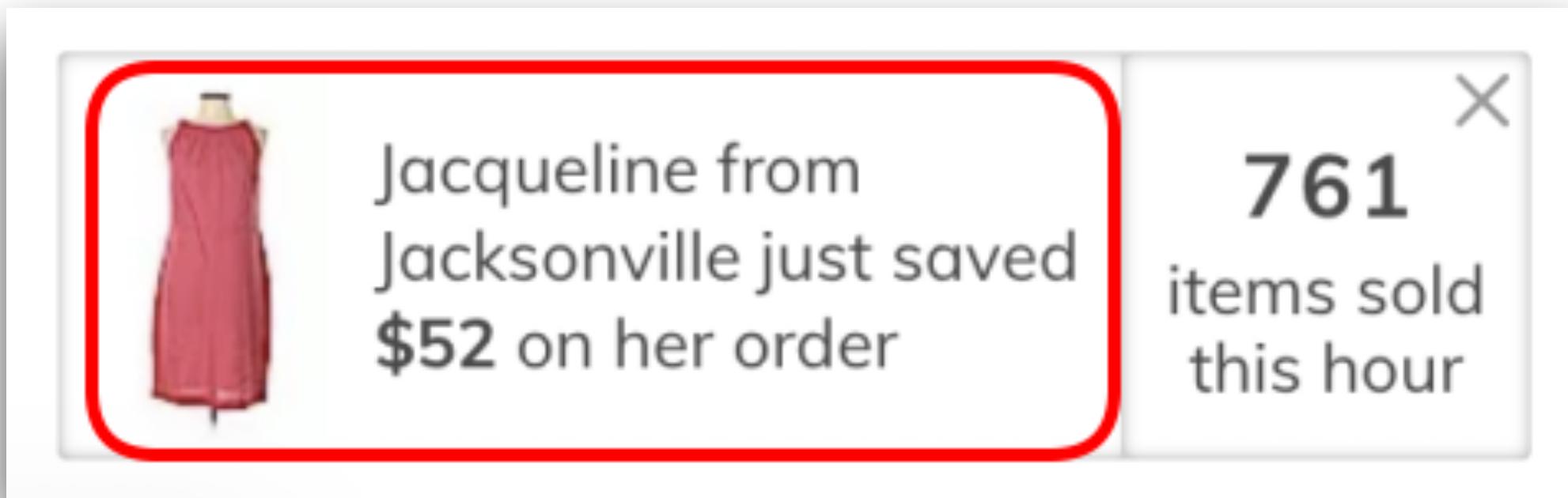
14 instances

DP #4: Social Proof – Activity Notification



313 instances (29 deceptive)

DP #4: Social Proof – Activity Notification



```
Ms = ["Abigail", "Alexandra", "Alexis", "Alicia", "Allison",
    "Alyssa", "Amanda", "Amber", "Amy", "Andrea", "Angela", "Anna",
    "April", "Ashley", "Brianna", "Brittany", "Brittney", "Brooke",
    "Caitlin", "Caroline", "Cassandra", "Catherine", "Chelsea",
    "Christina", "Christine", "Courtney", "Crystal", "Danielle",
    "Destiny", "Diana", "Elizabeth", "Emily", "Emma", "Erica",
    "Erika", "Erin", "Gabrielle", "Grace", "Hailey", "Haley",
    "Hannah", "Heather", "Isabella", "Jacqueline", "Jamie", "Jasmine",
    "Jenna", "Jennifer", "Jessica", "Jordan", "Julia", "Julie",
    "Kaitlyn", "Katelyn", "Katherine", "Kathryn", "Katie", "Kayla",
    "Kelly", "Kelsey", "Kimberly", "Kristen", "Kristin", "Laura",
    "Lauren", "Leah", "Lindsay", "Lindsey", "Lisa", "Madison",
    "Maria", "Marissa", "Mary", "Megan", "Melissa", "Michelle",
    "Molly", "Monica", "Morgan", "Natalie", "Nicole", "Olivia",
    "Paige", "Rachel", "Rebecca", "Samantha", "Sara", "Sarah",
    "Savannah", "Shannon", "Shelby", "Sierra", "Sophia", "Stephanie",
    "Sydney", "Taylor", "Tiffany", "Vanessa", "Victoria", "Whitney"
],
As = ["Albuquerque", "Anaheim", "Arlington", "Atlanta", "Aurora",
    "Austin", "Bakersfield", "Baltimore", "Boston", "Charlotte",
    "Chicago", "Cleveland", "Colorado", "Columbus", "Dallas",
    "Denver", "Detroit", "El Paso", "Fort Worth", "Fresno",
    "Honolulu", "Houston", "Indianapolis", "Jacksonville", "Kansas",
    "Las Vegas", "Long Beach", "Los Angeles", "Louisville", "Memphis",
    "Mesa", "Miami", "Milwaukee", "Minneapolis", "Nashville",
    "New Orleans", "New York City", "Oakland", "Oklahoma", "Omaha",
    "Philadelphia", "Phoenix", "Portland", "Raleigh", "Riverside",
    "Sacramento", "San Antonio", "San Diego", "San Francisco",
    "San Jose", "Santa Ana", "Seattle", "St. Louis", "Tampa",
    "Tucson", "Tulsa", "Virginia", "Washington", "Wichita"
],
```

DP #5: Misdirection – Visual Interference

CONTACT PREFERENCES

Please select **Yes** below if you are happy to receive email notifications of **exclusive member offers** from M8 Group companies. You will always have the option to unsubscribe from any emails you decide you would rather not receive.

YES I do want to hear about exclusive offers & discounts

NO I'd rather NOT hear about exclusive offers & discounts

Don't worry, we will never sell or rent your personal information, it's part of our [privacy policy](#). Also, you can update your preferences and unsubscribe from 'My Account' at any time.

25 instances

Code, Data, and More Examples

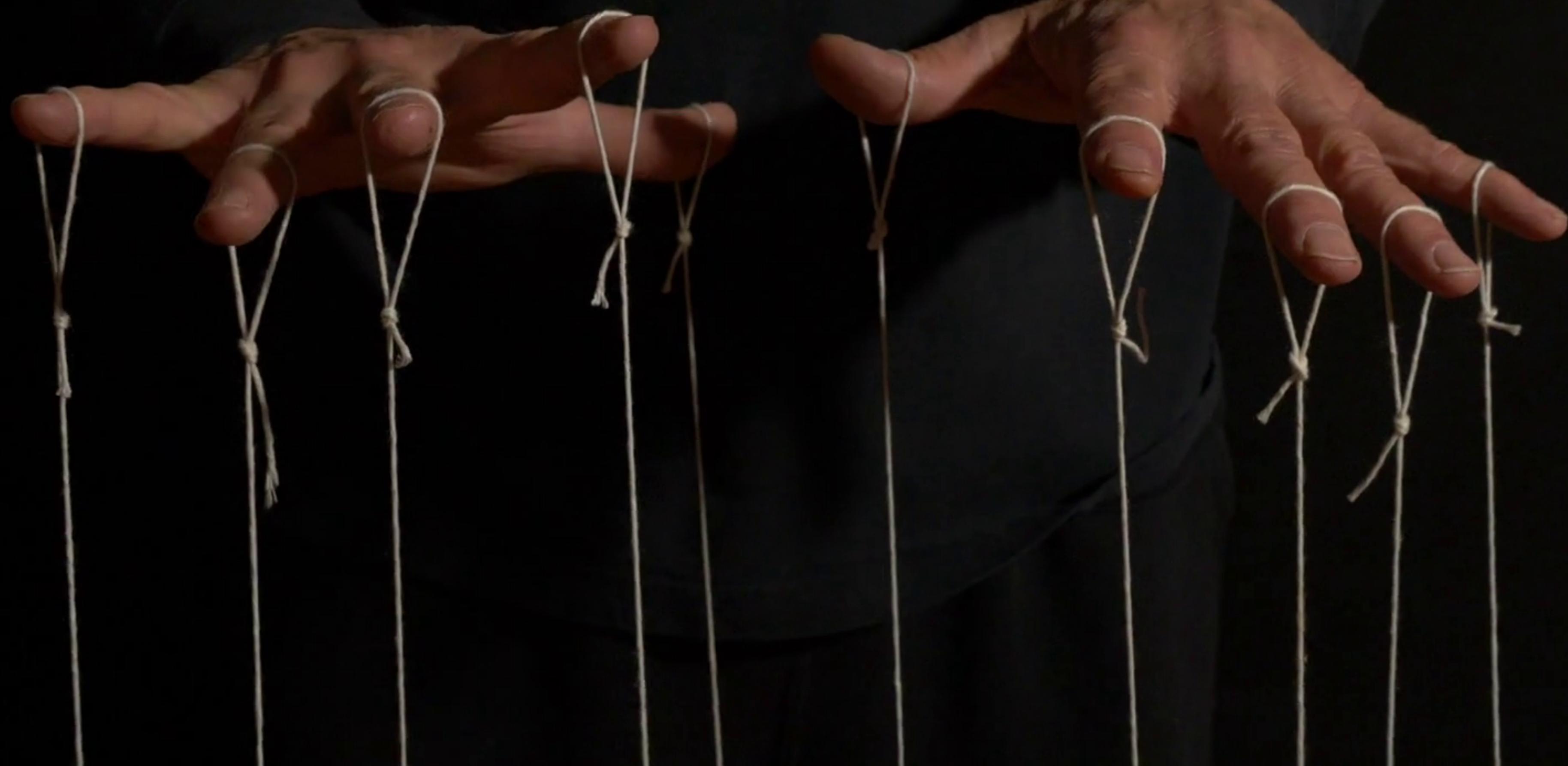
The screenshot shows a web page with a dark header bar containing links to 'Revisions', 'Citation', 'Links', and 'Contact'. The main title is 'Dark Patterns at Scale: Findings from a Crawl of 11K Shopping Websites'. Below the title, it says 'Accepted at [ACM CSCW 2019](#)'. A summary text explains that dark patterns are user interface design choices that benefit an online service by coercing, steering, or deceiving users into making unintended and potentially harmful decisions. The study analyzed ~53K product pages from ~11K shopping websites. A yellow button labeled 'Read the paper (final version) »' is present. At the bottom, a note says 'Please see the list of revisions [here](#)'.

Findings

- We discovered 1,818 instances of dark patterns on shopping websites, which together represent 15 types of dark patterns.
- These 1,818 dark patterns were present on 1,254 of the ~11K shopping websites (~11.1%) in our data set. Shopping websites that were more popular, according to Alexa rankings, were more likely to feature dark patterns.
- We demonstrate which of the dark patterns that we discovered rely on consumer deception. In total, we uncovered 234 instances of deceptive dark patterns across 183 websites.
- We identify 22 [third-party entities](#) that provide shopping websites with the ability to create dark patterns on their sites. Two of these entities openly advertise practices that enable deceptive messages.

webtransparency.cs.princeton.edu/dark-patterns

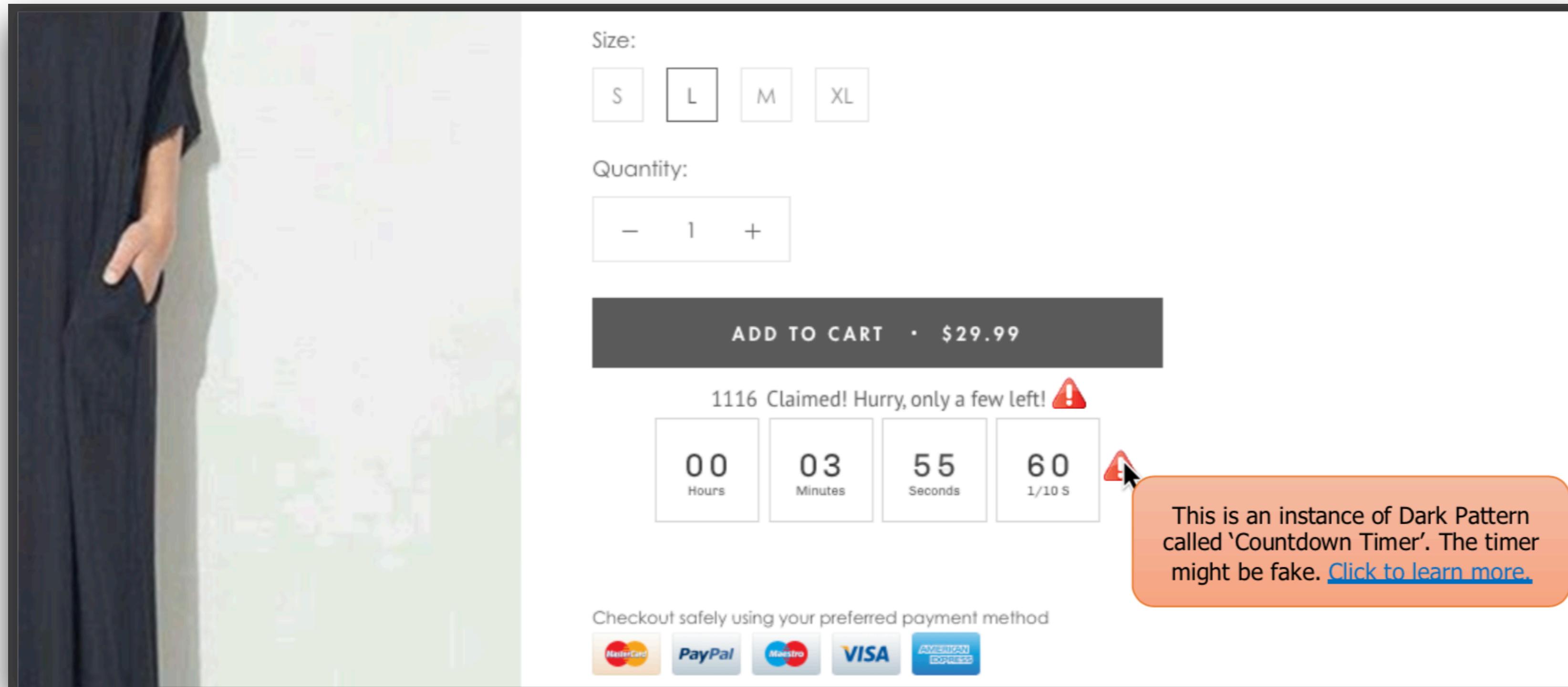
What can we do about dark patterns?



Future Research

1. Conduct longitudinal measurements of the prevalence of dark patterns on the web
2. Study the effect of interventions (e.g., reporting about websites' dark patterns) on prevalence
3. Gather users' perceptions of the types of dark patterns, and examine the effect of dark patterns on user behavior
4. Study the design process: how do dark patterns emerge?

Technical Solutions



Browser extension to alert users about dark patterns, or block third-parties that enable dark patterns

Legal Solutions

1. Many deceptive dark patterns violate Section 5 of the Federal Trade Commission (FTC) Act
2. “Sneaking” dark patterns violate the Consumer Rights Directive in the UK
3. Industry specific rules in the United States: Funeral Rule, Used Car Rule
4. Many consent dark patterns do not constitute informed and freely given consent under General Data Protection Regulation (GDPR)

Policy Proposals

Mark Warner @MarkWarner

You might not have heard of a “dark pattern,” but chances are you’ve seen these annoying, manipulative designs trying to trick you into clicking, buying, or signing up for something you don’t want. Today I introduced the DETOUR Act with [@SenatorFischer](#) to do something about them.

THE DETOUR ACT

GIF

1:00 PM · Apr 9, 2019 · Twitter Web Client

A screenshot of a Twitter post from Senator Mark Warner (@MarkWarner). The post includes a profile picture of him, his name, a blue verified checkmark, and his handle @MarkWarner. The text discusses dark patterns and introduces the DETOUR Act. Below the text is a large orange graphic featuring the words "THE DETOUR ACT" and a stylized arrow pointing right, which is a common visual metaphor for a misleading or unnecessary route. A small "GIF" label is at the bottom left of the graphic. At the very bottom of the tweet card, it says "1:00 PM · Apr 9, 2019 · Twitter Web Client".

Proposed Deceptive Experiences To Online Users Reduction (DETOUR) act reins in more broadly against design that “obscures, subverts, or impairs user autonomy and decision-making”.

1. Developed automated techniques to help experts identify dark patterns on the web at scale
2. Created a data set of 1,818 dark patterns on 1,254 shopping websites
3. Documented 22 third-party entities that enable dark patterns on websites
4. Created a descriptive taxonomy that characterizes how dark patterns work

webtransparency.cs.princeton.edu/dark-patterns

Questions?



amathur@cs.princeton.edu



@aruneshmathur