

# 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

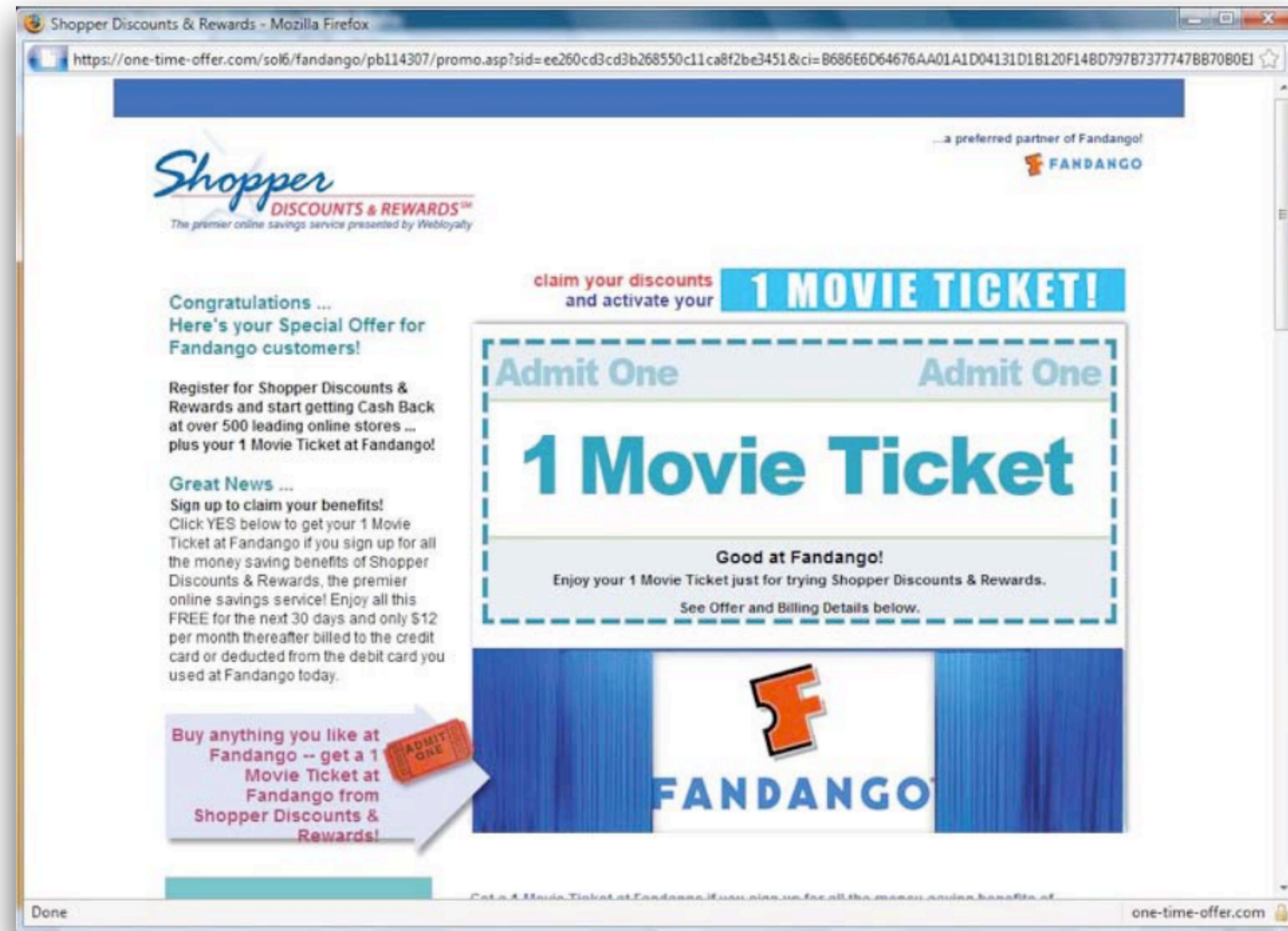


PRINCETON  
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CENTER FOR  
INFORMATION  
TECHNOLOGY  
POLICY  
PRINCETON UNIVERSITY

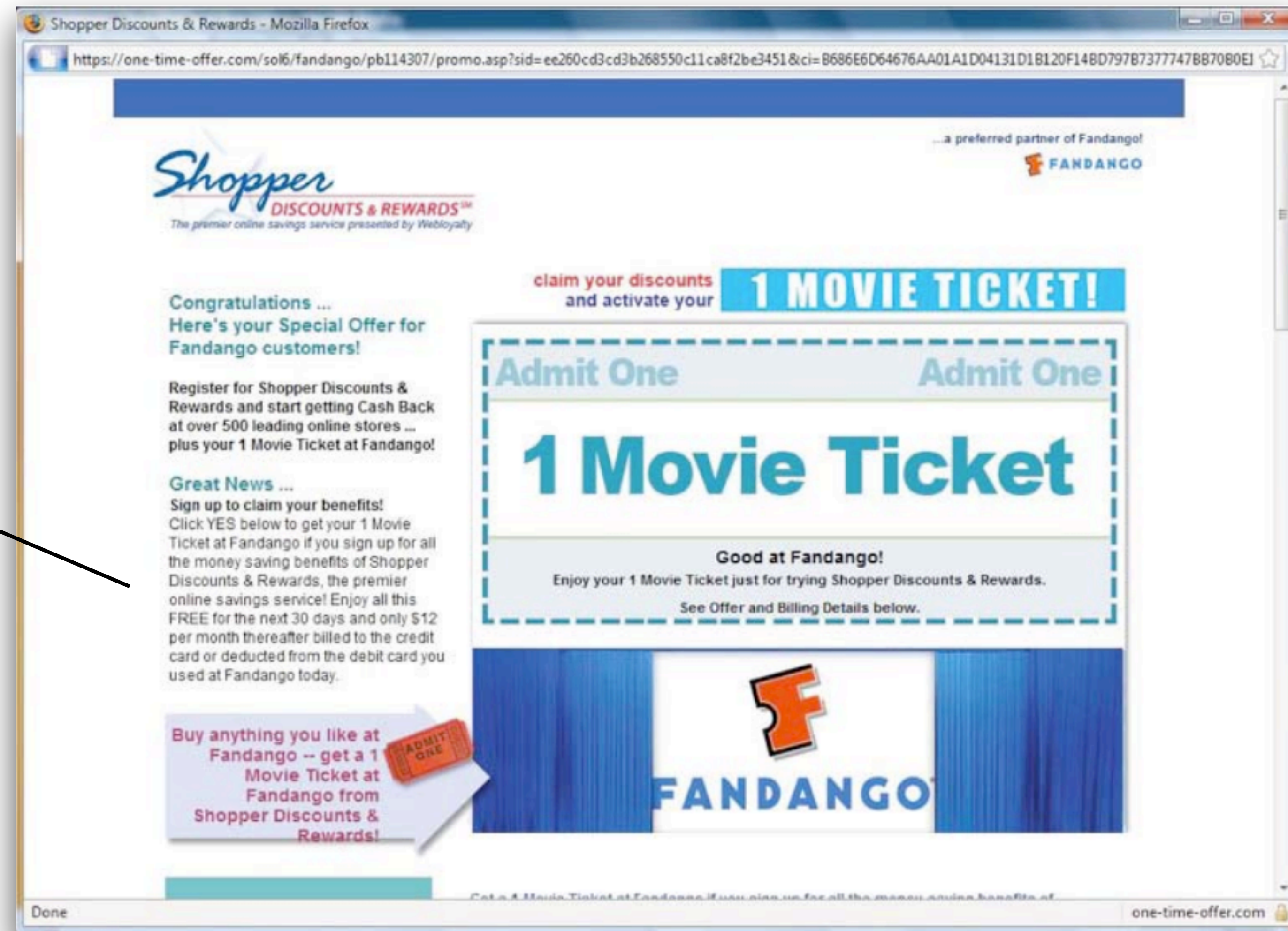
# Affinion Group Settlement (2010)





# Affinion Group Settlement (2010)

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

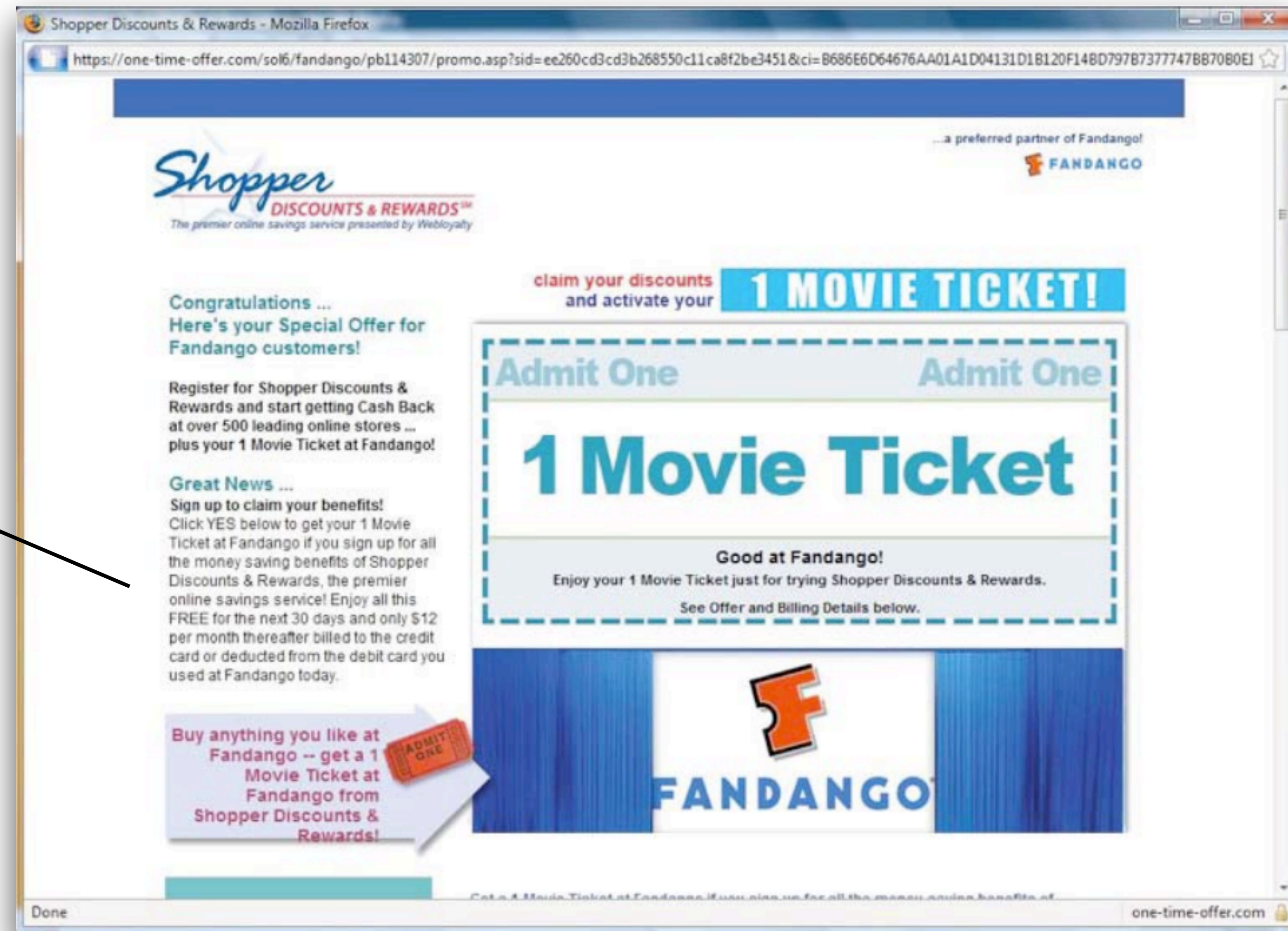




# Affinion Group Settlement (2010)

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\$8 million settlement  
with the New York  
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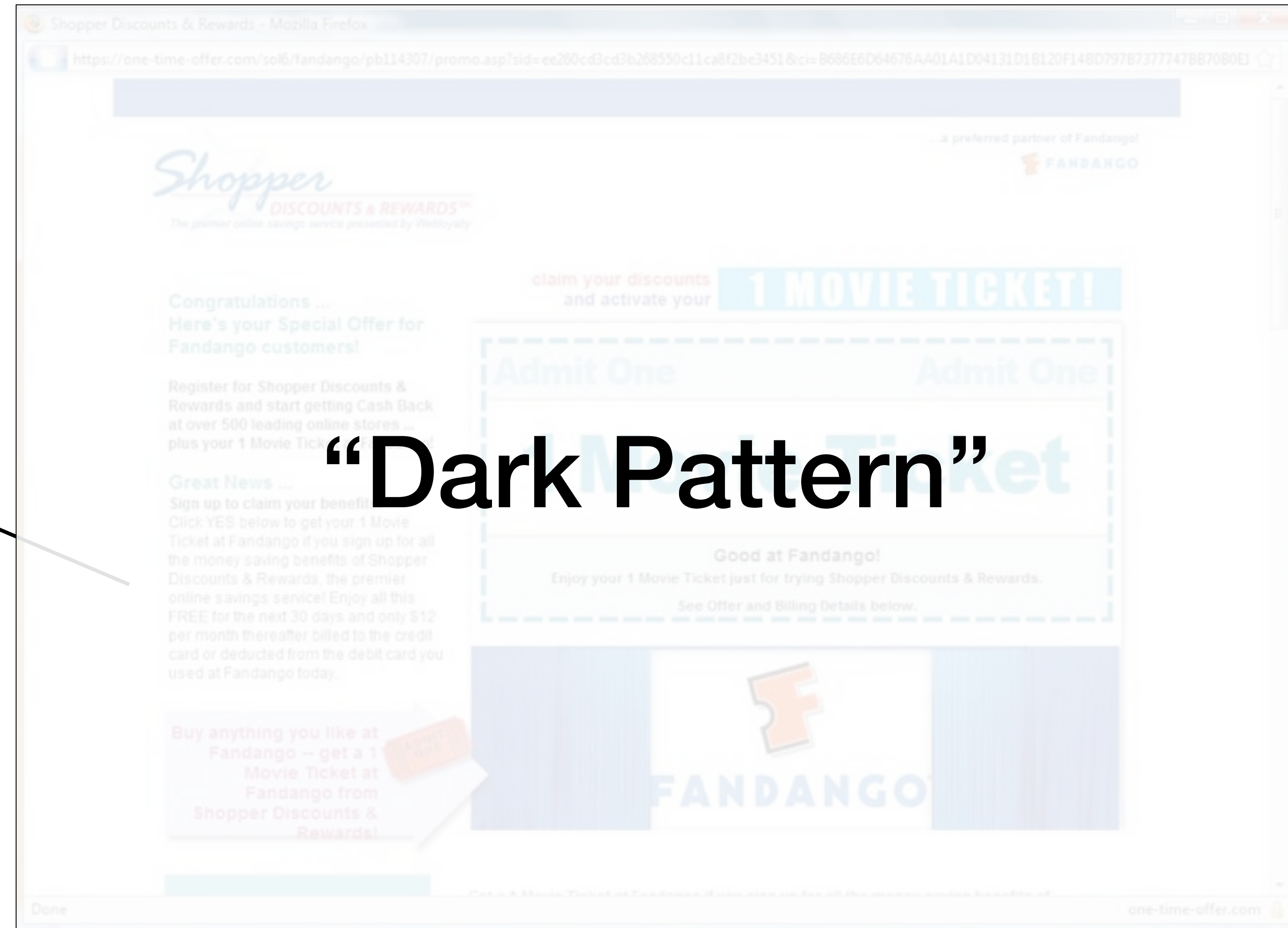




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“

**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.

”



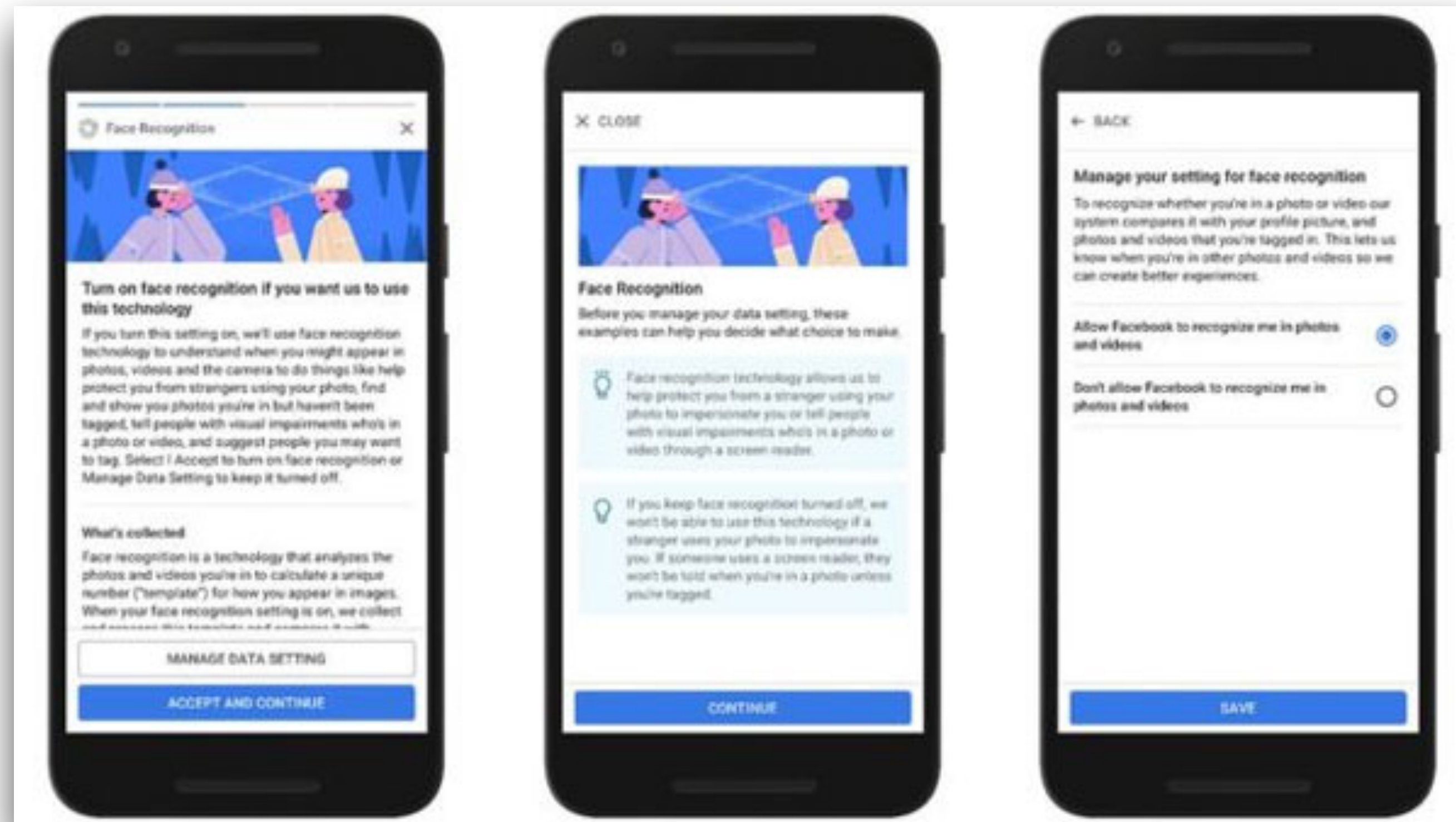
# Instagram Ad



Not a real  
strand of hair

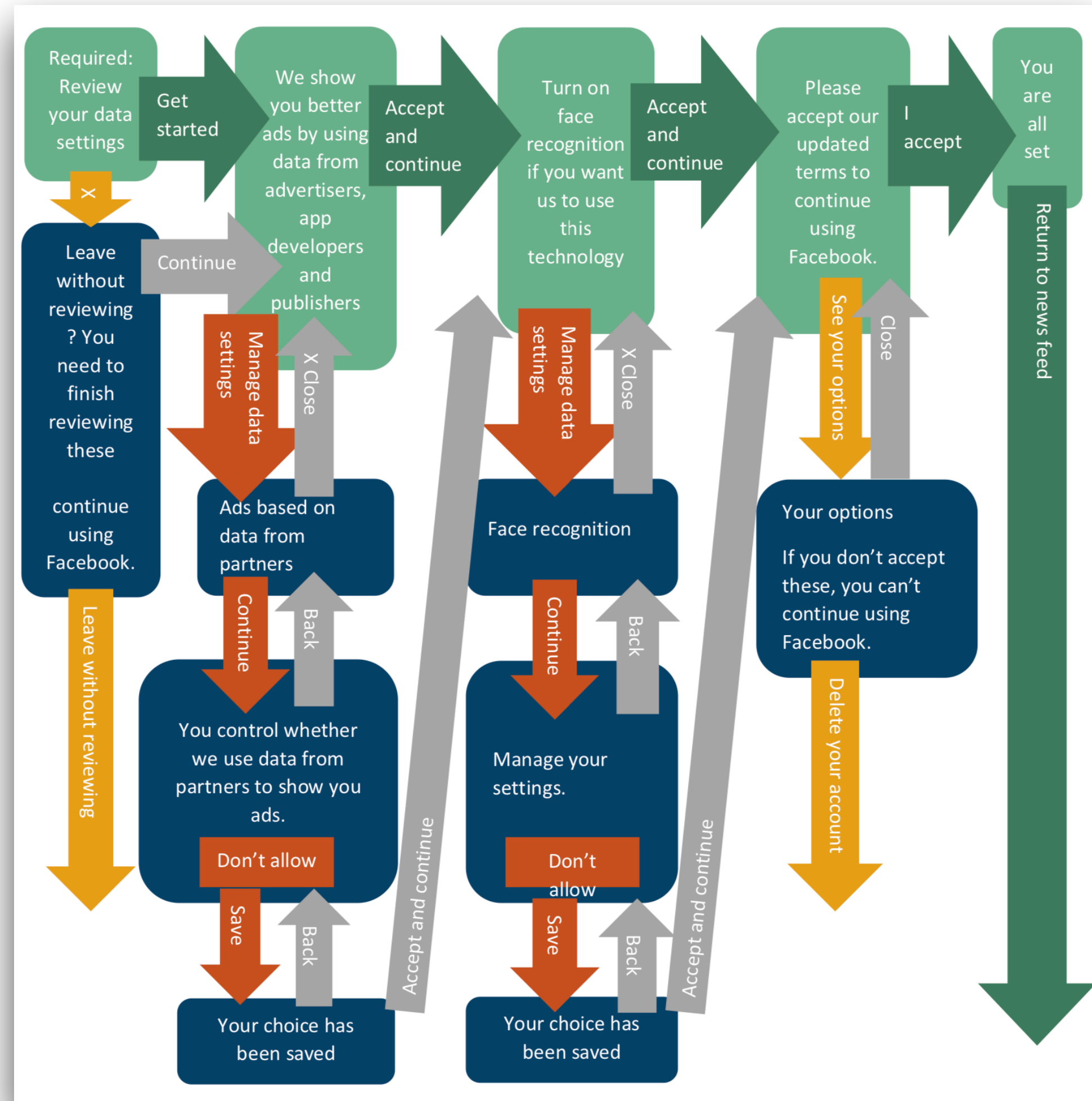


# Facebook Consent



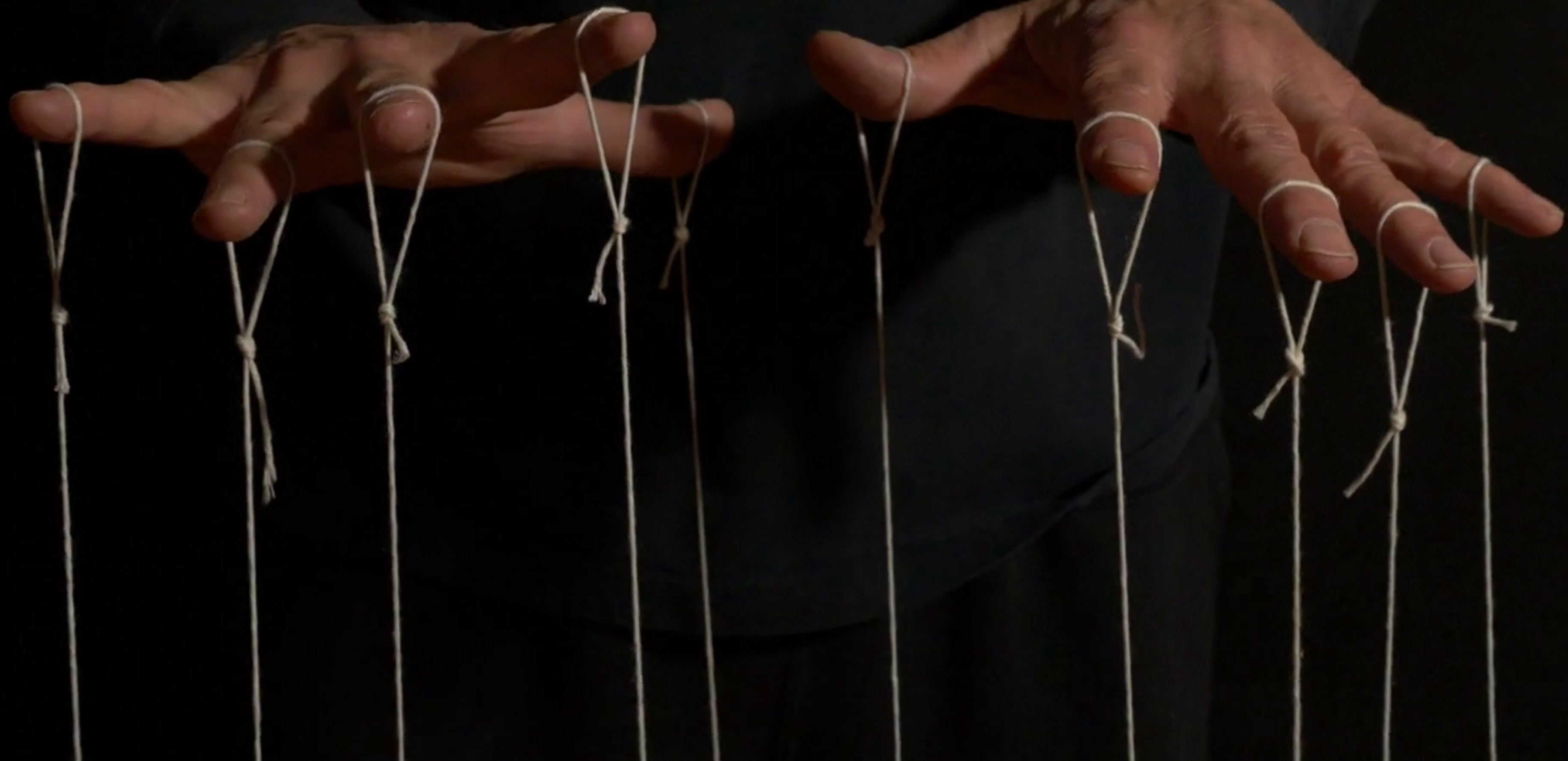


# Facebook Consent



3 clicks to provide consent  
14 clicks to revoke consent

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



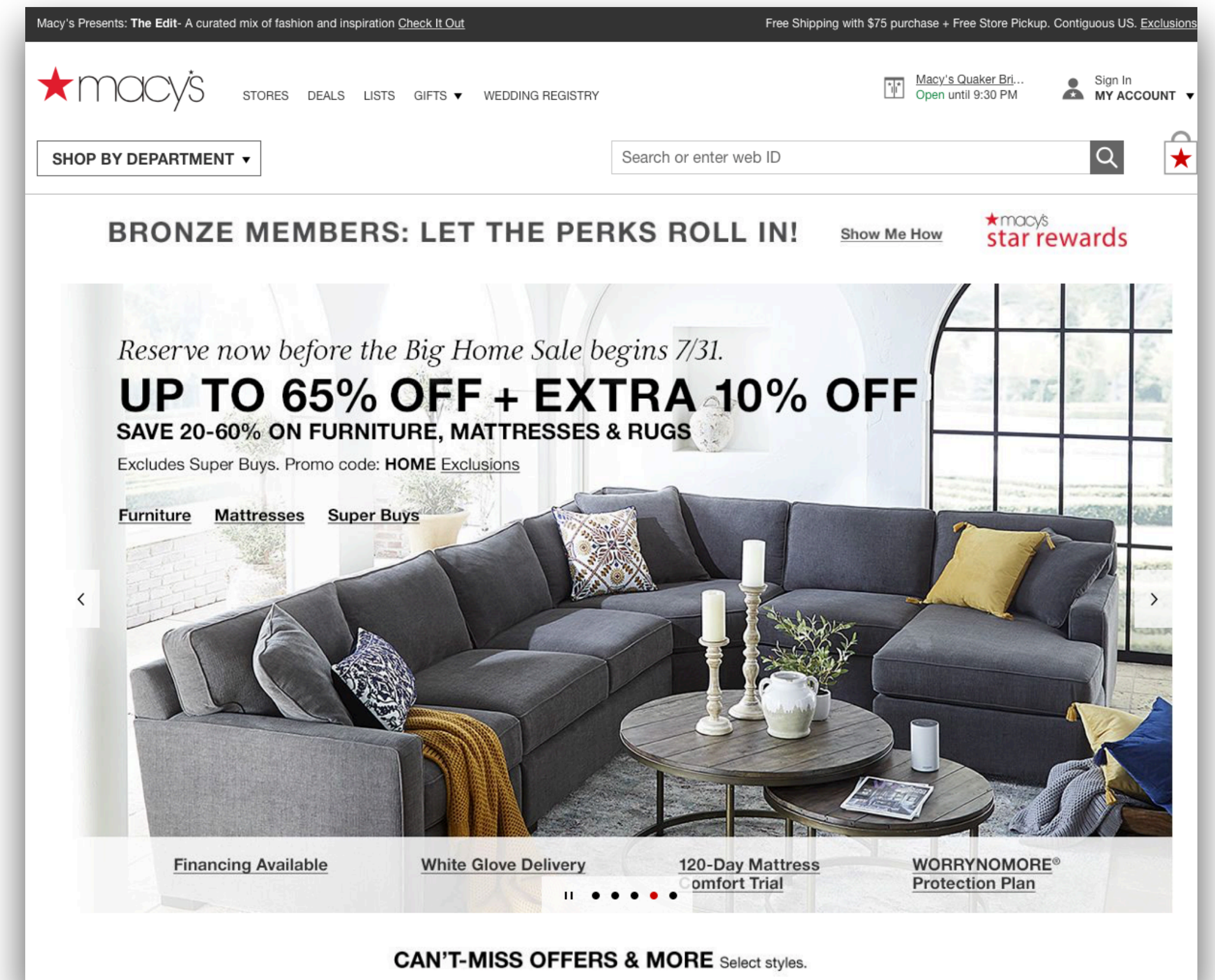


# Why Measurement?

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

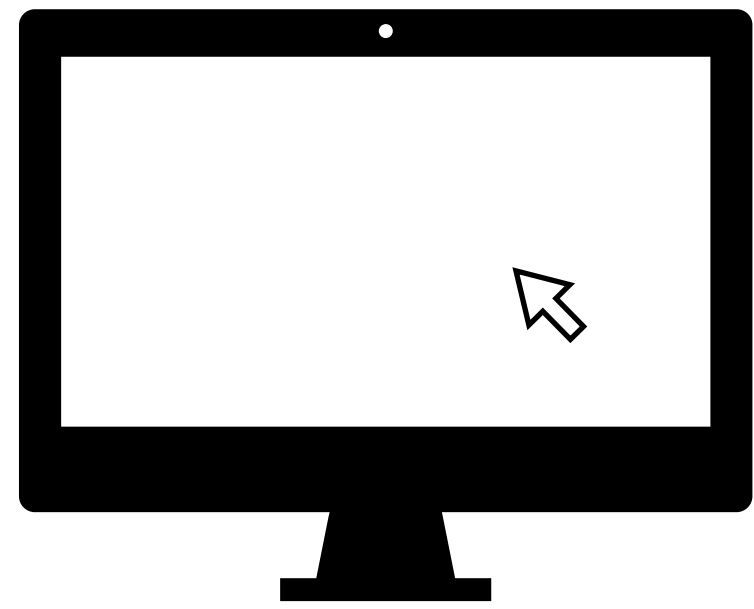
1. Developed automated techniques to help experts identify dark patterns on the web at scale
2. Created a data set of 1,818 dark patterns on 1,254 shopping websites (~11.1%)
3. Documented the third-party entities that enable dark patterns on websites
4. Created a descriptive taxonomy that characterizes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

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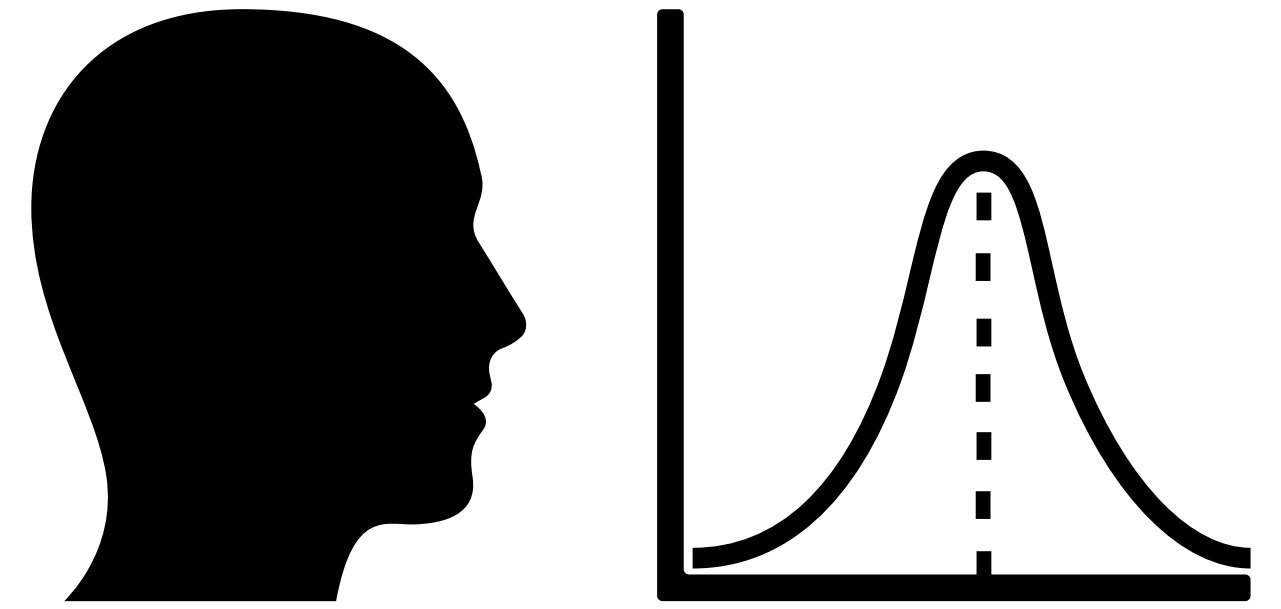
# Method: Three Key Steps



Mimicking a real user  
browsing websites

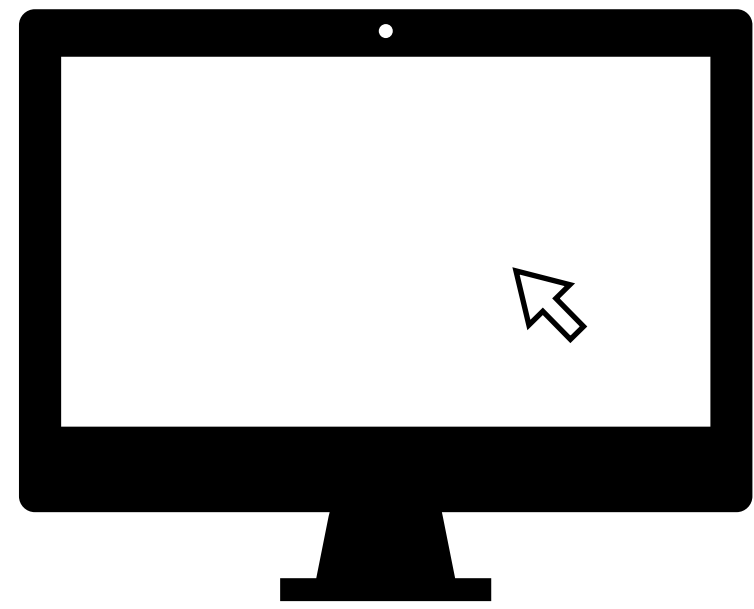


Collecting and storing  
data from websites



Analyzing collected  
data

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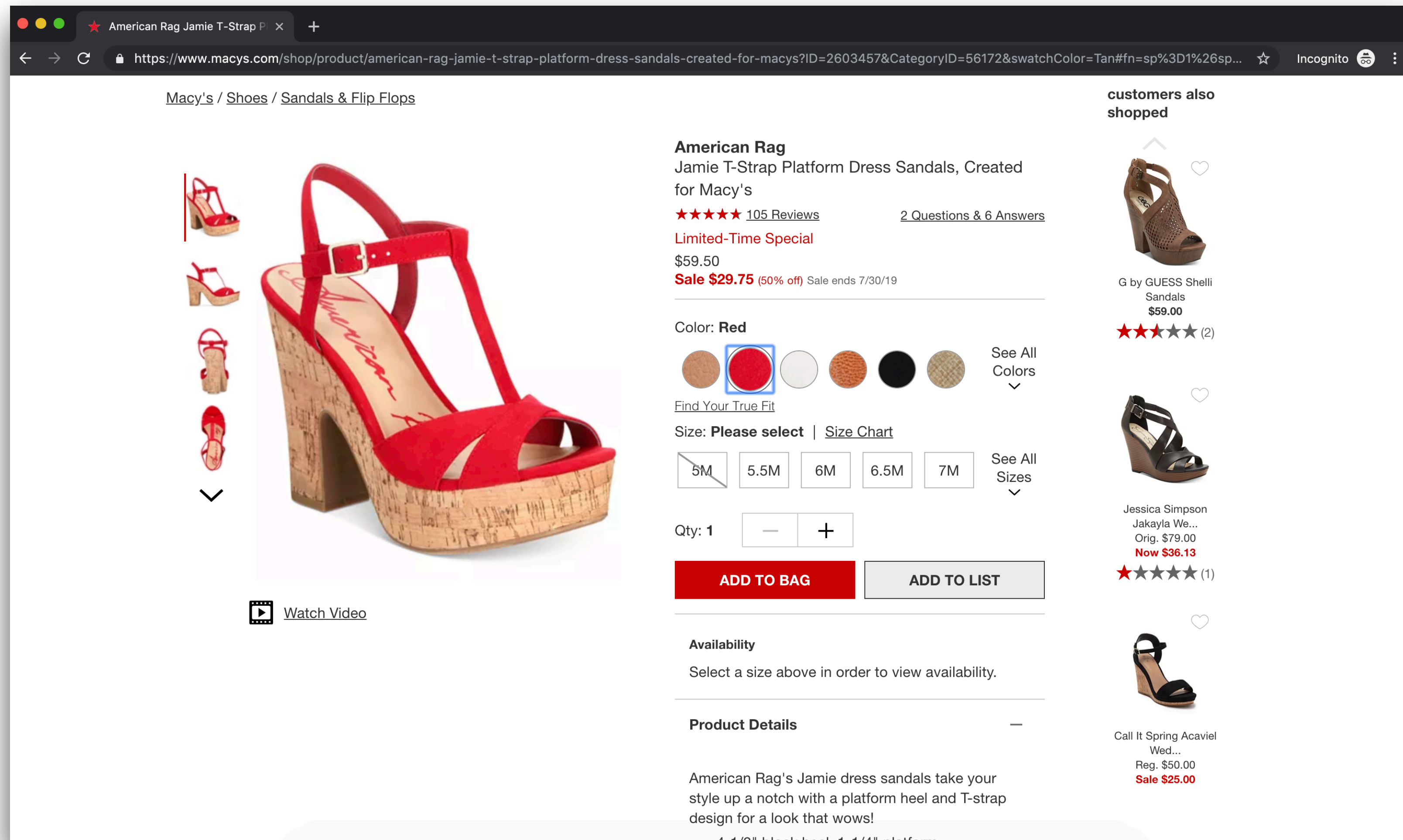


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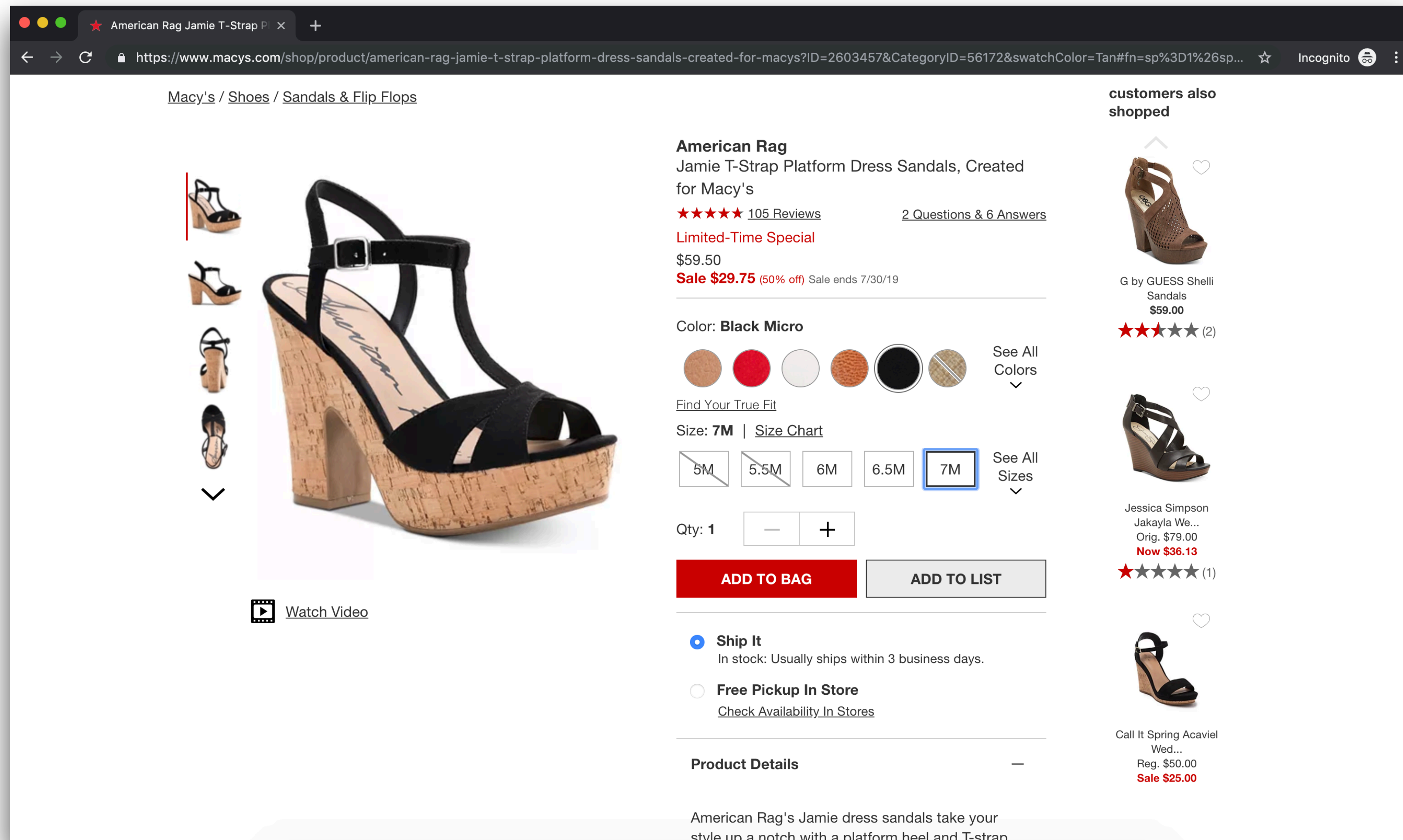
# Shopping Bot





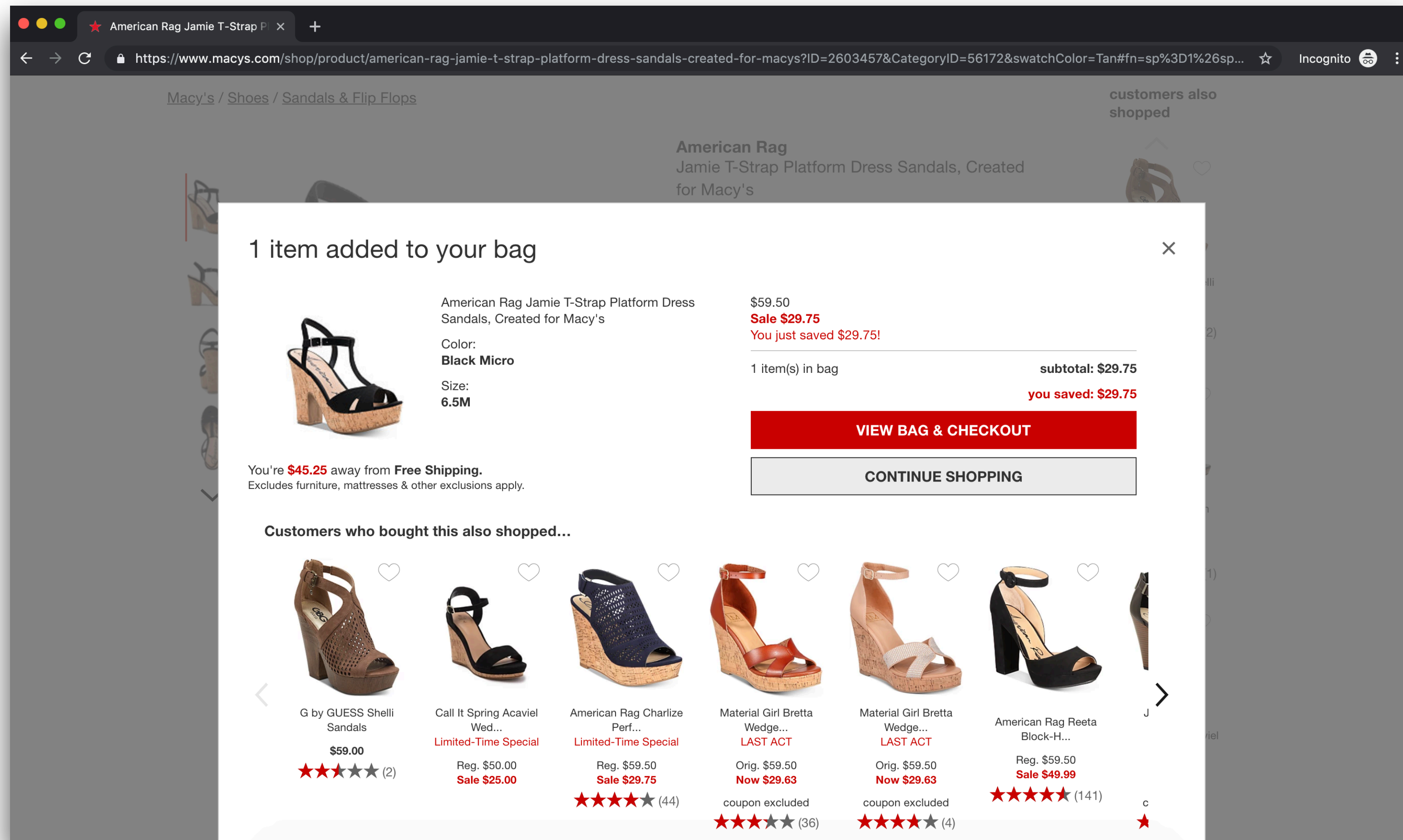


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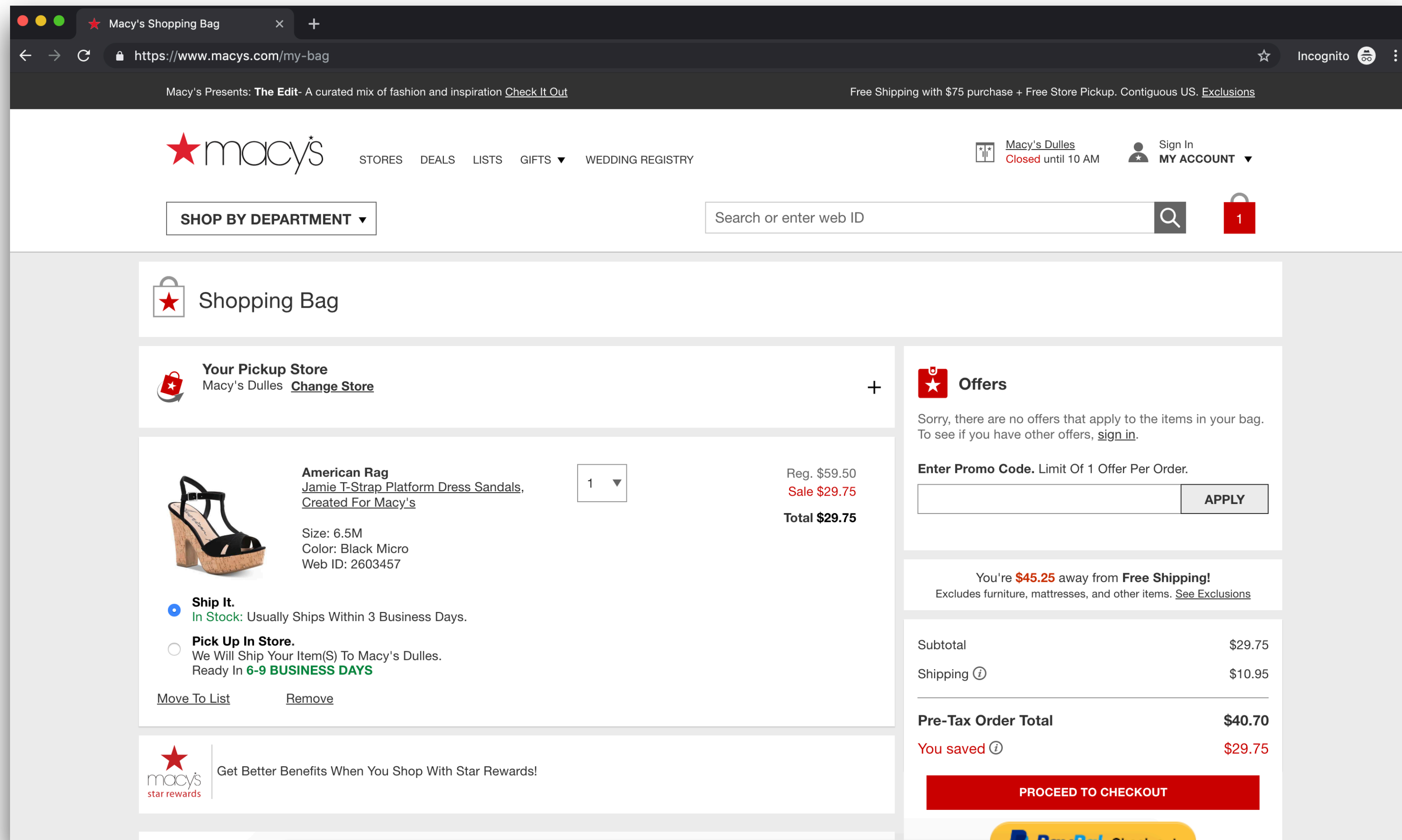


# Shopping Bot

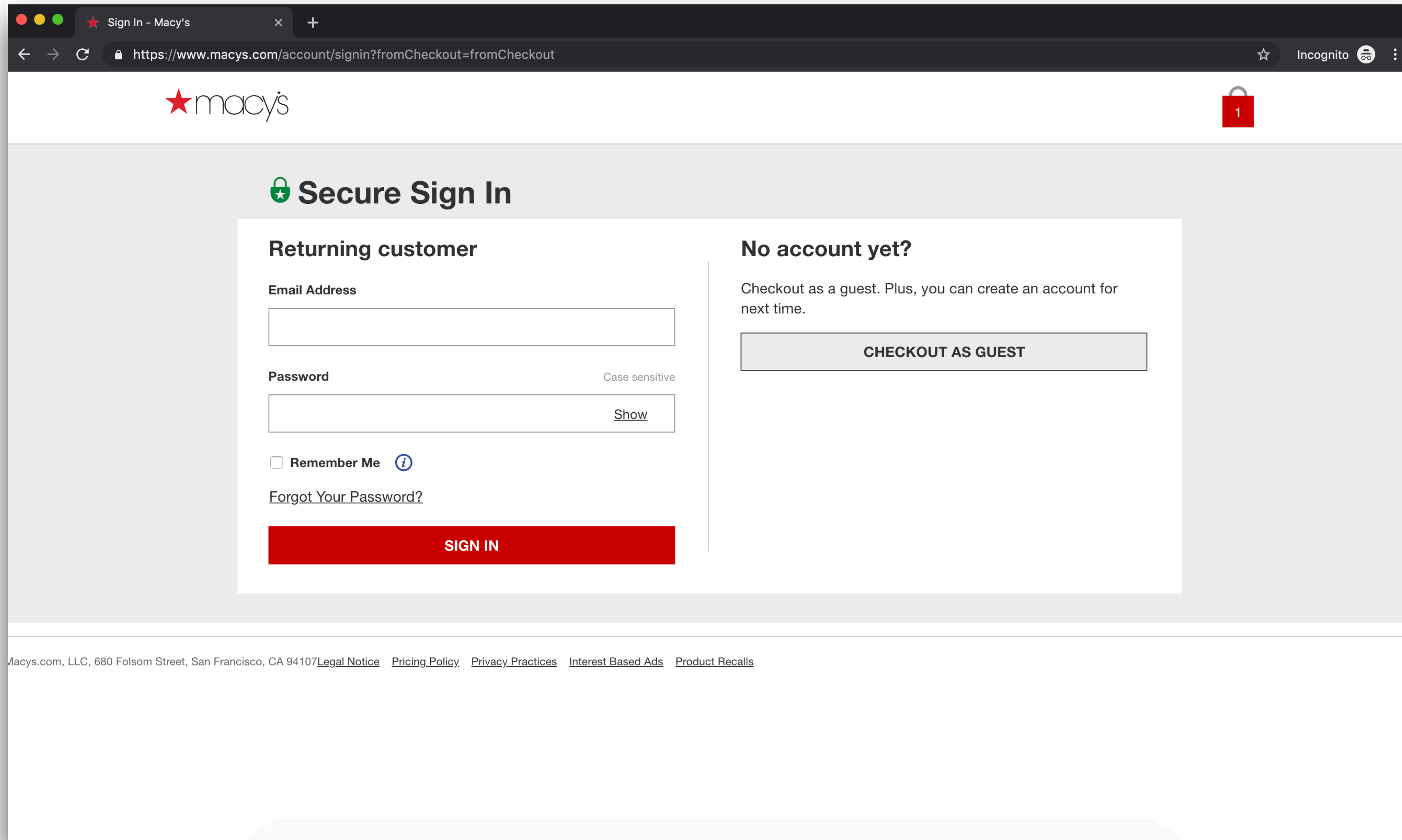




# Shopping Bot



# Shopping Bot



The image shows a web browser window with the title "Sign In - Macy's" and the URL "https://www.macys.com/account/signin?fromCheckout=fromCheckout". The browser is in Incognito mode. The Macy's logo is in the top left, and a shopping cart icon with the number "1" is in the top right. The main content area is titled "Secure Sign In" with a green padlock icon. It is divided into two columns. The left column, "Returning customer", contains fields for "Email Address" and "Password" (with a "Show" link and "Case sensitive" note), a "Remember Me" checkbox with an info icon, a "Forgot Your Password?" link, and a red "SIGN IN" button. The right column, "No account yet?", contains a "CHECKOUT AS GUEST" button. The footer includes the address "Macys.com, LLC, 680 Folsom Street, San Francisco, CA 94107" and links for "Legal Notice", "Pricing Policy", "Privacy Practices", "Interest Based Ads", and "Product Recalls".

Sign In - Macy's

https://www.macys.com/account/signin?fromCheckout=fromCheckout

Incognito

macys

1

## Secure Sign In

### Returning customer

Email Address

Password Case sensitive

[Show](#)

☐ Remember Me [i](#)

[Forgot Your Password?](#)

**SIGN IN**

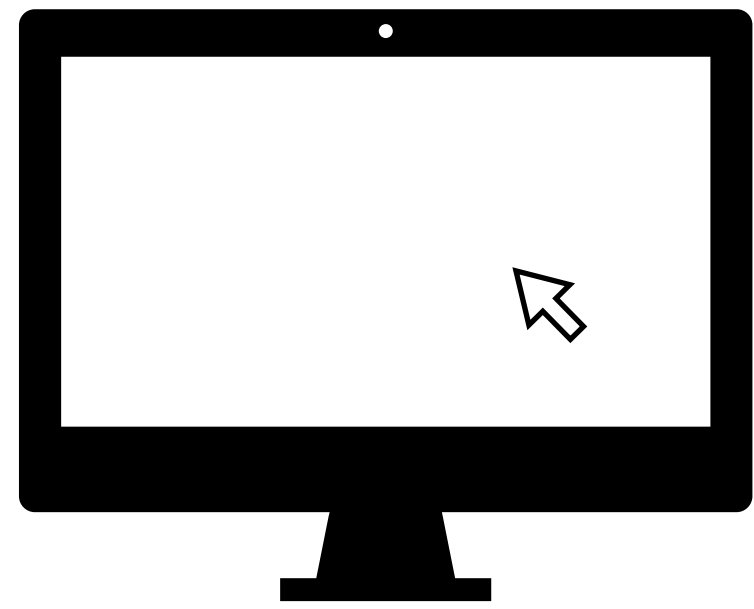
### No account yet?

Checkout as a guest. Plus, you can create an account for next time.

**CHECKOUT AS GUEST**

Macys.com, LLC, 680 Folsom Street, San Francisco, CA 94107 [Legal Notice](#) [Pricing Policy](#) [Privacy Practices](#) [Interest Based Ads](#) [Product Recalls](#)

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# 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](#)

6M

6.5M

9.5M

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-Resista. ...

Orig. \$79.00

**Now \$39.13**

★★★★★ (45)




Style & Co Angiee Lace-Up ...

Orig. \$79.50

**Now \$37.93**

★★★★★ (29)



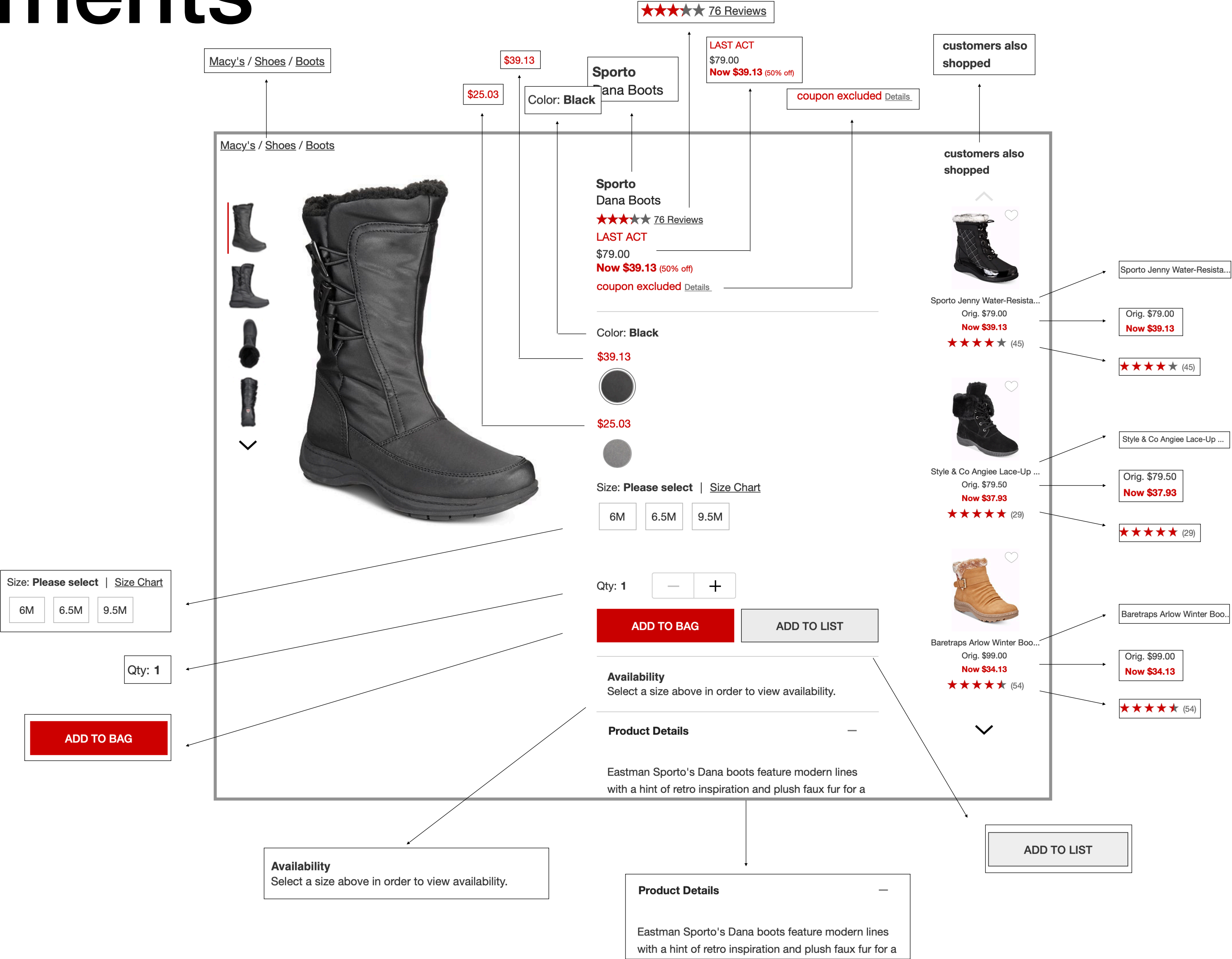
Baretraps Arlow Winter Boo. ...

Orig. \$99.00

**Now \$34.13**

★★★★★ (54)

# Page Segments





# Page Segments

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

Macy's / Shoes / Boots

Macy's / Shoes / Boots

Sporto Dana Boots

★★★★★ 76 Reviews

LAST ACT \$79.00 Now \$39.13 (50% off)

coupon excluded Details

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Size: Please select | Size Chart

6M 6.5M 9.5M

Qty: 1

ADD TO BAG

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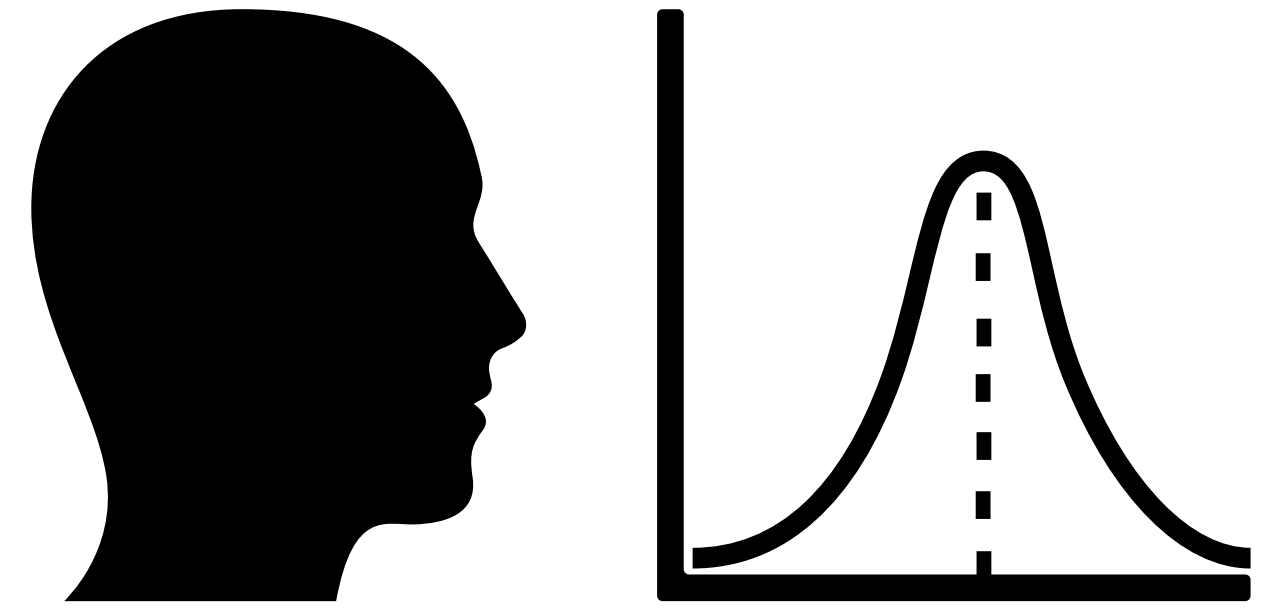
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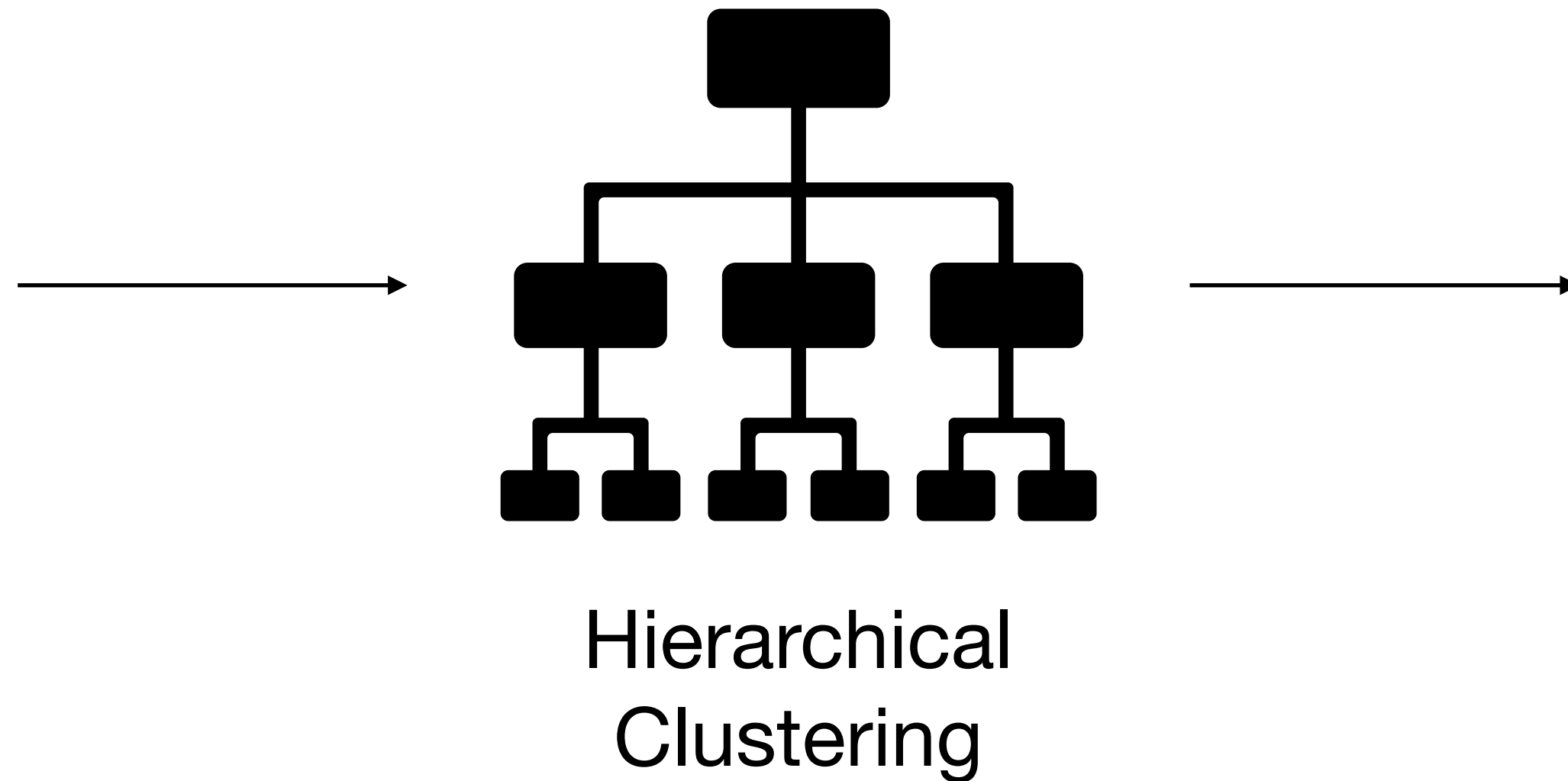
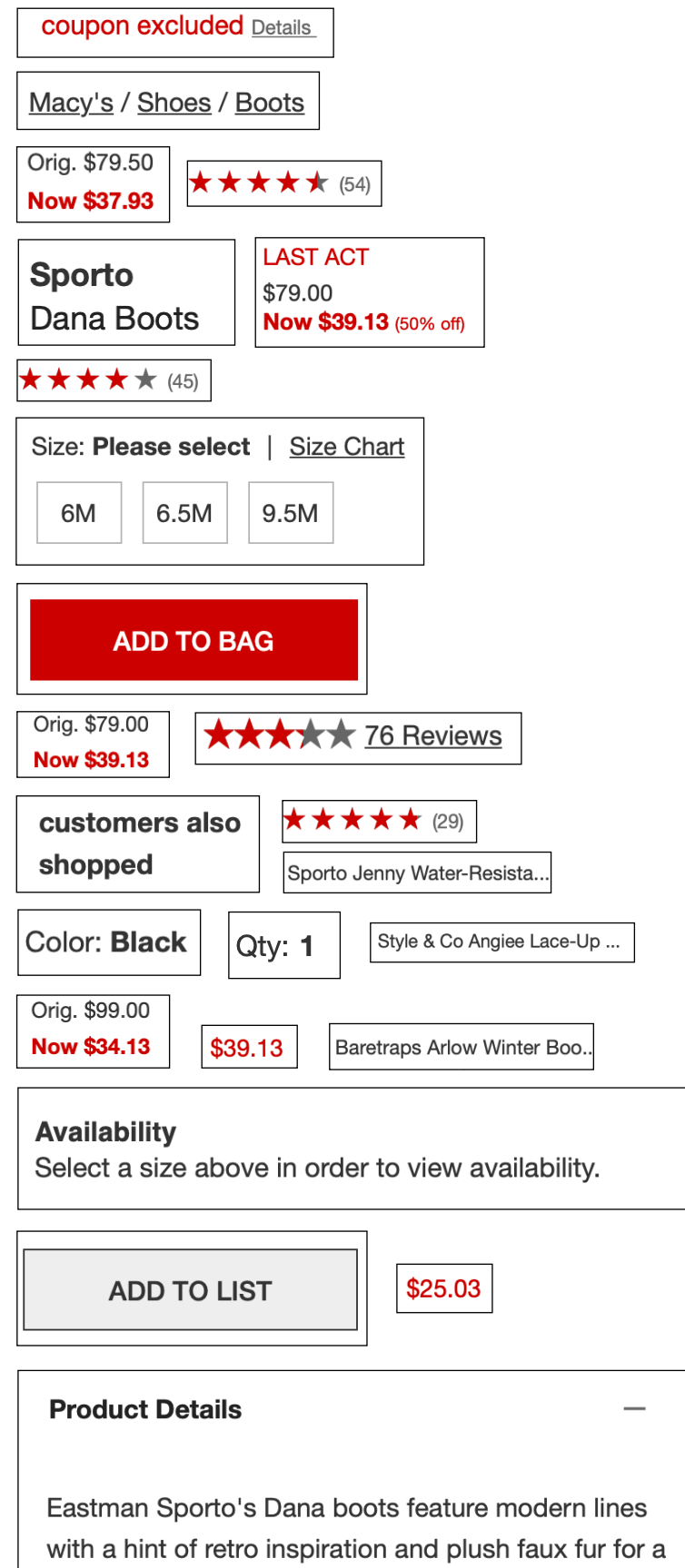
Collecting and storing  
data from websites



Analyzing collected  
data



# Clustering Segments



# 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

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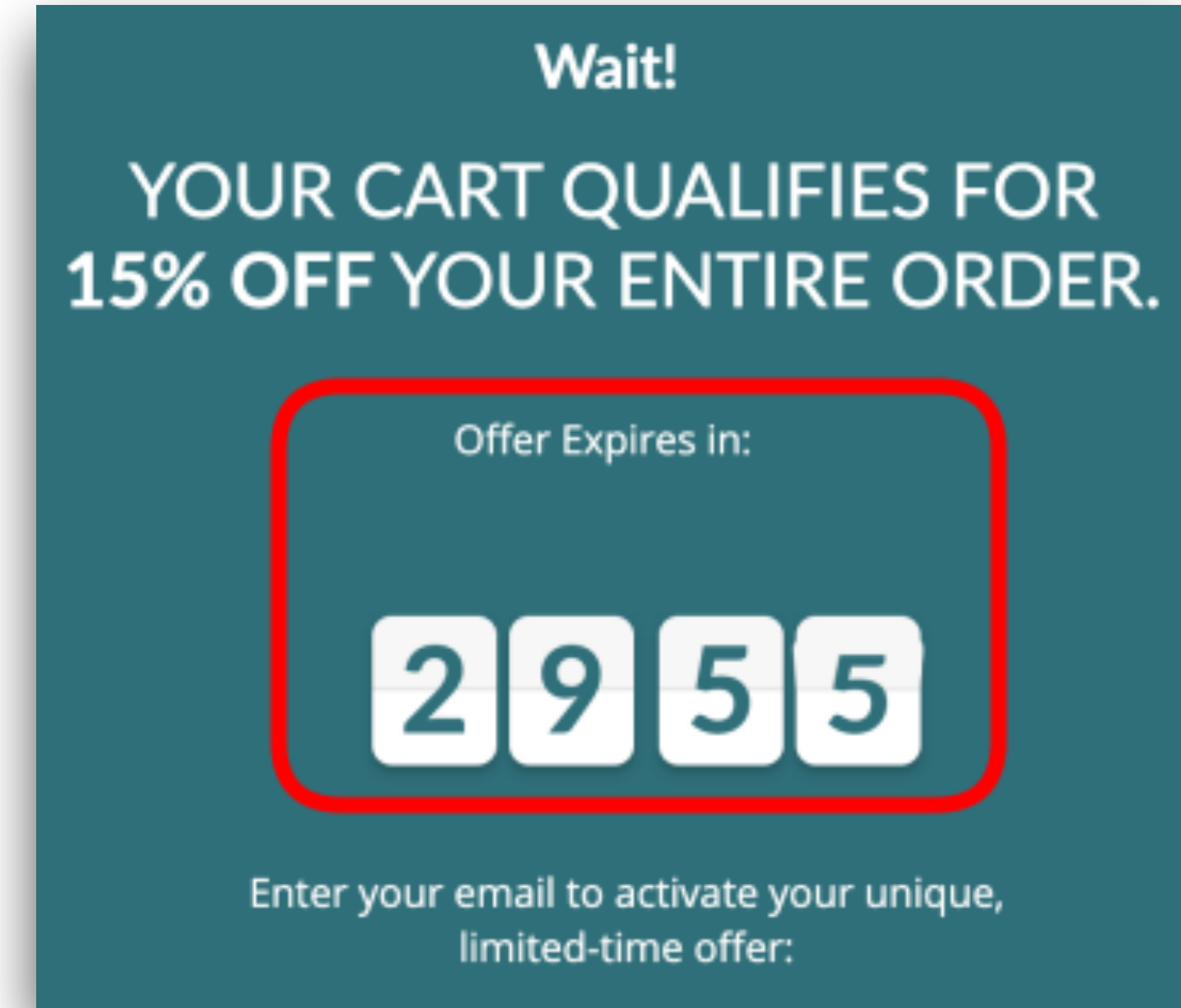
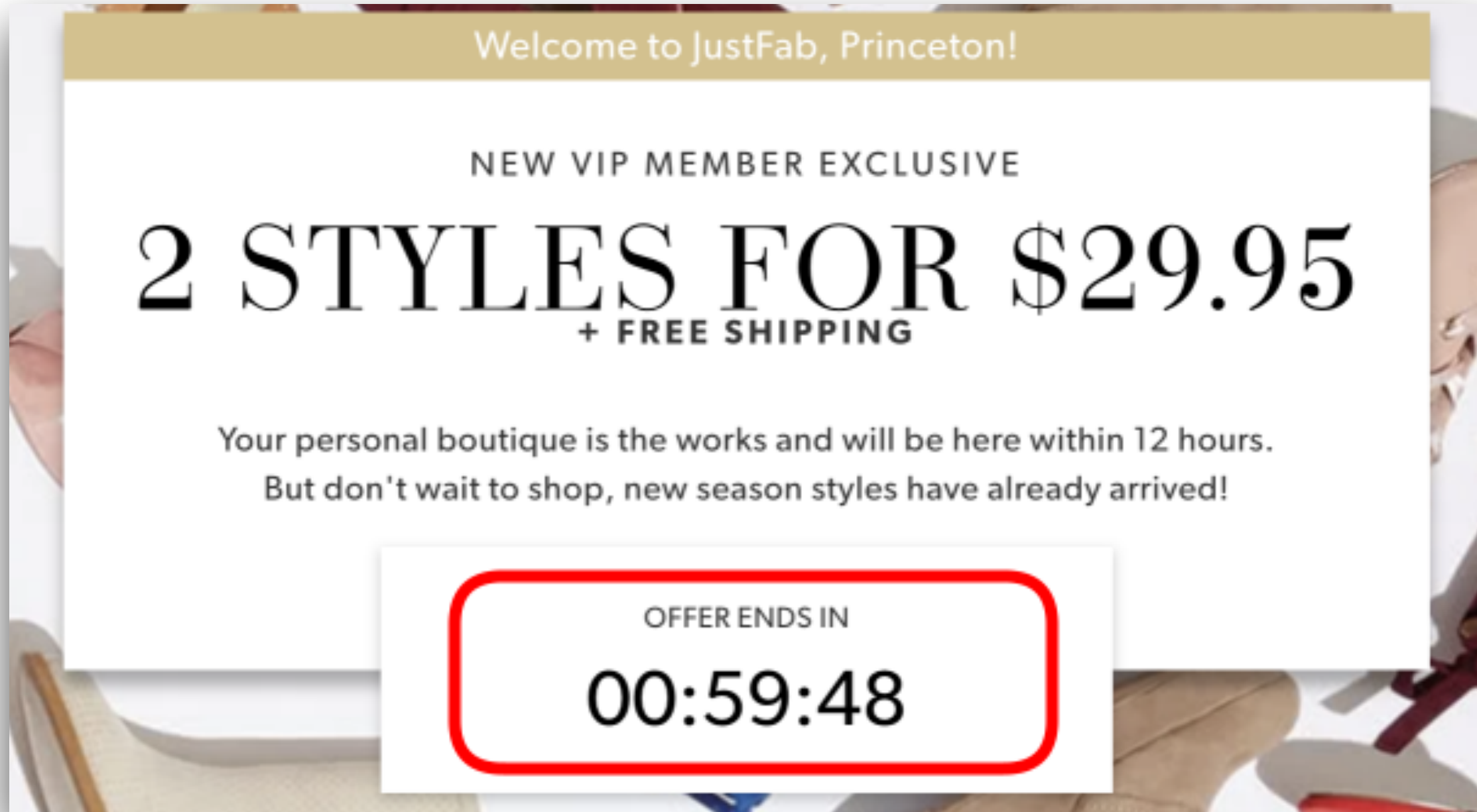
1. Hard to Cancel

## 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

2

3

Delivery Info



Billing Info

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
<div><div></div><div><div>Dreaming of Tuscany</div><div>Selected: "As Shown"</div><div>2nd choice: similar as possible, same look and feel</div></div></div> <div>1</div> <div>\$52.99</div> <div>\$52.99</div>			
<div><div></div><div><div>Greeting Card Service</div><div>Selected: "STANDARD"</div></div></div> <div>1</div> <div>\$3.99</div> <div>\$3.99</div>			

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  
Garauntee

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

**15 bottles for JUST \$13.29 each**

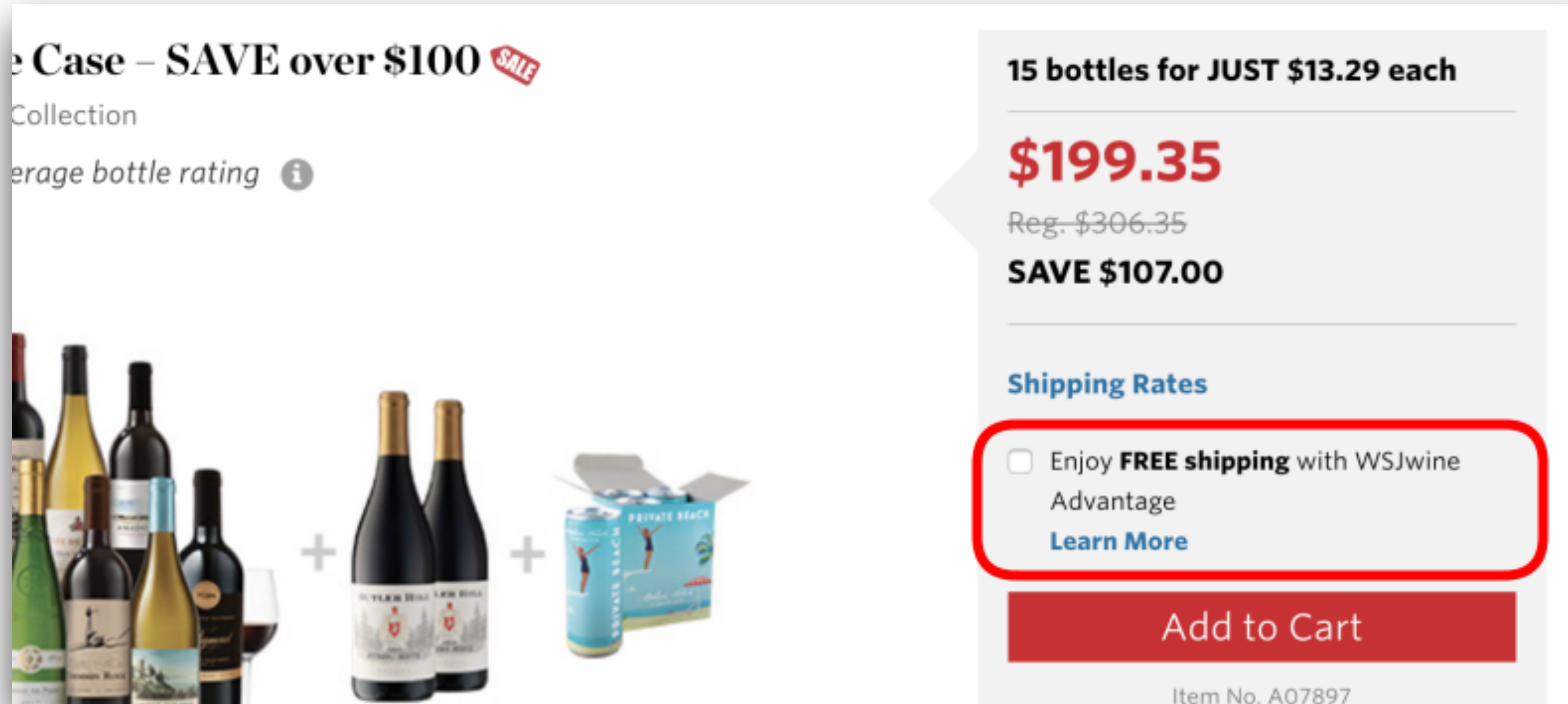
**\$199.35**  
Reg. \$306.35  
**SAVE \$107.00**

**Shipping Rates**

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

**Add to Cart**

Item No. A07897

A promotional banner for a wine collection. On the left, there's a group of various wine bottles and a box of 'Private Beach' cans. In the center, a large red box highlights the 'FREE shipping' option under the 'Shipping Rates' section. To the right, the price is shown as \$199.35, down from a regular price of \$306.35, with a savings of \$107.00. Below the shipping option is a red 'Add to Cart' button and the item number A07897.

**VIP ✨ rewards**  
**YOU DESERVE OUR SPECIAL TREATMENT!**

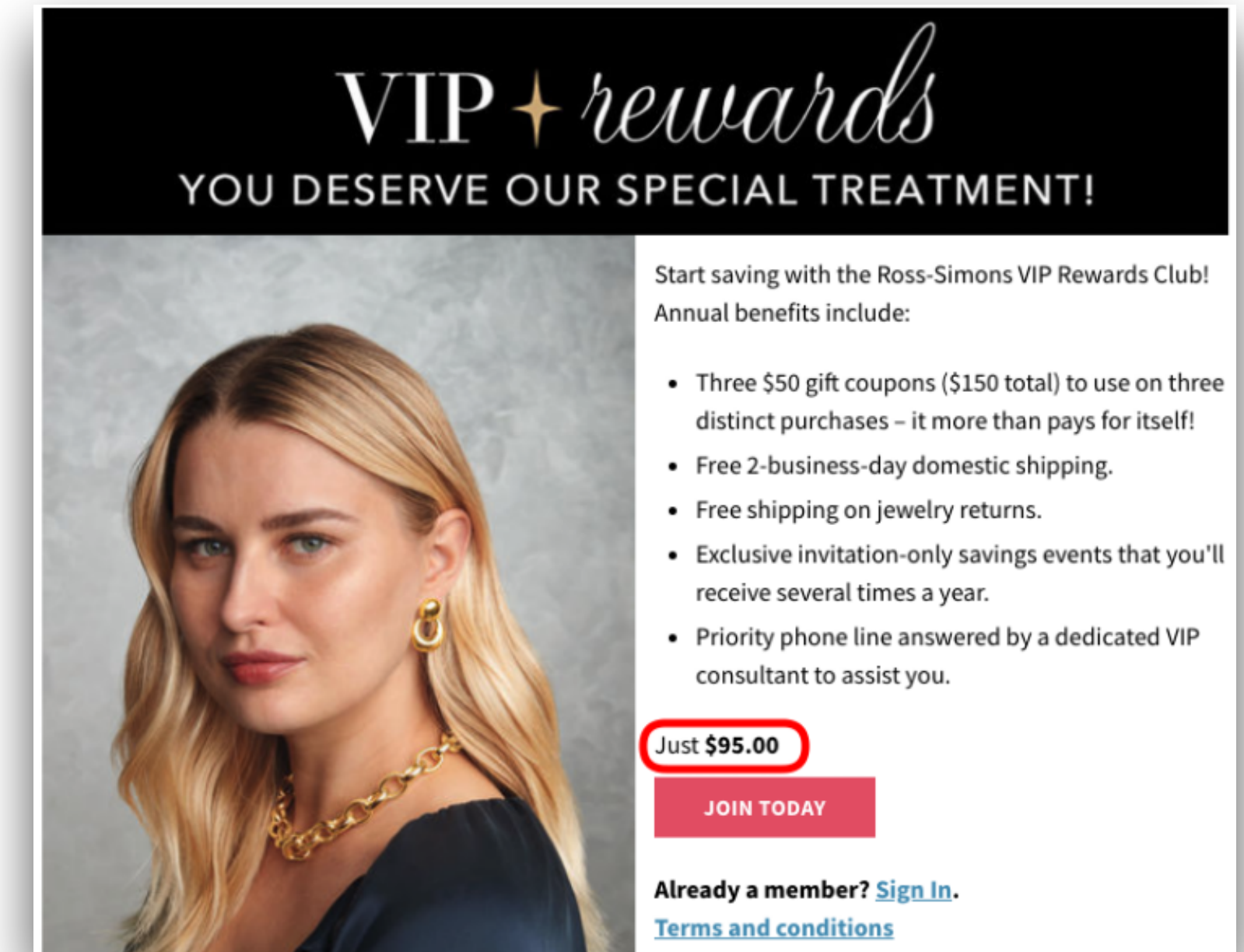
Start saving with the Ross-Simons VIP Rewards Club!  
Annual benefits include:

- 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**

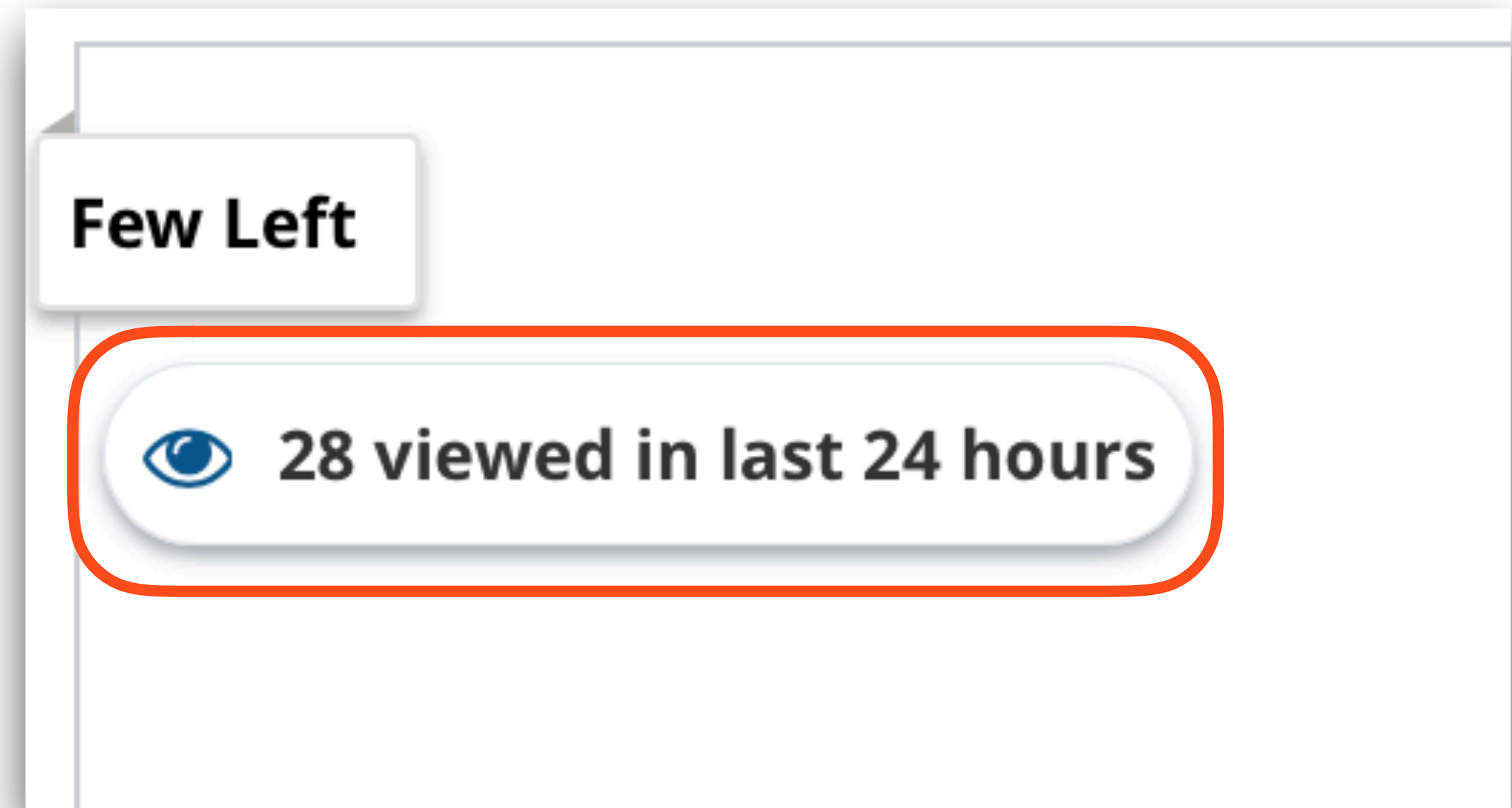
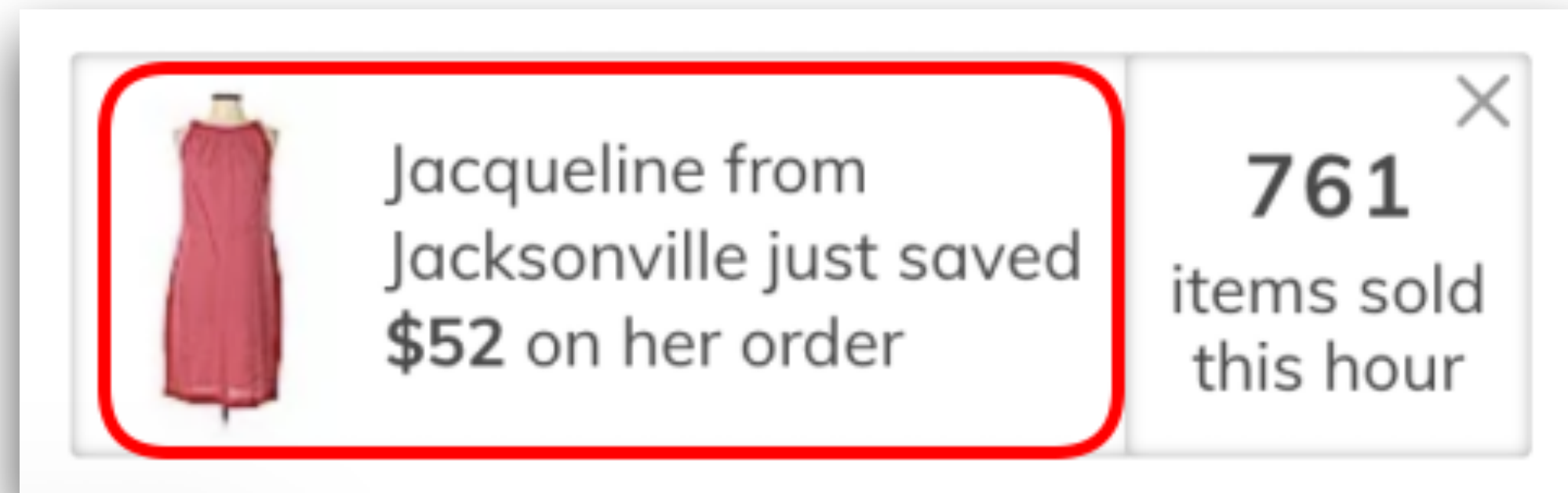
Already a member? [Sign In.](#)  
[Terms and conditions](#)

A promotional banner for the Ross-Simons VIP Rewards Club. On the left, a woman with blonde hair is wearing a gold necklace and earrings. To the right, a list of annual benefits is provided, including three \$50 gift coupons, free shipping, and exclusive events. The price is highlighted as 'Just \$95.00' in a red box, with a red 'JOIN TODAY' button below it. At the bottom, there are links for 'Sign In' and 'Terms and conditions'.

14 instances

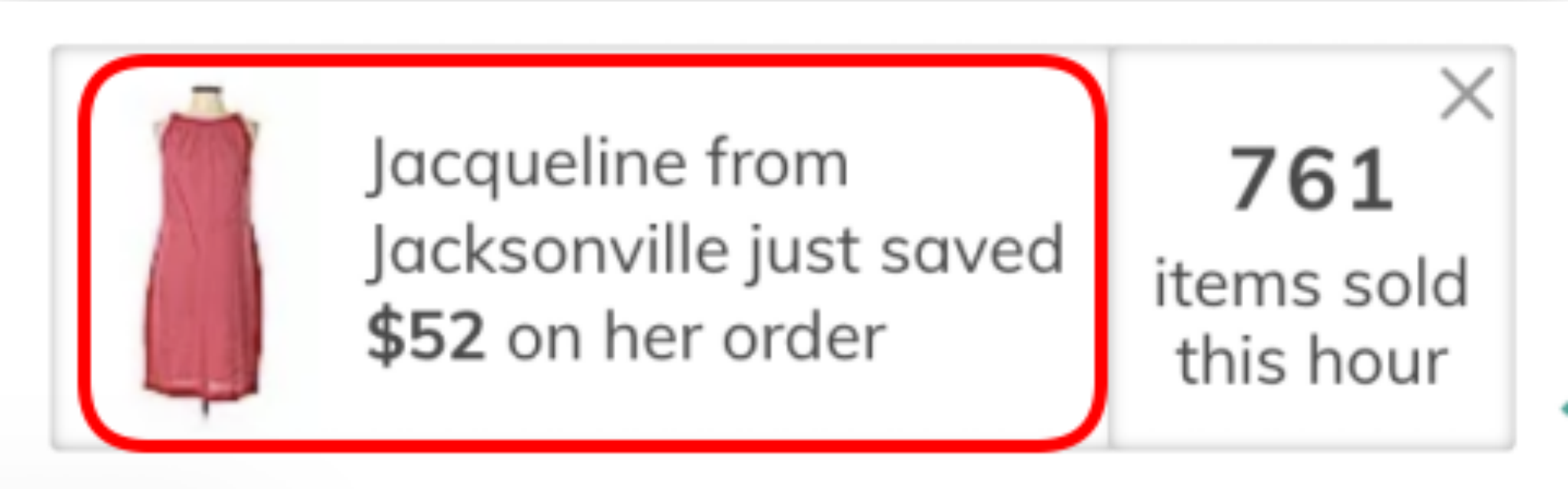


# DP #4: Social Proof — Activity Notification



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

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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.

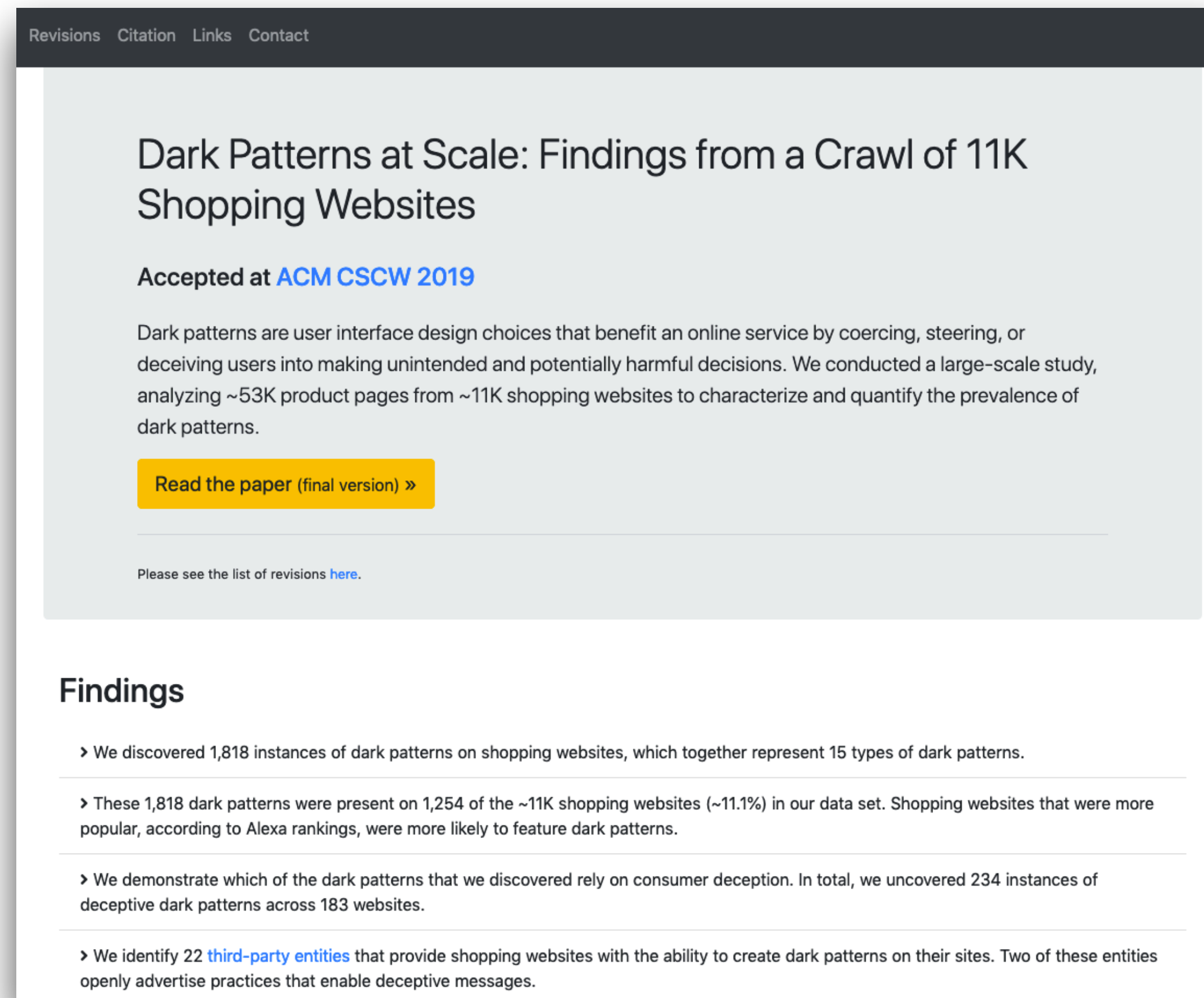
<input type="checkbox"/> <b>YES</b> I do want to hear about exclusive offers & discounts	<input type="checkbox"/> <b>NO</b> I'd rather NOT hear about exclusive offers & discounts
--	---

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

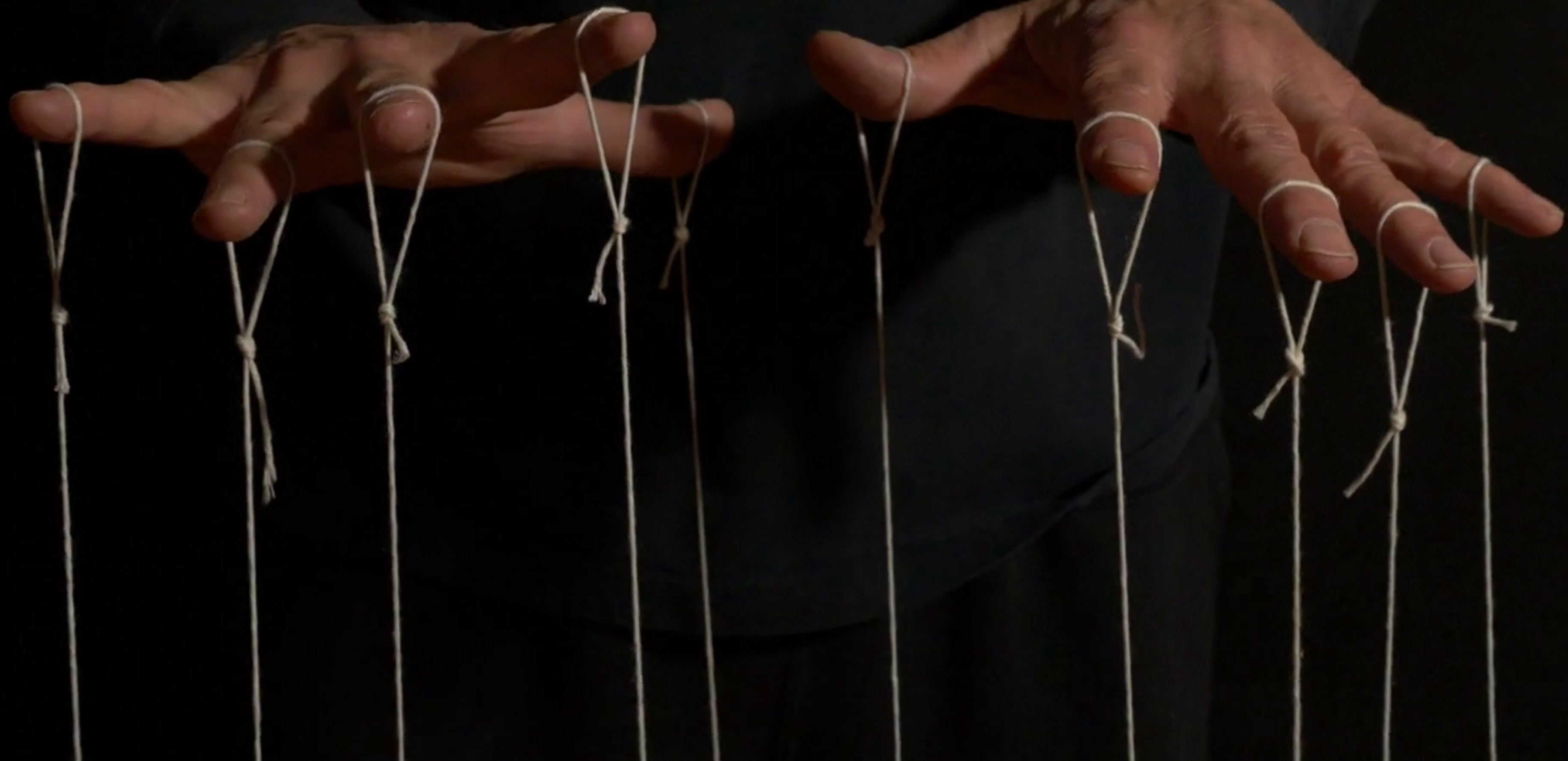


# Code, Data, and More Examples



webtransparency.cs.princeton.edu/dark-patterns

# What can we do about dark patterns?

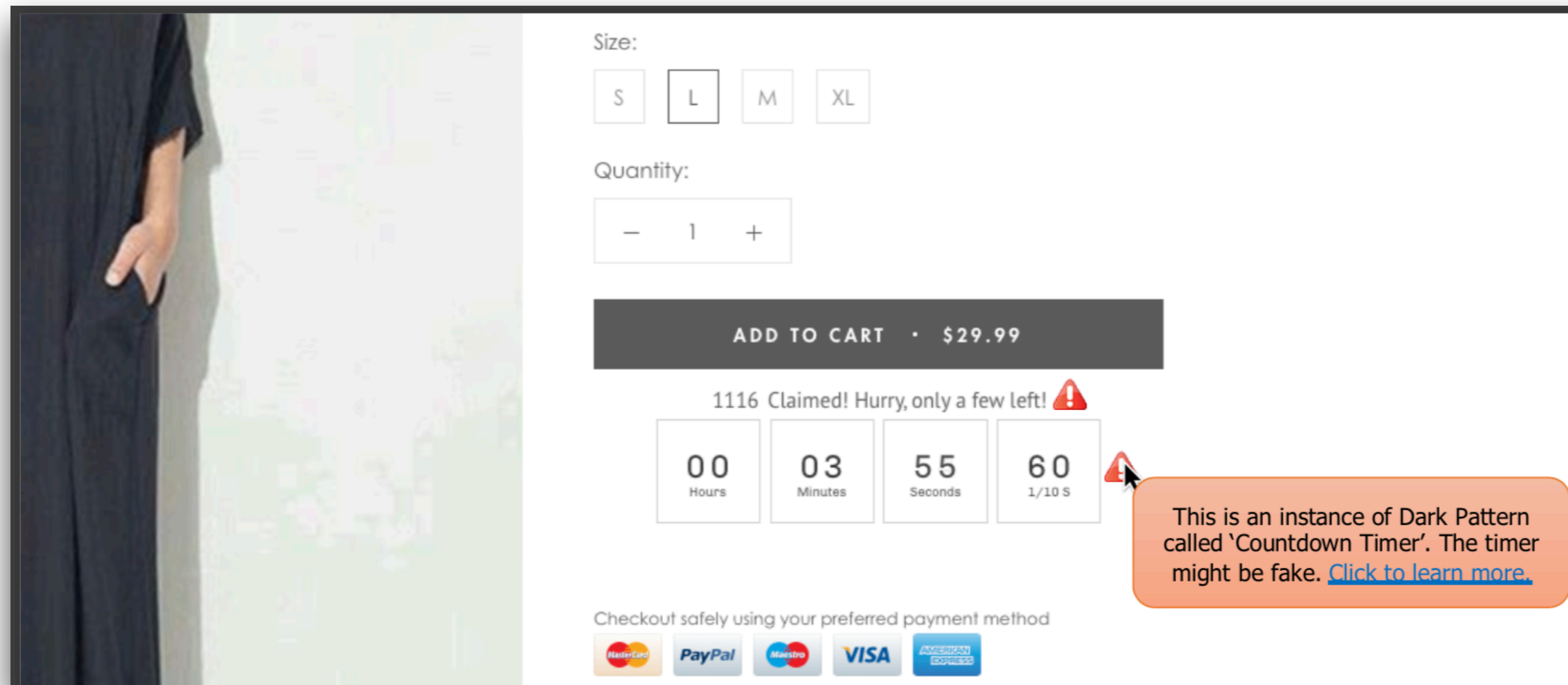


# Future Research

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



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
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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](https://webtransparency.cs.princeton.edu/dark-patterns)**

# Questions?

 amathur@cs.princeton.edu

 @aruneshmathur