IMPULSIVE BUYING & DARK PATTERNS

Are you really in control of the buying choices you make?

Problem Statement

What is the problem we are trying to solve?

Dark patterns are deceptive design tactics intentionally designed to manipulate users into taking actions that benefit companies. For example

- Scarcity: Platforms claim to have limited stock left or claim that something has high demand.
- Limited time deals: Platforms create urgency by putting a time limit on an offer.

This project aims to:

- Measure the impact of dark patterns on impulsivity and cognitive load, using a combination of physiological (pupil dilation), behavioral (mouse click data), and subjective (survey) data.
- Test the effectiveness of interventions (distraction and reflection) in reducing the effects of dark patterns.

Examples of Dark Patterns:

Limited-time deal

Scarcity

Why is it important?

User Manipulation: Dark patterns lead to unethical manipulation of users, often exploiting their cognitive limitations. This impacts users' autonomy and decision-making capacity, ultimately leading to regretful purchases or poor decision-making.

- A 2021 Baymard Institute study found that urgency-inducing dark patterns, such as countdown clocks or "only X left in stock" notifications, increased the likelihood of an unnecessary purchase by 40%.
- In a survey conducted by the Journal of Consumer Research (2019), participants reported that limited-time offers or "one-time-only" deals triggered impulsive buying 56% of the time.
- Increased impulsive buying has shown to increase financial distress and harm people with depression like tendencies that often fall into compuslive buying habits as a coping mechanism.

- Therefore it is important to find interventions (personalised) that can protect vulnerable users from falling into such traps that can harm them.

Potential Applications

Personalised warning system that work by identifying mechanisms behind a persons buying paterns in presence of different dark patterns.

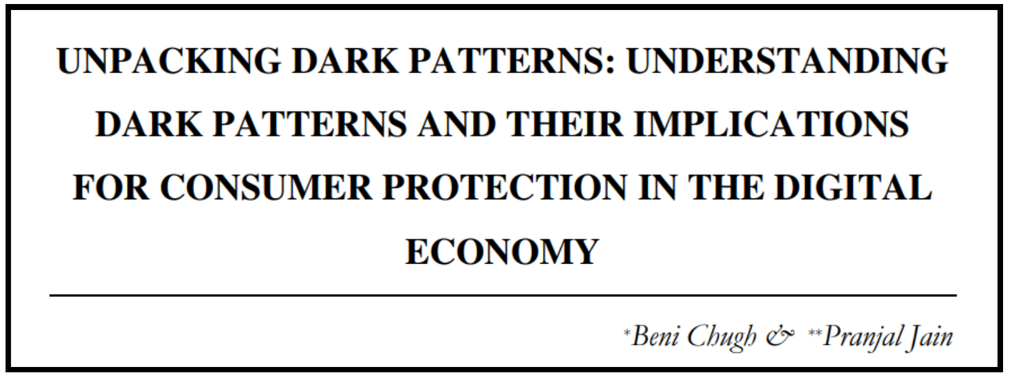
Shopoholics Rehab

Potential Impact

Literature Review

Literature review

PAPER 1


UNPACKING DARK PATTERNS: UNDERSTANDING DARK PATTERNS AND THEIR IMPLICATIONS FOR CONSUMER PROTECTION IN THE DIGITAL ECONOMY

*Beni Chugh & **Pranjal Jain

The paper discusses the use of dark patterns in digital interfaces, which manipulate users into making decisions that go against their preferences.

Insights:

System 1 vs. System 2 Thinking:

- Dark patterns appeal to System 1 (fast, automatic, impulsive thinking), leading users to make quick decisions that benefit providers, rather than carefully considered choices (System 2).

Vulnerability:

- People with lower education and income are more likely to be manipulated by dark patterns.

Power Imbalance:

- Dark patterns increase the power imbalance between consumers and digital platforms.

Literature review

PAPER 2

Behavioural Public Policy (2022), 1–27
doi:10.1017/bpp.2022.11

CAMBRIDGE UNIVERSITY PRESS

ARTICLE

Dark patterns in online shopping: do they work and can nudges help mitigate impulse buying?

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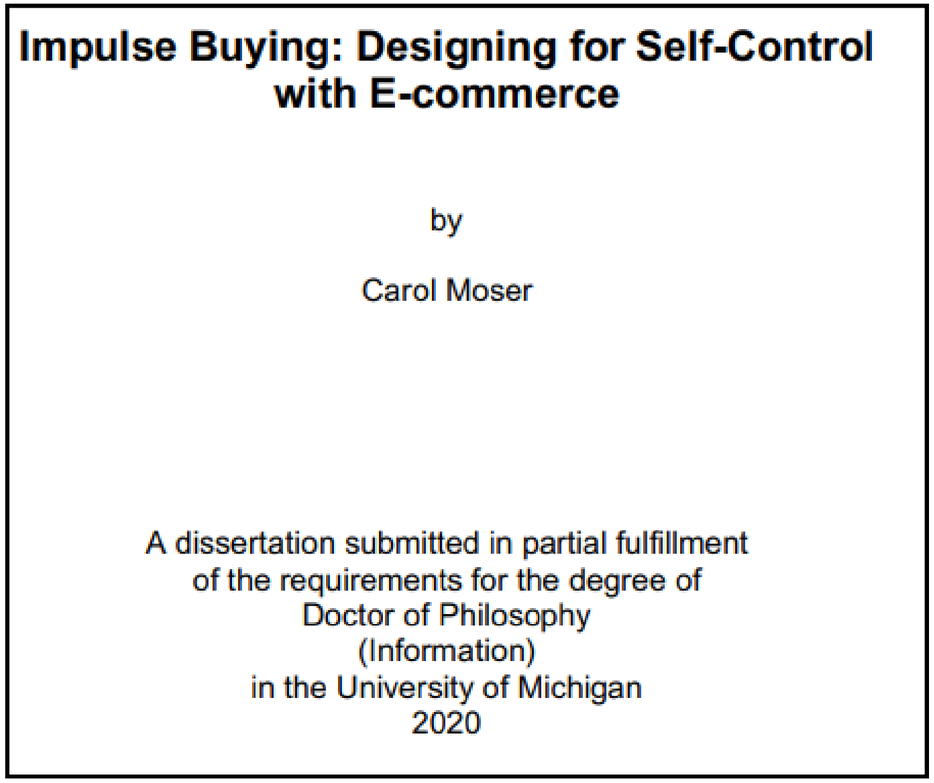
(Received 12 August 2021; revised 9 March 2022; accepted 23 March 2022)

- The paper explores how certain design elements on e-commerce websites, called **"dark patterns"** push people into making impulsive, often hasty purchases.

- It also evaluates different methods aimed at reducing the effect of these dark patterns, testing them in a more realistic shopping scenario with multiple products.

Literature review

PAPER 3



Impulse Buying: Designing for Self-Control with E-commerce

by

Carol Moser

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Information)
in the University of Michigan
2020

Impulse buying leads to financial hardship and regret. A study of 200 e-commerce websites shows widespread use of impulse-driving features.

Consumers express a need for tools that encourage reflection, and postpone purchases while rejecting guilt-based methods.

Intervention Insights:

Postponement:

- A 25-hour delay is useful but a 10-minute delay is ineffective if participants continue browsing.

Reflection & Distraction:

- Spending 3½ minutes on reflection &
- Spending 3½ minutes on distraction (no browsing possible) reduces urge and purchase intent.

How are we building upon these solutions ?

Incorporating Human Factors:

- Past research focused mainly on impulsivity and purchase behavior, through surveys.
- Our Approach: We assess cognitive load as well:
  - Physiological data (pupil dilation)
  - Behavioral data (purchasing patterns through click data)
  - Subjective data (surveys)

More Realistic Shopping Scenarios:

- Previous studies tested only one product, in a simplified interface
- Our Approach: We present multiple products, creating a more natural shopping experience for users.

Testing Intervention Effectiveness:

- Past research did not explore which intervention works best.
- Our Approach: We test and compare reflection and distraction interventions to find the most effective strategy in mitigating impulsive buying as a result of dark patterns.

Experimental Protocol

Overview:

15 Participants - 60 trials

Consent Form, Data privacy assurance

Pre-experiment survey

Baseline traits

Control variables

Experiment 1

15 trials

No dark patterns

(Control)

15 trials

Dark Patterns

(Treatment)

- Pupil dilation
- User actions using mouse clicks

- Post Study Survey on impulsivitey and cognitive load

ANOVA

Experiment 2 Intervention

Dark Patterns

(Treatment)

15 trials

Distraction

15 trials

Reflection

- Pupil dilation
- User actions using mouse clicks

- Post Study Survey on impulsivitey and cognitive load

ANOVA

Environment Control

ENVIRONMENTAL AND EQUIPMENT CONTROLS

- Location: Data was collected in a team room at the H2 lounge.
- Eye Tracker Setup: The eye tracker was positioned at the same angle for each participant to ensure consistency.
- Laptop Placement: The laptop was placed on a stack of books to keep the screen at eye level for all participants.
- Environmental Conditions: The room was quiet, and the temperature was kept consistent throughout the experiment.
- Equipment Consistency: All equipment, including laptop specifications, laptop height, and eye tracker, remained the same for every participant to ensure uniformity.

Experimental Setup

PRE-STUDY (BASELINE ASSESSMENT):

- Objective: Assess baseline factors (e.g., money-saving orientation, budget exhaustion tendencies) to control for individual differences.
- Participants: 15 participants, 60 trials, each participant gave data 4 times on different days.

MAIN TASK (SCENARIO)

Scenario:

- Participants are given 5000 rupees and a task to buy a specific product.
- Product: Ashwagandha Powder.
    - Reasons for Choosing:
        i. The product is obscure enough to minimize the impact of prior preferences (controls for potential confounds).
        ii. The non-standardized pricing allows for the manipulative nature of dark patterns to be tested.

They can spend the rest of the money however they wish to, this was done to create a more

Your Task

You need to purchase **Ashwagandha Powder** from the Health category. You have a budget of ₹5,000.

Shopping Guidelines

- First, choose your Ashwagandha powder from the Health category
- After selecting your Ashwagandha powder, you can spend the remaining budget on any products from:
  - Health Products
  - Food Products
  - Cosmetics Products

Budget Tracking

Your remaining budget will be displayed at the top of the page as you shop.

Pre-Study Survey

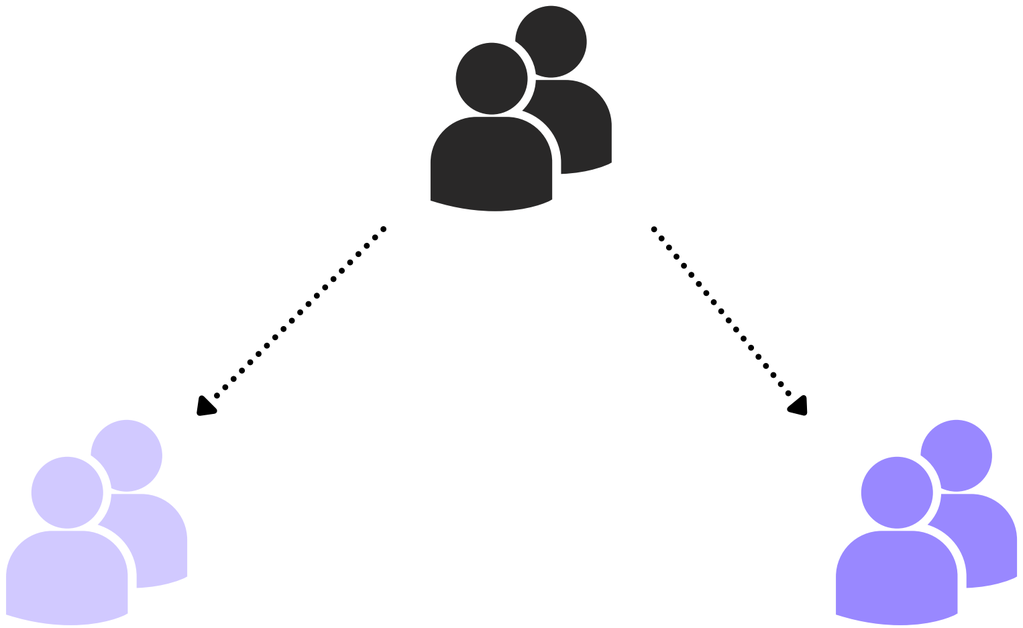
	Never	Rarely	Often	Always
When you receive a fixed budget (e.g., for shopping), do you tend to spend all of it?	○	○	○	○
How often do you make a purchase because you feel it is a "now or never" opportunity?	○	○	○	○
How often do you feel misled about an offer or product after making an online purchase?	○	○	○	○
When making online purchases, how often do you consider the long-term usefulness of the product?	○	○	○	○
How likely are you to save part of your budget for future expenses?	○	○	○	○

Post-Study Survey

	1	2	3	4	5
How impulsive did you feel while making your purchase? (1 = Not at all impulsive, 5 = Extremely impulsive)	○	○	○	○	○
How mentally taxing did you find making your decision? (1 = Not at all taxing, 5 = Extremely taxing)	○	○	○	○	○
How much did you hesitate before making your purchase? (1 = No hesitation at all, 5 = Hesitated a lot)	○	○	○	○	○

Experiment 1

Objective: Compare impulsivity and cognitive load/arousal
between participants exposed to different dark patterns (control vs. scarcity vs. limited time).

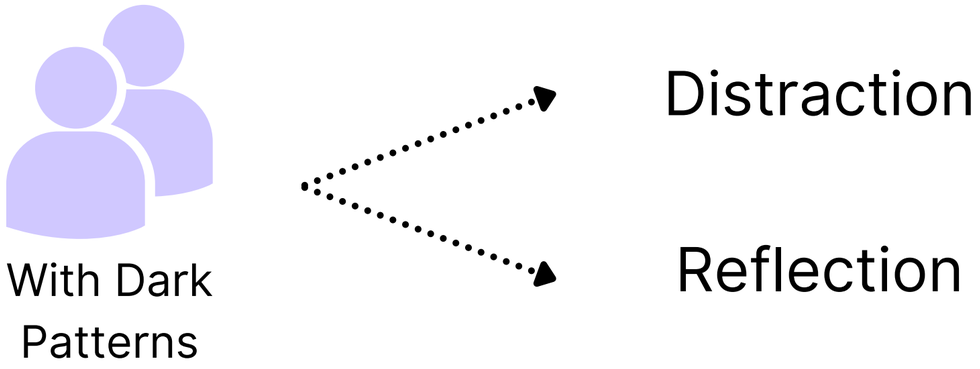


No dark pattern
(Control)

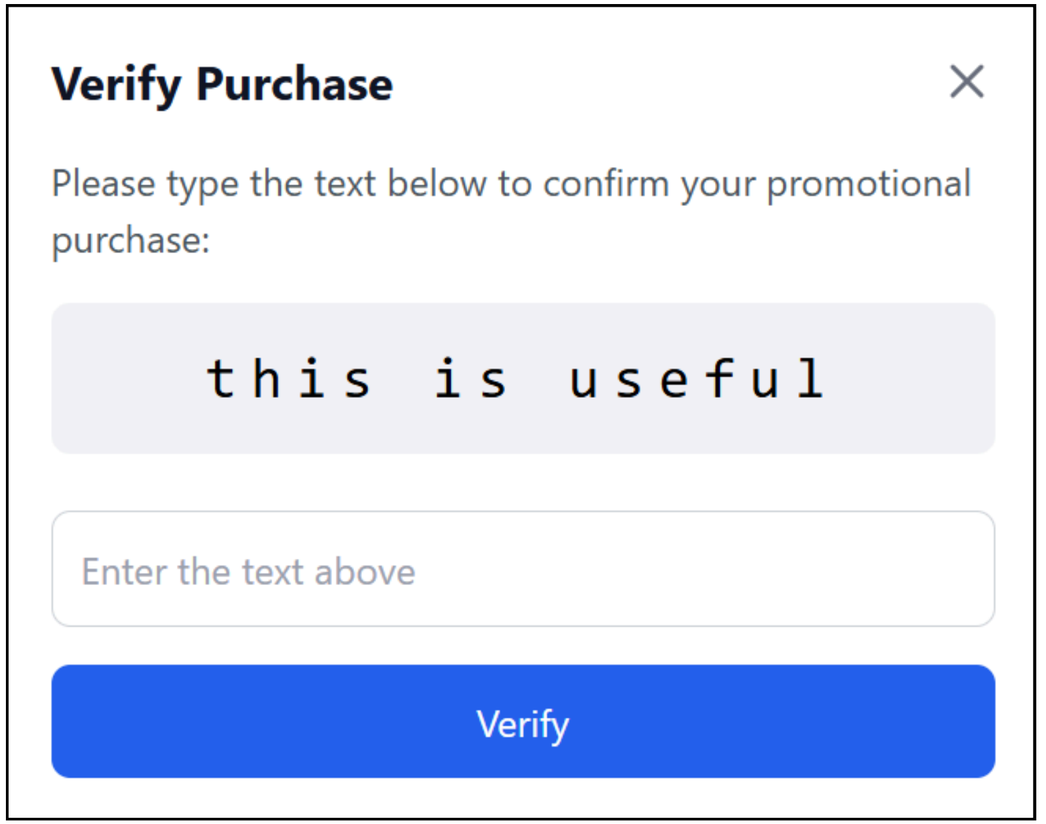
With Dark
Patterns

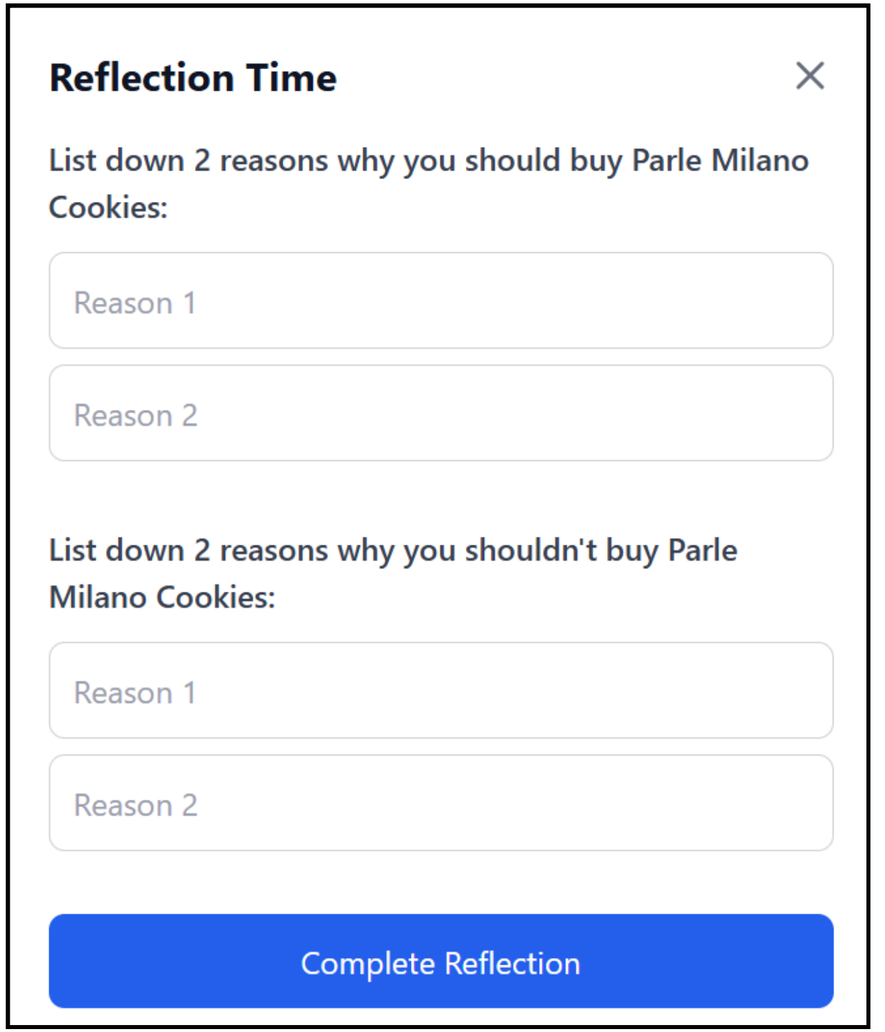
Experiment 2 (With Intervention)

Objective: Assess the interaction between dark patterns and interventions (distraction, reflection) on impulsivity and cognitive load.



Interventions





Links to websites

- https://dark-pattern-simulator-amanex.replit.app
- https:/dark-pattern-simulator-v-2-amanex.replit.app
- http:/dark-pattern-simulator-v-3-amanex.replit.app
- http:/dark-pattern-simulator-v-4-amanex.replit.app

Data Collection

Human Data

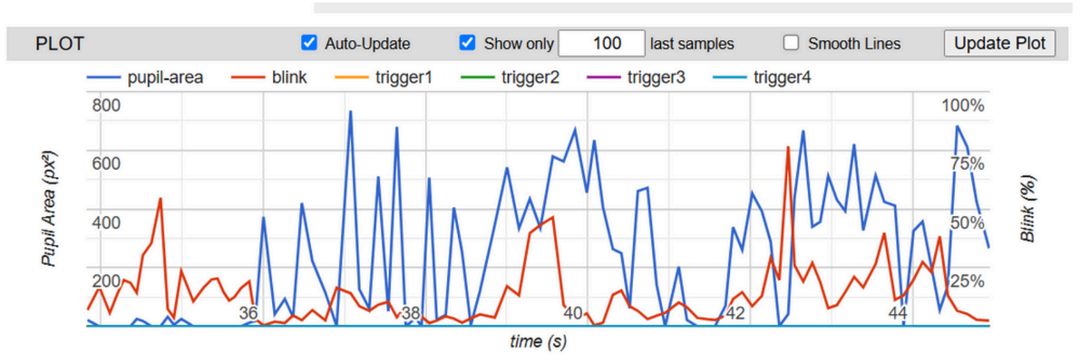
Pupil Dilation

- It refers to the widening of the pupils in response to various stimuli.
- Pupil dilation increases with increased cognitive load.

Model used:

DeepLabV3 is a segmentation model, which is good for pupil detection because its pixel-wise classification capabilities allow for precise segmentation of the pupil from surrounding areas.

https://www.pupillometry.it/



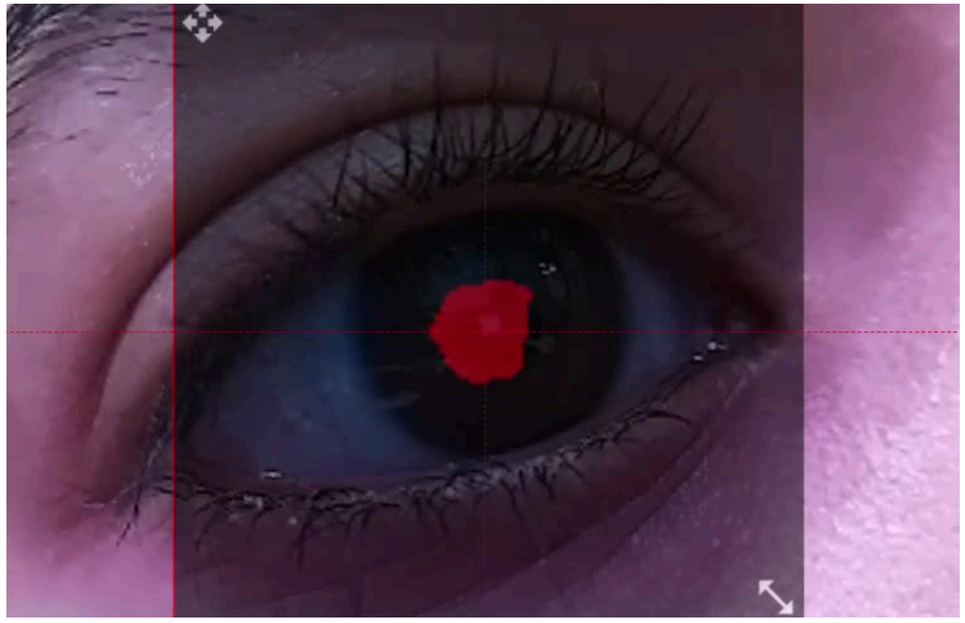
DATA (289) Auto-Update Update Table Clear Data Export CSV

timestamp	timecode	pupil-area	blink	px	py	t1	t2	t3	t4
2024-12-15T19:49:42.109Z	43.279	621.00	0.2	218.3	133.1	0	0	0	0
2024-12-15T19:49:42.221Z	43.391	327.00	0.2	203.5	140.2	0	0	0	0
2024-12-15T19:49:42.374Z	43.544	514.00	0.3	210.6	138.2	0	0	0	0
2024-12-15T19:49:42.480Z	43.650	424.00	0.4	208.3	137.1	0	0	0	0
2024-12-15T19:49:42.612Z	43.782	411.00	0.1	230.4	130.4	0	0	0	0
2024-12-15T19:49:42.718Z	43.888	0.00	0.1	-1.0	-1.0	0	0	0	0
2024-12-15T19:49:42.840Z	44.010	325.00	0.2	216.0	122.0	0	0	0	0
2024-12-15T19:49:42.952Z	44.122	357.00	0.3	212.3	125.6	0	0	0	0
2024-12-15T19:49:43.062Z	44.232	201.00	0.2	201.5	125.8	0	0	0	0
2024-12-15T19:49:43.163Z	44.333	55.00	0.4	239.6	120.4	0	0	0	0
2024-12-15T19:49:43.263Z	44.433	138.00	0.1	215.5	127.1	0	0	0	0
2024-12-15T19:49:43.378Z	44.548	684.00	0.1	237.5	122.3	0	0	0	0
2024-12-15T19:49:43.502Z	44.672	611.00	0.1	238.2	118.4	0	0	0	0
2024-12-15T19:49:43.616Z	44.786	426.00	0.0	252.3	125.2	0	0	0	0
2024-12-15T19:49:43.771Z	44.941	266.00	0.0	254.3	125.1	0	0	0	0



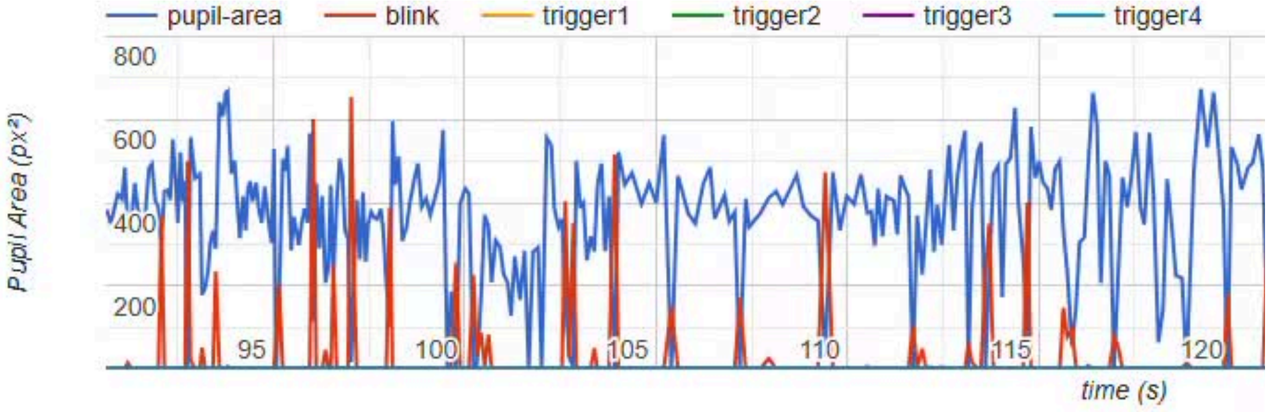






DATA (59) Auto-Update Update Table Clear Data Export CSV

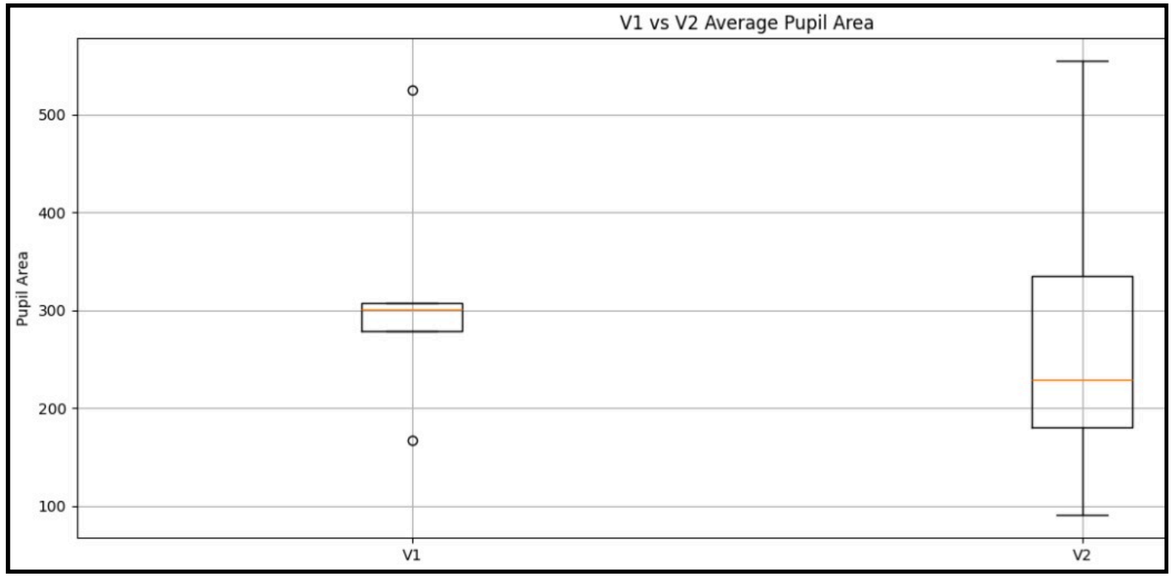
timestamp	timecode	pupil-area	blink	px	py	t1	t2	t3	t4
2024-12-15T23:11:06.603Z	60.870	412.00	0.0	356.5	308.2	0	0	0	0
2024-12-15T23:11:06.707Z	60.975	470.00	0.0	353.2	307.6	0	0	0	0
2024-12-15T23:11:06.821Z	61.088	426.00	0.0	352.0	307.6	0	0	0	0
2024-12-15T23:11:06.947Z	61.214	445.00	0.0	354.5	306.4	0	0	0	0
2024-12-15T23:11:07.061Z	61.328	598.00	0.0	330.4	302.3	0	0	0	0
2024-12-15T23:11:07.180Z	61.447	501.00	0.0	329.1	302.5	0	0	0	0
2024-12-15T23:11:07.298Z	61.565	609.00	0.0	324.8	305.4	0	0	0	0
2024-12-15T23:11:07.416Z	61.683	464.00	0.0	326.4	302.3	0	0	0	0
2024-12-15T23:11:07.581Z	61.848	441.00	0.0	324.3	302.8	0	0	0	0
2024-12-15T23:11:07.702Z	61.969	439.00	0.0	321.4	298.9	0	0	0	0
2024-12-15T23:11:07.845Z	62.112	396.00	0.0	323.1	297.5	0	0	0	0
2024-12-15T23:11:07.993Z	62.260	634.00	0.0	322.5	298.3	0	0	0	0
2024-12-15T23:11:08.140Z	62.407	0.00	0.0	-1.0	-1.0	0	0	0	0
2024-12-15T23:11:08.225Z	62.492	605.00	0.0	351.6	306.7	0	0	0	0
2024-12-15T23:11:08.350Z	62.617	0.00	0.1	-1.0	-1.0	0	0	0	0

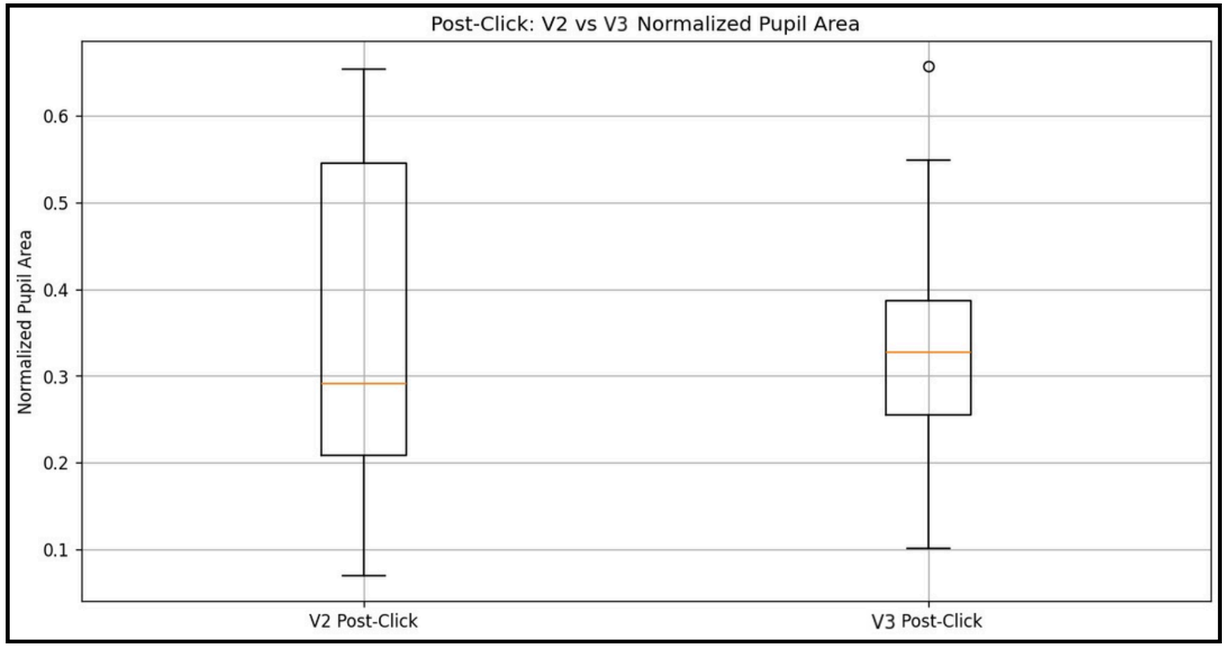


Mouse Click Data (Actions)

Action	Product ID	Product Name	Is Promoti	Timestam	Timecode
add	h4	Trivang Natural Ashwagandha Powder	TRUE	2024-12-1	17.781
add	h6	Ayuvya Body Ache Oil	FALSE	2024-12-1	20.8415
remove	h6	Ayuvya Body Ache Oil	FALSE	2024-12-1	27.7138
add	h9	Gut Health Superfoods Mix	TRUE	2024-12-1	38.8653
add	h11	The Body Temple Probiotics	TRUE	2024-12-1	49.3293
remove	h11	The Body Temple Probiotics	TRUE	2024-12-1	62.4566
add	f3	Parle Milano Cookies	TRUE	2024-12-1	69.4182
add	f4	Britannia Good Day Chunkies	FALSE	2024-12-1	71.8051
add	f5	Amul Chocolate Cookies	TRUE	2024-12-1	79.6357
add	f10	Amul Short Bread Cookies	FALSE	2024-12-1	83.4733
add	f7	Amul Lite Spread	TRUE	2024-12-1	98.4976

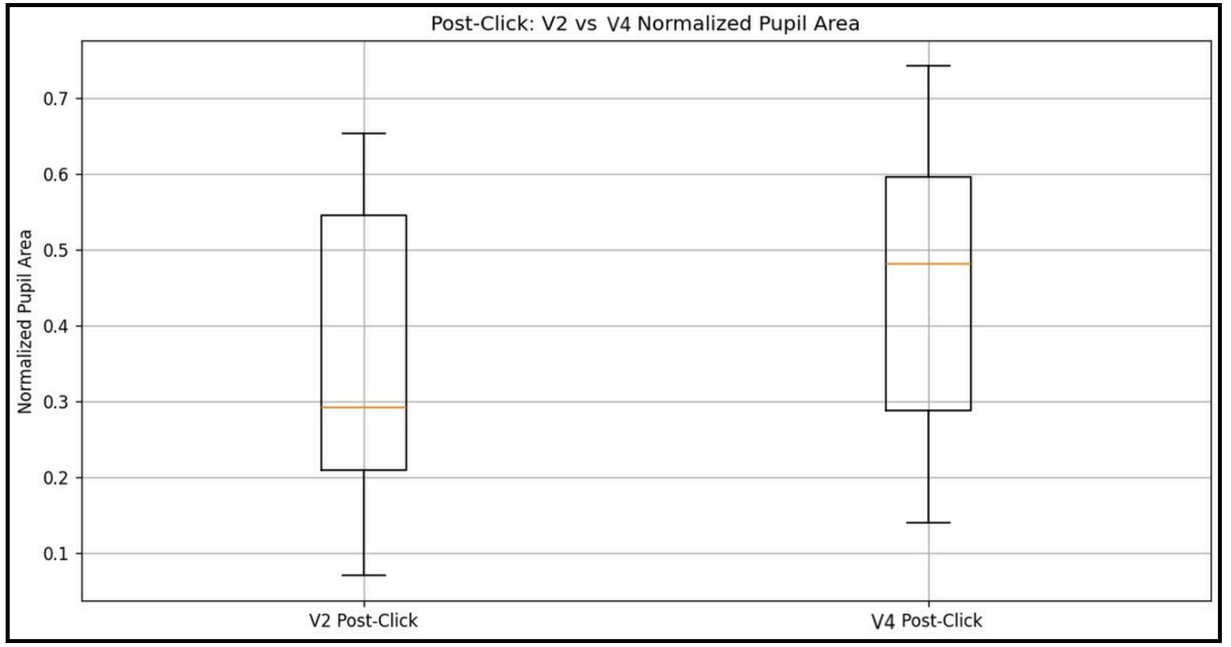
Analysis, Performance Metrics, and Deployability of the Solution





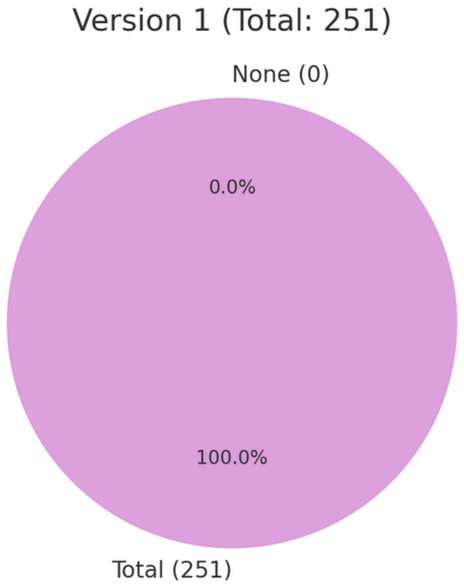
Cognitive load:

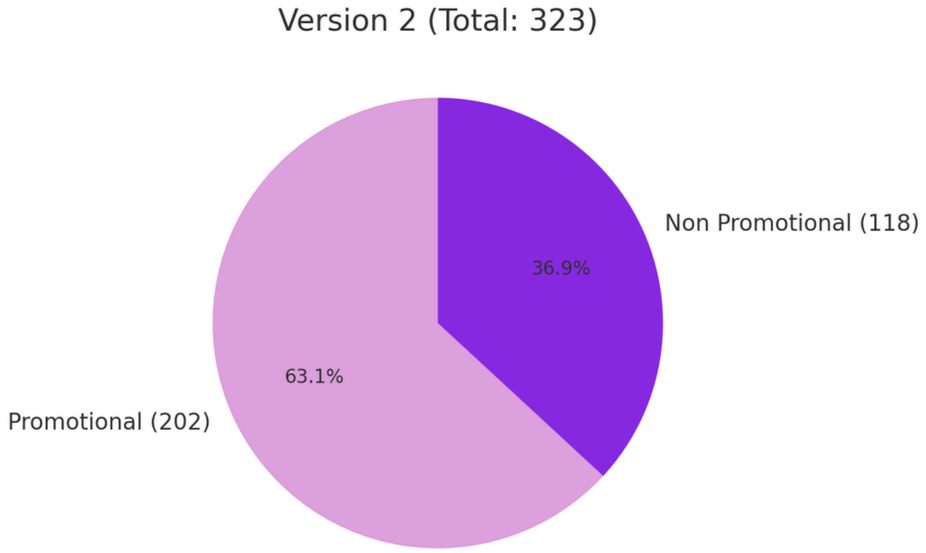
- Cognitive load, as measured by pupil dilation, was lower when dark patterns were displayed, indicating that users relied on System 1 (impulsive, automatic) thinking.
- The distraction intervention led to a slight increase in cognitive load.
- The reflection intervention increased cognitive load even further.

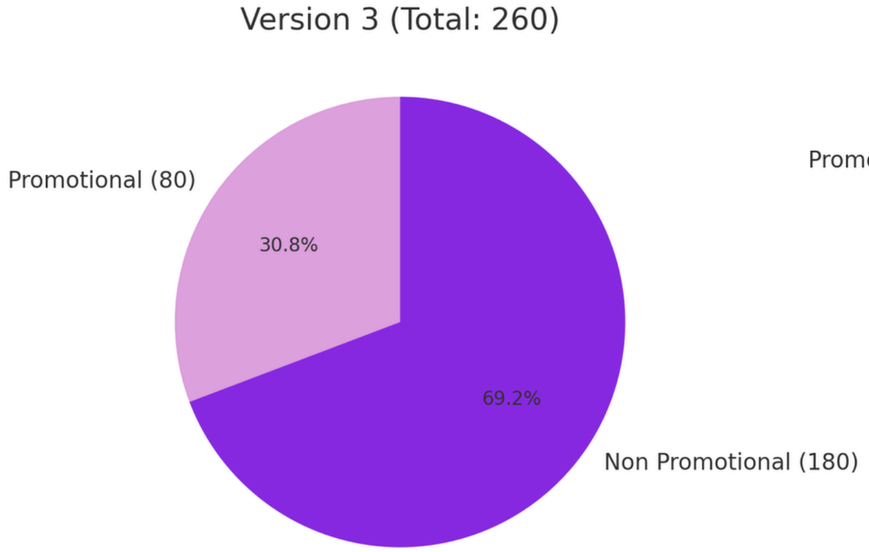


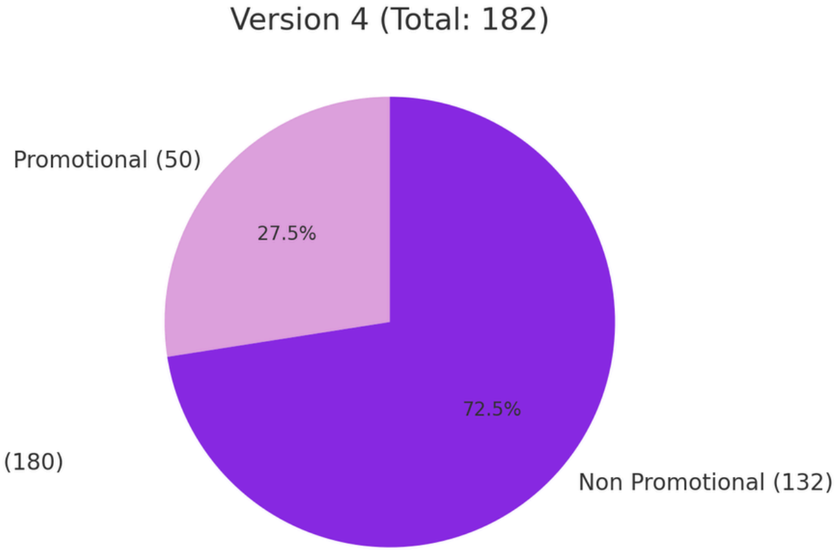
Impulsivity

- Impulsivity, as measured through survey data, was higher when dark patterns were displayed, indicating that users relied on System 1 (impulsive, automatic) thinking.
- The distraction intervention led to a slight decrease in impulsivity.
- The reflection intervention decreased impulsivity even further.









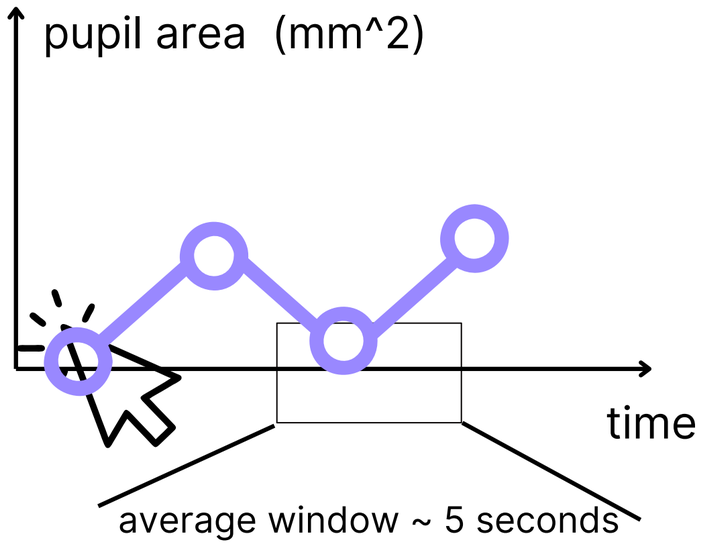
We attempted to run ANOVA to assess the statistical significance of the results. However, the results were insignificant, possibly due to the inherent biases in self-reported survey data. These biases might have impacted the accuracy of the impulsivity measurements.

```
Post-study ANOVA Test Result:
F-statistic: 1.1149228130360205, p-value: 0.3007275131544323
There is no significant difference in impulsivity between the control and treatment groups (post-study).

Pre-study ANOVA Test Result:
F-statistic: 0.0, p-value: 1.0
There is no significant difference in impulsivity between the control and treatment groups (pre-study).
```

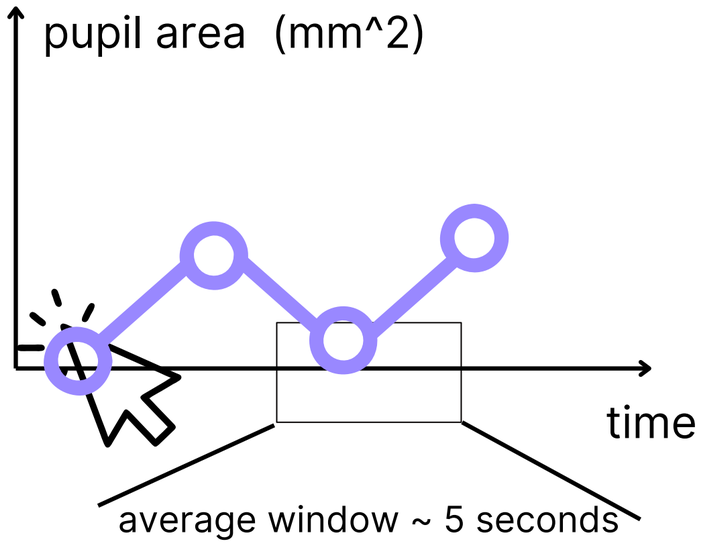
Treatment

(with intervention)



Control

(without intervention)



Data cleaning involved mean imputation and handling outliers, followed by normalization of the data.

Website action data and pupillometry data were merged based on time codes. For example, after a user clicks, 2 seconds after that a 5-second window was used to analyze the corresponding pupil dilation in the other versions.

Deployability in the Real World

The solution—using distraction or reflection interventions to reduce the effects of dark patterns—can be deployed in real-world applications to help users make more informed decisions and reduce impulsive behavior.

- Real-World Deployment: The interventions can be integrated into websites or apps as part of their UX design. For example, a subtle reminder or reflection prompt (e.g., "Are you sure you want to make this decision?") could appear after a user clicks on a dark pattern.
- Challenges at Scale: One challenge with scaling this solution is ensuring that the interventions are non-intrusive and do not negatively affect user experience.The solution would also need to be tested and adapted for diverse user demographics across different platforms and regions. Moreover there may be backlash from businesses who think it may negatively impact them.

Impact

Impact

This solution addresses the harmful effects of dark patterns by reducing impulsivity through distraction and reflection interventions, promoting more informed decision-making.

Larger Implications:

- **Consumer Protection:** Reduces the likelihood of users making impulsive, harmful decisions, such as buying unnecessary products or signing up for unwanted services.
- **Improved Autonomy:** Encourages users to reflect on their choices, leading to better decision outcomes.
- **Ethical Design:** Promotes ethical UX practices, encouraging transparent and user-friendly designs.

Broader Societal Impact:

- **Reducing Exploitation:** Protects vulnerable users from manipulative tactics, particularly those with lower income or digital literacy.
- **Long-Term Change:** Could inspire regulatory reforms for greater transparency and fairness in digital platforms and a more user-centered digital economy.

Thank you

Any questions ?