

SOCIAL FACTORS IN SECURITY & PRIVACY

Dr. Nina Gerber



**Fostering Dialogue and Social Support
for Digital Sovereignty**



**Challenging Gender Stereotypes in
Security and Privacy**



**Enhancing the Informed Consent
Principle**



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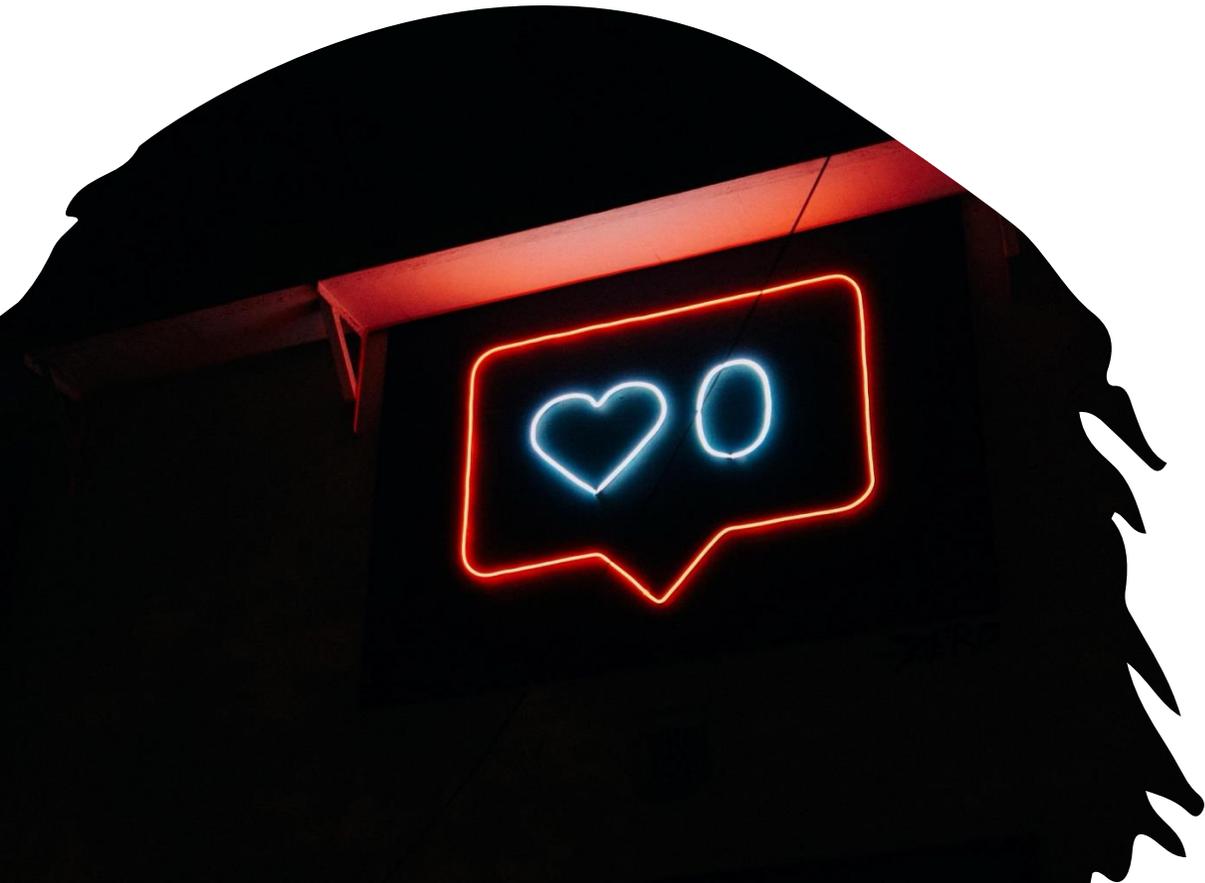
SOCIAL INFLUENCE

- Help from knowledgeable peers can impact the behavior of lay users positively
- *“Build a security neighborhood watch”* [Lipford & Zurko, 2012]
- *“Support tech-savvy people in giving peer-advice”* [Redmiles et al., 2016]
- Tech-savvy people have little interest in intervening in S&P behavior of their social environment



WHAT ARE OBSTACLES FOR SOCIAL INFLUENCE?

[Gerber, N., & Marky, K. (2022). The Nerd Factor: The Potential of S&P Adepts to Serve as a Social Resource in the User's Quest for More Secure and Privacy-Preserving Behavior. In *Eighteenth Symposium on Usable Privacy and Security (SOUPS 2022)*.)]



Interviews (N=13) and Co-creation workshops (N=11) with security and privacy (S&P) experts

- Lack of interest
- Social aspects, e.g., fear of negative reactions
- Lack of opportunities, e.g., S&P behavior is not directly observable
- Lack of legitimacy: there is no “right” level of privacy

THE ROLE OF STEREOTYPES

[Gerber, N., & Marky, K. (2022). The Nerd Factor: The Potential of S&P Adepts to Serve as a Social Resource in the User's Quest for More Secure and Privacy-Preserving Behavior. In *Eighteenth Symposium on Usable Privacy and Security (SOUPS 2022)*.)]

Interviews (N=13) and Co-creation workshops (N=11) with security and privacy (S&P) experts

“ I think if you're interested in data security, you always get these joking sayings that you're one of the tin foil hatters or paranoid people. ”

“ The technology nerd is imagined as an overweight, male basement dweller. ”



WHAT ABOUT LAY USERS?

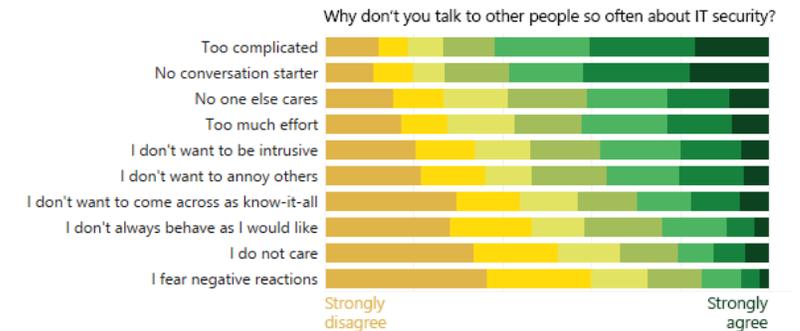
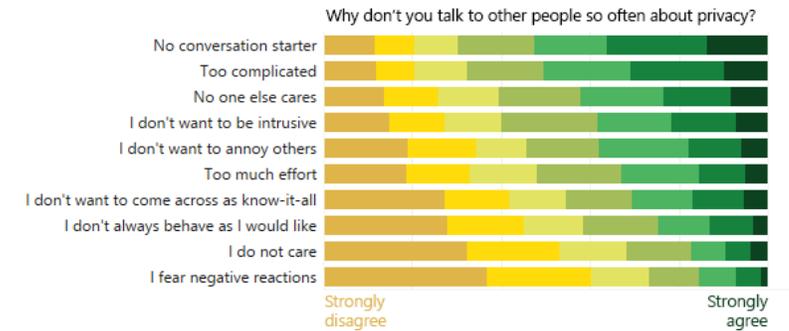
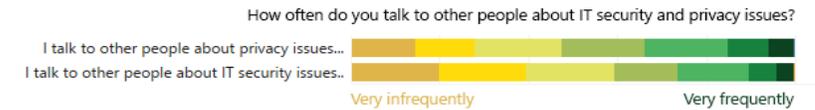
[Gerber, N., Zimmermann, V., von Preuschen, A., & Renaud, K. (2025). Unpacking the social and emotional dimensions of security and privacy user engagement. In *Twenty-First Symposium on Usable Privacy and Security (SOUPS 2025)*]



- Online survey study with representative sample of US citizens (N=496)
- Recruitment of Prolific

WHAT ABOUT LAY USERS?

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WHAT ABOUT LAY USERS?

[Gerber, N., Zimmermann, V., von Preuschen, A., & Renaud, K. (2025). Unpacking the social and emotional dimensions of security and privacy user engagement. In *Twenty-First Symposium on Usable Privacy and Security (SOUPS 2025)*]



“ I would talk about security and privacy more often if others were as interested in the subject as me. ”

“ If we are not willing to talk openly about privacy, we will continue to lose it. ”

HOW CAN WE FACILITATE S&P CONVERSATIONS?

[Gerber, N., Zimmermann, V., von Preuschen, A., & Renaud, K. (2025). Unpacking the social and emotional dimensions of security and privacy user engagement. In *Twenty-First Symposium on Usable Privacy and Security (SOUPS 2025)*]



Barriers to S&P Conversations:

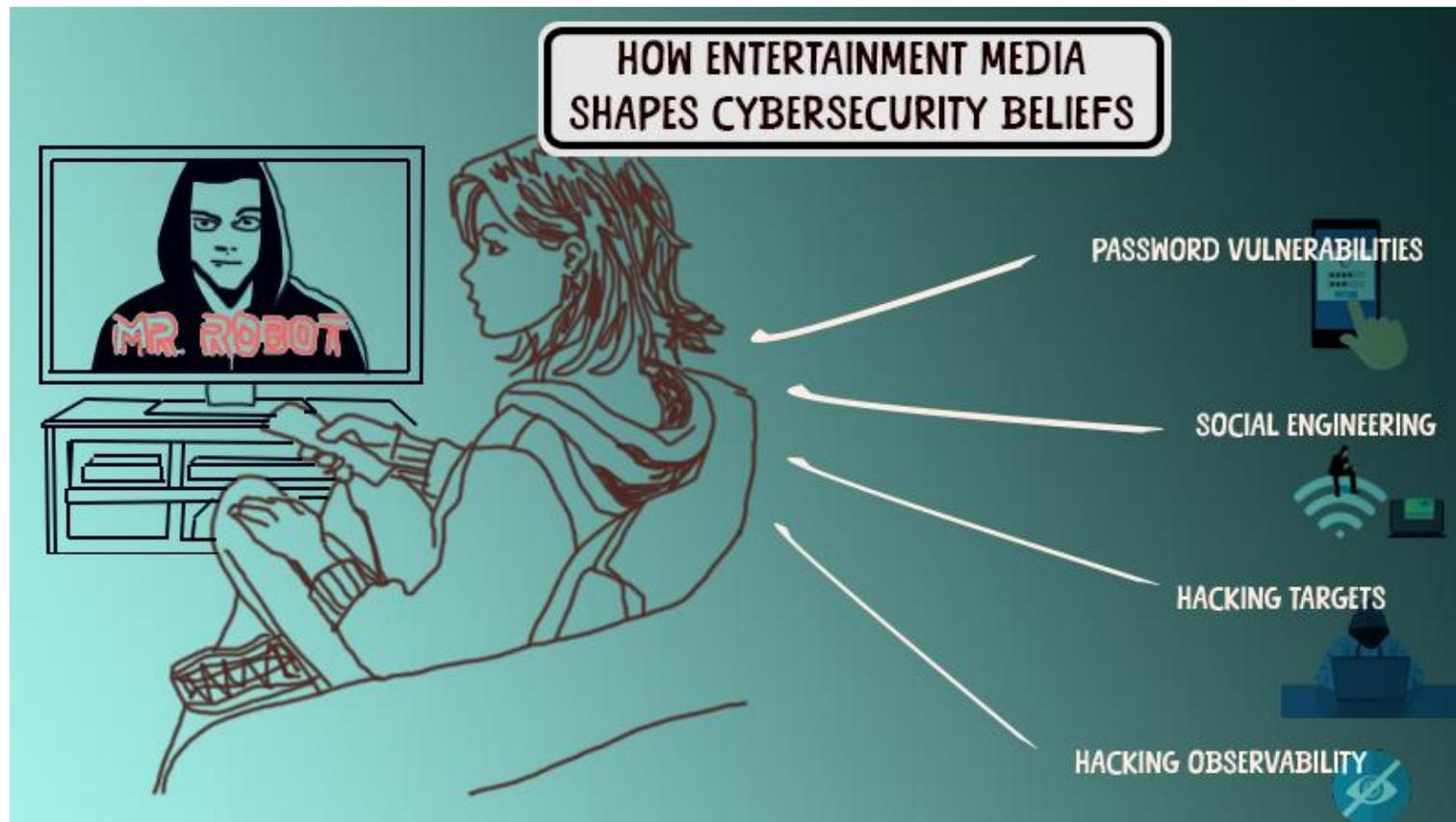
- Perceived peer disinterest and social taboos
- Fear of stereotyping as paranoid for privacy-conscious behaviors

Encouraging S&P Dialogue:

- Advocacy for more frequent and open conversations about S&P topics
- External triggers like media coverage and organizational training

CAN CHARACTERS IN ENTERTAINMENT MEDIA SERVE AS ROLE MODELS?

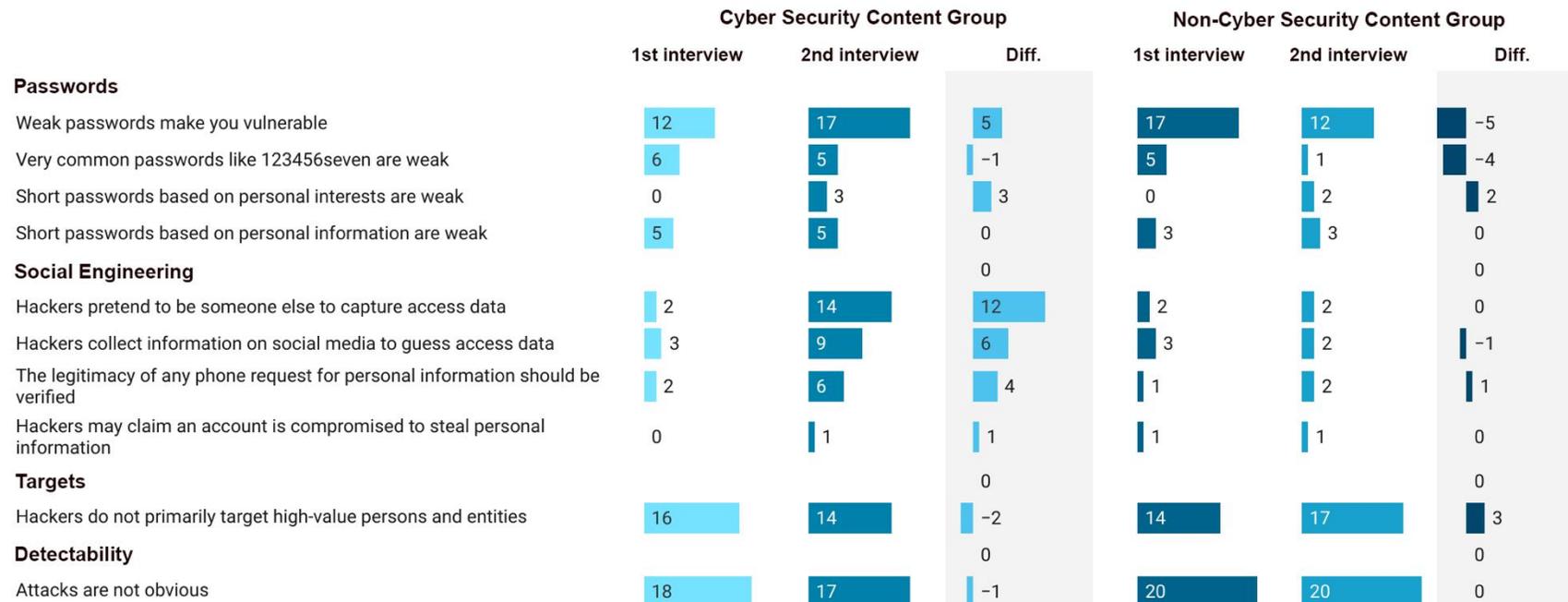
[Manuscript in preparation]



- Study with N=39, two rounds of interviews
- Showing clips from Mr. Robot including security content (study group) and non-security content (control group)

CAN CHARACTERS IN ENTERTAINMENT MEDIA SERVE AS ROLE MODELS?

[Manuscript in preparation]



- Increased awareness of password vulnerabilities and social engineering
- Does not translate to more comprehensive understanding defense mechanisms

SOCIAL DYNAMICS IN SHARED SMART SPACES

[Marky, K., Gerber, N., Pelzer, M. G., Khamis, M., & Mühlhäuser, M. (2022). “You offer privacy like you offer tea”: Investigating Mechanisms for Improving Guest Privacy in IoT-Equipped Households. *Proceedings on Privacy Enhancing Technologies (PETs)*, 4, 400-420.]

[Hahn, S., Al-Amrani, N., Allagah, S., Huang, H. R., Kircher, E., Rehs, C., Vogt, J., Marky, K., Gerber, N. (2024). How to Respect Bystanders' Privacy in Smart Homes - A Co-Creation Study. In *Proceedings of the 13th Nordic Conference on Human-Computer Interaction (NordiCHI '24)*.]

Interviews (N=21) and co-creation workshops (N=10) with IoT owners, survey with IoT owners & non-owners (N=264)

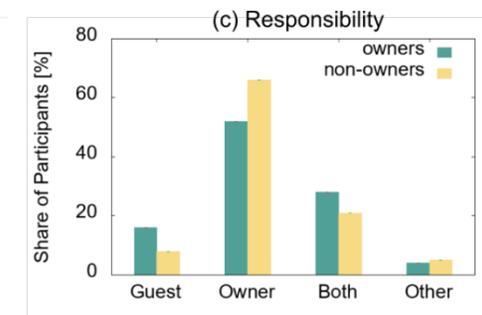
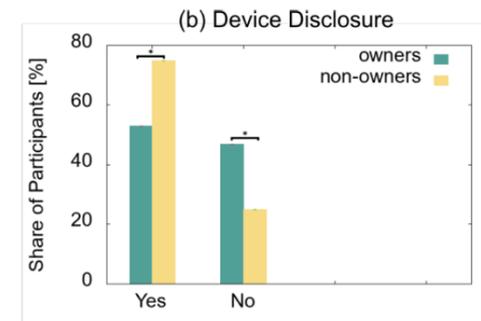
- Unclear responsibilities and social weirdness

“

I always joke that I'll give them my privacy policy to sign because there are cameras.

”

- IoT owners only inform guests if they know about privacy concerns
- IoT owners take it personally if guests like to adjust or check IoT device settings



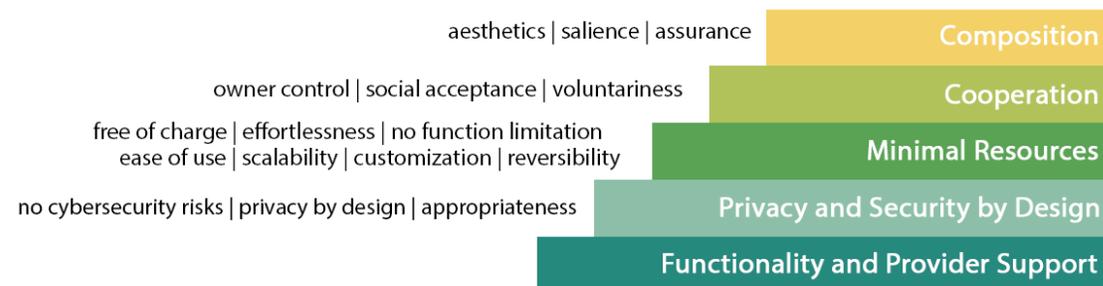
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- Conflicting preferences for technology-based solutions (e.g., salience vs. aesthetics)





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**Challenging Gender Stereotypes in
Security and Privacy**



**Enhancing the Informed Consent
Principle**

DO GENDER STEREOTYPES AFFECT WOMEN IN THE S&P FIELD?

[Gerber, N., Stöver, A., Mayer, P. (2024). Of Mothers and Managers – The Effect of Videos Depicting Gender Stereotypes on Women and Men in the Security and Privacy Field. In *Twentieth Symposium on Usable Privacy and Security (SOUPS 2024)*]

S&P field suffers from gender imbalances and stereotypes

Stereotype threat effect might affect women

Research questions

RQ1: Do videos that depict gender stereotypes influence S&P attitudes and intentions?

RQ2: Do videos that depict gender stereotypes influence (self-assessed) S&P knowledge?

DO GENDER STEREOTYPES AFFECT WOMEN IN THE S&P FIELD?

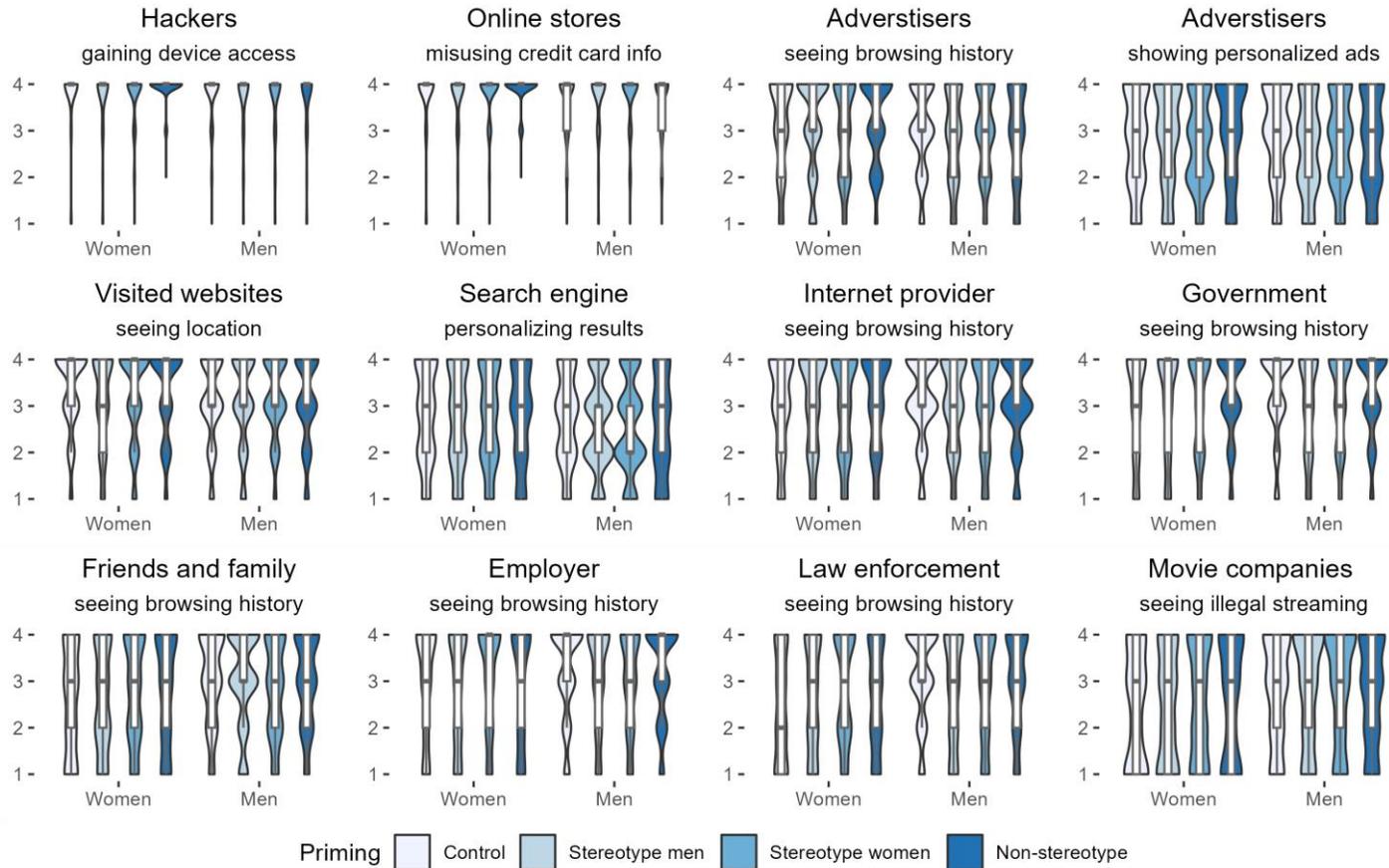
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- Between-subject online experiment (N=933)
- Selection of commercial videos on YouTube based on pre-study (N=92)
- Recruitment on Prolific
- 465 women, 468 men

VIDEOS

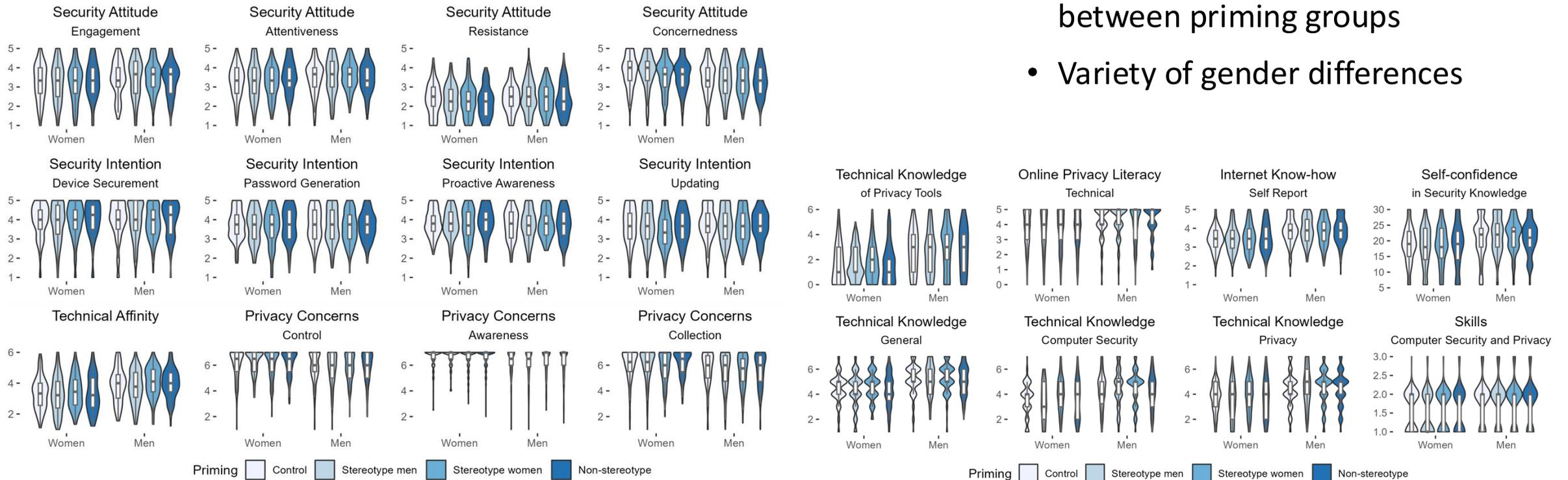


DO VIDEOS THAT DEPICT GENDER STEREOTYPES INFLUENCE S&P ATTITUDES, INTENTIONS, AND (SELF-ASSESSED) S&P KNOWLEDGE?



- Women in the *Non-stereotype* condition reported sig. more interested to **prevent hacker access** to their device than women in the *Stereotype women* and *Stereotype men* condition

DO VIDEOS THAT DEPICT GENDER STEREOTYPES INFLUENCE S&P ATTITUDES, INTENTIONS, AND (SELF-ASSESSED) S&P KNOWLEDGE?



- Few sig. differences ($p > .05$) between priming groups
- Variety of gender differences

DO GENDER STEREOTYPES AFFECT WOMEN IN THE S&P FIELD?

- Few priming effects
- Variety of gender differences
- Gender norms might have been adopted early on



Replicate study with focus on objective performance



Variate relevance of gender stereotypes

[Manuscript under review at CHI '26]



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HOW DOES THE GDPR DEFINE PRIVACY?

The concept of data protection can be approached through two main principles:



Privacy-as-confidentiality: minimizing the collection of private data



Privacy-as-control: granting users control over the use of their data



Regulations like the GDPR uphold the informed consent principle, thereby following the *privacy-as-control* principle

THE INFORMED CONSENT PRINCIPLE



For consent to be *informed*, users must understand the type of data being collected and how it will be processed



Research has provided evidence that many users lack this crucial knowledge



This led to growing criticism of the consent principle in the past

ARE USERS ABLE TO GIVE *INFORMED* CONSENT TO CONTACT TRACING APPS?

[Häring, M., Tiefenau, E., Tiefenau, C., Kretschmer-Pietralla, F., Stöver, A., & Gerber, N. (2025). I Have Not Understood but Agree: Studying Informed Consent in the Context of the German COVID-19 Contact Tracing App. *ACM Transactions on Computer-Human Interaction*, 32(3)]

Users are required to understand how their data is collected and processed within a technology

= Informed decision?

Research goal

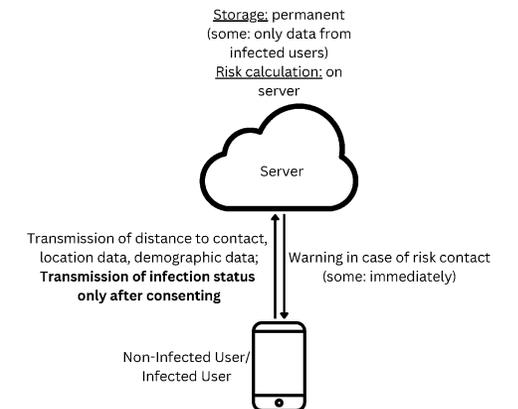
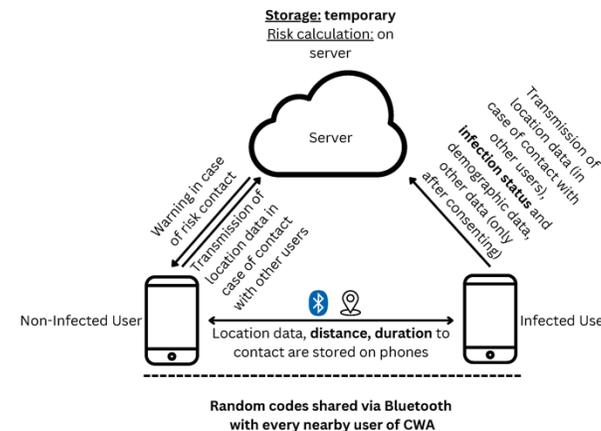
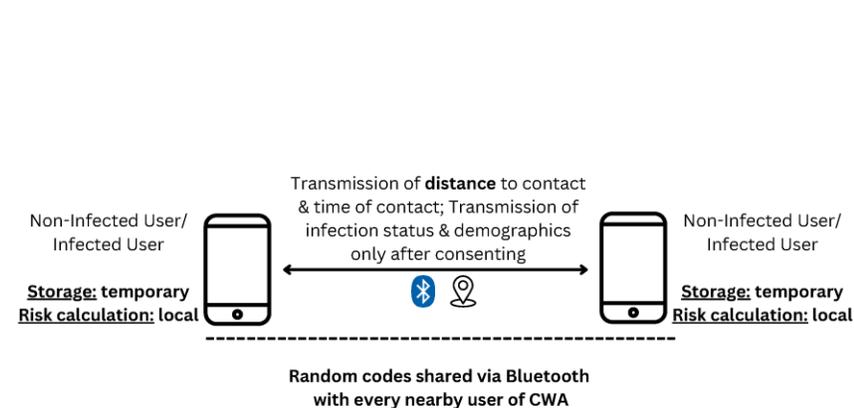
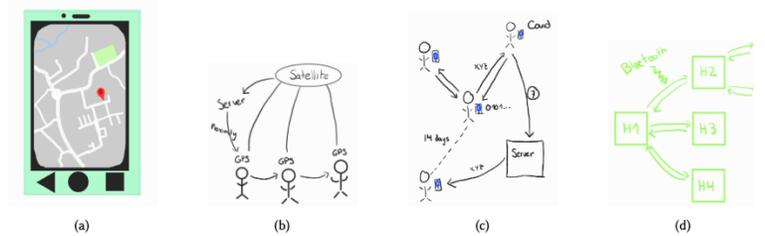
Explore whether users can be considered informed about data collection and processing within the German COVID-19 contact tracing app

ARE USERS ABLE TO GIVE *INFORMED* CONSENT TO CONTACT TRACING APPS?

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Interviews (N=20) and survey (N=352)

- Users, non-users, and past users have many misconceptions
- Users and people with higher awareness and control privacy concerns are sig. better informed (but still have many misconceptions)



CAN NUDGES IN COOKIE BANNERS MOTIVATE MORE DELIBERATE PRIVACY DECISIONS?

[Gerber, N., Stöver, A., Peschke, J., Zimmermann, V. (2023). “Don’t Accept All and Continue: Exploring Nudges for More Deliberate Interaction with Tracking Consent Notices,” *ACM Trans. Comput.-Hum. Interact. (TOCHI)*]

Users often automatically accept (or reject) tracking

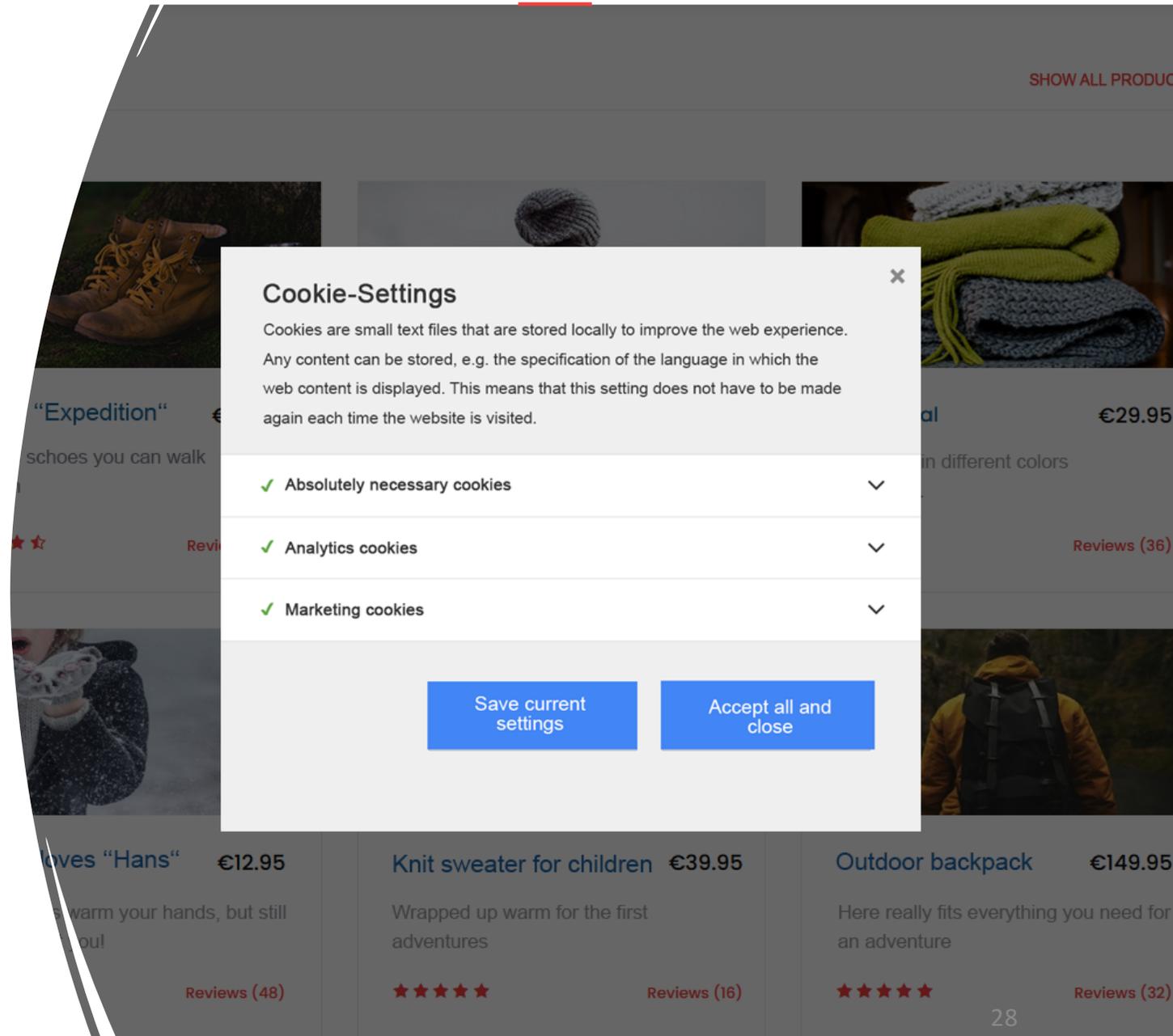
≠ Informed decision

Research goals

- (1) Explore whether nudges can interrupt automated behavior and prompt informed decisions
- (2) Compare different nudge designs

ONLINE EXPERIMENT

- Between-subject online experiment with 167 participants
- Cover story: Explore online shop
- 3 Nudges (color, social, timer)
- Opt-in vs. Opt-out



Cookie-Settings ✕

Cookies are small text files that are stored locally to improve the web experience. Any content can be stored, e.g. the specification of the language in which the web content is displayed. This means that this setting does not have to be made again each time the website is visited.

- ✓ Absolutely necessary cookies ▾
- ✓ Analytics cookies ▾
- ✓ Marketing cookies ▾

Save current settings Accept all and close

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0:09 Save current settings Accept all and close

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- ✓ Absolutely necessary cookies ▾
- ✗ Analytics cookies - 90% of our customers do not accept analytics cookies ▾
- ✗ Marketing cookies - 90% of our customers do not accept marketing cookies ▾

Save current settings Accept all and close

Cookie-Settings ✕

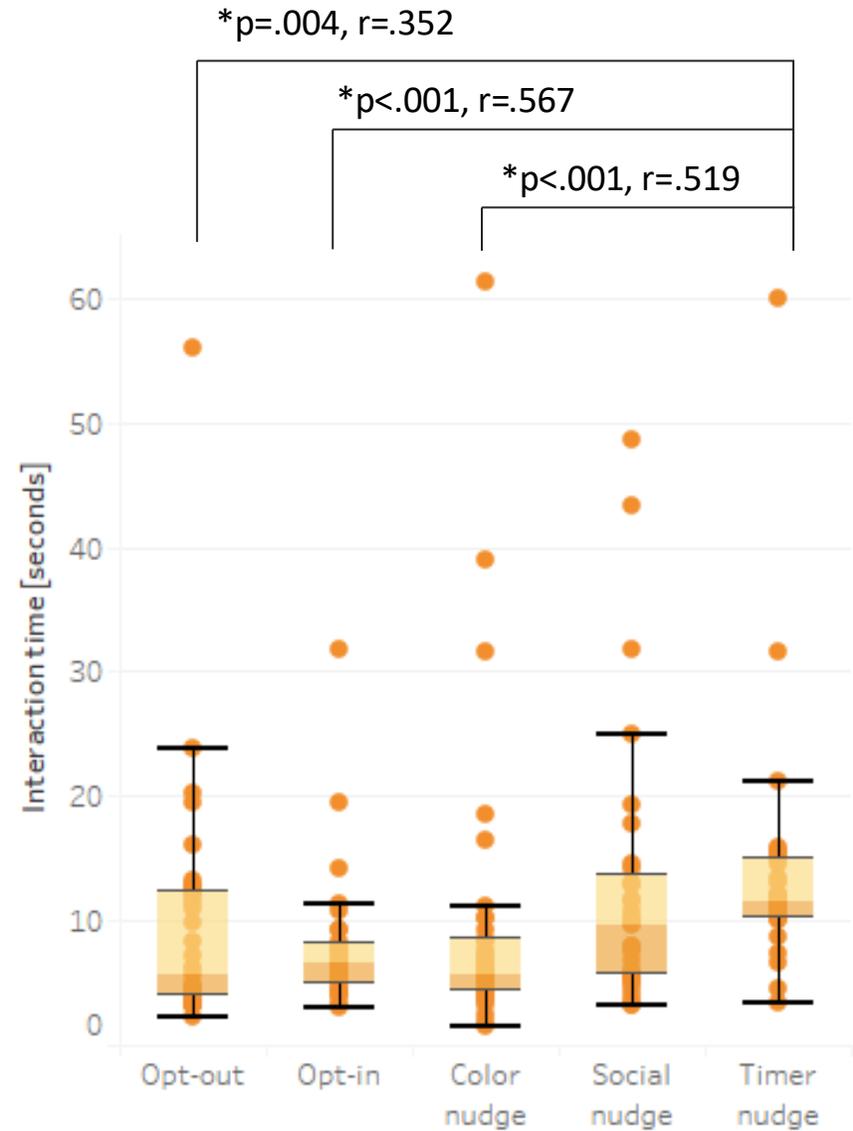
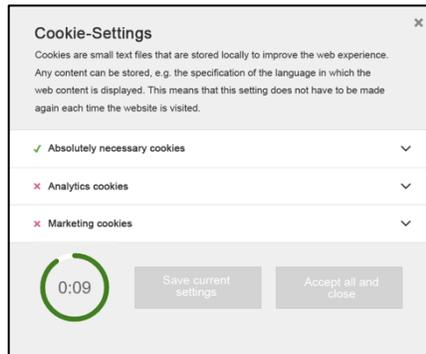
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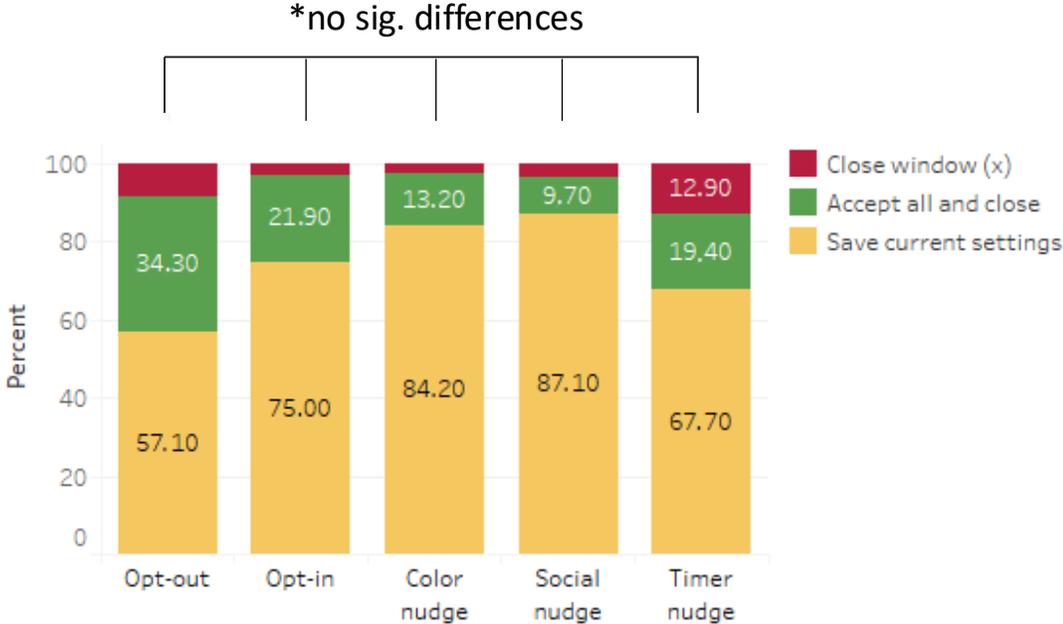
INTERACTION TIME

- Longest interaction in the timer nudge condition



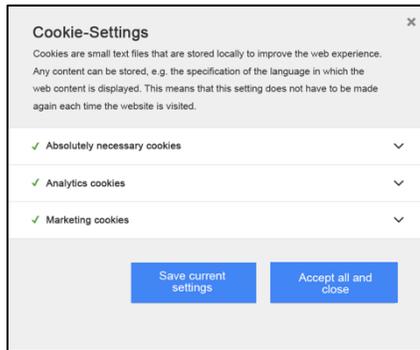
BUTTONS CLICKED

- Increased click rates for the “Save current settings” button in the nudging and opt-in groups

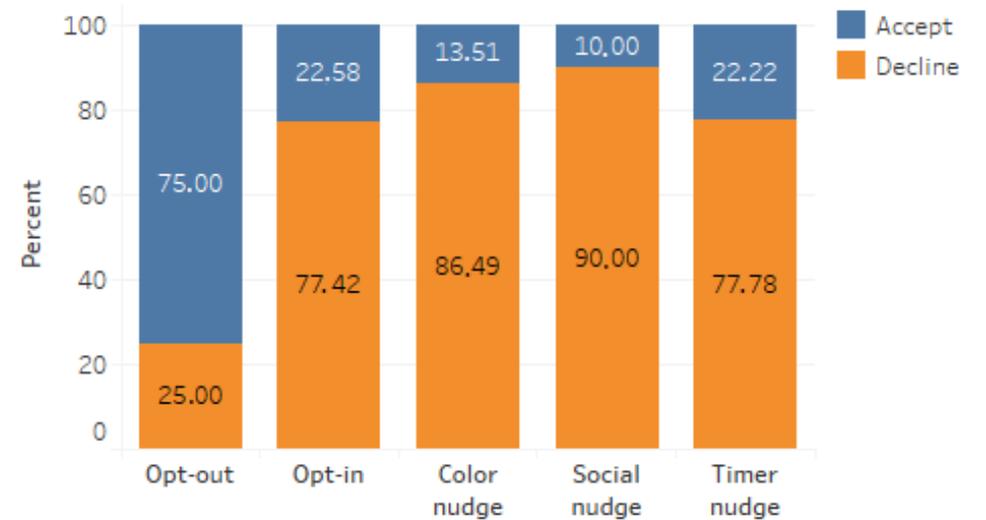
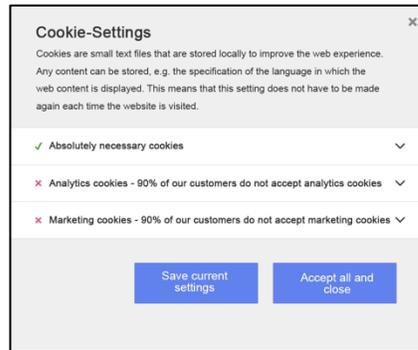


ACCEPTANCE OF OPTIONAL TRACKING

Opt-out: 75%



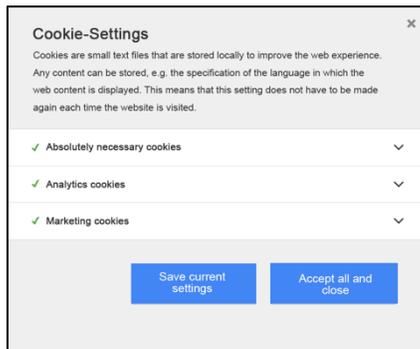
Social nudge: 10%



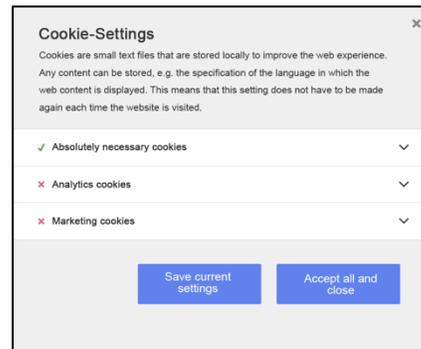
ACCEPTANCE OF OPTIONAL TRACKING

- The opt-out group is **11.8x** more likely to accept optional tracking than the opt-in group
- When controlled for privacy concerns, cookie knowledge, technical affinity, self-esteem

Opt-out



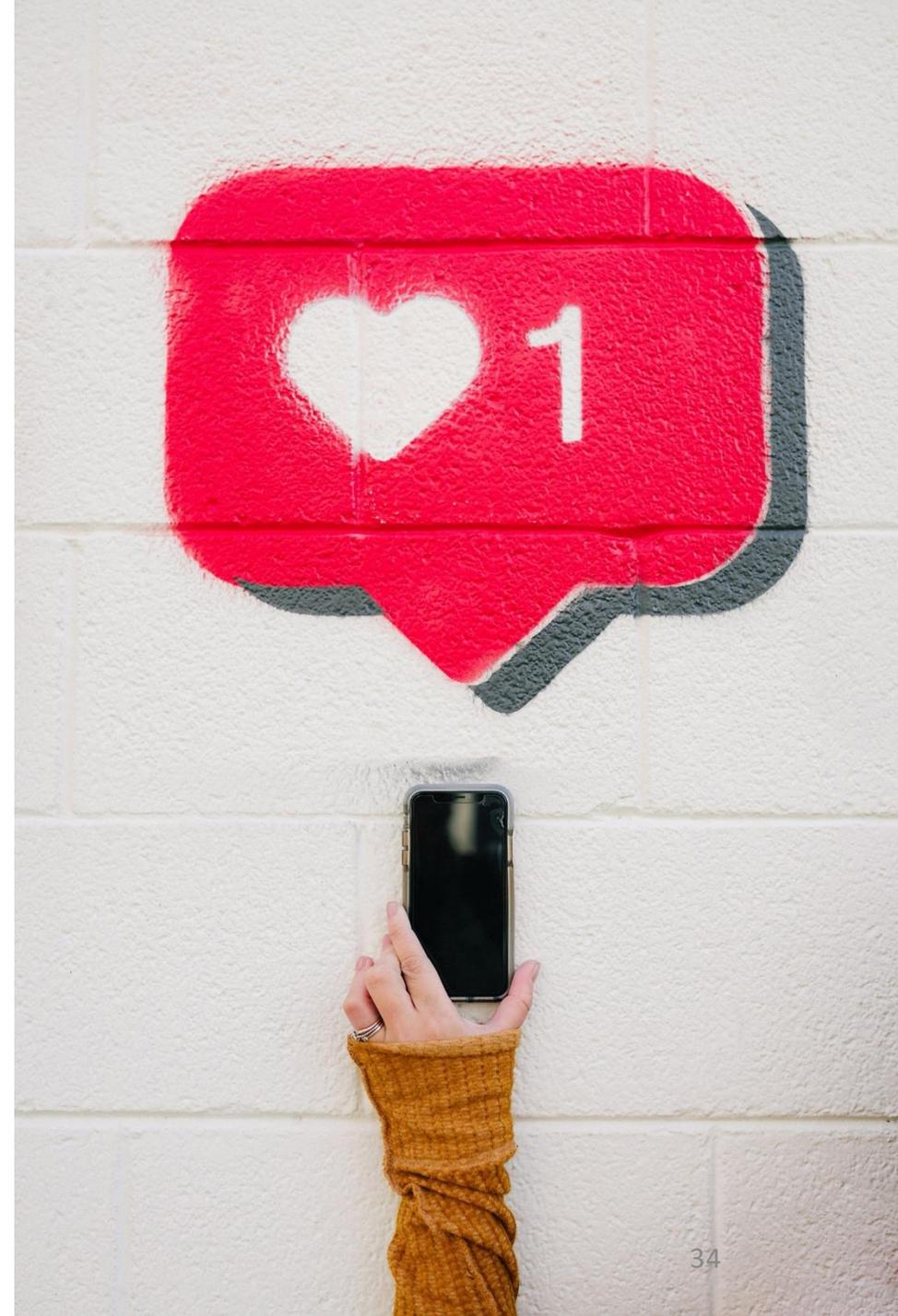
Opt-In



Variable	B (SE)	95% CI for the odds ratio		
		Lower	Odds ratio	Upper
Model 1				
Opt-in	–			
Opt-out	–2.331 (0.593) ^{***}	0.030	0.097	0.311
Nudge (Color)	0.624 (0.645)	0.527	1.867	6.606
Nudge (Social)	0.965 (.745)	0.610	2.625	11.303
Nudge (Timer)	0.021 (.632)	0.296	1.021	3.520
Model 2				
Opt-in	–			
Opt-out	–2.469 (.645) ^{***}	0.024	0.085	0.300
Nudge (Color)	0.947 (.707)	0.645	2.578	10.309
Nudge (Social)	1.141 (.803)	0.648	3.131	15.118
Nudge (Timer)	0.036 (.670)	0.279	1.037	3.858
Privacy concerns (Control)	–0.350 (.315)	0.380	0.705	1.308
Privacy concerns (Awareness)	0.262 (0.384)	0.613	1.299	2.755
Privacy concerns (Collection)	0.534 (0.190) ^{**}	1.176	1.705	2.472
Cookie knowledge	0.192 (0.174)	0.861	1.211	1.703
Technical affinity	0.205 (0.237)	0.771	1.227	1.953
Model 3				
Opt-in	–			
Opt-out	–2.467 (.650) ^{***}	0.024	0.085	0.303
Nudge (Color)	1.045 (.721)	0.692	2.844	11.684
Nudge (Social)	1.237 (.816)	0.696	3.444	17.043
Nudge (Timer)	0.056 (.676)	0.281	1.058	3.979
Privacy concerns (Control)	–0.350 (0.316)	0.379	0.704	1.309
Privacy concerns (Awareness)	0.269 (0.384)	0.616	1.309	2.779
Privacy concerns (Collection)	0.526 (0.192) ^{**}	1.161	1.691	2.463
Cookie knowledge	0.192 (0.175)	0.860	1.212	1.708
Technical affinity	0.199 (0.238)	0.765	1.221	1.947
Self-esteem	–0.086 (0.094)	0.762	0.917	1.104

DEFAULTS ARE IMPORTANT, BUT NOT SUFFICIENT

- Default settings are relevant for acceptance decision
- ...but not necessarily inspire deliberate interaction
- A combination of Opt-In and Social Norm Nudges might be promising



PURPOSE-RELATED DECISIONS DO NOT WORK

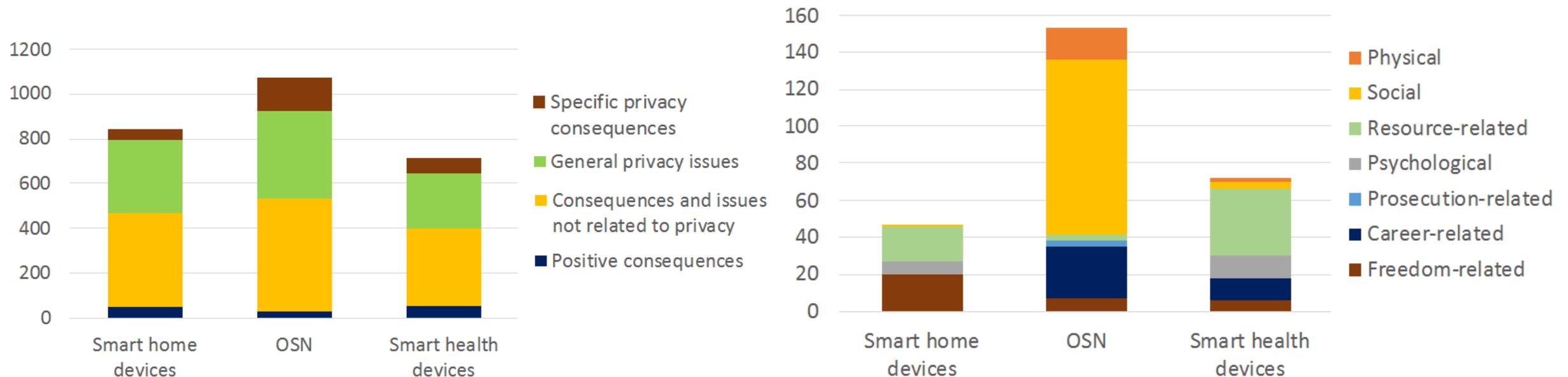
- Participants do not differ between analytics and marketing tracking
- Users might lack understanding of tracking risks and benefits



PEOPLE ARE NOT AWARE OF PRIVACY RISKS

[Gerber, N., Reinheimer, B., & Volkamer, M. (2018). Home sweet home? Investigating users' awareness of smart home privacy threats. In *Proceedings of an Interactive Workshop on the Human aspects of Smarthome Security and Privacy (WSSP) co-located at SOUPS 2018*].

- Survey study (N=1052)
- Closed coding based on the categories of privacy consequences identified by Karwatzki et al. (2017)



HOW CAN PRIVACY RISKS BE COMMUNICATED?

[Gerber, N., Reinheimer, B., & Volkamer, M. (2019). Investigating People's Privacy Risk Perception. *Proceedings on Privacy Enhancing Technologies (PETs)*, 3, 267-288.]

“ Your entered data and usage patterns are collected and analyzed by the various manufacturers of the smart home devices. ”

“ Your entered data and usage patterns are collected and analyzed by the various manufacturers of [use case]. The results of the analysis can harm you since from the analysis it is known where you are at what time. That way you can become a victim of **stalking**. ”

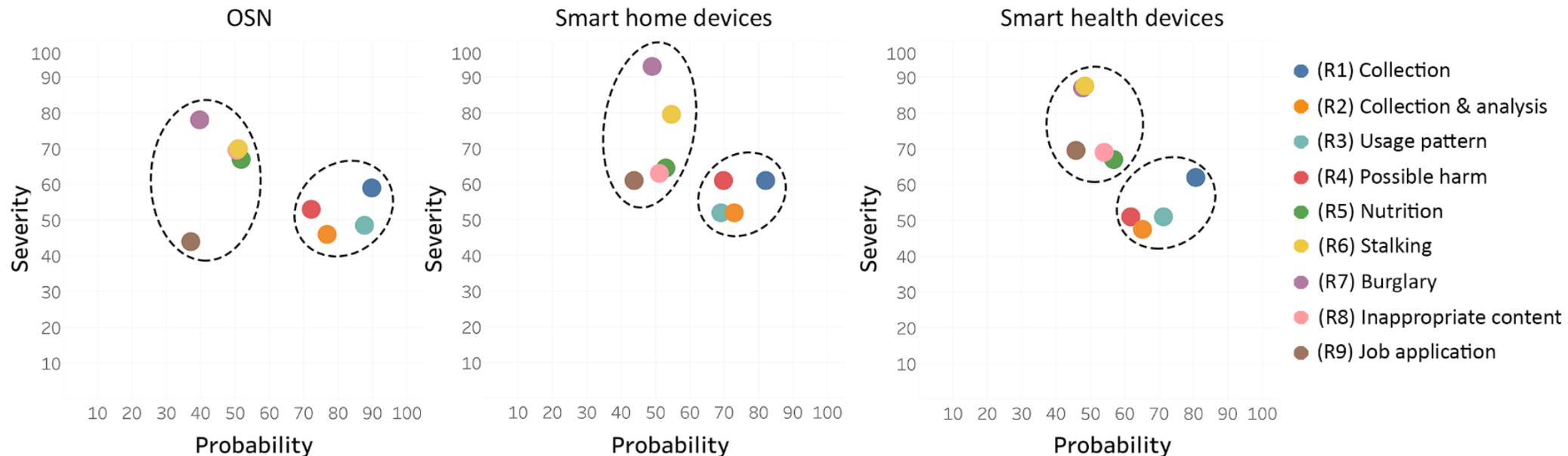


- Online experiment (N=942)
- Randomized presentation of a privacy risk scenario

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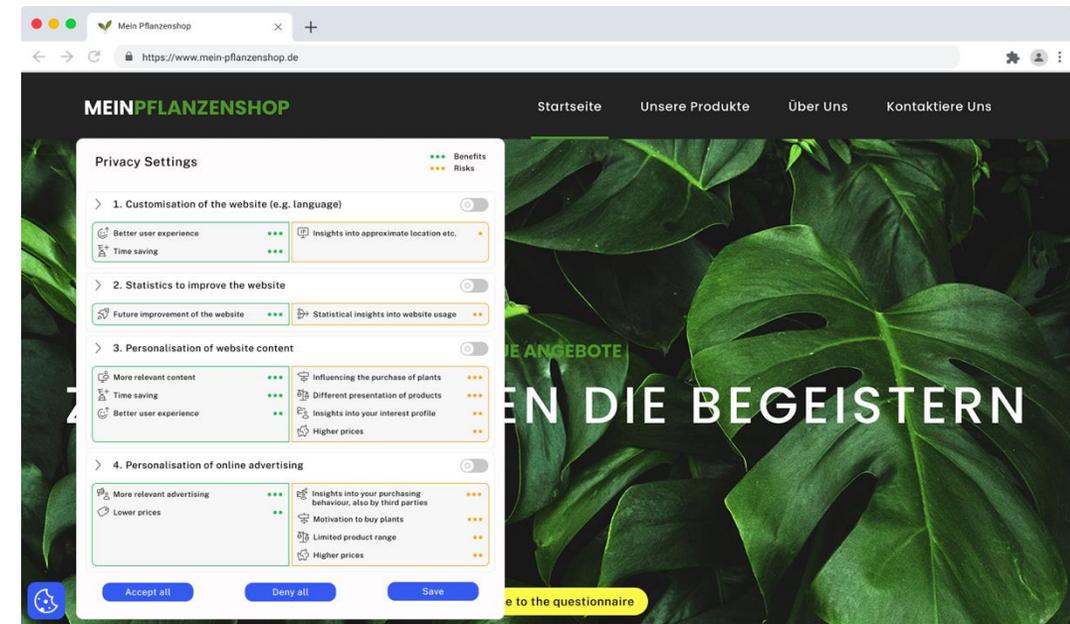
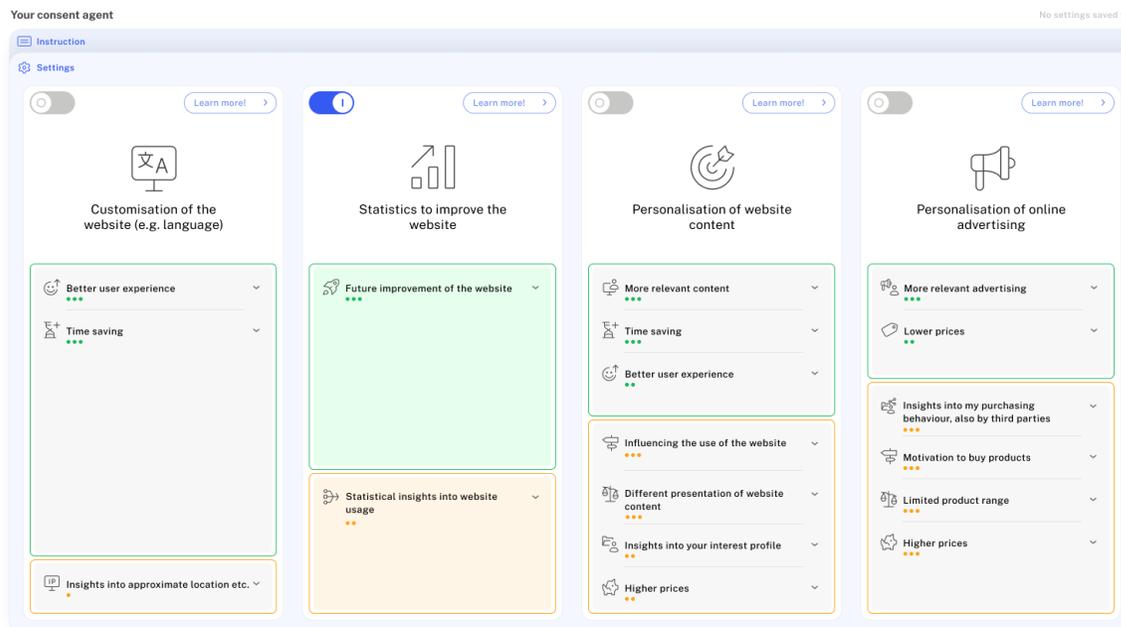
- Participants lack awareness of specific risks/consequences
- Risks with safety component (stalking, burglary) are most severe
- Severity is influenced by how much attacker benefits from data



HOW CAN PRIVACY RISKS BE COMMUNICATED?

[Grassl, P., Gerber, N., von Grafenstein, M. (2024) How Effectively Do Consent Notices Inform Users About the Risks to Their Fundamental Rights?, *European Data Protection Law Review*, 10(1).]

- By directly integrating them into privacy management tools such as Personal Information Management Systems (PIMS)
- Ongoing research on how well informed users are about risks and benefits when information is included directly in such PIMS



HOW CAN VISUALISATIONS SUPPORT INFORMED CONSENT?

[Zimmermann, V., Toth, A., Sievers, H., Fanconi, L., Isenring, Y., Henz, M., Stöver, A., & Gerber, N. (2025). Let's Get Visual-Testing Visual Analogies and Metaphors for Conveying Privacy Policies and Data Handling Information. In *2025 IEEE Symposium on Security and Privacy (SP)*]

Privacy policies are often lengthy and complicated

≠ Informed decision

Research goals

- (1) Explore whether visual metaphors can support informed decision making
- (2) Explore the effect of dynamic feedback on understanding

ONLINE EXPERIMENT

- Between-subject online experiment with 379 participants
- Cover story: Explore online shop
- 6 Visualizations
- 2 Text conditions: Feedback and no feedback

Welcome to our study. Please follow these instructions:

1. Add 3 items to your WISH LIST and compare them
2. Select one item and add it to your CART
3. Proceed to CHECKOUT, personalize your item(s) and pay with the voucher code "WELCOME"

~ shop design 4 me ~

SHOP

CART

WISH LIST

CHECKOUT

Shop Products



Unisex Baseball Cap

Make this classic yet modern cap something special by personalizing it with your name or logo.

Size: One size
Color: Dark red
Material: 100% cotton, machine wash

\$14.99

Add to Cart

Add to Wish List



Wooden Cutting Board

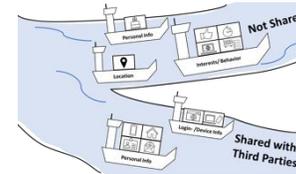
A handmade wooden cutting board makes a perfect gift, especially when personalized with the names of your family members or a special message for your loved ones.

Size: 25 x 15 cm
Material: wood

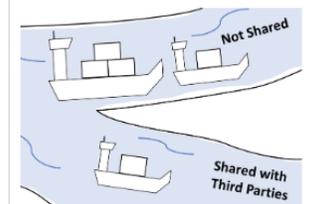
\$25.99

Add to Cart

Add to Wish List



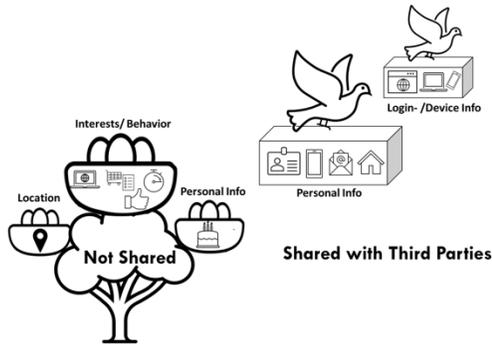
Privacy Settings



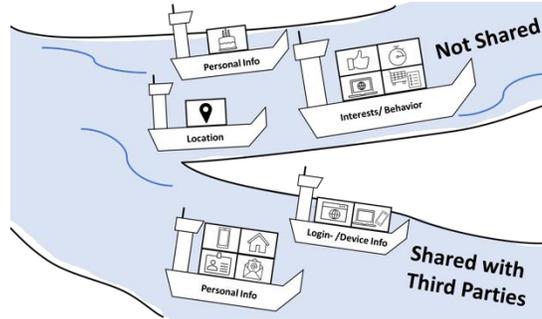
Based on your data handling selection "**Necessary**":

- we will collect your contact details for account verification
- we will only share your contact details with thirdparties for account verification.

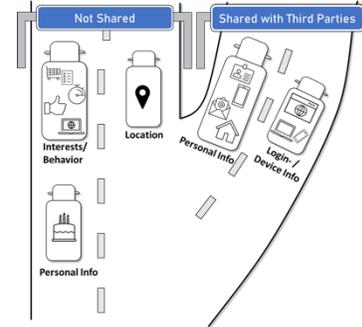
VISUALIZATIONS



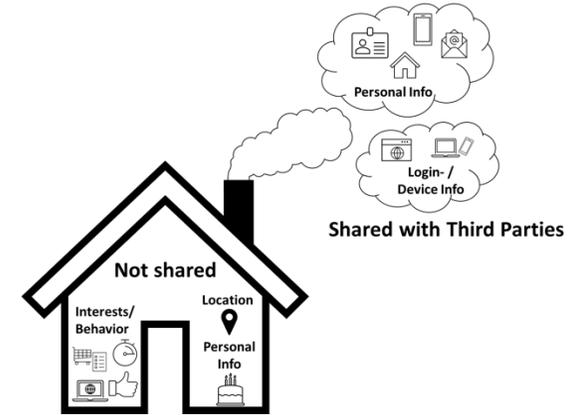
Messenger Pigeon
(partially inspired by Cranor et al., 2006)



Data Flow



Data Traffic



Private House

Shopping Cart				Home
Clock				Envelope
Thumbs Up			Laptop	Mobile Phone
Shopping Cart	Location	Birthday Cake	Browser	Person
Interests/Behavior	Location	Personal Info	Login-/Device Info	Personal Info
Not shared			Shared with Third Parties	

Privacy Nutrition Label
(inspired by Kelley et al., 2009-2010)

Data	Personal Info	Location	Login-/Device Info	Login-/Device Info	Interests/Behavior	Interests/Behavior	Interests/Behavior	Interests/Behavior				
Data Type	Personal Info	Personal Info	Personal Info	Personal Info	Location	Login-/Device Info	Login-/Device Info	Interests/Behavior	Interests/Behavior	Interests/Behavior	Interests/Behavior	Interests/Behavior
Shared with Third Parties	yes	no	yes	yes	yes	no	yes	yes	no	no	no	no

Privacy Label
(inspired by Emami-Naeini et al., 2019-2021)

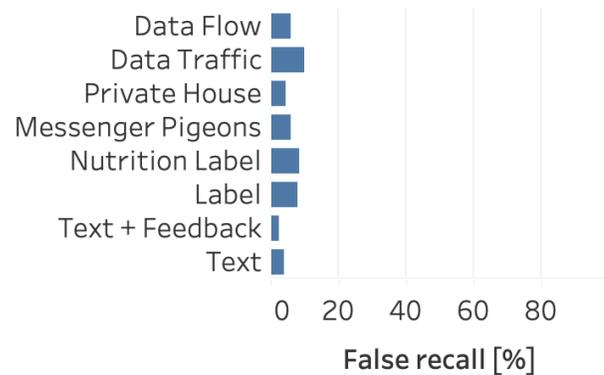
Personal information (i.e. name, postal address, email address, mobile phone number) and log-in/device information (i.e. hard-/software & browser information, device type) are collected and shared with third parties.

Personal information (i.e. birthday), location (i.e. country), interests/behaviour (i.e. buying history, duration/frequency, interests/preferences, visited websites) are collected but not shared with third parties.

Textual Control (with & without feedback)

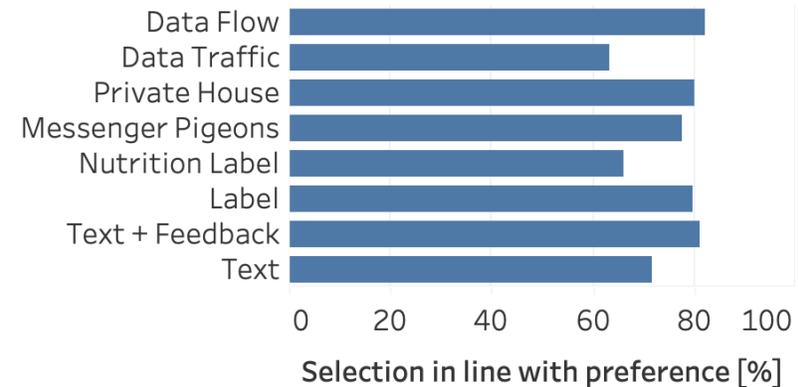
UNDERSTANDING

- All conditions supported participants' understanding of purpose selection with high levels of recall accuracy



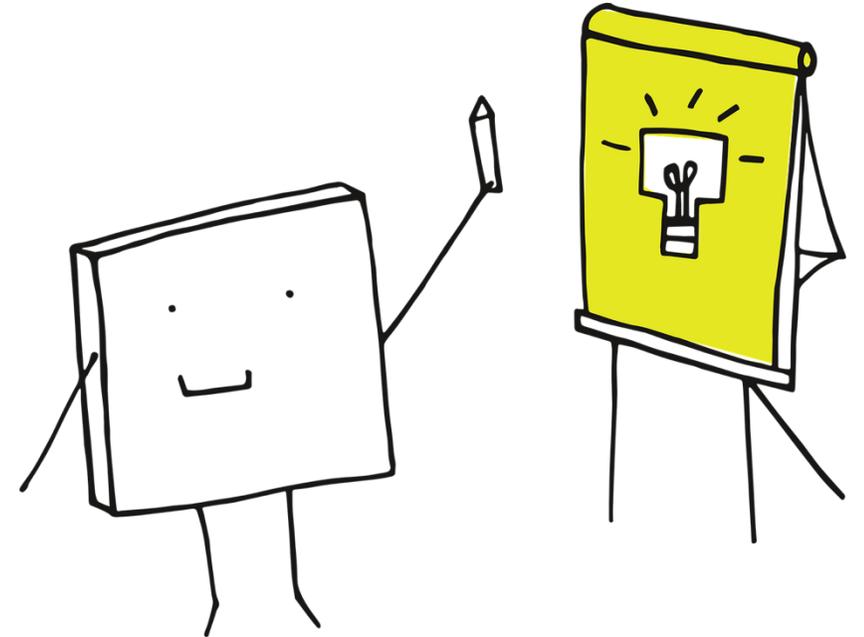
PREFERENCES

- Participants' selection aligned with their intentions and privacy preferences in all conditions



VISUALIZATIONS FOR POLICIES, TABLES FOR FEEDBACK

- Both visualizations and text supported users' understanding of data handling practices
- Metaphorical approaches, e.g., Private House and Messenger Pigeon, were well-perceived in terms of depicting data handling practices
- Tabular approaches, e.g., Privacy Label and Privacy Nutrition Label, were well-perceived in terms of understanding privacy feedback



QUESTIONS

