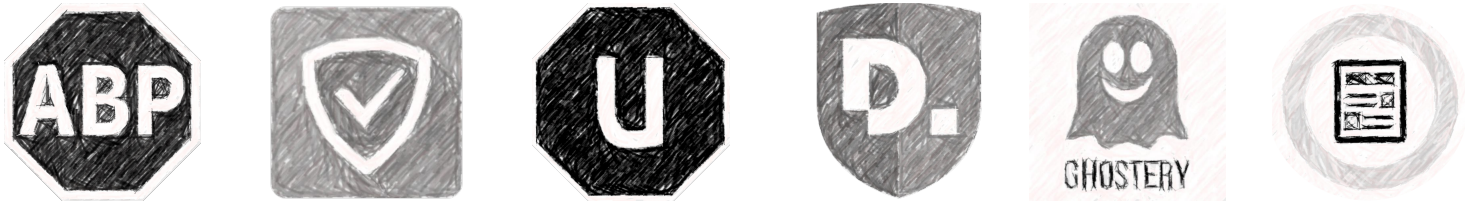

The Impact of Ad-Blockers on Product Search and Purchase Behavior: A Lab Experiment

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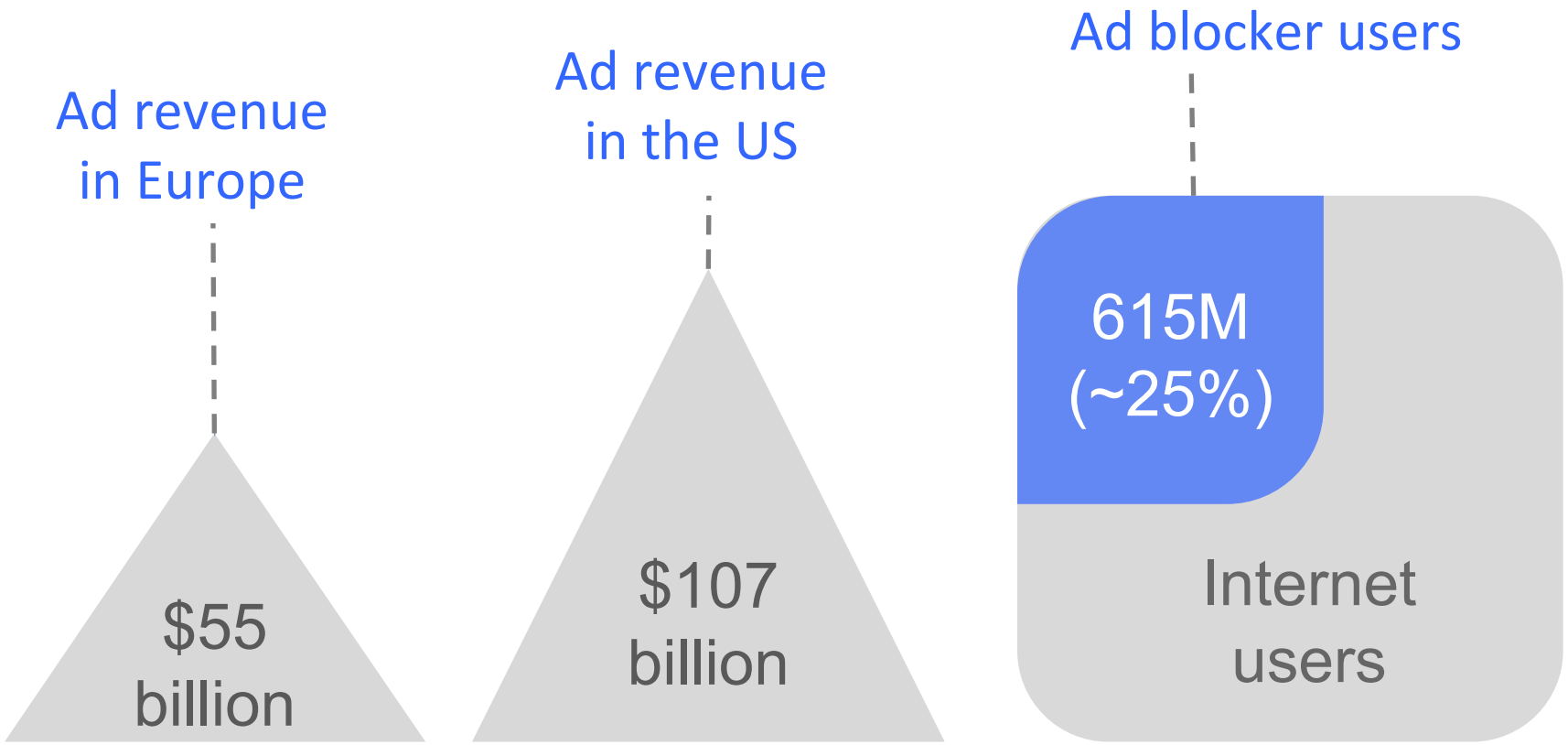
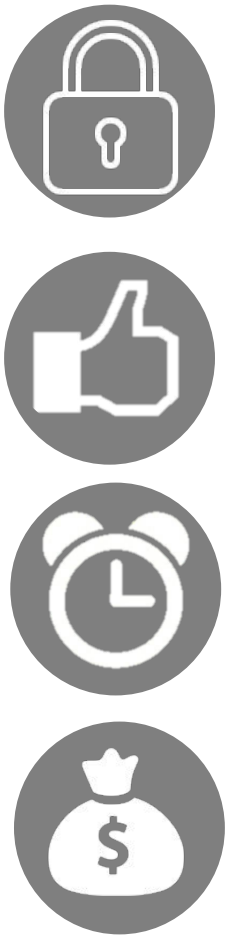
Motivation

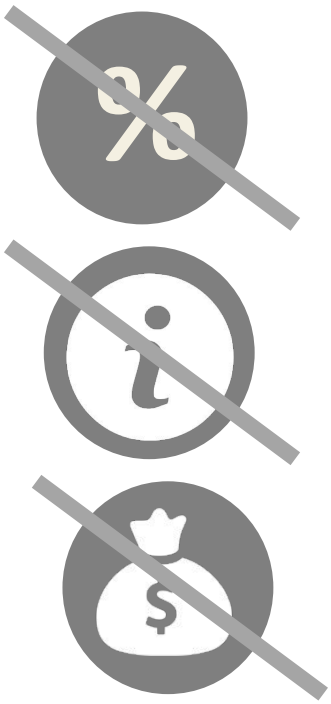


[1] IAB. 2018. https://iabeurope.eu/all-news/european-digital-advertising-market-exceeds-e55bn-in-2018/
[2] IAB. Internet advertising revenue report, 2018 full year results. Technical report, 2018.
[3] PageFair. The state of the blocked web: 2017 global adblock report. 2017.

Ad-blockers



VS.



Prior research

- Effectiveness and usability of ad-blockers
  - Impact on ad content removal [4,5], battery life[6], CPU and memory usage [7,8], usability [9], etc.

[4] Balebako, R., P Leon, R Shay, B Ur, Y Wang, and L Cranor. Measuring the effectiveness of privacy tools for limiting behavioral advertising. In WEB , 2012.

[5] Merzdovnik, G., M Huber, D Buhov, N Nikiforakis, S Neuner, M Schmiedecker, and E Weippl. Block me if you can: A large-scale study of tracker-blocking tools. In IEEE European Symposium on Security and Privacy, pages 319–333, 2017.

[6] Rasmussen, K., A Wilson, and A Hindle. Green mining: energy consumption of advertisement blocking methods. In Proceedings of the 3rd International Workshop on Green and Sustainable Software, pages 38–45. ACM, 2014.

[7] Mughees, MH, Z Qian, and Z Shafiq. Detecting anti ad-blockers in the wild. Proceedings on Privacy Enhancing Technologies, 2017(3):130–146, 2017.

[8] Shuba, A., A Markopoulou, and Z Shafiq. Nomoads: Effective and efficient cross-app mobile ad-blocking. Proceed. on Privacy Enhancing Technologies, (4):125–140, 2018.

[9] Pujol, E., O Hohlfeld, and A Feldmann. Annoyed users: Ads and ad-block usage in the wild. In Proceedings of the Internet Measurement Conference, pages 93–106, 2015.

Prior research

- Effectiveness and usability of ad-blockers
  - Impact on ad content removal, battery life, CPU and memory usage, usability, etc.

- Effectiveness of advertising
  - Impact on business revenues and market structure (sales, prices, competition, market concentration, etc.) [10-13]

[10] Chen, J., J Stallaert. An economic analysis of online advertising using behavioral targeting. MIS Quarterly , 38(2), 2014

[11] Jeziorski, P., and I Segal. What makes them click: Empirical analysis of consumer demand for search advertising. American Econ. Journal: Microeconomics, 7(3):24–53, 2015.

[12] Datta, A., MCl Tschantz, and A Datta. Automated experiments on ad privacy settings. In Proceedings on Privacy Enhancing Technologies, volume 1, pages 92–112, 2015.

Our study

- Research question:

What is the effect of ad-blocking deployment on consumers' product search and purchase behaviors and the resulting outcomes?

- Between-subject lab experiment
- 2 conditions: with and without an ad-blocker

METHOD

Variables

- Expenditures (prices of chosen products)

- Search time

- Satisfaction

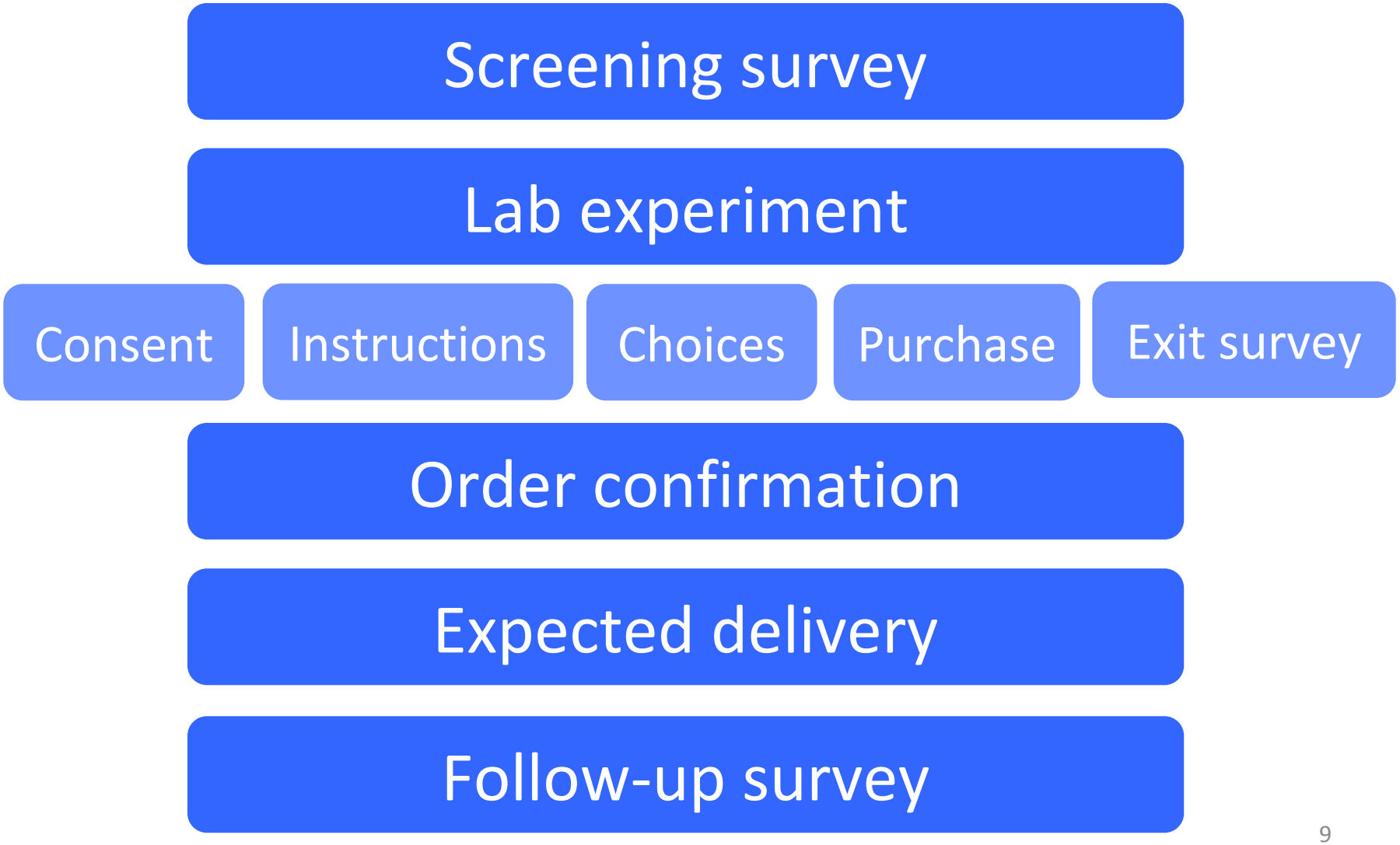
-- in “short” term -- immediately after purchasing

  - browsing experience
  - product choice, price, and *expected* product quality

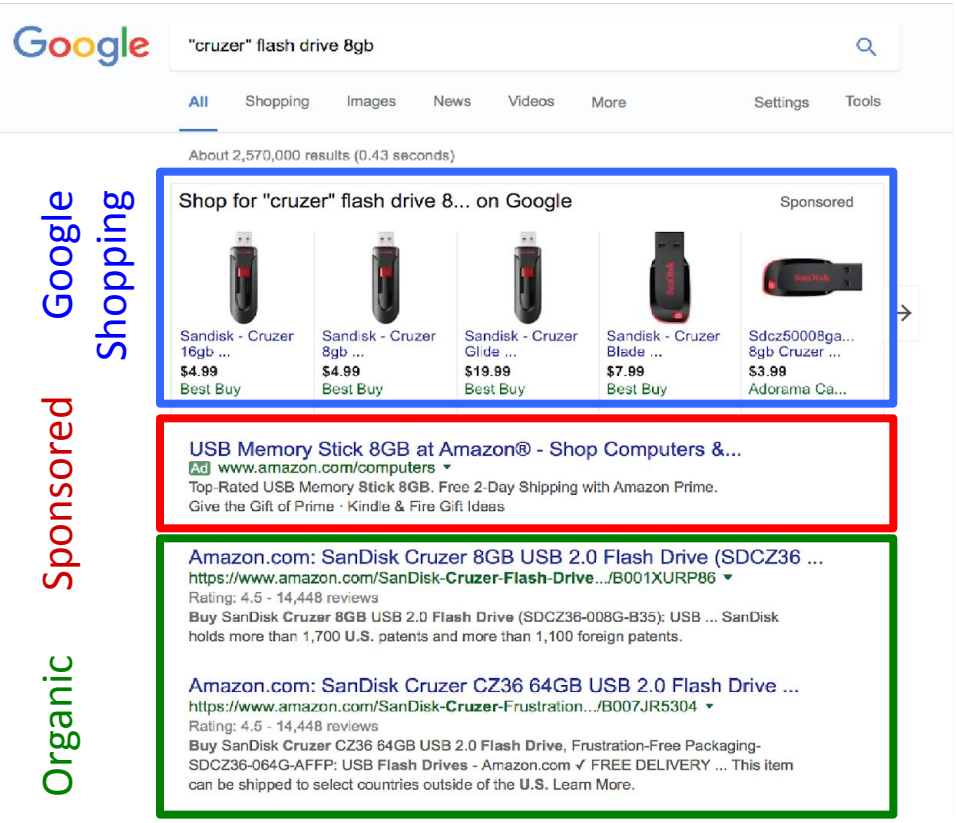
-- in “long” term -- after the product has been delivered

  - product choice, price, and *actual* product quality

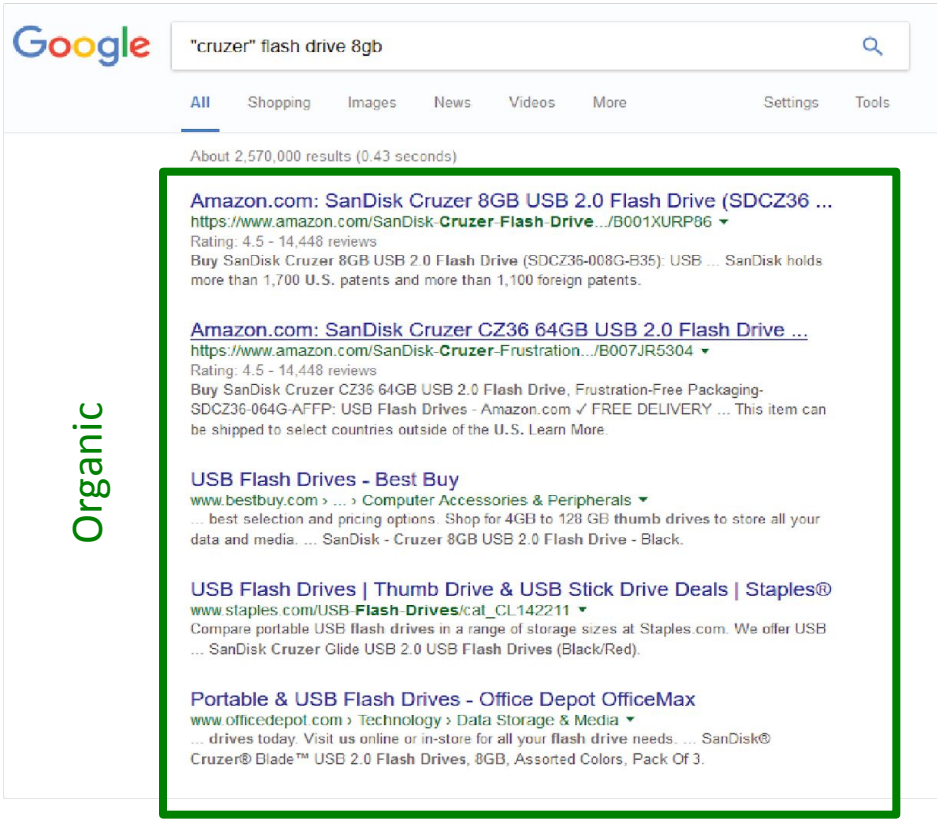
Experimental design



(a) NoBlock condition



(b) Block condition



Participants

- CMU participant pool, Craigslist, flyers
- 212 participants
- 52% female
- Age: mean=26, min=18, max=72
- Bachelor's degree and higher 59%

RESULTS

Attitudes to advertising

Table 1: Participants' responses (in %) to the exit survey question: "Indicate how much you agree or disagree with each of the following statements?"

Online advertising...	Disagree	Neutral	Agree
... is necessary to enjoy free services on the Internet	26.88	15.57	57.55
... saves money	45.75	21.70	32.55
... saves time	47.17	20.75	32.08
... helps me find products that match my personality and interests	33.97	17.92	48.11
... helps to buy the best product for a given price	47.64	20.28	32.08
... is intrusive	15.57	17.45	66.98
... is distracting	11.79	11.32	76.89
... is disturbing	32.54	21.23	46.23
... persuades to buy the products	44.34	18.40	37.26
... is informative about the available products, their prices, or discounts	27.83	9.91	62.26
... creates brand awareness	10.85	9.43	79.72

PRICES

Prices

- No sig treatment effect on prices

Table 6. Linear mixed model regression on price_log with random individual effects.

	(1)	(2)	(3)	(4)
Block condition	-0.00388		-0.00705	0.000493
	[-0.10,0.10]		[-0.10,0.09]	[-0.10,0.10]

Prices

- No sig treatment effect on prices
- Experienced (home) ad-blocker users chose products 10-11% cheaper than non-users

Table 6. Linear mixed model regression on price_log with random individual effects.

	(1)	(2)	(3)	(4)
Block condition	-0.00388		-0.00705	0.000493
	[-0.10,0.10]		[-0.10,0.09]	[-0.10,0.10]
Home computer ad blocker user		-0.111*	-0.111*	-0.104*
		[-0.21,-0.01]	[-0.21,-0.01]	[-0.21,-0.00]

SEARCH TIME

Search time

- No sig treatment effect on search time ($t(1682)=-0.85$, $p=.40$) and number of inspected search results ($t(1682)=.24$, $p=.81$)

Table 7. Linear mixed model regression on searching time (in minutes) with random individual effects.

	(1)	(2)	(3)	(4)
Block condition	0.192		0.197	0.263
	[-0.45,0.84]		[-0.45,0.85]	[-0.24,0.76]

Search time

- No sig treatment effect on search time
- Experienced (home) ad-blocker users did not spend less or more time on product searching

  (t(1682)=-.86, p=.39),

Table 7. Linear mixed model regression on searching time (in minutes) with random individual effects.

	(1)	(2)	(3)	(4)
Block condition	0.192		0.197	0.263
	[-0.45,0.84]		[-0.45,0.85]	[-0.24,0.76]
Home computer ad blocker user		0.198	0.203	0.0268
		[-0.45,0.84]	[-0.45,0.85]	[-0.46,0.52]

but inspected more search results (t(1682)=2.34, p=.02)

Search time

- Participants who chose the products from sponsored Google shopping listings spent less time on their searching than those, who chose the products following organic links (ANOVA: b=-1.64, p=0.00).

	Organic links	Sponsored Google Shop-ping listings	Sponsored links (top)	Sponsored links (bottom)	Overall
NoBlock	4.36	2.69***	4.72	6.1	4.12
Block	4.27				4.27

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

SATISFACTION
- browsing -

Browsing satisfaction

- Satisfaction with browsing:
  - overall pleasure from browsing experience,
  - speed of web page load,
  - relevance of the search results to the query,
  - selection of the products on the visited websites,
  - quality and professionalism of the visited websites,
  - ease of navigation on the visited websites,
  - technical functioning level (broken links, distorted elements).

Browsing satisfaction

- Satisfaction with web page loading speed was higher in the NoBlock condition (68% satisfied in the NoBlock vs. 46% satisfied in the Block; p=.00)
  - Ad-blocker uses additional computational resources [13] (use of multiple ad-blockers may have amplified the effect)⟶ Slower webpage loading speed
  - Reduced satisfaction, but not searching time

[13] BBC News. Ad code 'slows down' browsing speeds. 2019: https://www.bbc.com/news/technology-47252725

Browsing satisfaction

Index of satisfaction with browsing (Cronbach's α=.85)

- No sig treatment effects
- lower among experienced (home) ad-blocker users (p=0.01)

Table 8. Linear fixed effect model regression on the index of overall browsing satisfaction.

	(1)	(2)	(3)	(4)
Block condition	0.0878		0.0752	0.0189
	[-0.16,0.33]		[-0.17,0.32]	[-0.22,0.25]
Home computer ad blocker user		-0.337**	-0.334**	-0.262*
		[-0.58,-0.09]	[-0.58,-0.09]	[-0.50,-0.02]

SATISFACTION
- products -

Product satisfaction

- No sig treatment effect
- Experienced (home) ad-blocker users are less satisfied with product choices

short term

Table 9. Ordered logit regression on overall satisfaction with the chosen products, measured immediately after the experiment (*ex-ante*), with robust standard errors.

	(1)	(2)	(3)	(4)
Block condition	0.121		0.114	0.169+
	[-0.05,0.29]		[-0.06,0.28]	[-0.02,0.35]
Home computer ad blocker user		-0.193*	-0.189*	-0.131
		[-0.36,-0.02]	[-0.36,-0.02]	[-0.31,0.05]

long term

(*ex-post*), with robust standard errors.

	(1)	(2)	(3)	(4)
Block condition	0.0344		0.0730	-0.0756
	[-0.52,0.59]		[-0.50,0.64]	[-0.67,0.52]
Home computer ad blocker user		-0.476	-0.483	-0.882*
		[-1.07,0.12]	[-1.09,0.13]	[-1.56,-0.20]

Types of search ads

- Products chosen from sponsored Google shopping listings:
  - Lower prices (on 10% level of significance: b=-1.32, p=.06)
  - Shorter search time (b=-1.64, p=.00)

    BUT:
  - Lower price satisfaction (b=-.33, p=.04)
  - Lower quality satisfaction (short term) (b=-.68, p=.00)

- Products chosen from top sponsored links:
  - Higher prices (b=2.84, p=.01), but no effect on satisfaction
- Products chosen from bottom sponsored links:
  - Lower product choice (b=-1.05, p=.049)
  - Lower quality satisfaction (short term) (b=-1.01, p=.03)

Conclusions

- The use of privacy- and security-enhancing ad-blockers do not harm consumers' purchasing behaviors in terms of prices paid, product searching time, and satisfaction with products, their prices, and quality
- Ad-blockers may negatively affect satisfaction with web page loading speed, but not eventual searching time
- Experienced ad-blocker users tend to:
  - Choose cheaper products
  - Inspect more search results before making purchasing decision
  - Be less satisfied with browsing experience and product choices

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