How and Why People Use Virtual Private Networks

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Lancaster University, Princeton University∗, University of Chicago†

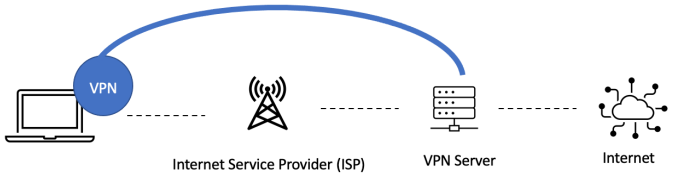
Lancaster University

PRINCETON UNIVERSITY

THE UNIVERSITY OF CHICAGO

Plan

- Introduction to VPNs



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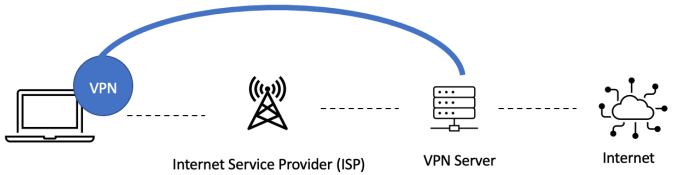

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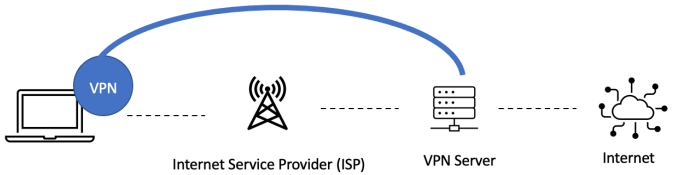

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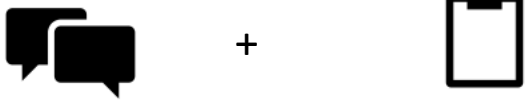

- Findings

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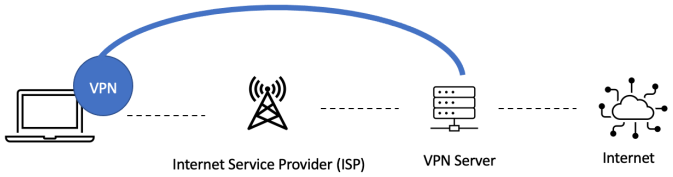


- Methods

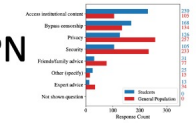
+

- Findings

- Implications

VPN = ?

VPN



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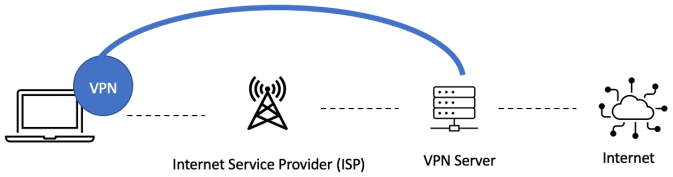

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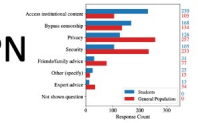

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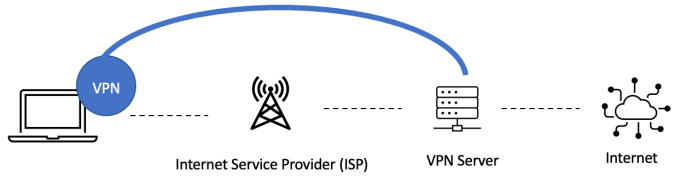

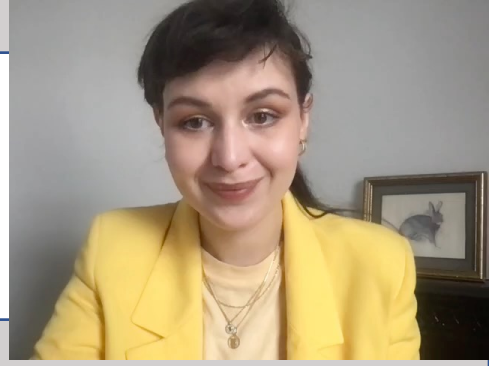

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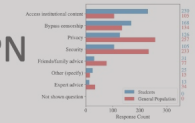
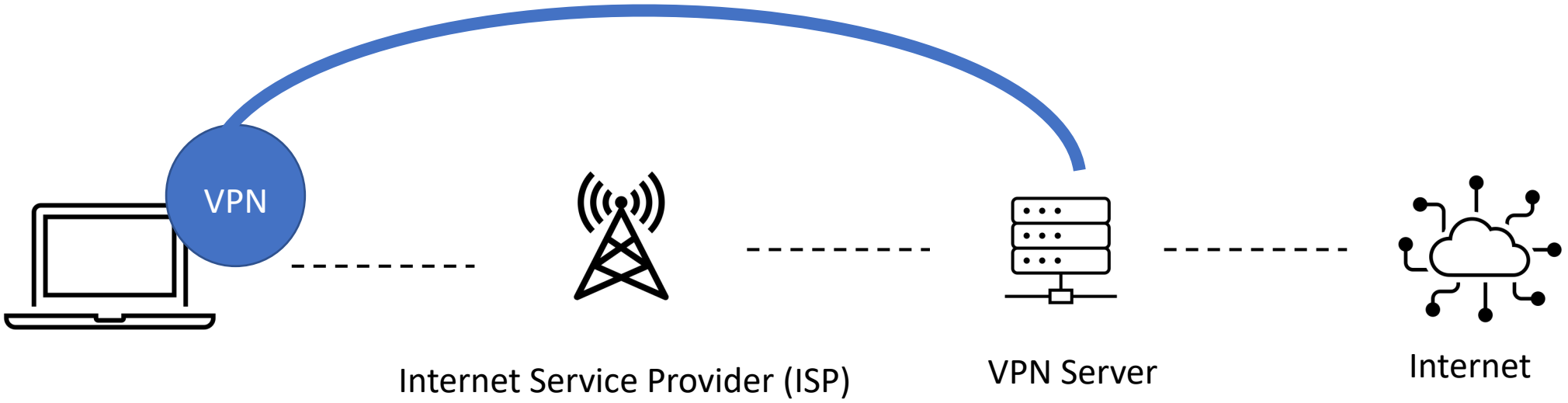


- Conclusions

Virtual Private Network (VPN)



VPNs

VPNs

Institutional

e.g. Campus network
for working off campus

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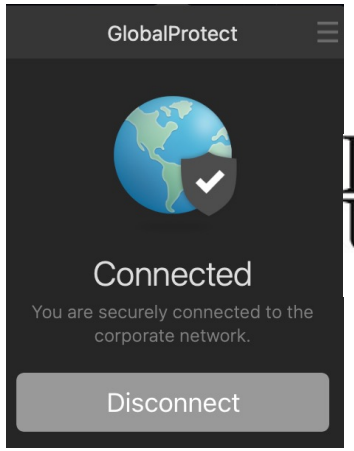

Lancaster University

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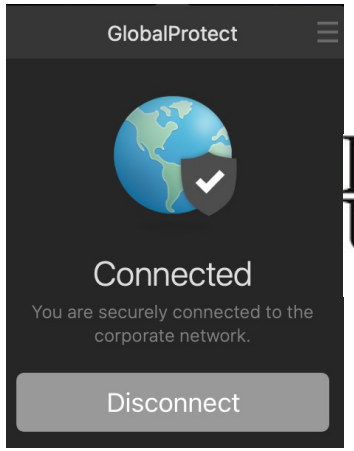

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Commercial

Both free and paid

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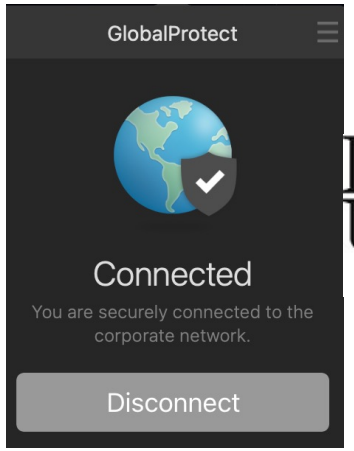

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Hotspot Shield

NordVPN®

Commercial VPNs

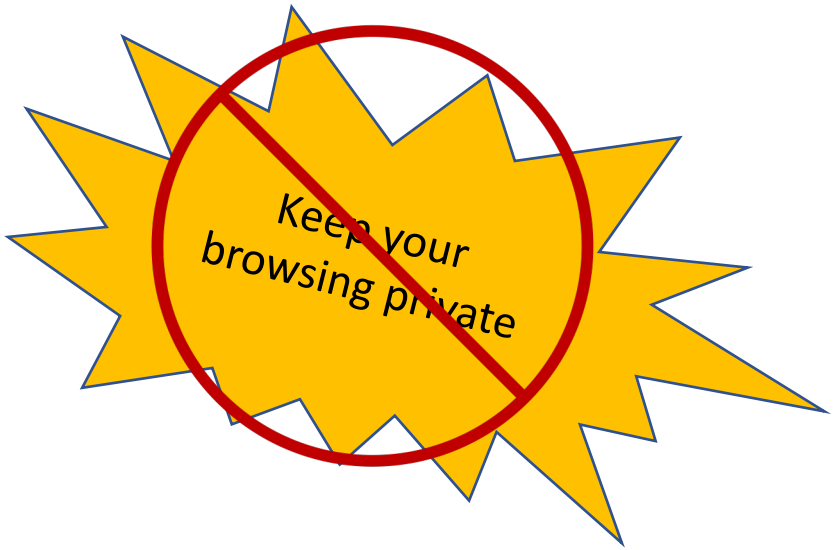
Ultimate Security Package!

Free protection!

Keep your browsing private

Commercial VPNs

Commercial VPNs



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Research Questions

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- Why do people use VPNs ?

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- Are people aware of the security & privacy risks of VPNs ?

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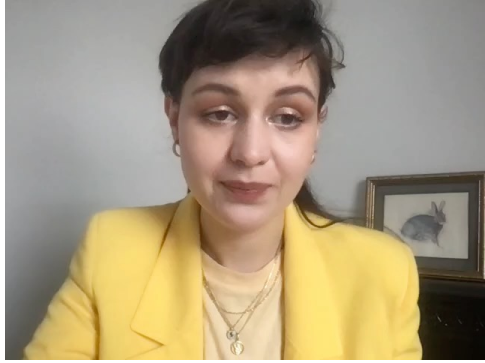
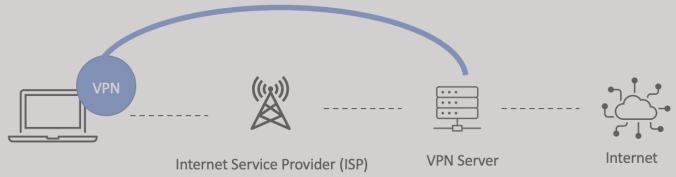


- Why do people use VPNs ?
- Are people aware of the security & privacy risks of VPNs ?
- How do people choose which VPNs to use ?

Plan

- Introduction to VPNs



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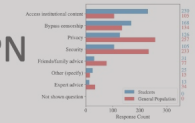

- Conclusions

Methods

729 U.S. VPN users

Methods

729 U.S. VPN users

Interviews

32 Students

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12 U.S.	37.5%
20 International	62.5%

Methods

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Survey

349 Students

+

348 General Population users on Prolific

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257 U.S.	74%
97 International	26%

+

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342 U.S.	98%
6 International	2%

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Interview Guide

1) INTERVIEW GUIDE

INTRODUCTION

1. Introduce yourself
2. Thank the interviewee for their time
3. Explain what our project is about.
4. Mention that some questions may feel personal since we will ask about participant's experience and thoughts on VPN and that we can stop any time participant wishes to.
5. Present consent form – explain anonymity.
6. Ask for signatures: under the first part of the consent form and under permission to record.
7. Make sure the participant does not have any questions before you begin.
8. Start recording.
9. Ask some warm-up questions

General Privacy and Security Awareness

Data Practices

1) What do you think censorship on the Internet is?
2) How do you feel about censorship on the Internet?
3) Is there online censorship in your home country? Tell me more about it.
4) What does the term online tracking mean to you?
5) Who do you believe is tracking you?
6) Why do you believe these entities are tracking you?

Privacy

7) Tell me about any tools you use to protect your privacy online or to overcome censorship

(Tracker blockers e.g. Privacy Badger, Ghostery, UBlock, Disconnect etc, Disable cookies on the browser, Private Browsing Mode, Tor Browser, Other)

8) How did you hear about these tools?

9) How long have you been using them?
10) Why do you use them?
11) Do you use these tools at the same time as your VPN? Why/Why not?

MAIN QUESTIONS

Past Experiences and Knowledge of VPNs

Current Usage of VPNs

12) Tell me in your own words what a Virtual Private Network means to you?
13) If they do not use a VPN:
    a. What have you heard about Virtual Private Networks?
    b. Who/Where have you heard about VPNs from?
    c. Is there any reason for non-use of a VPN?
14) Why do you use a VPN?
15) When was the last time you used a VPN?
16) Are there any specific websites you visit using VPN?
    -Are they normally blocked or not?
17) Tell me about your first experience using a VPN
18) Can you recall how you learned about VPNs that you have used?
19) How would you explain what VPN does when you use it?
20) How do you feel about browsing while using a VPN?
    -How do you feel if you are not using a VPN?
21) Which VPNs have you used? (Show list if needed and ask participant to check all that apply or show you their phone/laptop if needed)
22) Where do you use VPN – home country, US, other?
23) Have you ever tried to create your own VPN? Why?
24) Can you tell me more about VPN usage in your country? Is there any issue with that?

Configuration

25) What criteria do you use to assess if a VPN is trustworthy?
26) What is important for you when choosing a VPN provider?

27) Did you do anything to prepare your device for using VPN? (ex. enabling two-factor authentication, using browser extensions, IP-leak test) Why?
28) How do you feel about who the VPN service provider that you use is? Is that important for you? Why? Why not?
29) How do you check your VPN is connected/working?
30) Did you pay for your VPN? Why yes/not?
31) In your VPN do you have different countries you can choose to connect to?
32) Do you try to connect to any specific country? Which one and why?
33) Is the number of locations a VPN provider houses servers important for you? Why?(server network)
34) Did you get a clear description from your VPN provider of how to use VPN? Do you think it is needed/important? Why?

Privacy and Security

35) Can you tell me about how your VPN providers explain how your privacy and security work while using VPN? Does your VPN provider explain it in a clear way?
36) Did you get an explanation of where your IP address is viewable? Where do you think it is?
37) Have you ever looked through your VPN provider's privacy policy? Any thoughts on that?
38) Do you think VPN guarantees you anonymity? What does it guarantee? What isn't guaranteed?
39) Do you think your VPN provider monitors or logs your activity? Why do you think so? What for?
40) Do you think your VPN provider's practices are transparent?
41) Do you think you can be tracked while using VPN? Tell me more.
42) Do you know whether your VPN provider shares any of your information? What do you think? If yes - what information? What about billing/payment info?
43) Do you think VPN should provide different levels of protection? Why? Why not? to whom?
44) Can you tell me more about how you feel when using VPN in terms of privacy and security?

Strengths and Challenges of VPN Usage

45) Have you ever had any problems with a VPN?
- Tell me more
-How did you manage these issues?
46) Have you ever reported any issues to your VPN provider?
47) How would you describe your overall experience on Internet using VPN vs. not using VPN
48) Recall a time when you could not connect to VPN successfully. What did you think or feel?

Improvements to VPNs/General Privacy Enhancing Tools

49) How would you improve a VPN?
50) What in your opinion a perfect VPN would provide?
51) Cheap/Fast/Secure - how would you list these 3 starting from the most important when choosing VPN and why?
52) Would you be willing to pay for a VPN subscription? -Why? - How much per month/year?
53) Would you trust a free VPN? Why?
54) Have you seen VPNs commercials? How often? Which VPNs?
55) Do you trust these commercials? Why? Why not?

CONCLUSION

1. Ask the participant if there is anything s/he would like to add.
2. Explain what we are going to do with the data.
3. Ask for feedback.
4. Provide compensation or take details for compensation
5. Stop recording
6. Ask if the interviewee knows anyone else that wants to participate in the study
7. Thank the interviewee.

Data Analysis

Main Code	Definitions
Reasons for VPN usage	Motivations and goals behind VPN usage
What is a VPN?	Mental model of a VPN
Guidelines when choosing VPN	Personal preferences of VPN's qualities and strategy in choosing a VPN
Trust in VPN provider	Attitudes towards their VPN provider
Using institution related VPN	Usage habits regarding institutional VPNs
Use or trust free VPN	Attitudes towards commercial free VPNs
VPN practices	Thoughts on VPNs' data practices
What a VPN guarantees	Assumptions about VPNs' assertions
Tracking while using VPN	Assumptions about protection that VPNs provide against tracking

*Summary of **main codes** reported in the interviews coded in Dedoose*

Methods

729 U.S. VPN users

Interviews

32 students

Survey

349 Students

+

348 General Population users on Prolific

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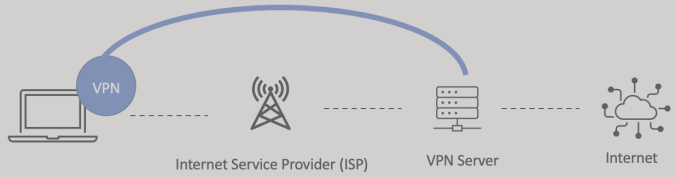

- Methods

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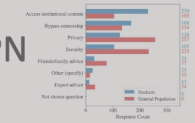
VPN = ?

VPN



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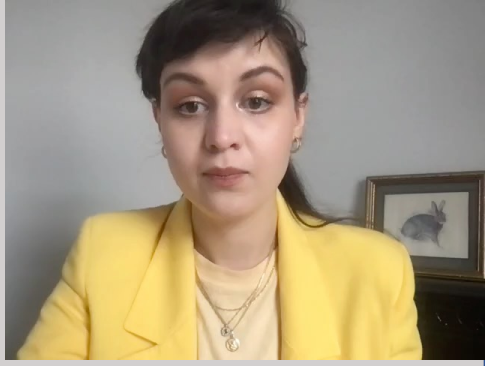


Findings

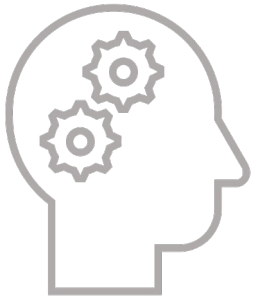
VPN Usage

Mental Models of VPNs

VPN Selection

Findings

VPN Usage



Mental Models of VPNs

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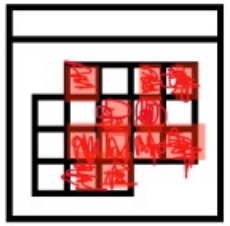
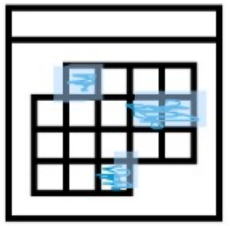
VPN Usage

General population



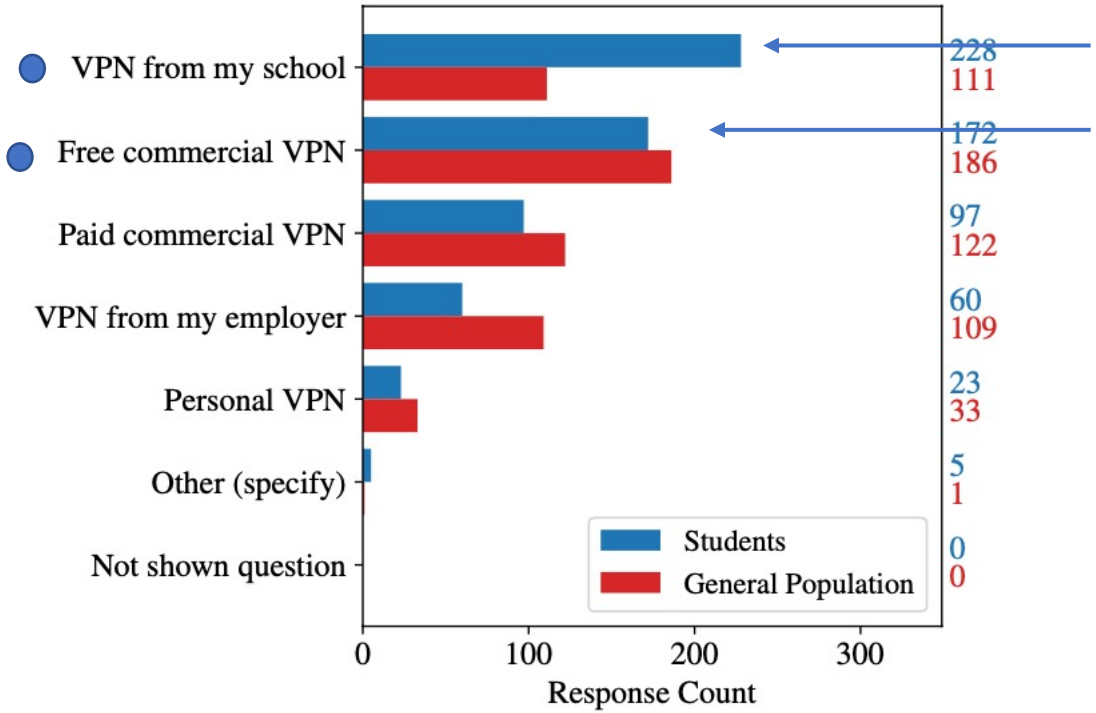
For privacy/security and continually

Students

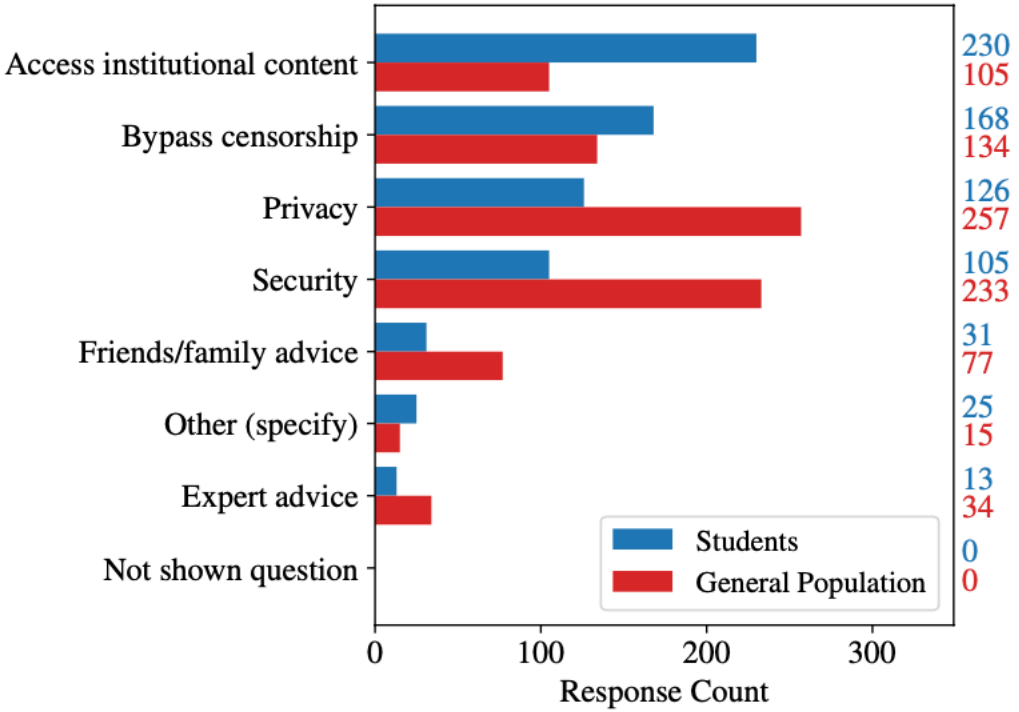


To access content, when needed

Findings:



***Types** of VPNs used (responses selected by participants)*



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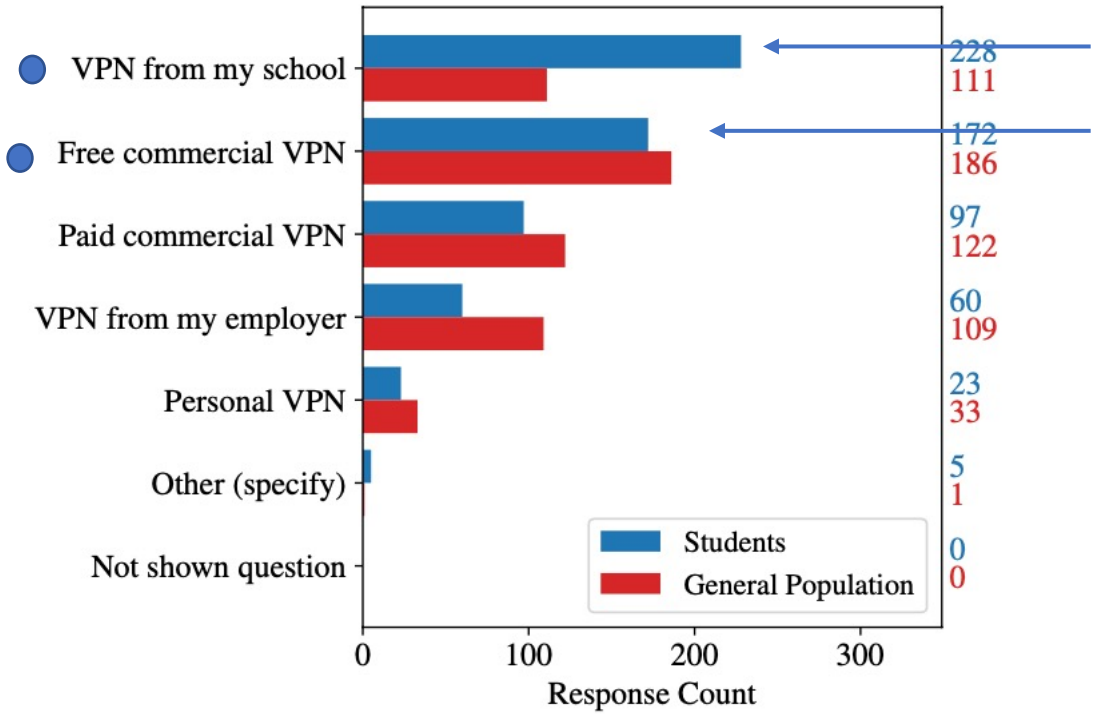

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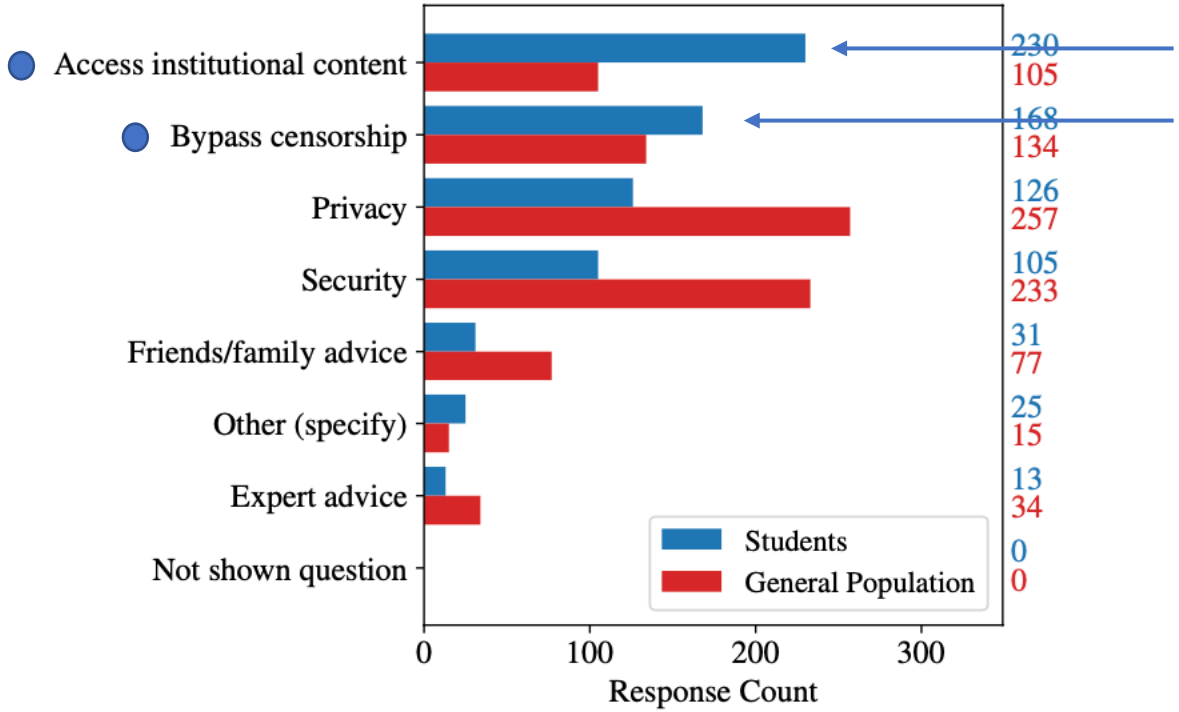

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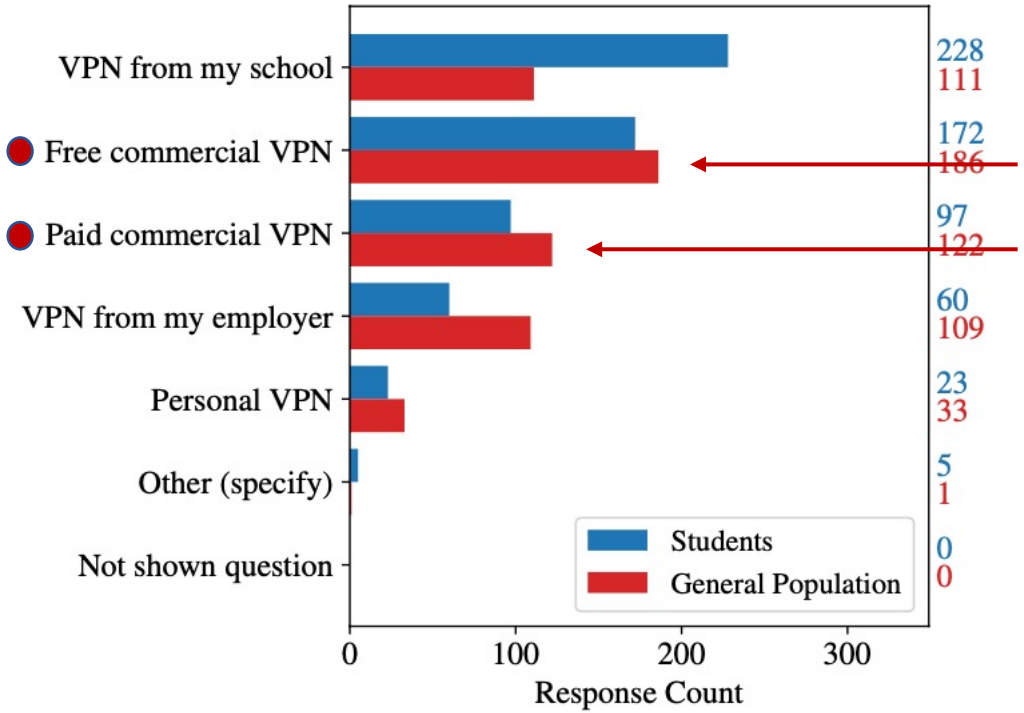

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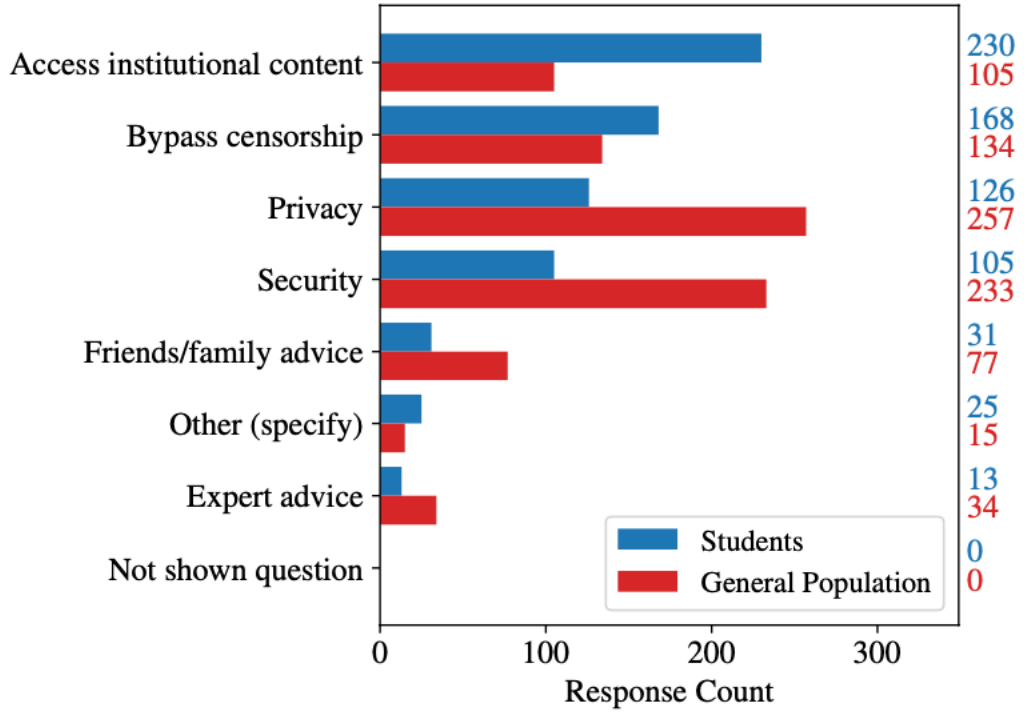

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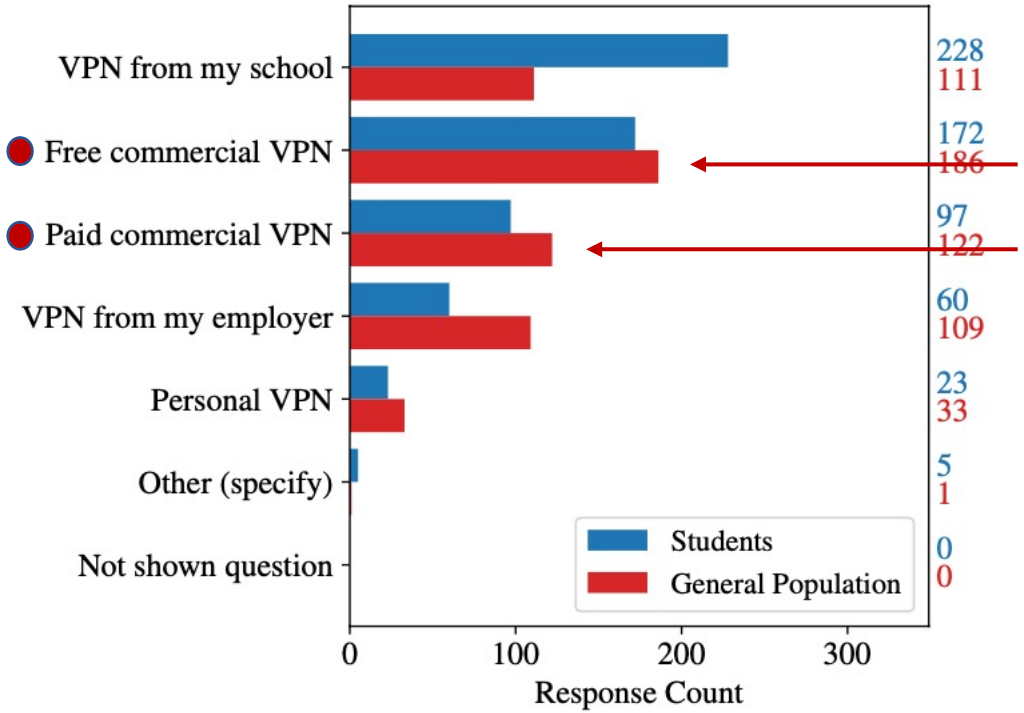

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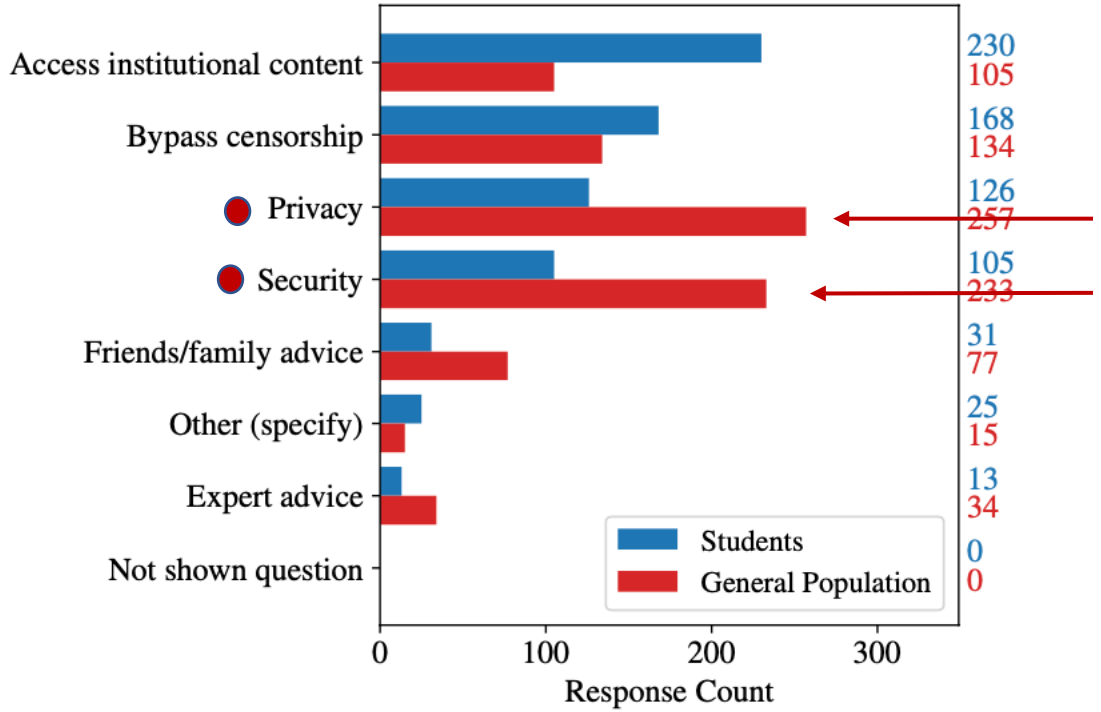

***Why** do/did you **use** a VPN? (responses selected by participants)*

Findings:

Survey	Response	VPN through school/employer	#	%	Paid VPN	#	%	Free VPN	#	%
General Population	Safe		41	22.3%		36	29.5%		8	4.3%
	Somewhat safe		69	37.5%		59	48.4%		47	25.3%
	Neutral		49	26.6%		25	20.5%		60	32.3%
	Somewhat vulnerable		18	9.8%		1	0.8%		65	34.9%
	Vulnerable		7	3.8%		1	0.8%		6	3.2%
University Students	Safe		54	23.5%		21	22.3%		4	2.8%
	Somewhat safe		73	31.7%		31	33%		46	31.9%
	Neutral		71	30.9%		27	28.7%		36	25%
	Somewhat vulnerable		32	13.9%		11	11.7%		46	31.9%
	Vulnerable		8	3.5%		4	4.3%		12	8.3%

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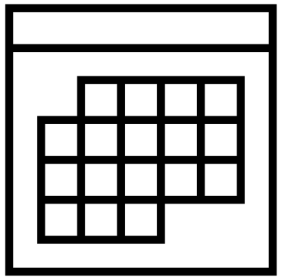
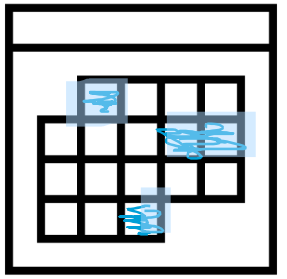


How often do you use VPNs?

Students:

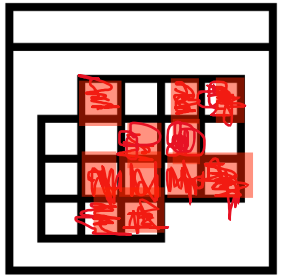
Sometimes or rarely: **302** /349



General population:

Sometimes: **164**/348

Most of the time: **91**/348.



Findings

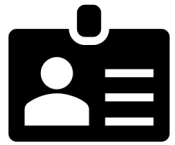
VPN Usage

Mental Models of VPNs

VPN Selection

Findings

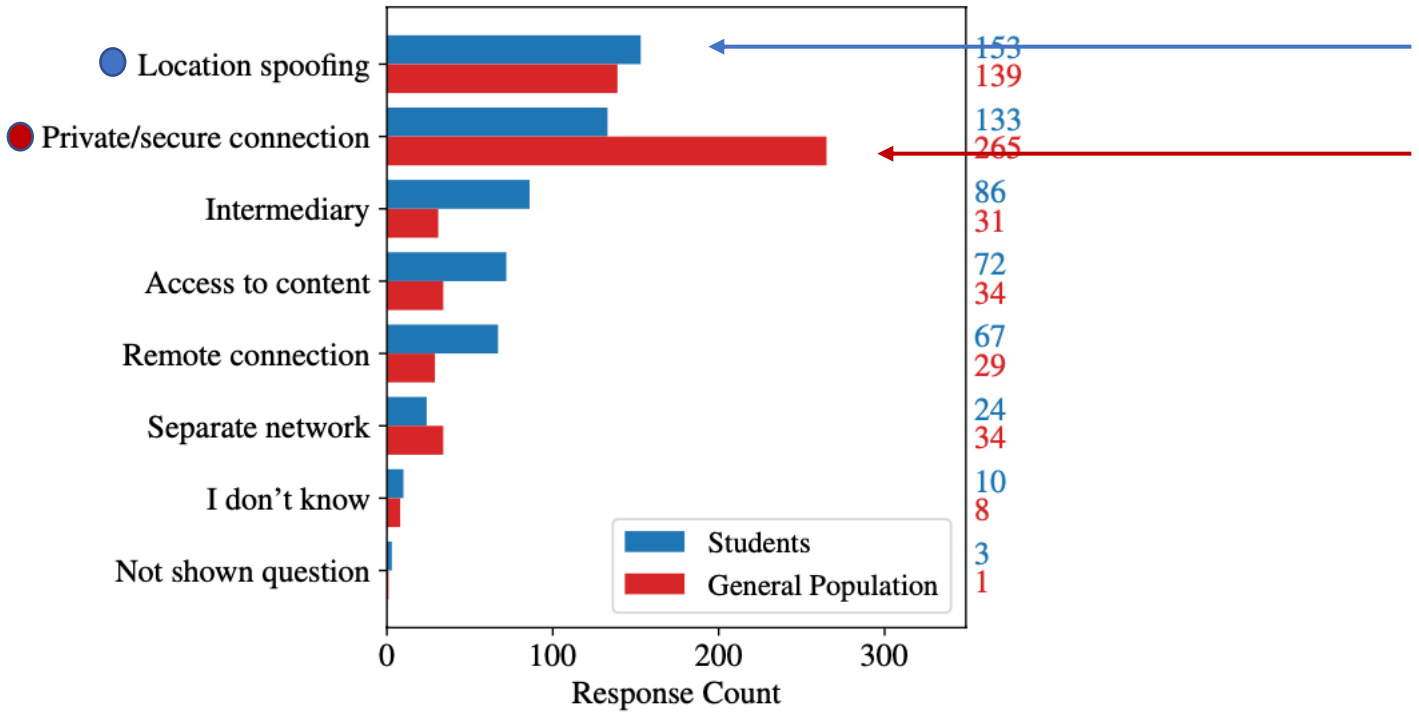
Mental Models of VPNs



VPNs collect data

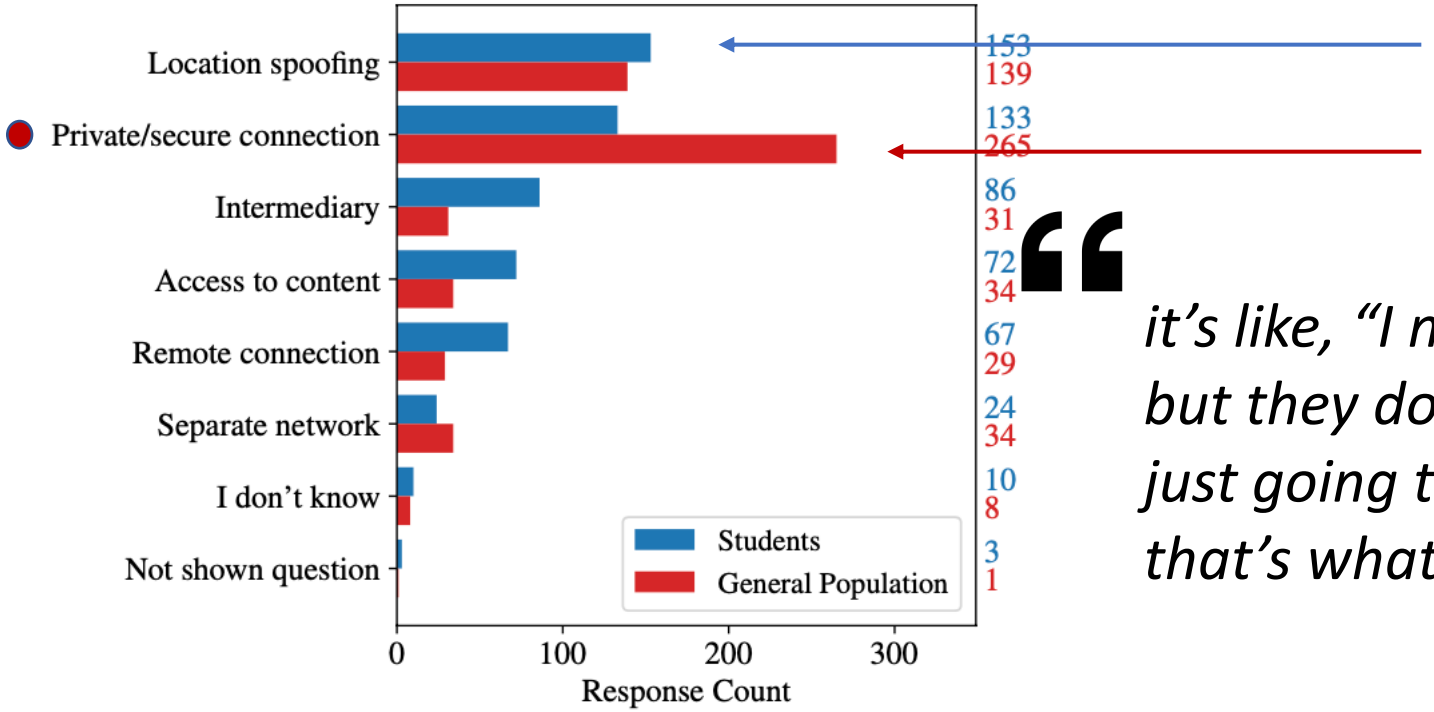
Pragmatic approach

Findings:



***What** do you think a **VPN is**? (response coded by researchers)*

Findings:

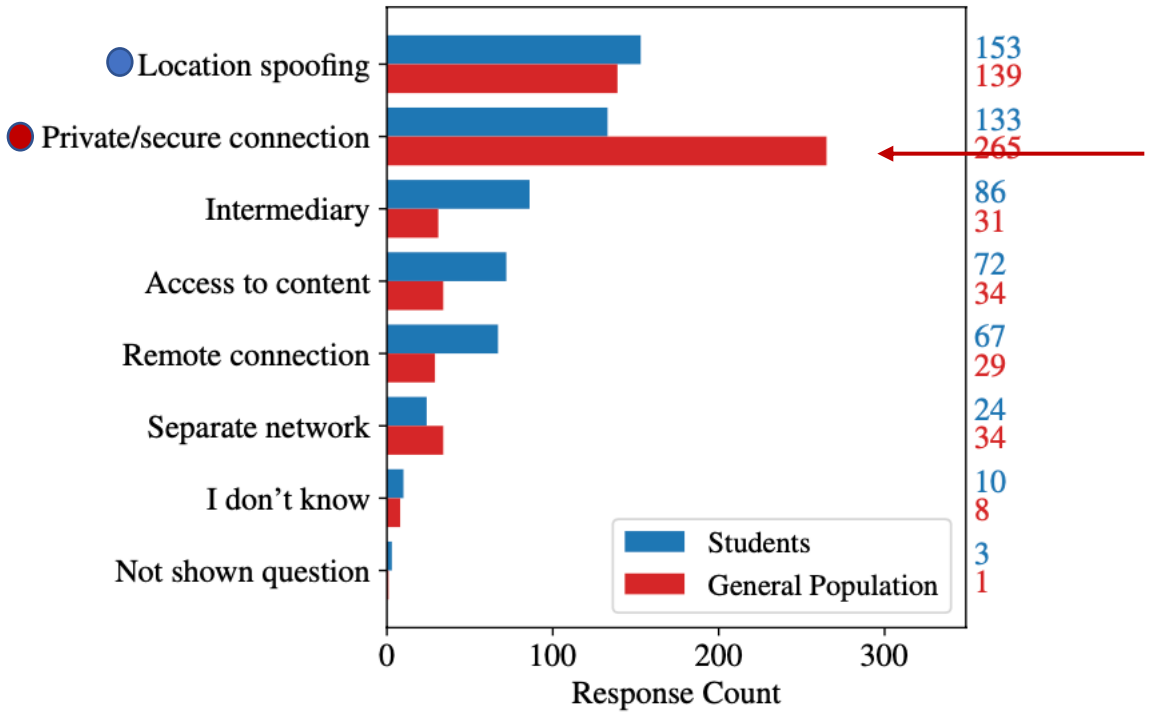


> *it's like, "I need to see this YouTube video, but they don't let me see it in Brazil so I'm just going to do it in Belgium." I think that that's what VPNs are to me.*

P25

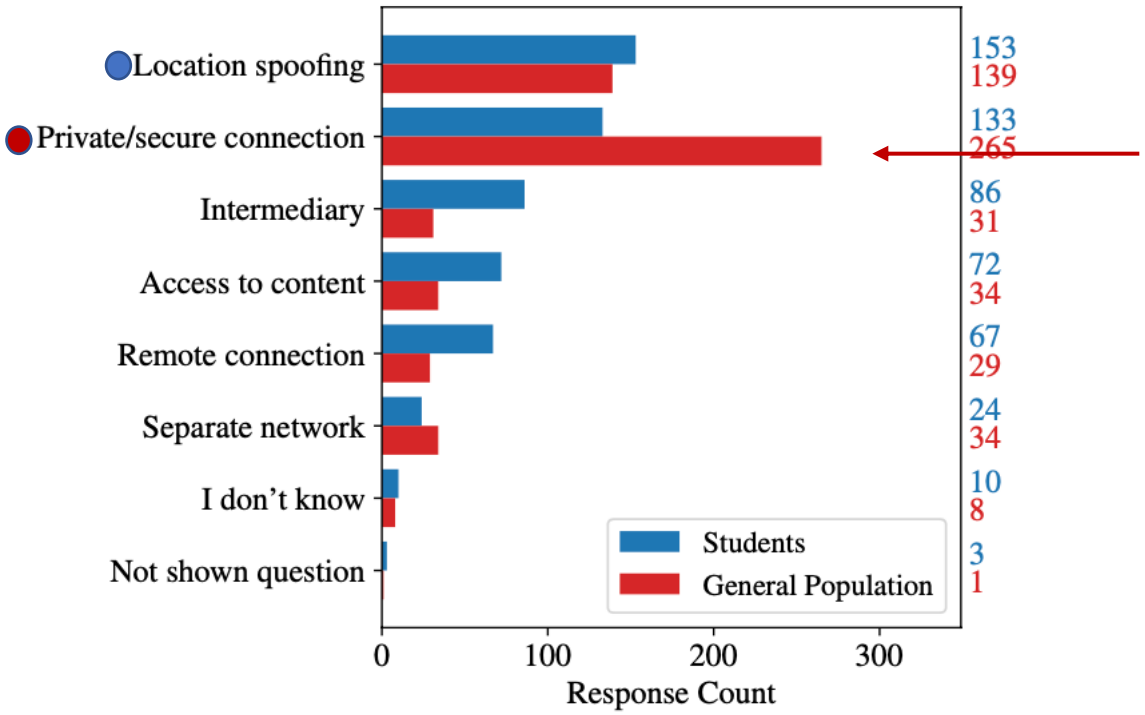
***What** do you think a **VPN is**? (response coded by researchers)*

Findings:



***What** do you think a **VPN is**? (response coded by researchers)*

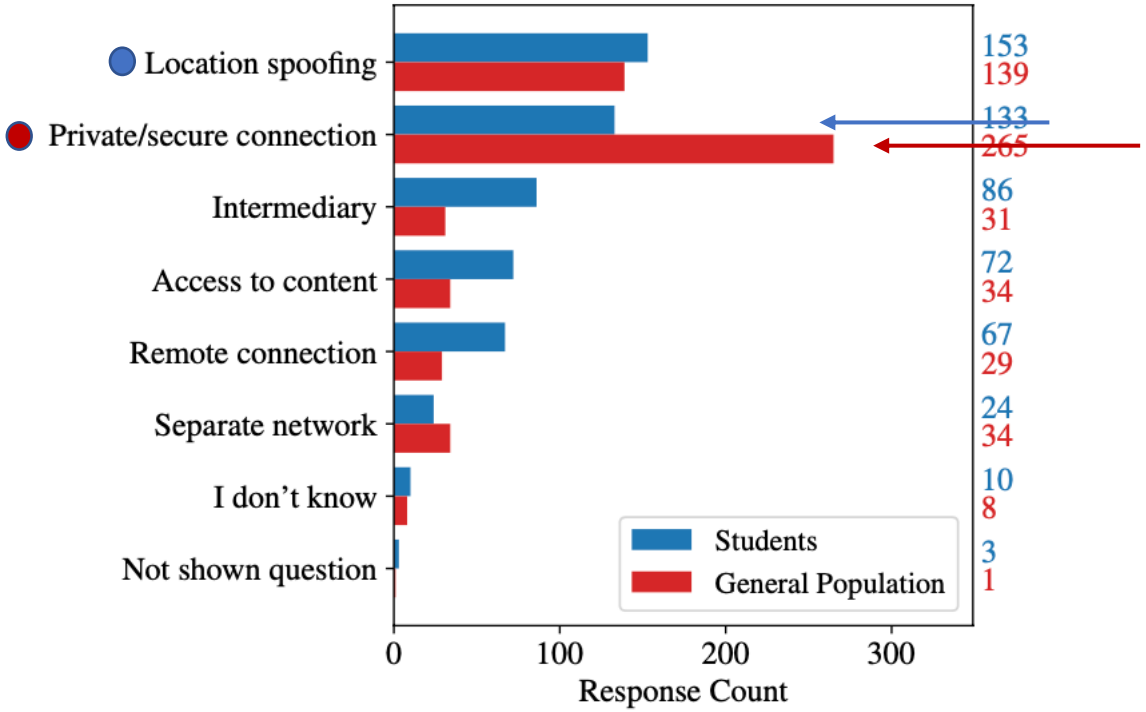
Findings:



230/348 of **General Population** believed VPNs collect data about users

***What** do you think a **VPN is**? (response coded by researchers)*

Findings:

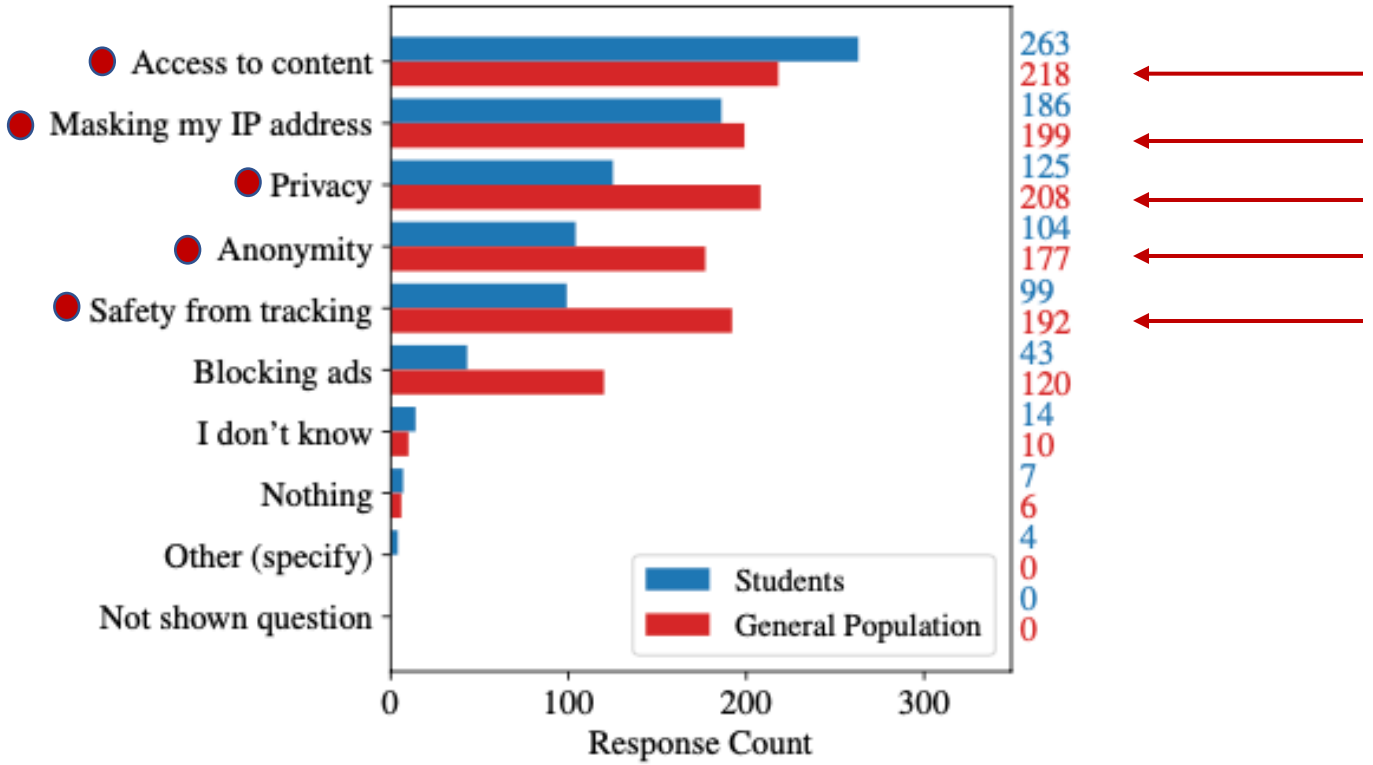


If you're using VPNs for a bit more nefarious means (…) I think some of them do keep logs, and they're able to give them over to police, and the governments, and things like that. (…) And then, other ones are a bit more simple, like tracking users' web habits to sell to advertisers (…)

P11

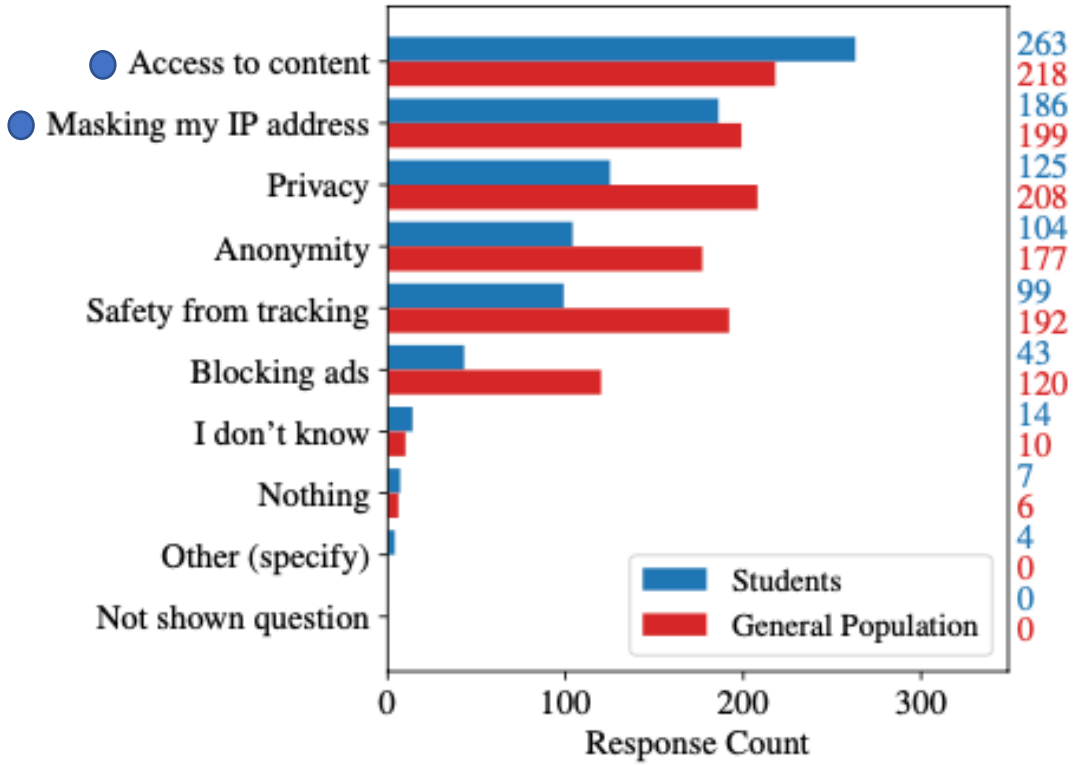
***What** do you think a **VPN is**? (response coded by researchers)*

Findings:



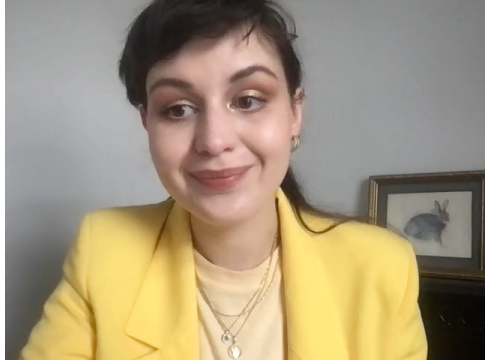
***What** do you think your **VPN guarantees**? (responses selected by participants)*

Findings:

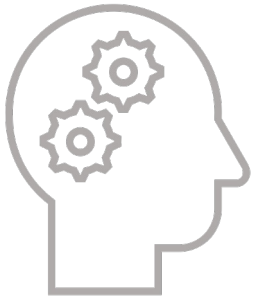


***What** do you think your **VPN guarantees**? (responses selected by participants)*

Findings



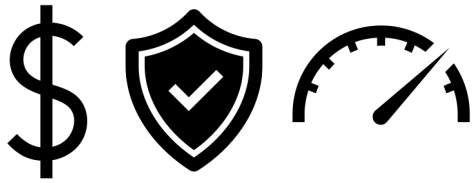
VPN Usage



Mental Models of VPNs

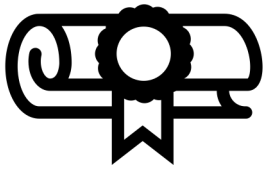
VPN Selection

Findings



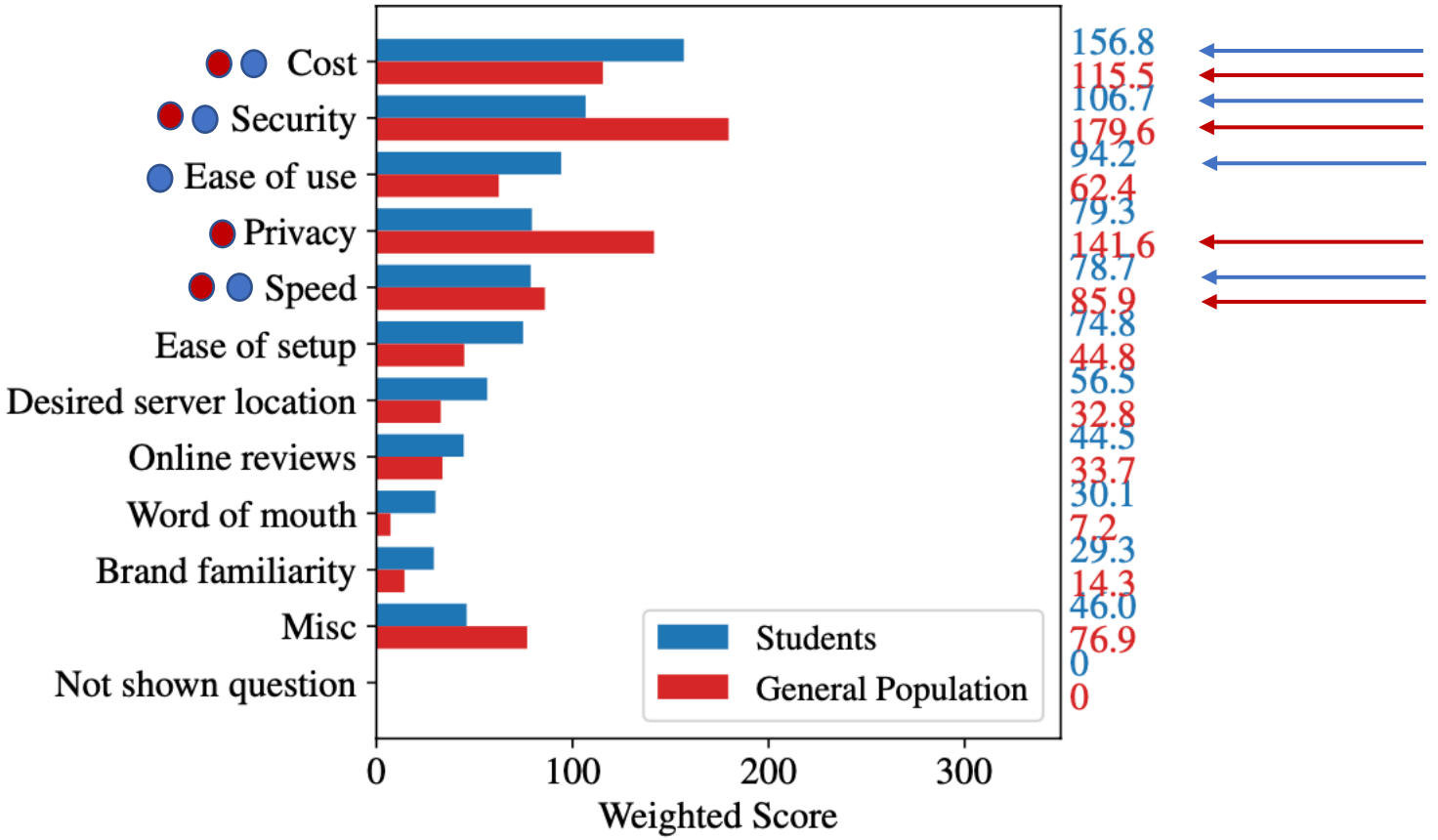
Main factors, when choosing a VPN

VPN Selection



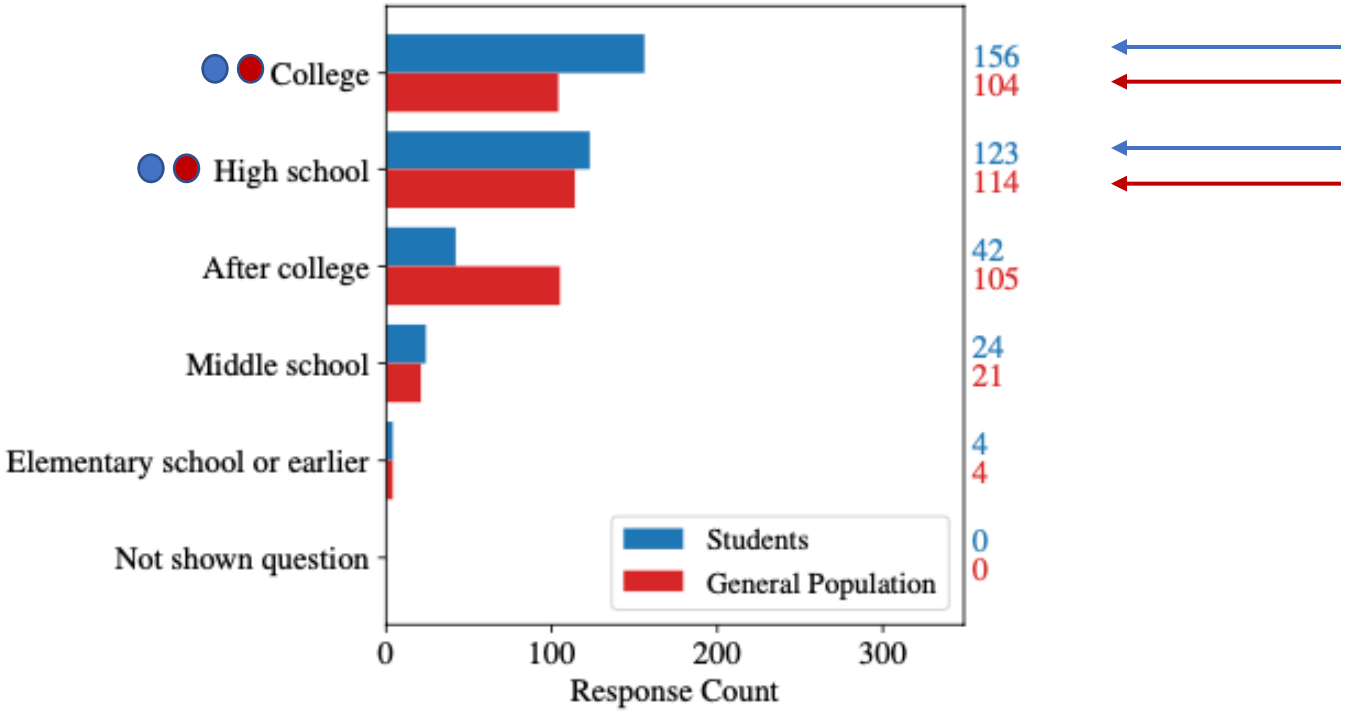
First use: Highschool/College

Findings:



*Rank the five most **important factors** when **choosing** a VPN.*

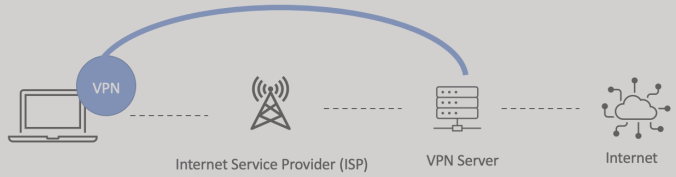
Findings:



*When did you **first use** a VPN? (response selected by participants)*

Plan

- Introduction to VPNs



- Methods

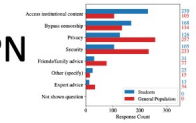
+

- Findings

- Implications

VPN = ?

VPN



- Conclusions

Implications

VPN = ?

Implications

VPN = ?

Better Resources and Tools

Implications

VPN = ?

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Better Resources and Tools

Implications

VPN = ?

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Better Resources and Tools

Privacy Equity

Implications

VPN = ?

Better Resources and Tools

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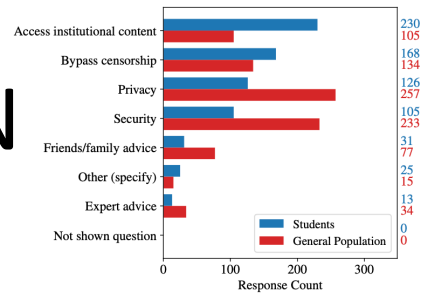
Privacy Equity

VPN



Implications

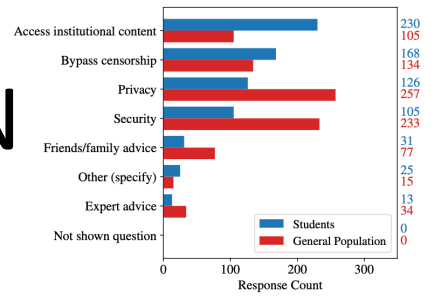
VPN = ?

Better Resources and Tools

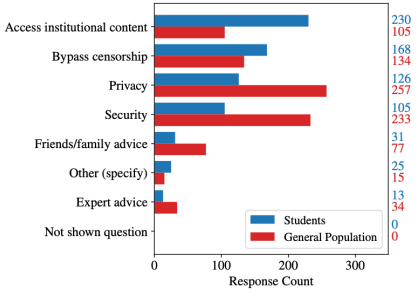
$

Privacy Equity

VPN

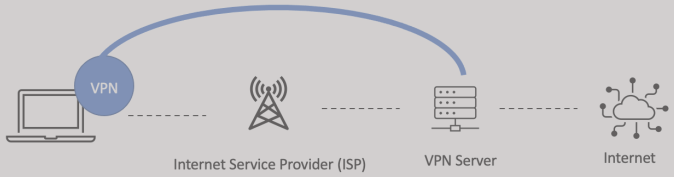


Other Privacy Enhancing Technologies



Plan

- Introduction to VPNs



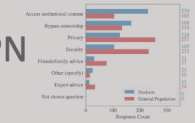
- Methods

- Findings

- Implications

VPN = ?

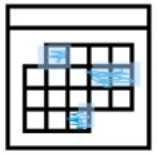
VPN



- Conclusions

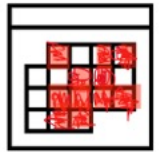
Conclusions!

Students



To access content, when needed

General population



For privacy/security and continually

VPNs collect data

Pragmatic approach

Main factors, when choosing a VPN

First use: Highschool/College

Thank you!

Questions? **a.dutkowska-zuk@lancaster.ac.uk**

We thank our paper shepherd Katharina Krombholz and our anonymous reviewers for their feedback!

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