MacOS versus Microsoft Windows: A Study on the Cybersecurity and Privacy User Perception of Two Popular Operating Systems

No Author Given

No Institute Given

1 Qualitative Cybersecurity Analysis

In this section, we analyze surveyee responses to why they might think that Windows or MacOS might offer more cybersecurity. We categorized the participant responses into different subject areas to be able to acquire a feeling for how the surveyees were perceiving the cybersecurity of an OS. Table 1 presents this categorization.

Responses are categorized in reputation, malware resistance, better technology, enclosed ecosystem, small user base, wide usage, financial power, and type of the OS (i.e., UNIX-based). Malware resistance of the MacOS is one of the most mentioned topics among MacOS and Windows users. Reputation was also one of the common topics.

Table 1. Participant comments on why did they choose one OS over another for cybersecurity

Comment	Windows	MacOS
MacOS is malware proof	8	27
The positive reputation of MacOS	12	15
The positive reputation of Windows	5	-
The "bad" reputation of Windows	1	-
Better cybersecurity technology on MacOS	4	14
Better cybersecurity technology on Windows	4	-
The enclosed ecosystem and better monitoring of MacOS (i.e., difficult to break)	5	2
Relatively small user base of MacOS provides better cybersecurity	6	8
wide usage of Windows provides some cybersecurity advantages (e.g., more people audit the system)	3	-
The impressive financial power of Apple provides better cybersecurity	3	-
The impressive financial power of Microsoft provides better cybersecurity	1	-
MacOS is a UNIX-based system, hence, making it automatically more secure (according to these users)	-	5

Note that although 38 Windows users mentioned positively for MacOS cybersecurity, none of the MacOS users mentioned positively for Windows. This aligns with the results from the quantitative section that we observed most of the MacOS users perceive that MacOS is at least as good as Windows in cybersecurity.

2 Qualitative Privacy analysis

In this section, we present our analysis for the responses to which operating system provides better privacy. Similar to the previous section, we categorized the responses from surveyees to acquire a better sense of the perceptions of the participants. Table 2 presents this categorization.

Similar to the cybersecurity case, we categorized the responses in reputation, privacy-supporting technology, and type of the OS (i.e., UNIX-based). Unlike the cybersecurity section, however, surveyees mentioned new topics that we categorized as feelings and experiences, whether companies care about their customers, whether the companies are likely to sell their data, and whether privacy is a marketing strategy for that product.

Table 2. Participant comments on why did they choose one OS over another for privacy

Comment	Windows	MacOS
The positive reputation of MacOS	8	23
The positive reputation of Windows	9	-
Privacy-supporting technology on MacOS	6	-
MacOS is a UNIX-based system, hence, making it automatically more secure (according to these users)	3	-
Good feelings and experience with MacOS	1	6
Privacy is a marketing strategy for MacOS	3	4
Apple cares more about their clients	4	5
Microsoft cares about their clients	1	-
MacOS does not share user info with third parties, and is not interested in selling user data	-	8
More people use Windows so it is more likely to sell/leak our data.	-	2

Similar to the cybersecurity analysis, none of the MacOS users mentioned positively for Windows. Also, fewer Windows users mentioned positively for MacOS in the privacy comparison. Note that surveyees have more definitive ideas about their cybersecurity decisions.

3 Limitations

We performed out experiments on Amazon Mechanical Turk, hence, we did not directly engage with the participants. The additional ability to interview participants face to face might have been useful and we might have the opportunity to ask follow up questions. However, any in person experiments were made impossible because of the COVID pandemic. According to [**?**], our work on Amazon Mechanical Turk should be representative of the U.S. population with some skew towards to more technology inclined individuals. This skew, in our case, is not a problem as we were interested in recruiting participants who were computer users.

Our work could also have some bias since we only recruited and looked into two operating systems. At the same time, we were specifically interested in the differences of cybersecurity and privacy perceptions between the users of these operating systems. To measure the cybersecurity skills of the participants, we asked 6 cybersecurity, and 5 behavioral habit questions. Although we are confident that the questions we asked indicate the cybersecurity knowledge level of a participant, we could have asked more questions to obtain more precise results. However, balancing the number of questions versus the time we wanted each participant to spend in answering our survey had to be a trade off.

4 Survey Questions

- Demographic Survey Questions
  - Q1: Which operating system are you primarily using?
    - Chrome OS
    - Fedora
    - Microsoft Windows
    - Solaris
    - Apple MacOS
    - Free BSD
    - Debian
    - Other
  - Q2: Which option best describes your age group?
    - Under 18
    - 18 - 24
    - 25 - 29
    - 30 - 39
    - 40 - 49
    - 50 - 59
    - 60 - 69
    - 70 or older
  - Q3: What is the highest level of education you have completed?
    - Some High School
    - High School Diploma

    * Some College
    * Associate Degree
    * Bachelor's Degree
    * Master's Degree
    * Ph.D. degree or Higher
  - Q4: Worker ID
    * short answer text
- Main Survey Questions
  - Q1: How much time do you spend on your computer each day?
    * Less than 1 hour
    * From 1 hour up to 4 hours
    * From 4 hour up to 8 hours
    * From 8 hours up to 12 hours
    * 12 hours or more
  - Q2: How do you feel about Apple's reputation in cybersecurity? (1 to 7 Likert scale)
    * 1 - Poor Cybersecurity
    * 7 - Excellent Cybersecurity
  - Q3: How do you feel about Apple's reputation in privacy? (1 to 7 Likert scale)
    * 1 - Poor Privacy
    * 7 - Excellent Privacy
  - Q4: How do you feel about Microsoft's reputation in cybersecurity? (1 to 7 Likert scale)
    * 1 - Poor Cybersecurity
    * 7 - Excellent Cybersecurity
  - Q5: How do you feel about Microsoft's reputation in privacy? (1 to 7 Likert scale)
    * 1 - Poor Privacy
    * 7 - Excellent Privacy
  - Q6: Which operating system are you primarily using?
    * Apple MacOS
    * Microsoft Windows
  - Q7: Which operating system would you use if you were not constrained by price or your job?
    * Apple MacOS
    * Microsoft Windows
  - Q8: Which operating system do you think offers more cybersecurity? (1 to 7 Likert scale)
    * 1 - Extremely Windows
    * 7 - Extremely MacOS
  - Q9: Which operating system do you think cares more about privacy? (1 to 7 Likert scale)
    * 1 - Extremely Windows
    * 7 - Extremely MacOS
  - Q10: Why do you think this operating system offers more cybersecurity?
    * short answer text
  - Q11: Why do you think this operating system cares more about privacy?
    * short answer text
  - Q12, Q13, Q14 repeates Demographic Survey Q2, Q3, Q4

5 Cybersecurity-Behavior Questions

- Cybersecurity Questions
  - Q1: Where could phishing attacks take place?
    - Text messages
    - Emails
    - Phone Calls
    - Social Media Posts
    - All of the above
    - None of the above
    - Not sure
  - Q2: What is malware?
    - It is software that tries to gain unauthorised access to your computer system
    - It is software that tries to damage your computer system
    - It is software that tries to disrupt your computer system
    - All of the above
    - None of the above
    - Not sure
  - Q3: Which files do you think might have viruses?
    - Word files
    - Executable files
    - Image files
    - All of the above
    - None of the above
    - Not sure
  - Q4: What is a Script Kiddie?
    - People who have high technical skills and creating some malicious tools
    - People who have low technical skills and uses some malicious tools
    - People who have high technical skills and not using this skills to being malicious
    - All of the above
    - None of the above
    - Not sure
  - Q5: When you switch to private browsing, what happens?
    - It prevents attacks on the Internet
    - It provides complete anonymity on the Internet
    - It prevents the browser from storing some files in the computer
    - All of the above
    - None of the above
    - Not sure
  - Q6: Some sites use "http://" and some use "https://". Please select the difference between them?
    - "s" tag is only reserved for special sites
    - "s" tag makes the connection faster

    * "s" tag represents encrypted traffic between server and browser
    * All of the above
    * None of the above
    * Not sure
- Behavior Questions
  - Q1: Are you using an antivirus program?
    * Yes
    * No
  - Q2: Do you backup your data?
    * Yes
    * No
  - Q3: Do you cover your webcam with a physical cover?
    * Yes
    * No
  - Q4: Are you trying to create strong passwords for your accounts? (1 to 7 Likert scale)
    * 1 - Never
    * 7 - Always
  - Q5: In a typical week, how often do you use private mode of your browser? (1 to 7 Likert scale)
    * 1 - Never
    * 7 - Always

6 Regression Analysis

Table 3. Cybersecurity regression table

	(1) Security_c	(2) Security_c	(3) Security_c	(4) Security_c	(5) Security_c	(6) Security_c	(7) Security_c	(8) Security_c
OS (Windows = 1)	-1.174***	-0.749***	-0.753***	-0.721***	-0.709***	-0.676***	-0.689***	
	(-6.05)	(-4.28)	(-4.30)	(-3.93)	(-3.82)	(-3.60)	(-3.67)	
Apple cybersecurity Reputation		0.524***	0.524***	0.539***	0.549***	0.554***	0.562***	0.510***
		(8.28)	(8.26)	(8.29)	(8.30)	(8.35)	(8.45)	(7.64)
Microsoft cybersecurity reputation		-0.379***	-0.374***	-0.393***	-0.395***	-0.390***	-0.408***	-0.407***
		(-5.87)	(-5.74)	(-5.92)	(-5.89)	(-5.77)	(-5.91)	(-6.15)
Cybersecurity score			0.0445	0.0495	0.0501	0.0416	0.0198	0.0332
			(0.72)	(0.79)	(0.80)	(0.66)	(0.31)	(0.53)
From 1 hour up to 4 hours				-1.290	-1.201	-1.068	-0.881	-1.063
				(-1.44)	(-1.33)	(-1.17)	(-0.89)	(-1.12)
From 4 hour up to 8 hours				-1.089	-1.007	-0.846	-0.716	-0.900
				(-1.25)	(-1.14)	(-0.94)	(-0.74)	(-0.96)
From 8 hours up to 12 hours				-1.076	-1.014	-0.885	-0.775	-0.995
				(-1.22)	(-1.14)	(-0.98)	(-0.80)	(-1.06)
12 hours or more				-0.892	-0.826	-0.659	-0.548	-0.753
				(-0.97)	(-0.89)	(-0.70)	(-0.54)	(-0.77)
Age 25-29					-0.0729	-0.0822	-0.146	-0.243
					(-0.22)	(-0.25)	(-0.44)	(-0.76)
Age 30-39					-0.233	-0.341	-0.421	-0.406
					(-0.75)	(-1.07)	(-1.31)	(-1.30)
Age 40-49					-0.0191	-0.169	-0.225	-0.261
					(-0.06)	(-0.48)	(-0.64)	(-0.76)
Associate degree						-0.0620	-0.0457	-0.110
						(-0.17)	(-0.12)	(-0.31)
Bachelor's degree						-0.177	-0.138	-0.0784
						(-0.68)	(-0.53)	(-0.31)
Master's degree						0.257	0.306	0.256
						(0.87)	(1.03)	(0.88)
Ph.D. degree						-0.341	-0.164	-0.0842
						(-0.56)	(-0.27)	(-0.14)
Female							-0.197	-0.00622
							(-0.29)	(-0.01)
Male							0.128	0.315
							(0.19)	(0.48)
Desired OS								-0.903***
								(-4.93)
Constant	5.650***	4.411***	4.232***	5.295***	5.293***	5.238***	5.312***	5.596***
	(40.97)	(12.14)	(9.61)	(5.51)	(5.24)	(5.02)	(4.91)	(5.31)
R^2	0.1508	0.3883	0.3899	0.3987	0.4027	0.4156	0.4253	0.4546
N	208	207	207	207	207	207	207	207

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4. Privacy regression table

	(1) Privacy_c	(2) Privacy_c	(3) Privacy_c	(4) Privacy_c	(5) Privacy_c	(6) Privacy_c	(7) Privacy_c	(8) Privacy_c
OS (Windows = 1)	-1.264***	-0.616***	-0.616***	-0.613***	-0.649***	-0.663***	-0.683***	
	(-6.63)	(-3.68)	(-3.67)	(-3.54)	(-3.72)	(-3.78)	(-3.96)	
Apple privacy reputation		0.592***	0.593***	0.603***	0.601***	0.590***	0.604***	0.559***
		(10.10)	(10.04)	(10.04)	(9.97)	(9.76)	(10.15)	(9.47)
Microsoft privacy reputation		-0.431***	-0.430***	-0.442***	-0.446***	-0.432***	-0.457***	-0.453***
		(-7.18)	(-7.12)	(-7.25)	(-7.31)	(-7.00)	(-7.48)	(-7.80)
Cybersecurity score			0.0109	0.0117	0.0184	0.00829	-0.0225	-0.0148
			(0.18)	(0.20)	(0.31)	(0.14)	(-0.38)	(-0.26)
From 1 hour up to 4 hours				-0.477	-0.366	-0.270	-0.172	-0.407
				(-0.58)	(-0.44)	(-0.32)	(-0.19)	(-0.48)
From 4 hour up to 8 hours				-0.0854	0.0142	0.171	0.167	-0.0563
				(-0.11)	(0.02)	(0.21)	(0.19)	(-0.07)
From 8 hours up to 12 hours				0.0274	0.144	0.301	0.267	-0.00331
				(0.03)	(0.18)	(0.36)	(0.31)	(-0.00)
12 hours or more				0.0838	0.184	0.364	0.326	0.0870
				(0.10)	(0.21)	(0.42)	(0.36)	(0.10)
Age 25-29					0.159	0.183	0.109	0.0128
					(0.53)	(0.60)	(0.36)	(0.04)
Age 30-39					0.212	0.149	0.0361	0.0354
					(0.74)	(0.51)	(0.12)	(0.13)
Age 40-49					0.532	0.439	0.353	0.314
					(1.69)	(1.36)	(1.11)	(1.03)
Associate degree						-0.264	-0.252	-0.329
						(-0.76)	(-0.74)	(-1.00)
Bachelor's degree						-0.501*	-0.460	-0.400
						(-2.05)	(-1.91)	(-1.73)
Master's degree						-0.120	-0.0685	-0.101
						(-0.44)	(-0.25)	(-0.39)
Ph.D. degree						-0.305	-0.0742	-0.00555
						(-0.54)	(-0.13)	(-0.01)
Female							0.192	0.437
							(0.31)	(0.74)
Male							0.687	0.921
							(1.14)	(1.57)
Desired OS								-0.902***
								(-5.43)
Constant	5.359***	4.021***	3.972***	4.070***	3.743***	3.985***	3.791***	4.034***
	(39.59)	(14.07)	(10.14)	(4.68)	(4.12)	(4.25)	(3.96)	(4.34)
R^2	0.1761	0.4567	0.4568	0.4704	0.4809	0.4973	0.4789	0.5521
N	208	207	207	207	207	207	207	207

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5. User behavior regression table

	(1) AV	(2) AV	(3) Backup	(4) Backup	(5) Cover	(6) Cover	(7) Password	(8) Password	(9) Private	(10) Private
OS	0.216***	0.210***	-0.0923	-0.121*	0.184**	0.160*	0.340*	0.289	0.119	0.0881
(Windows = 1)	(3.81)	(3.43)	(-1.66)	(-2.05)	(2.69)	(2.20)	(2.13)	(1.70)	(0.45)	(0.31)
Cybersecurity		-0.00290		0.0205		0.0376		-0.0107		-0.191
score		(-0.13)		(0.96)		(1.44)		(-0.18)		(-1.86)
From 1 hour		-0.415		0.362		-0.0304		0.639		0.530
up to 4 hours		(-1.24)		(1.12)		(-0.08)		(0.69)		(0.34)
From 4 hour		-0.467		0.266		-0.201		0.895		0.464
up to 8 hours		(-1.42)		(0.84)		(-0.51)		(0.98)		(0.30)
From 8 hours		-0.394		0.454		-0.153		0.999		0.931
up to 12 hours		(-1.19)		(1.42)		(-0.39)		(1.10)		(0.61)
12 hours		-0.537		0.255		-0.263		0.742		0.307
or more		(-1.56)		(0.77)		(-0.64)		(0.78)		(0.19)
Age 25-29		0.133		-0.100		-0.0125		-0.328		0.465
		(1.16)		(-0.91)		(-0.09)		(-1.04)		(0.88)
Age 30-39		0.129		-0.0878		0.0237		0.0455		0.408
		(1.18)		(-0.83)		(0.18)		(0.15)		(0.80)
Age 40-49		0.122		-0.0507		0.142		0.115		0.281
		(1.01)		(-0.43)		(0.99)		(0.34)		(0.50)
Associate		-0.171		-0.0158		-0.255		-0.0799		-0.0141
degree		(-1.34)		(-0.13)		(-1.69)		(-0.23)		(-0.02)
Bachelor's		-0.0943		0.0208		-0.0496		-0.0574		0.252
degree		(-1.05)		(0.24)		(-0.46)		(-0.23)		(0.60)
Master's		-0.0745		0.0596		-0.181		-0.135		0.458
degree		(-0.73)		(0.61)		(-1.50)		(-0.48)		(0.97)
Ph.D.		-0.259		0.229		-0.0616		-1.188*		1.155
degree		(-1.23)		(1.13)		(-0.25)		(-2.04)		(1.18)
Male		0.133		-0.0667		-0.240		-0.439		-0.284
		(0.58)		(-0.30)		(-0.89)		(-0.70)		(-0.27)
Female		0.157		-0.0477		-0.257		-0.425		-0.199
		(0.68)		(-0.21)		(-0.94)		(-0.67)		(-0.19)
Constant	0.660***	0.934**	0.845***	0.546	0.359***	0.699	5.689***	5.455***	3.738***	3.429*
	(16.37)	(2.69)	(21.39)	(1.63)	(7.42)	(1.69)	(50.47)	(5.69)	(19.82)	(2.12)
R^2	0.0657	0.1049	0.0132	0.0850	0.0340	0.0961	0.0218	0.0892	0.0010	0.0561
N	208	208	208	208	208	208	206	206	208	208

t statistics in parentheses

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