

# Inter-University Comparison of Network Security Behaviors

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## 1: Abstract

We apply the previously proposed Security Behavior Intentions Scale (SeBIS) and Revised Security Behavior Intentions Scale (RSeBIS) to a population sample of 221 students. First, we test the validity of both the scales then send RSeBIS to different universities to get in depth comparison. We then build a model to compare the security behaviors and find that participants from different universities exhibit different behavior. For instance, participants from LUMS had the most diverse security behavior while the participants from FAST had the most secure online practices. Most of the students are aware of security risk involved when using the internet but they choose not to do anything about it.

## 2: Methodology

In this project we wanted to create a method of finding and analysing perceptions people have about Network Security and Security in general. To do this there were two options, User research and Surveys. User research would follow classical practices of User-Centred Design. These also allowed us to brainstorm on the problem of security perceptions in pakistan. After which we also wanted to test two surveys that were designed to gather information about network security practices, SeBIS and RSeBIS. These surveys were designed for an international market were not tested in pakistan, hence their applicability also needed to be tested.

### 2.a: Initial User Research

We initially did a user research to find out what kind of behavioral study would best be suited for the people living in Pakistan for our research type. It included interviews with our peers and instructors. By the end, we had interviewed 22 people from ages ranging from 17 to 52. The interviews were open ended and discussed problems and confusions users had about security.

## 2.b: Survey

The two surveys that we tested, SeBIS[1] and RSeBIS[2] have one fundamental difference and that is that SeBIS is designed for an american market while RSeBIS is designed for an international market. We wanted to test which of the two is more applicable to our demography.

### 2.b.i: SeBIS vs RSeBIS in LUMS

An initial survey was conducted in lums. Computer Science students participated in the survey. The survey was conducted at the end of a network security class, friends and peers were also asked to fill the survey. Over 32 people participated in SeBIS and 189 in RSeBIS. We also included additional open ended questions that inquired about participants' past history with security, their opinions about the survey and if they preferred it in another language.

### 2.b.ii: RSeBIS in Pakistani Universities

We expanded our previous methodology to other universities. These included FAST, BNU and NUST. Paper surveys were conducted in BNU, similar to LUMS, in data mining and warehousing class. Due to logistic constraints online surveys were conducted in FAST and NUST. Also due to logical constraints we only selected one of the two surveys, RSeBIS, as it was designed to be more international. Overall we gathered 49 results from BNU, 36 from FAST and 77 from NUST.

## 3: Results

### 3.a: SeBIS vs RSeBIS in LUMS

We first conducted a survey in LUMS to see how reliable were the two surveys and how much effect did changing just the wording of the questions had on the overall mean of the questions. The Cronbach's alpha value for SeBIS came out to be 0.746 and for RSeBIS it was 0.612. Anything above 0.7 is considered a good, reliable scale. To our surprise, RSeBIS scored lower than SeBIS. This might have been due to the smaller dataset of just 27 students for RSeBIS and 32 for SeBIS. However, this did show that similar questions with different wording make students perceive questions very differently.

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	ReSEBIS_Q1	3.1852	27	1.21012	.23289
	SEBIS_Q14	2.6296	27	1.21365	.23357
Pair 2	ReSEBIS_Q2	3.5185	27	1.34079	.25804
	SEBIS_Q15	3.0000	27	1.14354	.22008
Pair 3	ReSEBIS_Q3	4.0370	27	1.15962	.22317
	SEBIS_Q3	3.8889	27	1.01274	.19490
Pair 4	ReSEBIS_Q4	3.8148	27	1.49453	.28762
	SEBIS_Q1	4.0370	27	1.15962	.22317
Pair 5	ReSEBIS_Q5	4.0741	27	1.32798	.25557
	SEBIS_Q4	4.2593	27	1.05948	.20390
Pair 6	ReSEBIS_Q6	4.0741	27	1.38469	.26648
	SEBIS_Q2	4.5556	27	.69798	.13433
Pair 7	ReSEBIS_Q7	3.2963	27	1.46274	.28150
	SEBIS_Q13	2.6296	27	1.04323	.20077
Pair 8	ReSEBIS_Q8	3.5556	27	1.28103	.24653
	SEBIS_Q9	3.2963	27	1.13730	.21887
Pair 9	ReSEBIS_Q9	2.9630	27	1.28547	.24739
	SEBIS_Q16	2.4815	27	1.34079	.25804
Pair 10	ReSEBIS_Q10	2.8148	27	1.27210	.24482
	SEBIS_Q12	3.3333	27	1.07417	.20672
Pair 11	ReSEBIS_Q11	3.1481	27	1.13353	.21815
	SEBIS_Q10	3.3704	27	1.00568	.19354
Pair 12	ReSEBIS_Q12	2.0000	27	1.10940	.21350
	SEBIS_Q5	2.1481	27	1.09908	.21152
Pair 13	ReSEBIS_Q13	2.5556	27	1.50214	.28909
	SEBIS_Q6	2.8889	27	1.12090	.21572
Pair 14	ReSEBIS_Q14	3.3704	27	1.33440	.25681
	SEBIS_Q8	3.0370	27	1.40004	.26944
Pair 15	ReSEBIS_Q15	2.8889	27	1.28103	.24653
	SEBIS_Q7	2.8148	27	1.03912	.19998
Pair 16	ReSEBIS_Q16	2.7037	27	1.38160	.26589
	SEBIS_Q11	2.9630	27	1.01835	.19598
Pair 17	ReSEBIS_Q17	2.4815	27	1.08735	.20926
	SEBIS_Q17	2.3704	27	1.24493	.23959
Pair 18	ReSEBIS_Q18	1.7778	27	.89156	.17158
	SEBIS_Q18	1.8519	27	.86397	.16627
Pair 19	ReSEBIS_Q19	1.0000	27	.00000	.00000
	SEBIS_Q19	1.1111	27	.32026	.06163

Fig 3.a(i) shows a comparison of mean, standard deviation and standard error mean of LUMS SeBIS and RSeBIS.

Paired Samples Test									
		Paired Differences				t	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower Upper				
Pair 1	ReSEBIS_Q1 – SEBIS_Q14	.55556	1.86740	.35938	-.18316 1.29427	1.546	26	.134	
Pair 2	ReSEBIS_Q2 – SEBIS_Q15	.51852	1.90889	.36737	-.23661 1.27365	1.411	26	.170	
Pair 3	ReSEBIS_Q3 – SEBIS_Q3	.14815	1.37851	.26529	-.39717 .69347	.558	26	.581	
Pair 4	ReSEBIS_Q4 – SEBIS_Q1	-.22222	2.20721	.42478	-1.09537 .65092	-.523	26	.605	
Pair 5	ReSEBIS_Q5 – SEBIS_Q4	-.18519	1.88184	.36216	-.92962 .55924	-.511	26	.613	
Pair 6	ReSEBIS_Q6 – SEBIS_Q2	-.48148	1.62600	.31292	-1.12471 .16174	-1.539	26	.136	
Pair 7	ReSEBIS_Q7 – SEBIS_Q13	.66667	1.46760	.28244	.08610 1.24723	2.360	26	.026	
Pair 8	ReSEBIS_Q8 – SEBIS_Q9	.25926	1.85208	.35643	-.47340 .99192	.727	26	.473	
Pair 9	ReSEBIS_Q9 – SEBIS_Q16	.48148	1.84746	.35554	-.24935 1.21231	1.354	26	.187	
Pair 10	ReSEBIS_Q10 – SEBIS_Q12	-.51852	1.39698	.26885	-1.07115 .03411	-1.929	26	.065	
Pair 11	ReSEBIS_Q11 – SEBIS_Q10	-.22222	1.36814	.26330	-.76344 .31899	-.844	26	.406	
Pair 12	ReSEBIS_Q12 – SEBIS_Q5	-.14815	1.74761	.33633	-.83948 .54318	-.440	26	.663	
Pair 13	ReSEBIS_Q13 – SEBIS_Q6	-.33333	1.54422	.29719	-.94421 .27754	-1.122	26	.272	
Pair 14	ReSEBIS_Q14 – SEBIS_Q8	.33333	2.11224	.40650	-.50224 1.16891	.820	26	.420	
Pair 15	ReSEBIS_Q15 – SEBIS_Q7	.07407	1.61545	.31089	-.56498 .71313	.238	26	.814	
Pair 16	ReSEBIS_Q16 – SEBIS_Q11	-.25926	1.31829	.25371	-.78076 .26224	-1.022	26	.316	
Pair 17	ReSEBIS_Q17 – SEBIS_Q17	.11111	1.64862	.31728	-.54106 .76328	.350	26	.729	
Pair 18	ReSEBIS_Q18 – SEBIS_Q18	-.07407	1.20658	.23221	-.55138 .40323	-.319	26	.752	
Pair 19	ReSEBIS_Q19 – SEBIS_Q19	-.11111	.32026	.06163	-.23780 .01558	-1.803	26	.083	

**Fig 3.a(ii) shows a comparison of LUMS SeBIS and RSeBIS. T-test result shows that there are huge differences in means of many questions, particularly pair 7.**

### 3.b: Inter University Comparisons

We wanted to find if there was some correlation between the security behaviours of students with the university they are studying in. We choose 3 other universities that offered similar computer science program and sent them RSeBIS to complete. As there was no other dependant variable, other than the university itself, we compared only its alpha values, mean and variance.

	ALPHA	MEAN	VARIANCE
LUMS	0.612	3.126	1.647
BNU	0.459	3.170	1.325
FAST	0.724	3.326	1.308
NUST	0.500	3.164	1.383

Fig 3.b(i) shows a comparison of alpha values, mean and variance between different universities. FAST has the highest mean, lowest variance and the maximum alpha value.

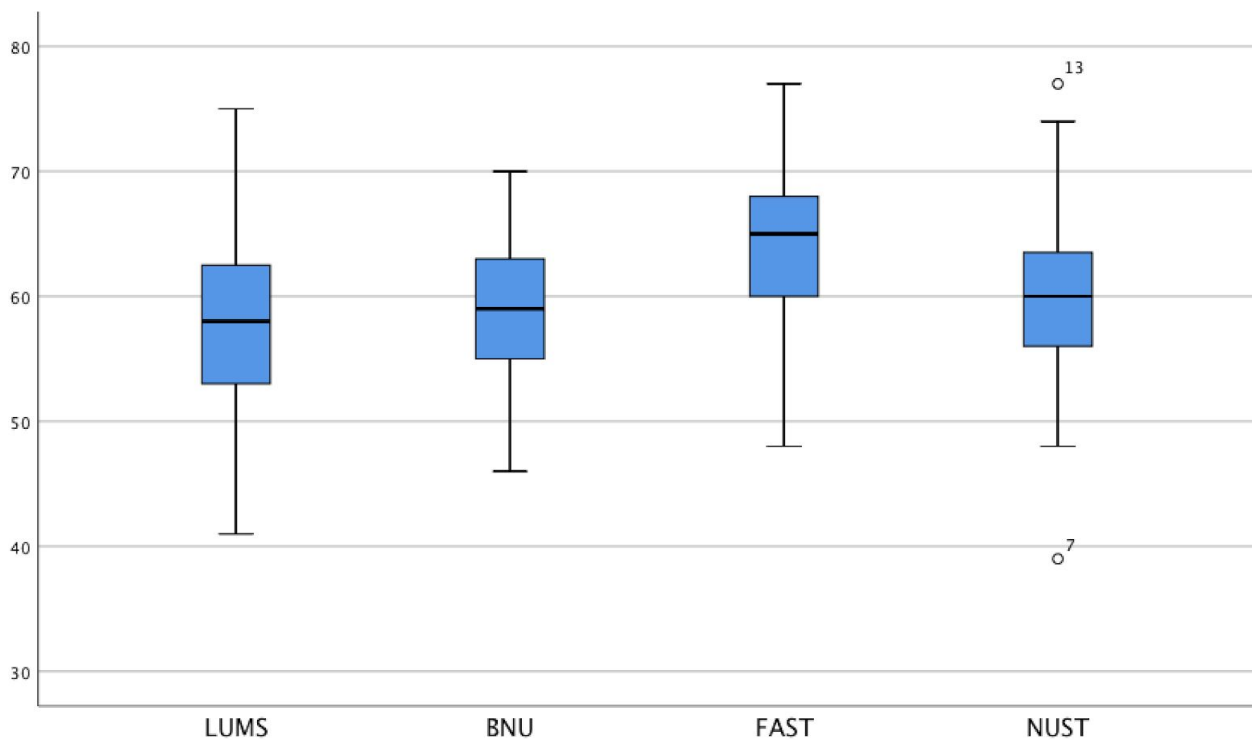


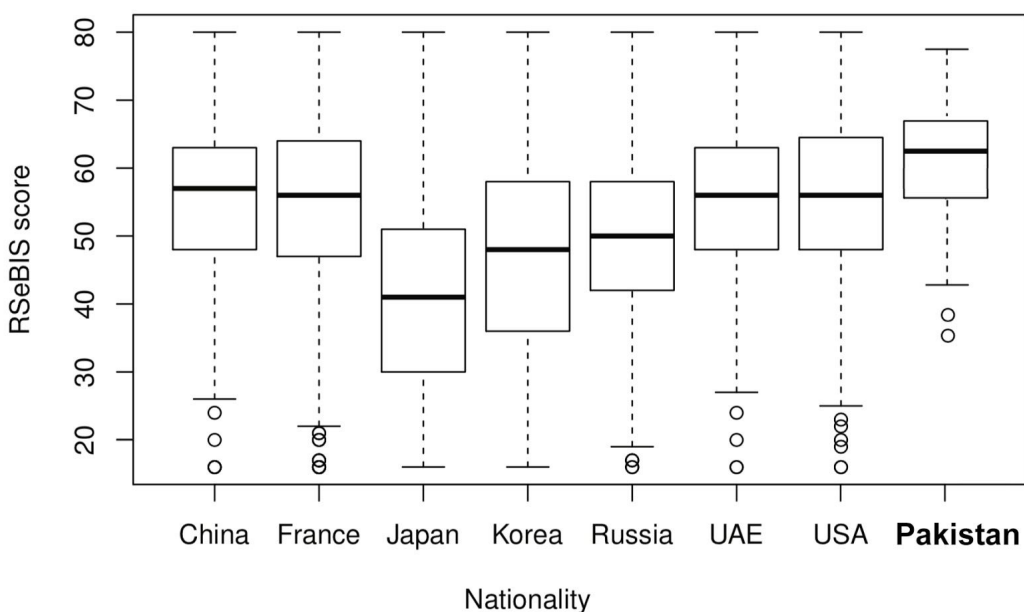
Fig 3.b(ii) shows the total score comparison of participants of different universities. Highest score being 77 (FAST) and going as low as 41 (LUMS).

### 3.c: RSeBIS in Pakistani Universities vs The rest of the world

We then aggregated all the RSeBIS results collected from computer science departments in Pakistani universities and compared it with the rest of the world where this survey had been conducted previously. We had collective data of 187 students with mean 3.174, variance 1.402 and Cronbach's alpha of 0.579. First, we compared Cronbach's alpha, mean and standard deviation. Alpha came out to be strikingly low for Pakistani universities, threatening the reliability of the scale. However, our CS departments had the highest mean and lowest standard deviation, indicating that pakistani students are more aware of the security threats on the internet compared to other countries. We then compared the RSeBIS score with other nationalities, in which Pakistan again lead with the highest 1st and 3rd quartiles and the lowest interquartile range.

	PAKISTAN	CHINA	FRANCE	JAPAN	KOREA	RUSSIA	UAE	USA
<b>Cronbach's Alpha</b>	0.579	0.895	0.896	0.928	0.906	0.855	0.852	0.881
<b>Mean</b>	60.31	42.44	41.81	36.83	43.49	43.29	32.89	43.83
<b>SD</b>	7.68	13.09	15.43	13.92	13.54	11.47	8.37	17.84

**Fig 3.c(i) shows a comparison of Cronbach's alpha value, mean and standard deviation of different nationalities for RSeBIS**



**Fig 3.c(ii) shows a comparison of RSeBIS scores of different Nationalities.**

We also conducted factor analysis on the aggregated RSeBIS results to compare our Barlett's test of sphericity and the Measure of Sampling Adequacy (retaining all components with eigenvalues > 1.0) with the original SeBIS paper. With exception of the Chi-Square, we have yielded a very similar Sampling Adequacy of 0.605 compared to the original 0.869. However, our test of sphericity was significantly lower, scoring 602.734 at 171 df compared to 2037.7 at 276 df.

#### KMO and Bartlett's Test

Kaiser–Meyer–Olkin Measure of Sampling Adequacy.		.605
Bartlett's Test of Sphericity	Approx. Chi-Square	602.734
	df	171
	Sig.	.000

**Fig 3.c(iii)** shows the KMO and Bartlett's Test done on the aggregated values of RSeBIS.

### 3.d: Comment Sections

In the end of the survey, we asked our participants that have they ever been hacked. This question required the answer to be in written form, not in likert scale, therefore it was not included in our testing. However, we got some very interesting responses. Most of them were not sure, but there were many who had their facebook account and email address hacked. Furthermore, we also asked our participants how confident were they that they've kept their personal data private on social media. To this, one person answered "You never know...". This indicates that although there had not been any signs of your account being illegally used, it does not mean that someone, somewhere does not have your ID, passwords, personal pictures and your deleted information. In general, there was a distrust in social media sites. People were mostly aware of the risks associated with the internet but they didn't care much to be bothered by it. Lastly, we asked the participants if they would prefer this survey taken in Urdu. Most of them disagreed but there were few who said they would prefer it in their native language.

## 4: Discussion

### 4.a: Cross University Security Importance

We wanted to find if there was a correlation between security behaviors of students and the university they study in. Although we did not consider the factors that results from different universities or socio-economic factors of the participants. We saw that the most diverse behavior came from LUMS, while the most secure behavior was of FAST. This raises few new questions like what are the factors that make students of FAST more secure over the internet compared to students of LUMS. This can lead to further studies to find the factor that affects such behaviors.

### 4.b: Validation of RSeBIS

In order to find the validity of RSeBIS, we aggregated the RSeBIS scores of all the universities and compared it with the results of the RSeBIS paper. The KMO and Bartlett's Test came out to be positive but Cronbach's alpha was significantly low. This might be because of the small sample size, but it would not explain why the aggregated alpha as well as the individual alphas was also very low. This hints that RSeBIS is not suitable for a country like Pakistan. However, we cannot conclude this because we had restricted our sample to only computer science students. In order to make such conclusions, we need to have a bigger, more diverse dataset.

## 5: Limitations

Our biggest limitation was that we had targeted only universities and particularly only computer science students. This is not the proper representation of the country because computer science students would already be well aware of the security threats internet poses. Secondly, our per university sample size was also very low, around 60 students per university. Although it was enough to draw correlations but not sufficient enough to be a representation.



## 6: Conclusion

We applied the previously proposed SeBIS and its revised version, RSeBIS to total size of 221 students. From this sample, 32 students from LUMS were given SeBIS to check its validity and rest was divided in different universities and given the RSeBIS. This included 27 participants from LUMS, 49 participants from BNU, 36 participants from FAST and 77 participants from NUST. We found that SeBIS scored very well for the Cronbach's alpha while the RSeBIS did very poorly. This might be because of small sample size or the fact that we had restricted ourselves to computer science students only. Later we found that LUMS had the most diverse security behavior, some students being extremely caution while few not caring about their security behavior at all. It was surprising to see this because the survey had been conducted in the Network Security class itself. The best results were shown by the students of FAST who were extremely careful at opening unknown links and were watchful for phishing sites. This leads to another study of the factors that result in such security behaviors. We then aggregated the score of all the universities that took part in the survey and compared it with the rest of the world. Remarkably, Pakistan came first but it has to be taken into consideration that this survey only represents the computer science students of different universities of Pakistan, it does not represent the Pakistani population. It would be an interesting to know how general Pakistani public perceive security and their security behaviors.

## 7: Acknowledgements

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- Dr. Amjad Hussain. Professor, FAST.
- Ayesha Masood. Assistant Professor, Anthropology, LUMS.

## 8: References

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