Hooked on Smartphones: An Exploratory Study on Smartphone Overuse among College Students

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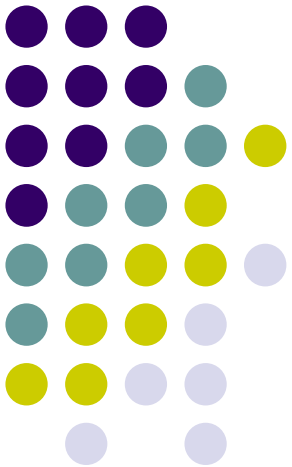
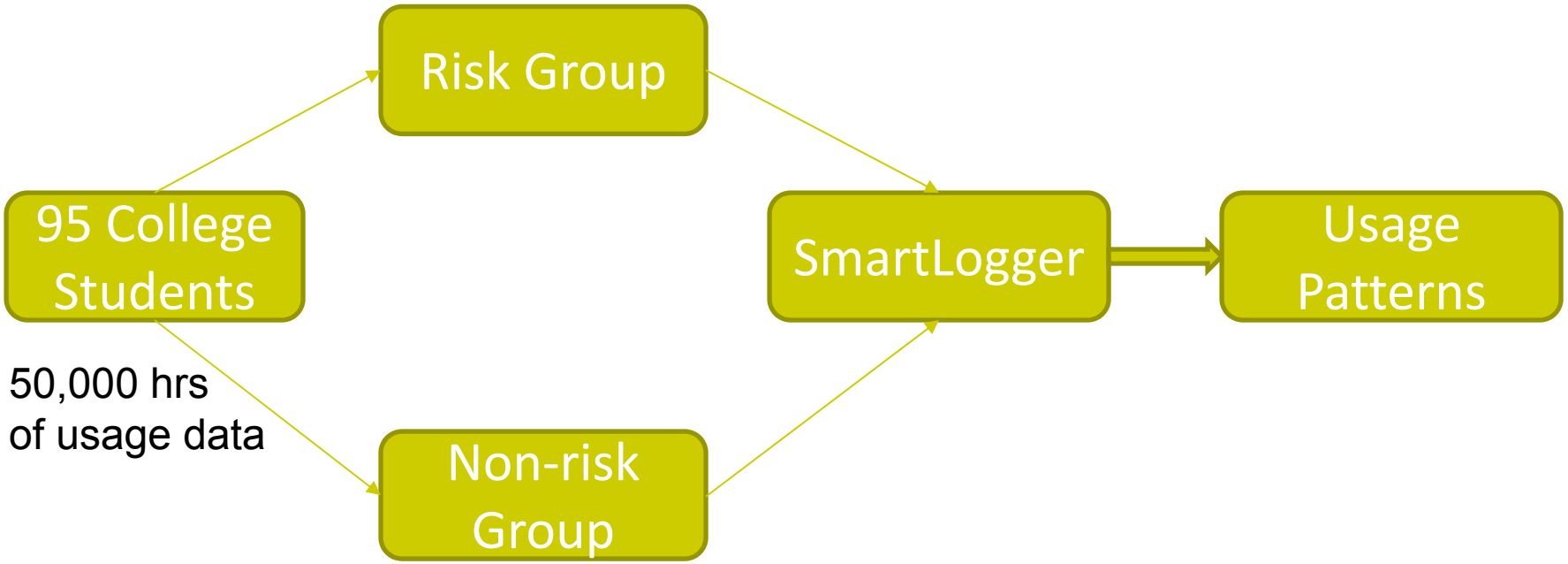


Introduction

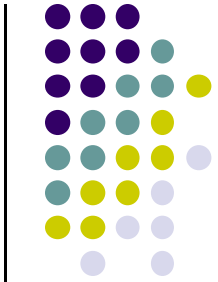
- Popularity of smartphones and overuse
- Negative aspects: poor mental health, disruption of social interactions, etc.
- How smartphone overuse is reflected in actual phone use?

Introduction

- Analyze usage patterns related to smartphone overuse

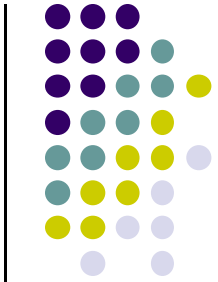


Related Work



	Previous Studies	This Paper
Technological Addiction	Focus on psychological factors	performs an exploratory data analysis of real usage datasets
Smartphone Usage	General overviews of smartphone usage	Investigate usage patterns related to smartphone overuse
HCI Research into Addictive Behavior	Develop effective addiction intervention mechanisms	Provide guidelines to facilitate intervention software design

Methodology



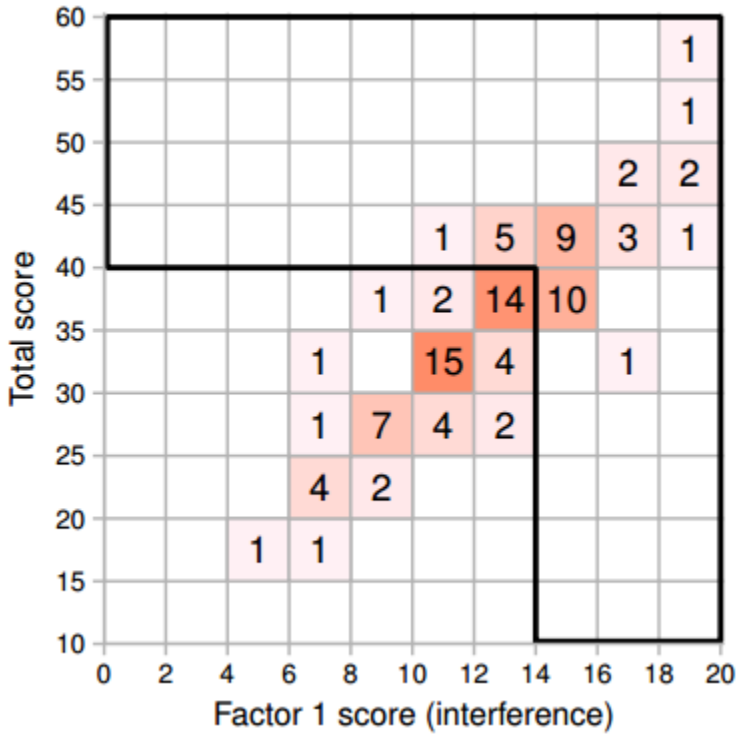
- Participants
  - 95 College Students, Average age is 20.6 years
  - Time span: average 26.8 days
- SmartLogger
  - Application, system, phone events
  - Unobtrusive method

Methodology

- User Surveys and Interviews

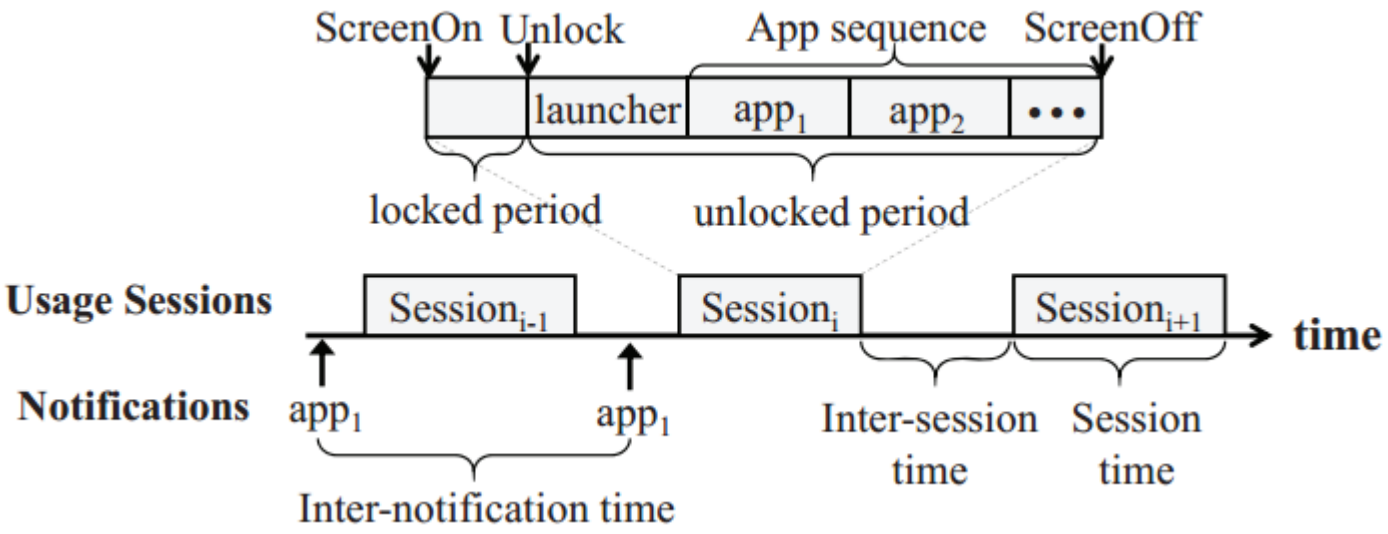
Smartphone Addiction Proneness Scale
F1: Interference
F2: Virtual World
F3: Withdrawal
F4: Tolerance

High/At-risk: Total score ≥ 40 or F1 score ≥ 14



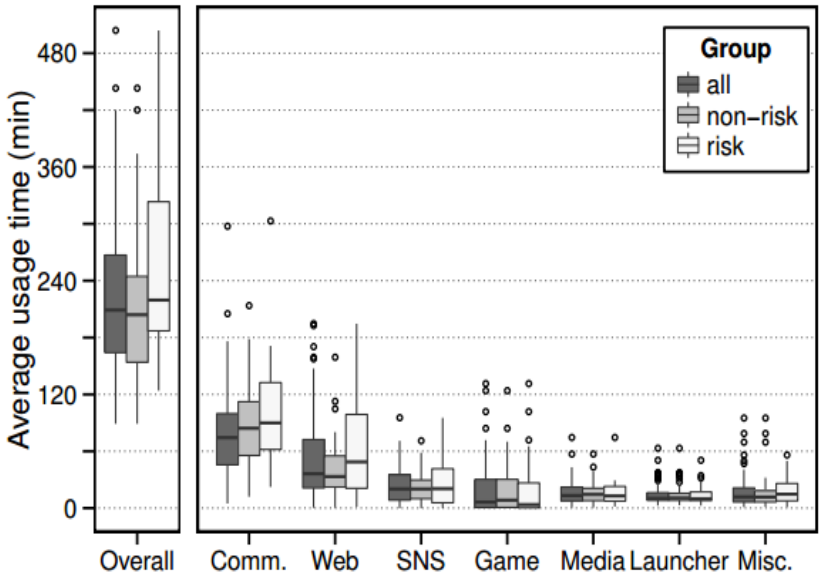
Methodology

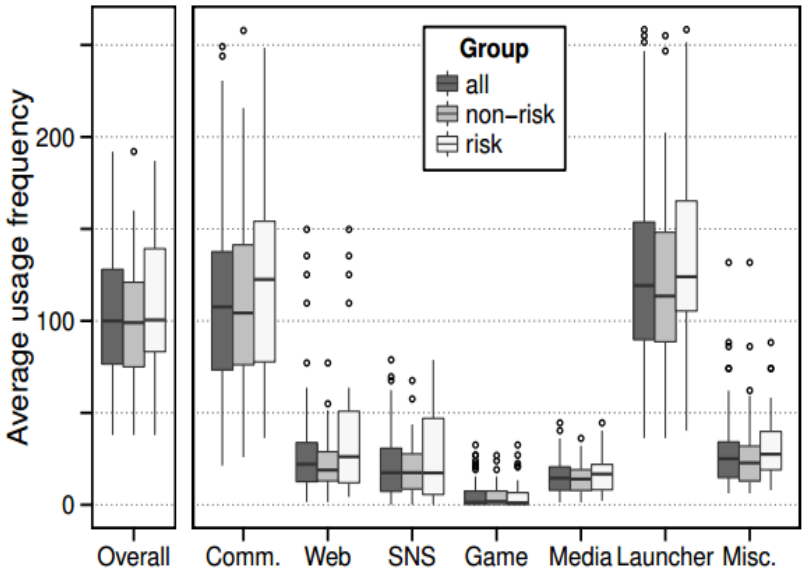
- Usage Data Analysis Model



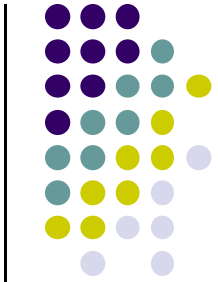
Overall Differences in Usage Patterns

- Overall Usage Results





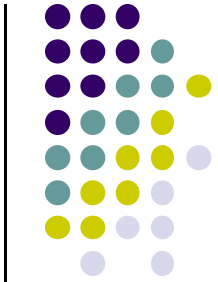
Overall Differences in Usage Patterns



- Aggregated Usage

	Daily Usage	Usage Frequency	
		Session Frequency	Inter-session time
Risk Group	253.0 min	111.5	729.1
Non-risk Group	207.4 min	100.1	816.6

Overall Differences in Usage Patterns

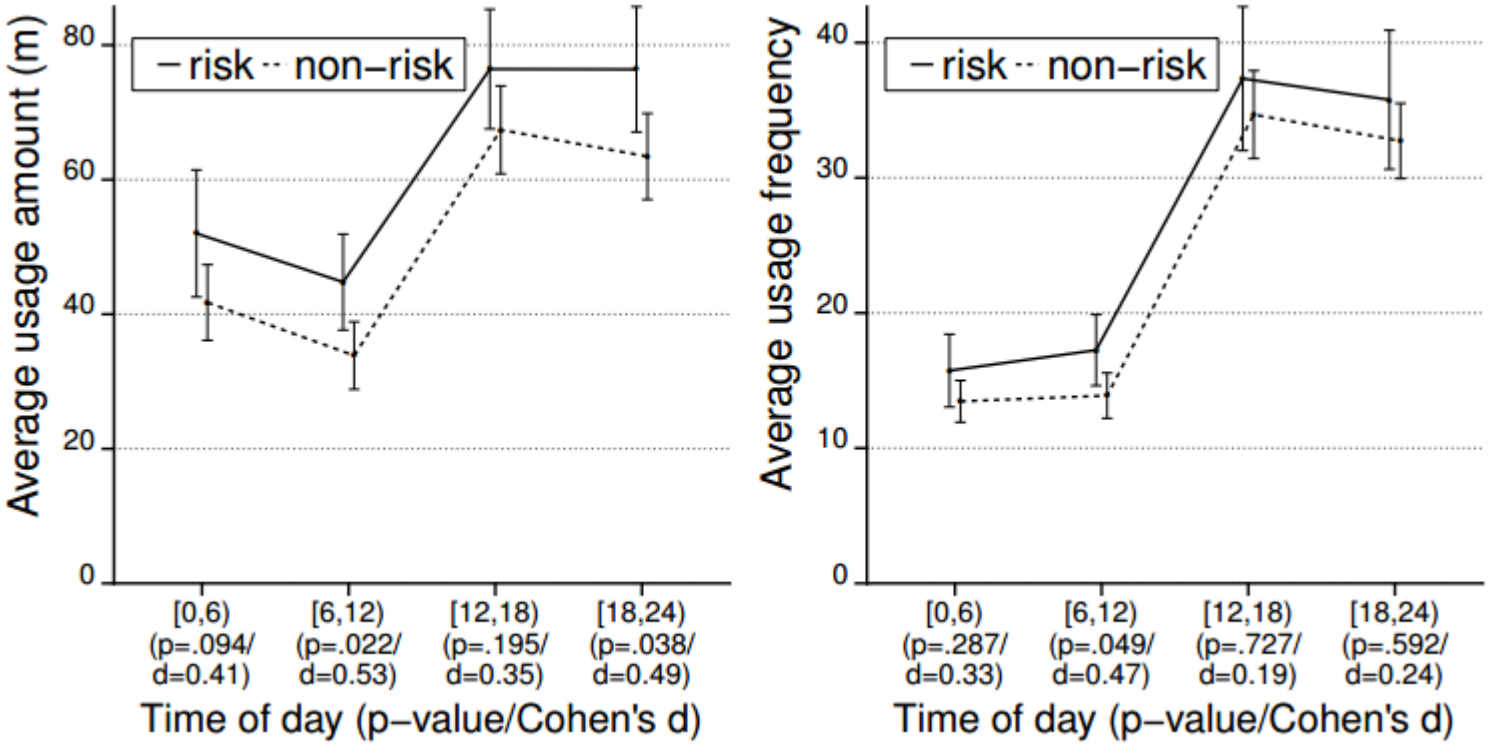


- Session-Level Usage

Session Usage	Non-Risk [95% CI]	Risk [95% CI]	T	P	d
Session time (s)	129.9 [115.6, 144.1]	157.6 [123.6, 191.6]	1.53	.134	0.36
Inter-ses. time (s)	816.6 [726.9, 906.4]	729.1 [623.7, 835.5]	1.25	.216	0.26
# unique apps	65.5 [60.0, 70.1]	66.1 [60.1, 72.1]	0.15	.885	0.03
Sequence len.	3.16 [2.9, 3.3]	3.53 [3.2,3.9]	1.84	.072	0.42
Agg. seq. len	204.2 [181.7, 226.6]	235.2 [204.4, 265.9]	1.66	.099	0.35
Top-5 entropy	1.96 [1.9, 2.0]	1.85 [1.7,1.9]	2.02	.046	0.42
Top-10 entropy	2.53 [2.5, 2.6]	2.40 [2.3, 2.5]	1.74	.085	0.36
#1 app time (m)	69.9 [60.6,79.0]	97.8 [81.5, 114.2]	3.02	.003	0.66
#1 app freq	115.4 [105.1,125.5]	134.7 [119.0,150.6]	2.18	.031	0.46
#2 app time (m)	37.2 [32.5, 42.6]	47.4 [38.4, 56.4]	1.93	.060	0.43
#2 app freq	70.3 [62.4, 78.1]	85.3 [70.2, 100.4]	1.78	.080	0.41

Overall Differences in Usage Patterns

- Diurnal Usage



Category-specific Usage Patterns

- Two popular app categories: communications and web browsing

Comm. Usage	Non-Risk [95% CI]	Risk [95% CI]	T	P	d
Usage time (m)	87.1 [75.8, 98.3]	98.8 [80.0, 118.6]	1.15	.257	0.24
Usage freq	112.5 [100.7, 124.2]	126.3 [107.4, 145.2]	1.32	.189	0.28
Voice time (m)	12.0 [9.4, 14.6]	14.5 [8.9, 20.0]	0.83	.411	0.20
Voice freq	6.2 [5.4, 7.0]	5.8 [4.6, 7.0]	0.51	.610	0.11
SMS time (m)	2.7 [2.1, 3.3]	4.4 [2.4, 6.4]	1.64	.108	0.41
SMS freq	6.9 [5.8, 8.0]	9.5 [6.7, 12.2]	1.75	.086	0.42
MIM time (m)	65.8 [56.1, 75.6]	75.6 [58.8, 92.3]	1.08	.281	0.23
MIM freq	76.9 [66.6, 87.2]	91.2 [73.9, 108.5]	1.53	.130	0.32
Inter-MIM time (m)	25.6 [19.8, 31.4]	21.0 [16.2, 25.8]	1.21	.228	0.23
Inter-MIM noti (m)	9.5 [4.9, 14.0]	6.9 [3.8, 10.0]	0.94	.351	0.17
MIM noti freq	378.5 [227.1, 529.8]	451.8 [449.1, 454.7]	0.64	.353	0.16

Communication App Use

- Mobile Instant Messaging (MIM) Usage- KakaoTalk
  - MIM, Voice calls, SMS, E-mail
- Notifications as External Cues for Usage
  - Notifications regarded as potential trigger of problematic usage behavior.

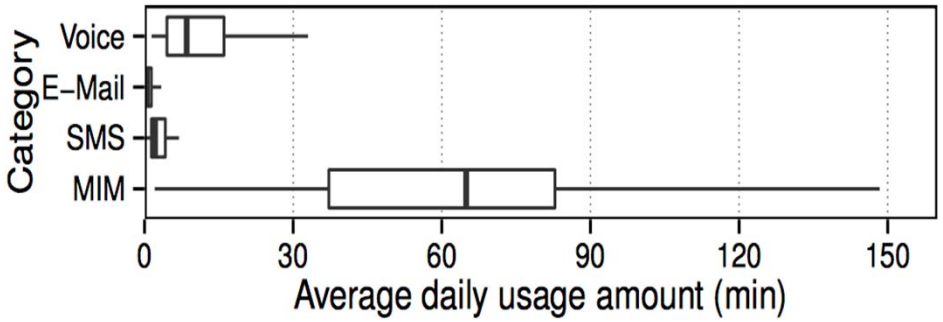


Figure 6. Usage statistics for communication apps

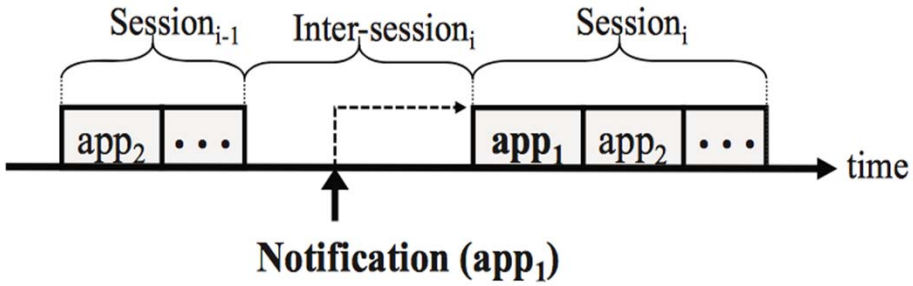
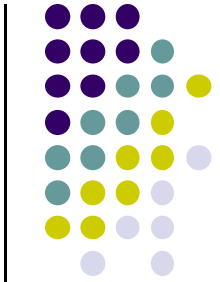


Figure 7. Illustration of an external session

Communication App Use



- Summary of Findings
  - MIMs mainly used for mobile communications, and over 60 minus/day.
  - More than 400 notifications/day and 90% from MIMs.
  - The risk group spend significantly more time on MIM-initiated sessions.

Web Browsing App Use

- Usage Pattern Analysis

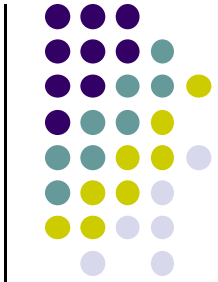
Web Usage	Non-Risk [95% CI]	Risk [95% CI]	T	P	d
Usage time (m)	41.1 [33.6, 48.6]	67.1 [48.4, 85.9]	2.60	.012	0.61
Usage freq	22.3 [18.7, 26.0]	38.5 [25.7, 51.3]	2.47	.018	0.61
Inter-web time (m)	81.0 [68.4, 93.5]	71.4 [53.3, 89.4]	0.90	.370	0.19

- Content Consumption Pattern Analysis

	Community	Portal	News	Search	Entertainment	School	Misc.	Total
Risk (SD)	43.7(101.7)	8.9 (14.8)	19.0 (59.2)	9.6 (9.2)	0.6 (0.8)	2.4 (3.8)	14.3 (11.3)	99.5 (130.6)
95% CI	[9.3, 78.1]	[3.9, 13.9]	[1.0, 39.1]	[6.5, 12.7]	[0.3, 0.8]	[1.1, 3.7]	[10.5, 18.1]	[55.3, 143.7]
Non-Risk (SD)	7.5 (13.2)	2.7 (3.1)	1.0 (1.4)	4.0 (5.3)	1.6 (3.6)	1.5 (2.1)	7.6 (11.6)	24.8(28.6)
95% CI	[4.0, 10.9]	[1.9, 3.5]	[0.6, 1.3]	[2.6, 5.3]	[0.4, 2.8]	[1.0, 2.1]	[4.6, 10.6]	[17.3, 32.2]
P (d)	.076 (0.53)	.049 (0.60)	.107 (0.46)	.013 (0.75)	.125 (0.42)	.189 (0.30)	.034 (0.57)	.014 (0.79)

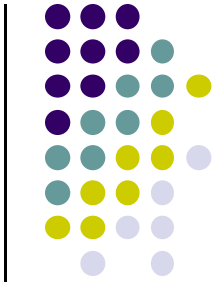
Table 5. Distribution of the visit frequency on each category by the risk and non-risk groups

Web Browsing App Use



- Summary of Findings
  - Risk group browsed the web more often and tended to search for content updates more frequently.
  - A few of risk participants searched for and consumed online content in an excessive manner and exhibited unique surfing patterns

Analytic Modeling of Usage Behavior



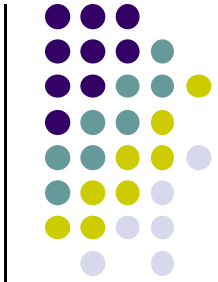
- Regression Analysis
  - The usage time and frequency were closely related with smartphone overuse.

	Total	Inter.	Virtu.	Withd.	Toler.
Model Summary					
Adjusted R^2	.12**	.14**	.07*	.07*	0.14**
F	6.25	5.05	6.83	6.84	7.76
Standardized β					
Usage freq	.26**			.26**	
Top 1 app time		.30**			
6-12 usage time			.26**		
Web usage time	.21**				.31**
# ext. sessions					.23**
Ext. MIM agg. seq. len.		.48**			

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

Table 6. Regression analysis results

Analytic Modeling of Usage Behavior

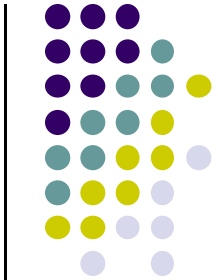


- Classification Analysis
  - Investigating various category-specific usage patterns was of critical important for accurately classifying the groups.

Feature set	Acc. (%)	Pre.	Rec.	F-score	Classifier
All	81.05	.816	.811	.813	DT
General	72.63	.723	.726	.724	DT
Category	87.37	.874	.874	.874	DT
Temporal	78.95	.792	.789	.790	DT
ExtCue	64.21	.622	.642	.632	NB
ExcludeGeneral	85.26	.863	.853	.858	DT
ExcludeCategory	80.00	.806	.800	.803	NB
ExcludeTemporal	77.89	.782	.779	.780	DT
ExcludeExtCue	81.05	.816	.811	.813	DT

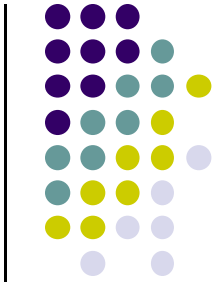
Table 7. Classification Results

Problematic Usage Behavior



- Overall usage behavior
  - Participants use smartphones for various purposes.
  - Used longer time in the morning and evening and brief and frequent during the day.
- Frequent interferences
  - Instant messages interfered with different degrees: loss attention, disturb sleep pattern, interrupt social activity.
- Habitual usage and limited Self-Control
  - The risk group has difficulty in regulating the smartphone usage

Discussion and Conclusion



- Risk group spend longer time with a highly skewed usage pattern and longer periods in the morning and evening.
- Participants mainly use smartphones for communications.
- MIM was the most frequently used app with >400 notifications
- MIM notification can lead to excessive smartphone usage.

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