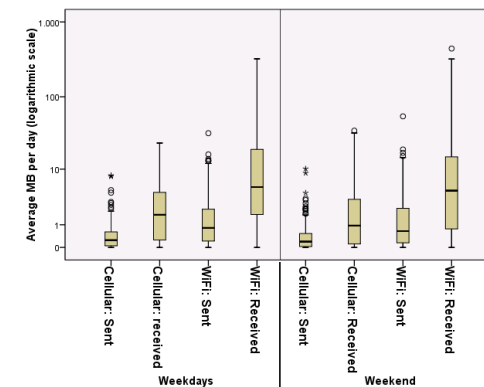
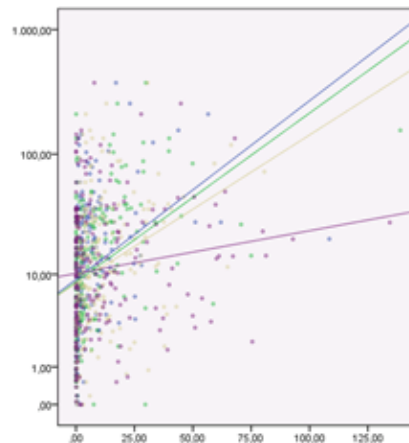


Preferences in data usage and the relation to the use of mobile applications

Harry Bouwman (TU Delft, Åbo Akademi)
Mark de Reuver (TU Delft)



Research issue

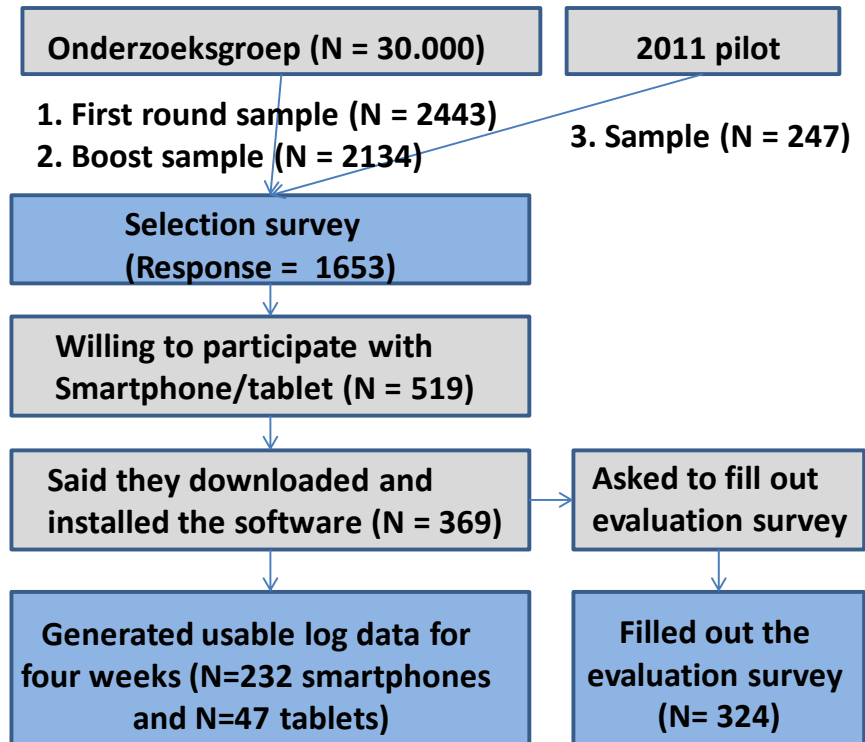
- Practical problem
 - Load balancing on cellular networks
 - Invest in 4G? Offloading to WiFi?
 - Which applications really drive the use of cellular vs WiFi networks?
 - How can operators stimulate or reduce usage of cellular networks?
- Gap in literature
 - Most studies on adoption of mobile focus on applications, not networks
 - People hardly know which networks they use and why
- Research question
 - Which applications drive usage of cellular versus WiFi networks?
 - Using log data directly collected on smartphones rather than survey data

Method: Approach

- Consortium
 - Arbitron Mobile: software + server
 - Market Response: Sampling from panel of 20,000 households
 - CBS: Funding, Safeguard privacy and representativeness
 - TU Delft: Project management, Data analysis
- 2011
 - Pretest among students
 - 129 participants, 28 days, Fall 2011
- 2012
 - Selection survey, post survey
 - Actual log data

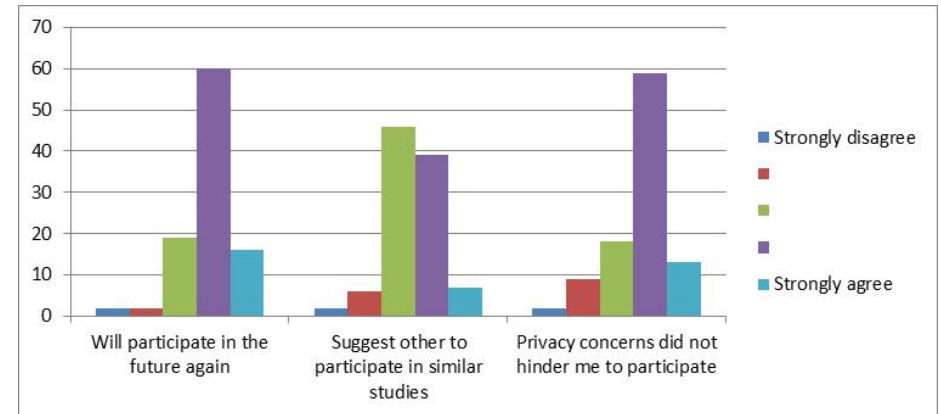


Method: Sampling



- Population
 - NL Android + iOS users, > 15 y
 - No sample framework
- Non response:
 - Not reached
 - Don't own a smartphone
 - Usual reasons
 - Study related reasons:
 - Privacy reasons
 - Company telephone
 - Problems with downloading, implementation of APP
- Partial non response:
 - Various reasons, e.g. battery

Method: Privacy



- Privacy issues
 - Very detailed data on behavior of respondents
 - Comply with regulation, industry standards, practices of commissioner
- Consequence
 - Informed consent
 - Data-collection and analyses separated (unique identifier)
 - Data protected: stored and accessed via password
 - Reports only on aggregated level

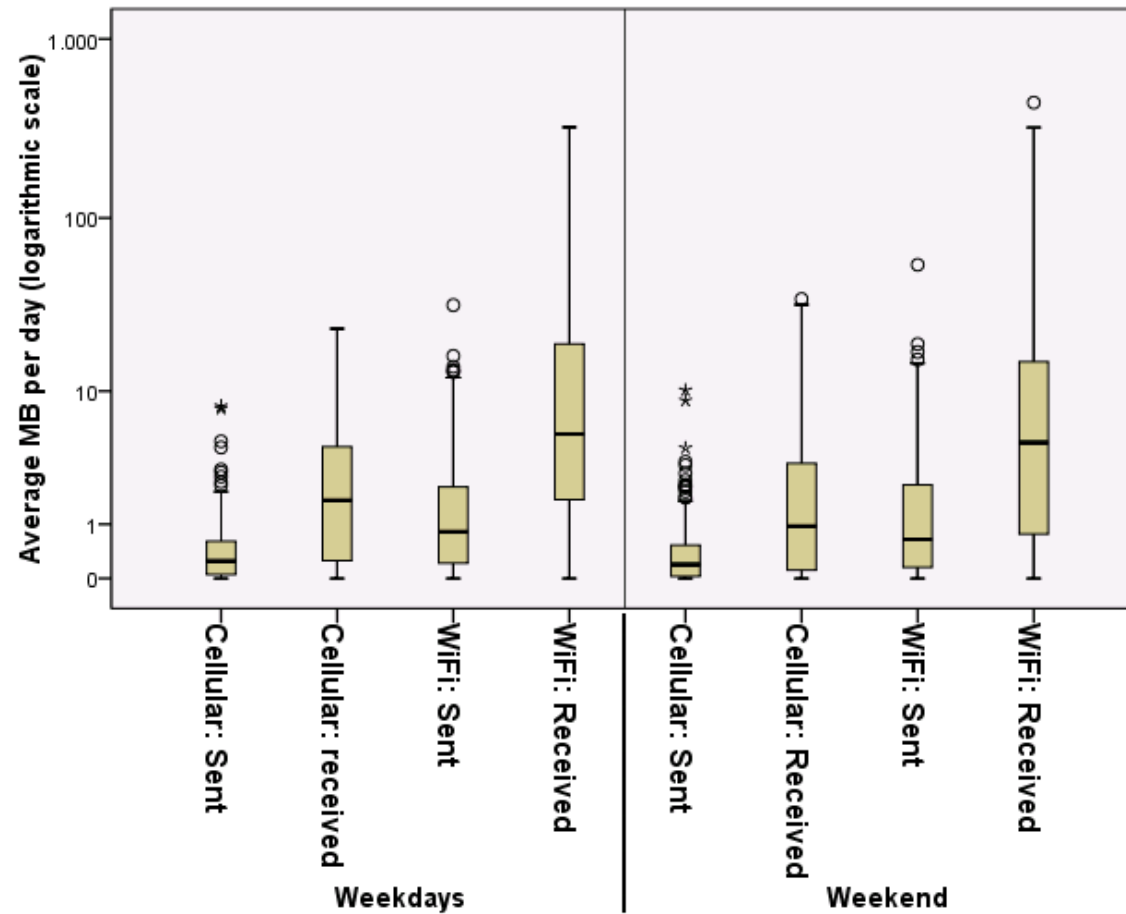
Data: Example

```

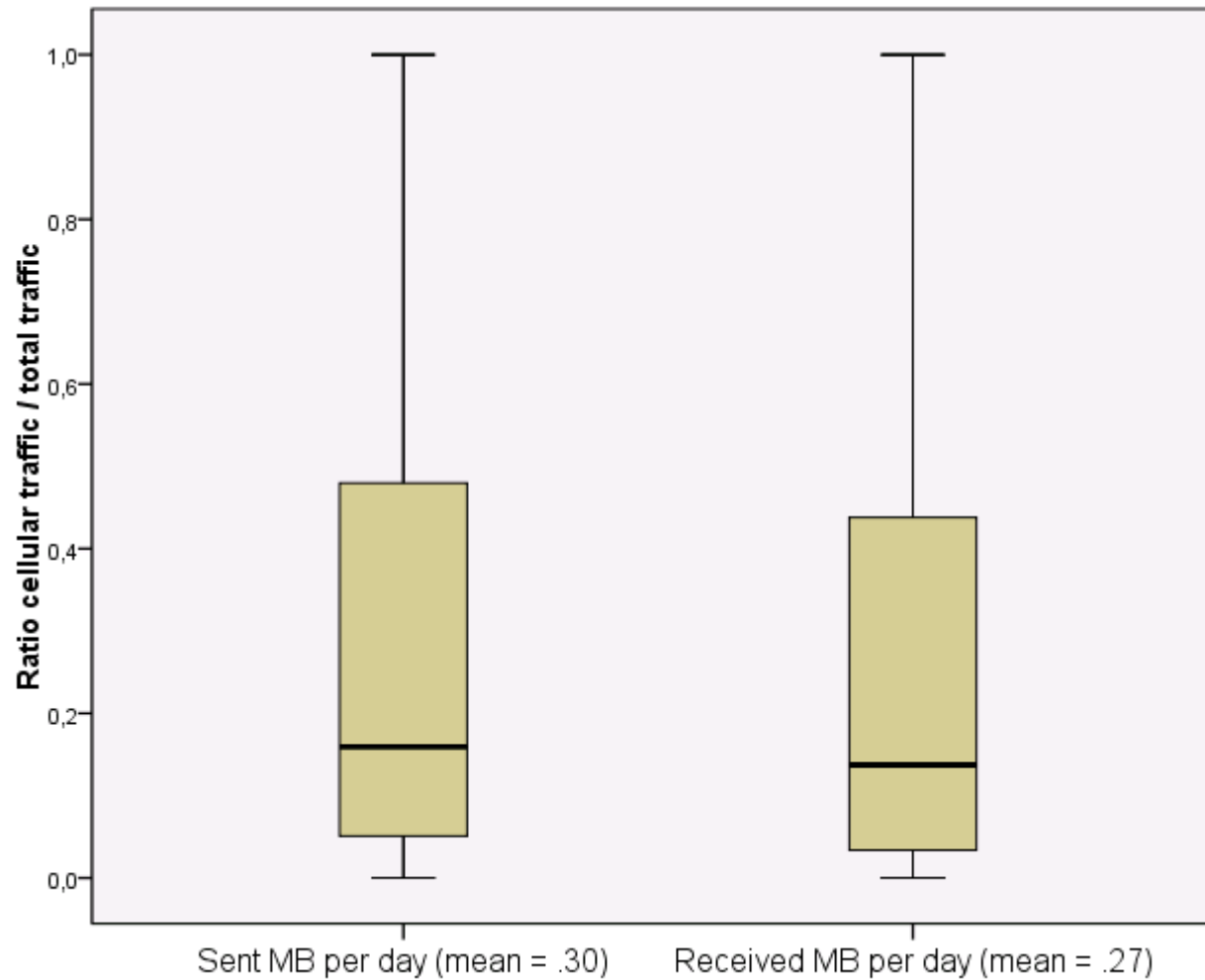
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uid      observation_date      application_type
application_category
number_distinct_application_class
number_distinct_application_name
facetime_minute_day
facetime_minute_session_mean
facetime_minute_session_median sessions_day
total_sessions_day      session_ferquency
12877  4/26/2011      platform      browsing
1      1      0.17      0.17      0.17      1      1
1
12889  4/26/2011      platform      browsing
1      1      12.2      2.44      2.62      5      34
0.15
12889  4/26/2011      platform      messaging
2      2      17.24      1.08      0.83      16      34
0.47
12889  4/26/2011      platform      multimedia
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0.12

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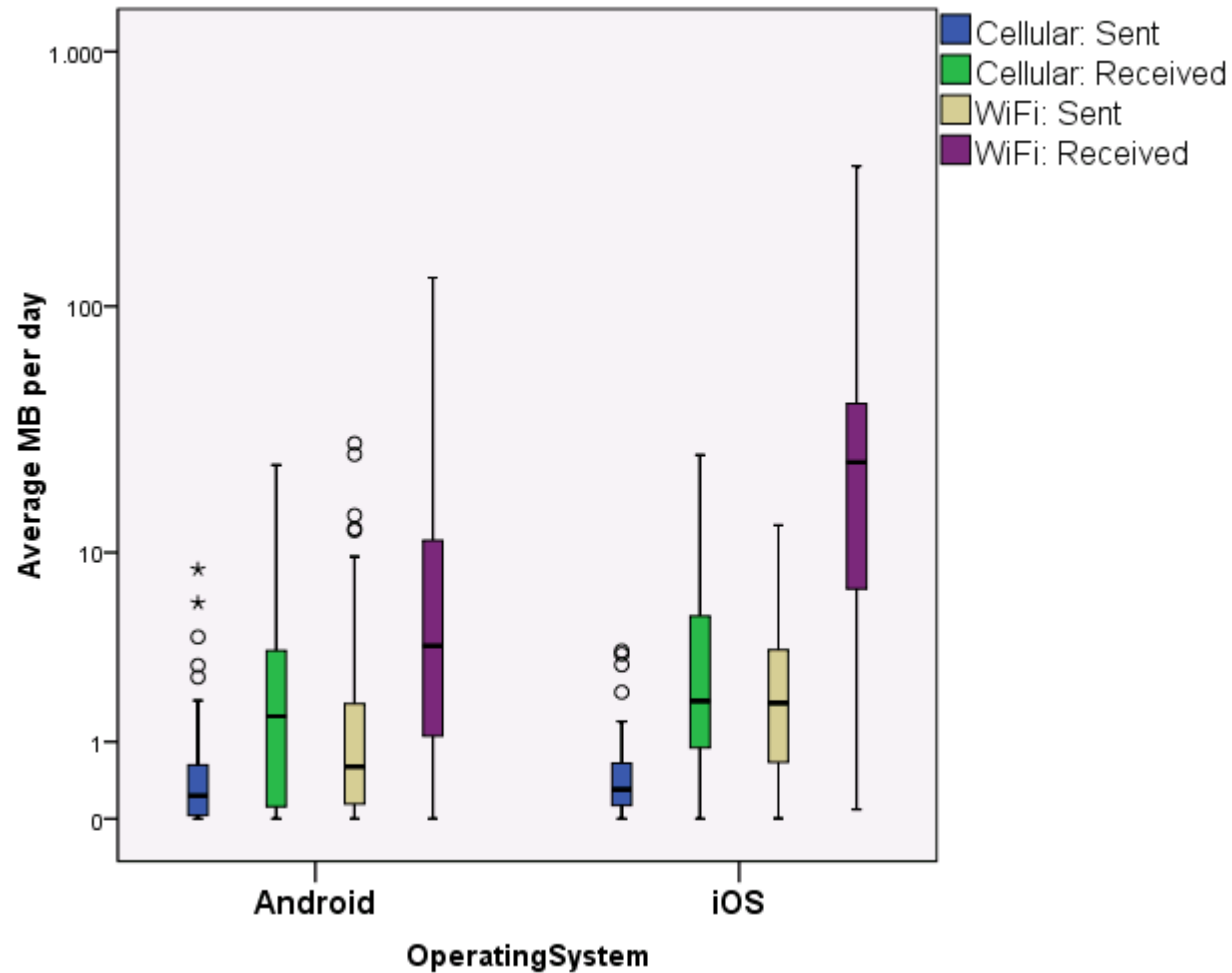
Exploration: Data consumption



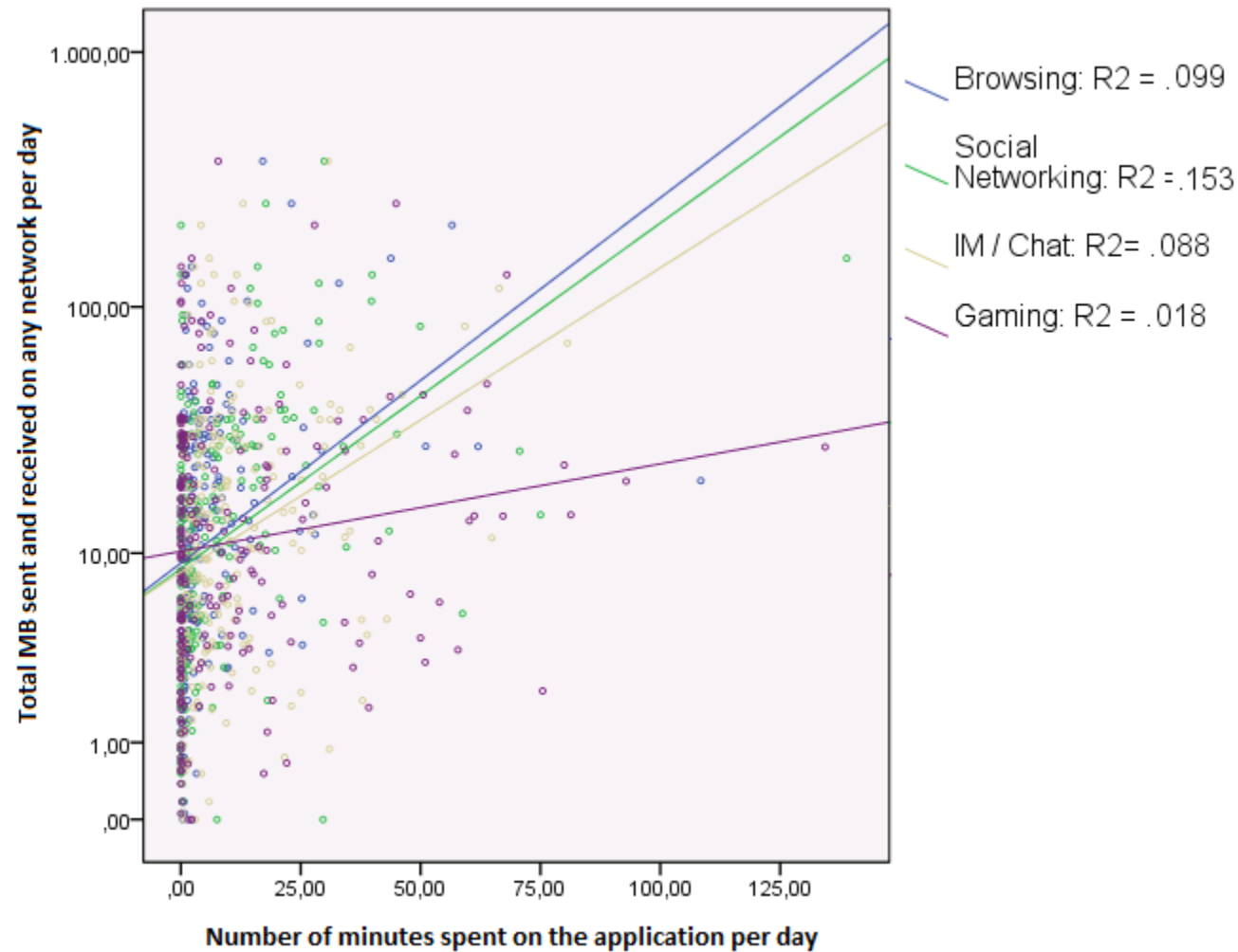
Exploration: Cellular / total data



Exploration: Handset brands



Application --> Data usage



Application --> Data usage

Structural equation model

	Cellular data sent & received	WiFi data sent & received
Video	-.15*	n.s.
Social networking	.15*	.17**
Browsing	.26***	.24***
Gaming	-.12*	n.s.
IM / Chat	.12*	n.s.
Productivity	n.s.	n.s.
Maps / Navigation	n.s.	n.s.
App store	n.s.	n.s.
Explained variance	.198	.116
Overall model fit	$\chi^2(3) = .070$, $p = .995$, NFI = 1.00, CFI = 1.00, TLI = 1.22, RMSEA = .000	$\chi^2(6) = 8.166$, $p = .226$, NFI = .955, CFI = .985, TLI = .910, RMSEA = .039

Demographics not significant
Data bundle size not significant

Application --> Data usage

Self-reported app usage

	Cellular data sent & received	WiFi data sent & received
Mobile TV	n.s.	.14*
Social networking	.21**	n.s.
Browsing	.20**	n.s.
Gaming	-.17*	n.s.
IM / Chat	n.s.	n.s.
Productivity	n.s.	n.s.
Maps / Navigation	n.s.	n.s.
Explained variance	.141	.086

Conclusions

- Main findings
 - Great differences in data consumption patterns, esp cellular
 - No explanatory effect from demographics and data plan
 - Application usage only partly explains data usage
 - Cellular network data is driven by social networking, browsing and instant messaging
 - Log data explains data usage better than self-reported app usage
- Implications
 - Telcos have limited means to steer data consumption via applications
 - Streaming video apparently does NOT affect data loads
 - Implications for net neutrality debate

Discussion

- Limitations / further research
 - Representativeness of the sample
 - Differentiate home and work context from mobile context
 - Differentiate 3G and 4G
 - Focus on heavy users of cellular networks
- Broader research program on mobile cloud and offloading
 - Overview of mobile cloud and offloading (INFO 2012)
 - Conjoint experiment on whether people are willing to open their phone for WiFi offloading (INFO 2013)
 - Agent based model to simulate effects of WiFi offloading on cellular loads (ongoing)



Backup slides

Existing research

- Handful of studies
 - Nokia / Aalto: Verkasalo & Hammainen, 2007; Smura et al, 2011
 - MIT: Eagle & Pentland, 2006
 - Microsoft: Falaki et al, 2010
 - Technology-focused: Oliver 2010; Shye et al, 2009
 - Self-report versus logdata: Boase & Ling, 2011; Kobayashi & Boase, 2012
- Smartphones studies making use of questionnaire data:
 - Becoming more common

Telephony

- On average people report to make phone calls for about (N= 1409 due to the fact that phone calls are not made via tablets)
 - 16 minutes a day on an ordinary day in the week, and
 - about 9 minutes in the weekend.
- Of the respondents
 - 6% don't make calls on average day in the week, and
 - 9% during the weekend.
- Most people (modus) phone for 5 minutes on an ordinary day (22%, N = 1409), and during the weekend (28%).
- The range for
 - week days is from no phone calls (5.6%) to 420 minutes per day (1 person), and
 - from no phone calls (9.5%) in the weekend to 180 minutes (again one person).

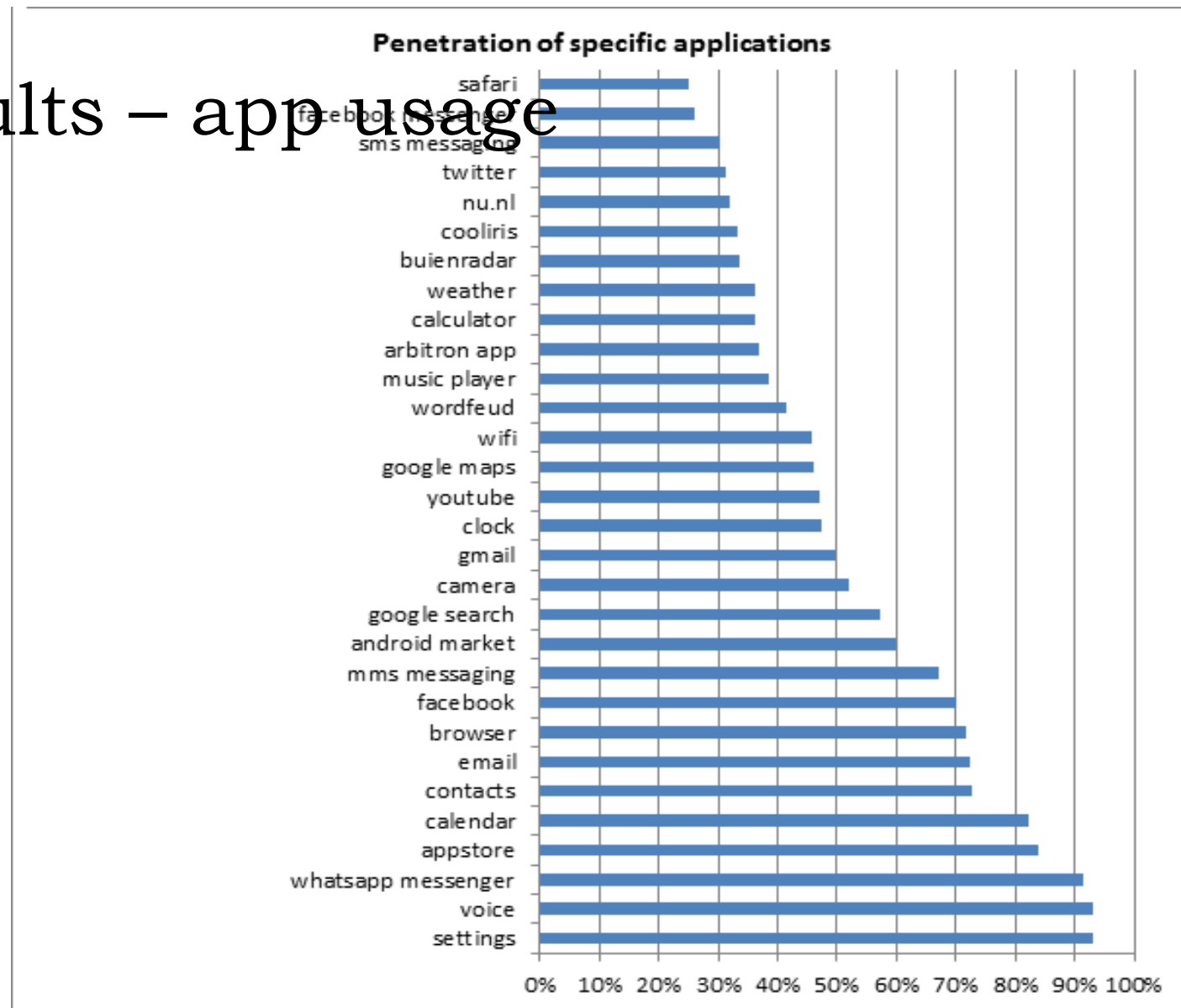
Other results

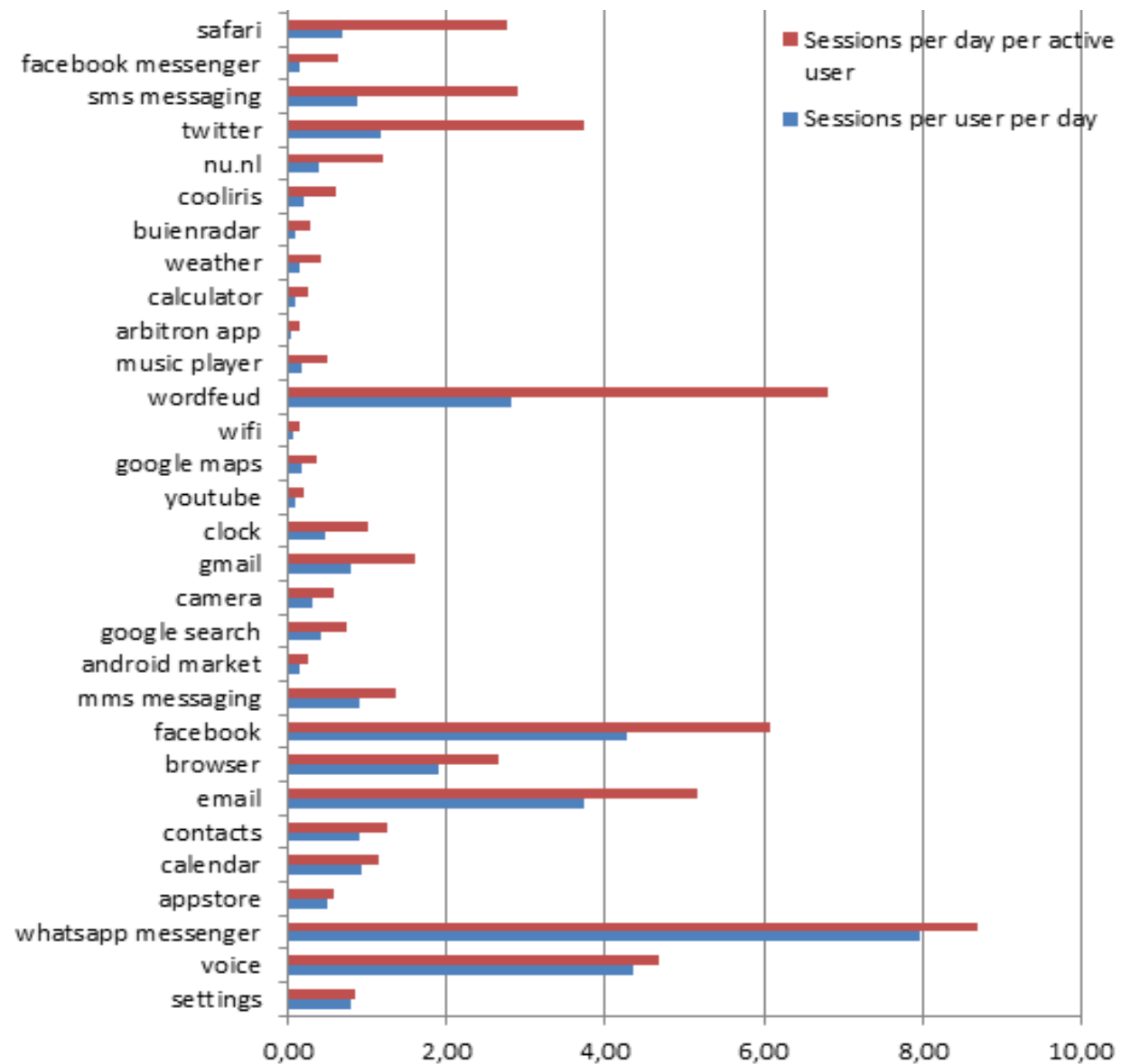
- Information use related
 - more than 50% (53%) consult news and weather information on a daily basis;
 - about 45% daily surf the Internet via smart phone or tablet;
- Game, entertainment related
 - one third of the respondents of the selection questionnaire play games on a daily basis via smart phone or tablet;
 - 23% watch television via a tablet a couple of times during a month. Daily use is only 3%. For smart phones this is a bit lower: 16% watch television via smart phone a couple of times during a month. Daily use is 1%.

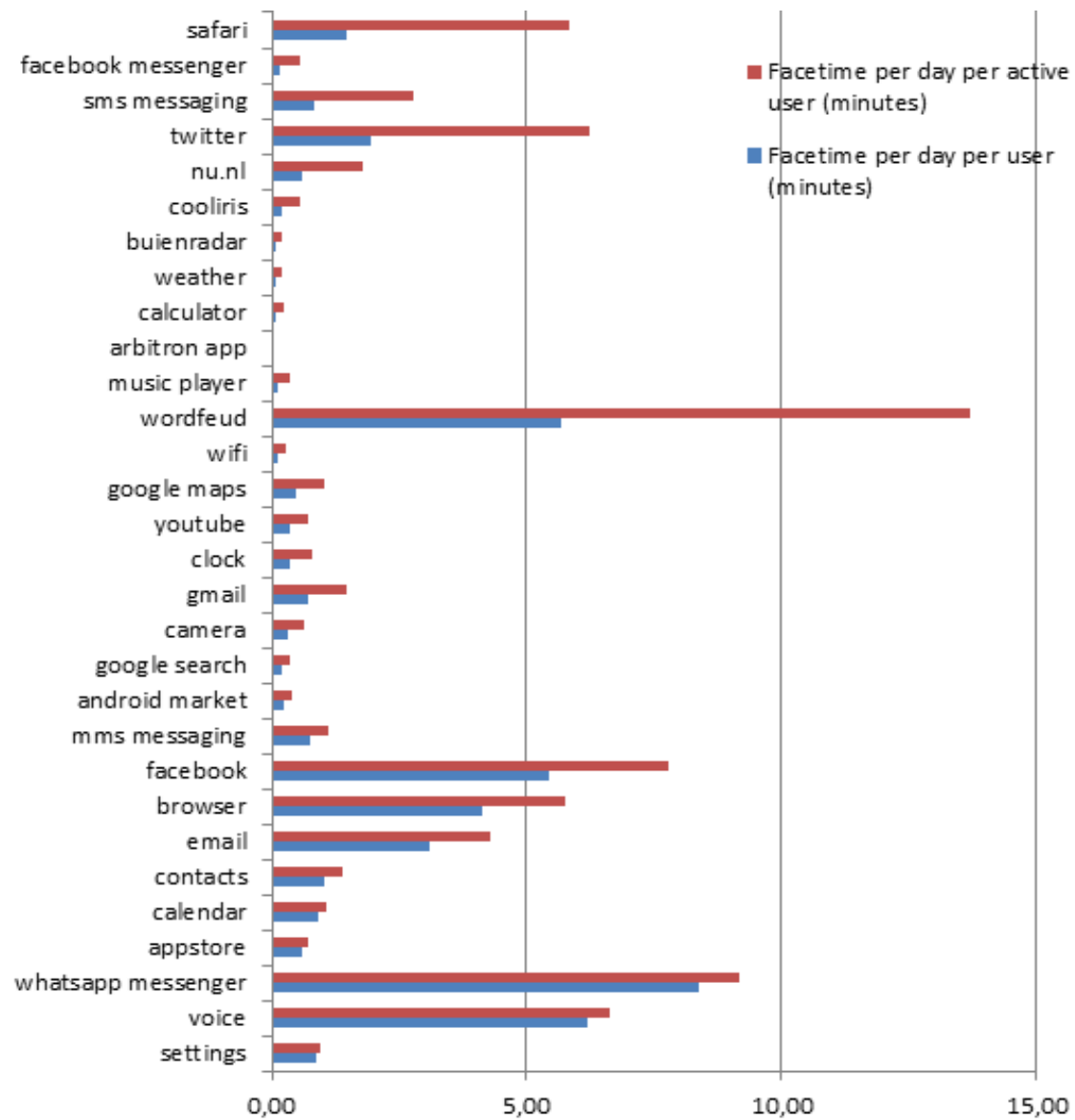
Results: Revisiting hypes

- Mobile VOIP (Skype)
 - 18% a couple of times per month; 2% daily basis
- Mobile messaging / chat
 - 47% of respondents regularly
- Social networking
 - 39% daily basis
 - 31% never
- Transactions
 - 1% uses mobile payment on daily basis
 - 83% never uses mobile payment
- Location based services
 - Localization: 15% uses weekly, 29% monthly
 - Navigation: 22% uses weekly, 33% monthly
- Business applications

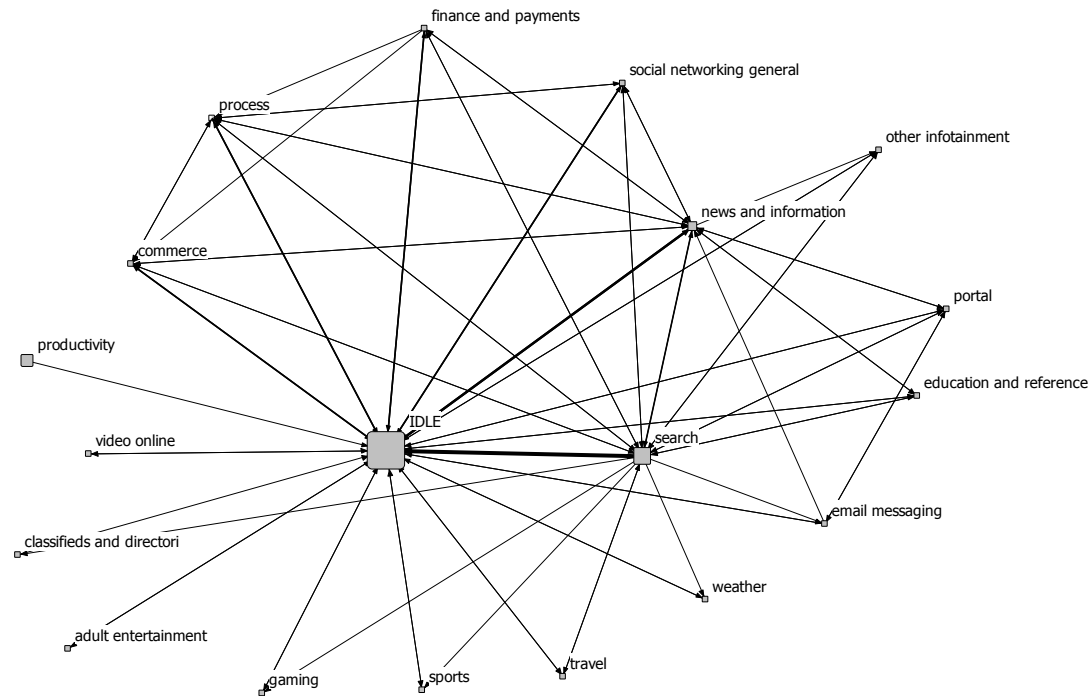
Results – app usage







Browsing across: websites categories



Results – Start of panel data

