Making mobile notifications useful, usable and used
Wait a second...

- Aren’t they already?
Used?

- We receive dozens daily
- Certainly used by app developers!

<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>Participants</th>
<th>Avg/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pielot et al.</td>
<td>2014</td>
<td>15</td>
<td>65.3</td>
</tr>
<tr>
<td>Visuri et al.</td>
<td>2019</td>
<td>40</td>
<td>313.4</td>
</tr>
<tr>
<td>Komninos et al.</td>
<td>2019</td>
<td>40</td>
<td>232.5</td>
</tr>
</tbody>
</table>
Notification Hell

12 hours worth...

A “smart” environment...
**Notifications can be**
- Removed by the system
- Clicked by the user
- Dismissed by the user

In Visuri et al. (2019), users interacted with just 12.3% of notifications:
- 2.6% clicked
- 9.7% dismissed

Too many notifications reduce click ratio, reduce the user experience, and the amount of received information.
- Threshold @ 100-120 notifications per day.
How do people perceive notifications?

Aranda et al. 2016
Coping strategies

- From Aranda et al. (2016)
  - Put the phone away (bag, box)
  - Turn on DND (in context, or always)
  - Select airplane mode
  - Use the website instead of the app
  - Uninstall the app
  - Risk it

- People simply don’t bother with setting up custom rules and settings.
- Fear of missing out
Why this low engagement?

• There’s always something to “clear”: it’s a lot of extra work for the user.

• Maybe notifications are not as USABLE or USEFUL
Usable?

- In order to be engaging, the notification must be perceived.

- Missed notification by ringer mode (Mehrotra et al. 2016):
  - Silent: 14.63%,
  - Vibrate: 15.38%,
  - Sound only: 23.75%
  - Sound+Vibrate: 21.05%

- Others (e.g. Pielot et al. 2016) report a quicker response time to notifications in Vibrate mode (!)

- Users regularly check their device even if it’s in silent mode.

- Users have to manage ringer mode – don’t assume they will do it successfully always.
Usable?

- Apart from ringer mode, actual modality (programmed + ringer mode) also plays a role (Komninos et al. 2018)
  - Audio is most perceptible
  - Vibration is less so
  - LED is a nice back-up for missed notifications
Usable?

- Is the notification modality helpful?
- There is a distinct preference towards engagement with specific **kinds** (Shahami Shirazi et al. 2014) and **sources** (Lee et al. 2019)
- People are curious – they will speculate upon reception (Chang et al. 2019).
  - Which app? (39.7%)
  - Who from? (3.7%)
  - Or both (49.6%)
- And they will fail...
  - When the app does not provide a distinctive sound/vibration pattern (esp. the latter)
  - When they can’t associate the time/context with a possible event
Usable?

• Is the notification presentation helpful?
  • Textual content in the preview is important (Fischer et al. 2010).
  • Icon on status bar vs. foreground bubble (Mehrotra et al. 2016)
  • Bundling of notifications adds little value (new elements add minimal information) (Visuri et al. 2019)
  • CTR improves with adding icons and images to notification body (Bahir 2019)
  • Too many items in the drawer can “hide” important notifications (Weber et al. 2019)

<table>
<thead>
<tr>
<th>Option</th>
<th>Count (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sender is important</td>
<td>31.546</td>
</tr>
<tr>
<td>The content is important</td>
<td>27.129</td>
</tr>
<tr>
<td>The content is urgent</td>
<td>14.511</td>
</tr>
<tr>
<td>The content is useful</td>
<td>31.546</td>
</tr>
<tr>
<td>I was waiting for this notification</td>
<td>15.773</td>
</tr>
<tr>
<td>The action demanded by the sender does not require a lot of effort</td>
<td>20.189</td>
</tr>
<tr>
<td>At this moment, I was free</td>
<td>37.224</td>
</tr>
</tbody>
</table>

Table 3. User response about why they accept (click) notifications.
Useful?

- Is the notification timely?
  - Disruption => Frustration
  - Non-engagement
- Much work in this area to discover opportune moments to defer notifications to (e.g. Poppinga et al. 2014, Okoshi et al. 2017, Pielot et al. 2017)
- Simple time-awareness can also help

Pielot et al. 2014
Komninos et al. 2019
Dingler & Pielot 2015
What’s my target?

Be clicked within half a minute

Figure 3: CTR as a function of number of hours since the notification was sent.

Bahir et al. 2019

Sahami Shirazi et al. 2014
What’s my target?

Be a messaging app

<table>
<thead>
<tr>
<th>Category</th>
<th>Users</th>
<th>Apps</th>
<th>Click times</th>
<th>Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>messenger</td>
<td>29,627</td>
<td>10</td>
<td>2,508,203</td>
<td>883</td>
</tr>
<tr>
<td>voice &amp; messenger</td>
<td>27,768</td>
<td>9</td>
<td>335,530</td>
<td>470</td>
</tr>
<tr>
<td>mail</td>
<td>26,120</td>
<td>8</td>
<td>781,502</td>
<td>610</td>
</tr>
<tr>
<td>social</td>
<td>22,173</td>
<td>12</td>
<td>501,159</td>
<td>382</td>
</tr>
<tr>
<td>calendar</td>
<td>12,292</td>
<td>5</td>
<td>18,990</td>
<td>305</td>
</tr>
<tr>
<td>alarm clock</td>
<td>11,849</td>
<td>7</td>
<td>18,678</td>
<td>50</td>
</tr>
<tr>
<td>music</td>
<td>15,366</td>
<td>16</td>
<td>47,786</td>
<td>114</td>
</tr>
<tr>
<td>game</td>
<td>3,046</td>
<td>6</td>
<td>43,206</td>
<td>41</td>
</tr>
<tr>
<td>market</td>
<td>29,326</td>
<td>6</td>
<td>192,357</td>
<td>156</td>
</tr>
<tr>
<td>reader/news</td>
<td>3,958</td>
<td>7</td>
<td>11,036</td>
<td>50</td>
</tr>
<tr>
<td>utility</td>
<td>13,202</td>
<td>27</td>
<td>29,990</td>
<td>105</td>
</tr>
<tr>
<td>tool</td>
<td>11,494</td>
<td>18</td>
<td>33,352</td>
<td>42</td>
</tr>
<tr>
<td>system</td>
<td>27,269</td>
<td>21</td>
<td>229,067</td>
<td>304</td>
</tr>
<tr>
<td>other</td>
<td>13,511</td>
<td>21</td>
<td>44,370</td>
<td>124</td>
</tr>
<tr>
<td>overall</td>
<td>37,233</td>
<td>173</td>
<td>4,795,226</td>
<td>3,636</td>
</tr>
</tbody>
</table>

Sahami Shirazi et al. 2014
Make them useful and usable!

- Have something of value to say (legit!)
  - Users speculate – Often they expect something related to their context, if you’re not it, then it’d better be important.
- Attract attention at the right time
  - Think before you ping: What would be the best time to alert the user to take action?
  - Can you ask the user for the right time to defer?
- Attract attention in the right way
  - Ensure notifications have distinguishable audio/haptic/visual identity.
  - Respect potentially private / sensitive times. Use notification channels, adapt modality based on time and context, adapt to current ringer mode.
• Make them useful and usable!

• Say it in the right way!
  • Textual content is very important: Carry value!
  • Use icons/images sparingly to communicate importance and urgency.
  • Entropy must be high – don’t just repeat the same blurb.

• Am I doing it right?
  • Measure engagement
  • Take corrective action
“[...] developers should protect users’ attention by being respectful and thoughtful in each notification that is sent.” (Aranda et al. 2016)
Thanks!

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http://www.komninos.info
References


Video links

- https://www.youtube.com/watch?v=Mc0DjzAHp1s
- https://www.youtube.com/watch?v=RAjkkOEvhDw