Measuring user engagement: 
a holistic view

Mounia Lalmas
Yahoo Labs London
mounia@acm.org
What is user engagement?

“User engagement is a quality of the **user experience** that emphasizes the phenomena associated with wanting to use a technological resource longer and frequently” (Attfield et al, 2011)

**self-report**: happy, sad, enjoyment, …

**physiology**: gaze, body heat, mouse movement, …

**analytics**: click, upload, read, comment, share …

emotional, cognitive and **behavioural** connection that exists, at any point in time and over time, between a user and a technological resource

focus of this talk … Big Data
Why is it important to engage users?

> In today’s wired world, users have enhanced expectations about their interactions with technology … resulting in increased competition amongst the purveyors and designers of interactive systems.

> In addition to utilitarian factors, such as usability, we must consider the hedonic and experiential factors of interacting with technology, such as fun, fulfillment, play, and user engagement.

(O’Brien, Lalmas & Yom-Tov, 2014)
Why is it important interpret user engagement measurement well?
Characteristics of user engagement (I)

**Focused attention** (Webster & Ho, 1997; O’Brien, 2008)
- Users must be focused to be engaged
- Distortions in the subjective perception of time used to measure it

**Positive Affect** (O’Brien & Toms, 2008)
- Emotions experienced by user are intrinsically motivating
- Initial affective “hook” can induce a desire for exploration, active discovery or participation

**Aesthetics** (Jacques et al, 1995; O’Brien, 2008)
- Sensory, visual appeal of interface stimulates user & promotes focused attention
- Linked to design principles (e.g. symmetry, balance, saliency)

**Endurability** (Read, MacFarlane, & Casey, 2002; O’Brien, 2008)
- People remember enjoyable, useful, engaging experiences and want to repeat them
- Reflected in e.g. the propensity of users to recommend an experience/a site/a product
Characteristics of user engagement (II)

- **Novelty**
  (Webster & Ho, 1997; O’Brien, 2008)
  - Novelty, surprise, unfamiliarity and the unexpected
  - Appeal to users’ curiosity; encourages inquisitive behavior and promotes repeated engagement

- **Richness and control**
  (Jacques et al, 1995; Webster & Ho, 1997)
  - Richness captures the growth potential of an activity
  - Control captures the extent to which a person is able to achieve this growth potential

- **Reputation, trust and expectation**
  (Attfield et al, 2011)
  - Trust is a necessary condition for user engagement
  - Implicit contract among people and entities which is more than technological

- **Motivation, interests, incentives, and benefits**
  (Jacques et al., 1995; O’Brien & Toms, 2008)
  - Difficulties in setting up “laboratory” style experiments
  - Why should users engage?
# Measuring user engagement

<table>
<thead>
<tr>
<th>Measures</th>
<th>Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Self-report</strong></td>
<td></td>
</tr>
<tr>
<td>Questionnaire, interview, survey</td>
<td>Subjective</td>
</tr>
<tr>
<td>Think-aloud and think after protocols</td>
<td>Short- and long-term</td>
</tr>
<tr>
<td></td>
<td>Lab and field</td>
</tr>
<tr>
<td></td>
<td>Small scale</td>
</tr>
<tr>
<td><strong>Physiology</strong></td>
<td></td>
</tr>
<tr>
<td>EEG, SCL, fMRI</td>
<td>Objective</td>
</tr>
<tr>
<td>eye tracking</td>
<td>Short-term</td>
</tr>
<tr>
<td>mouse-tracking</td>
<td>Lab and field</td>
</tr>
<tr>
<td></td>
<td>Small and large scale</td>
</tr>
<tr>
<td><strong>Analytics</strong></td>
<td></td>
</tr>
<tr>
<td>Intra- and inter-session metrics</td>
<td>Objective</td>
</tr>
<tr>
<td>so-called ... data science</td>
<td>Short- and long-term</td>
</tr>
<tr>
<td></td>
<td>Field</td>
</tr>
<tr>
<td></td>
<td>Large scale</td>
</tr>
</tbody>
</table>
Large scale measurements – analytics

- **intra-session** engagement measures success in attracting user to remain on site for as long as possible.
- **inter-session** engagement measured by observing lifetime user value.

<table>
<thead>
<tr>
<th>intra-session metrics</th>
<th>inter-session metrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dwell time</td>
<td>Fraction of return visits</td>
</tr>
<tr>
<td>Session duration</td>
<td>Time between visits (inter-session time, absence time)</td>
</tr>
<tr>
<td>Bounce rate</td>
<td>Total view time per month (video)</td>
</tr>
<tr>
<td>Play time (video)</td>
<td>Lifetime value (number of actions)</td>
</tr>
<tr>
<td>Mouse movement</td>
<td>Number of sessions per unit of time</td>
</tr>
<tr>
<td>Click through rate (CTR)</td>
<td>Total usage time per unit of time</td>
</tr>
<tr>
<td>Number of pages viewed (click depth)</td>
<td>Number of friends on site (social networks)</td>
</tr>
<tr>
<td>Conversion rate</td>
<td>Number of UCG (comments)</td>
</tr>
<tr>
<td>Number of UCG (comments)</td>
<td>Number of UCG (comments)</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

**short-term**

**activity**

**loyalty**

**popularity**

**long-term**

intra-session engagement measures success in attracting user to remain on site for as long as possible.

inter-session engagement measured by observing lifetime user value.
From short- to long-term engagement: Prediction

We monitor short-term metric(s)

how users engage within a session?

We know what it will mean

We know what it will mean

proxy

long-term metric(s)

how users engage across sessions?

future engagement
Example: Absence time

Ranking function on Yahoo Answer Japan

Two-weeks click data on Yahoo Answer Japan: search

One millions users

6 ranking functions

30-minute session boundary
Absence time and survival analysis

Users (%) who read story 2 but did not come back after 10 hours

SURVIVE

Users (%) who did come back

DIE = RETURN TO SITE ➔ SHORT ABSENCE TIME
Search session metrics

- Number of clicks
- Click at given position
- Time to first click
- Skipping
- Abandonment rate
- Number of query reformulations

short absence is a sign of loyalty
important indication of user satisfaction
Absence time and number of clicks on search result page

experience starts

dwell time

dwell time

dwell time

time

absence time

absence time

censored absence time

survival analysis: high hazard rate (die quickly) = short absence

$$h(t) = h_0(t) \exp(\beta_i \mathbb{1}_{\text{n clicks} = i})$$

control = no click

3 clicks

5 clicks

Number of clicks on the Search Result Page
Absence time and search experience

1. No click means a bad user experience
2. Clicking between 3-5 results leads to same user experience
3. Clicking on more than 5 results reflects poorer user experience; users cannot find what they are looking for

1. Clicking lower in the ranking (2\textsuperscript{nd}, 3\textsuperscript{rd}) suggests more careful choice from the user (compared to 1\textsuperscript{st})
2. Clicking at bottom is a sign of low quality overall ranking
3. Users finding their answers quickly (click sooner) return sooner to the search application
4. Returning to the same search result page is a worse user experience than reformulating the query