Internet based e-health applications - development and evaluation

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eHealth interventions
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eHealth vs. mHealth
The development and evaluation of (mainly) web-based eHealth interventions

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eHealth Interventions

- Social media – social self-help (?)
  - Self-help groups, chat groups, moderator/not
- Technology mediated therapy
  - Phone (incl. video), chat, email; stand-alone / adjunctive
- **Automated self-help interventions**
  - Brief interventions: screening and feedback
  - Intensive follow-up
- Videogames/gamification
- Sensor technology
  - Heart rate, breathing, walking, skin conductance, accelerometer, GPS etc
App types

• Native app
  – The intervention program (i.e., application) is installed on your device, and runs directly on the operating system of your device

• Web app
  – The application is installed on a web server, and depends on your devices web-browser to function

• Hybrid app
  – E.g. A “thin” native app that are in fact a web-browser that is locked to your web-app
    • often reduced browser functionality
    • may also go beyond standard browser functionality

• Both
  – E.g. Gmail/Facebook are available as both web- and native-apps
Native app

- Must be downloaded
- Internet access for downloading only
  - Data collection with time-lag or missing data
- Several operating systems & app stores
  - Frequent tech updates
  - Time & money
- Control & options with graphics & functionality
  - Integrate built in sensors & other apps
  - Advanced gaming features
  - Push features

Web app

- No download
- Internet access throughout treatment
  - Data collection: continuous complete & instantaneous
- One operating system and no app stores
  - Cheaper
  - Simpler
- Responsive design: platform independent
  - Backup solution available
  - More crude look/feel
  - Less push (but: eMail/SMS/IVR)
What works?

- Cahill et al. (2011). Nicotine receptor partial agonists for smoking cessation. (Cochrane review)
  - Conclusion: Nicotine receptor partial agonists works!

- Whittaker et al. (2009). Mobile phone-based interventions for smoking cessation. (Cochrane review)
  - Conclusion: Mobile phone-based interventions may work.
... but what if:

- Cahill et al. (2011). Nicotine receptor partial agonists for smoking cessation. (Cochrane review)
  - Conclusion: Nicotine receptor partial agonists works!
- Whittaker et al. (2009). Mobile phone-based interventions for smoking cessation. (Cochrane rev)
  - Conclusion: Mobile phone-based interventions may work.
- Von Münchausen et al. (1797). Pill-based interventions for smoking cessation. (Hypothetical review)
  - Conclusion: Pills do not work.
Available advice

• “more extensive use of theory was associated with increases in effect size … interventions that incorporated more behavior change techniques also tended to have larger effect… and the effectiveness of Internet-based interventions was enhanced by the use of additional methods of communicating”

Webb, Joseph, Yardley, Michie (2010)
Using the internet to promote health behavior change: a systematic review and meta-analysis of the impact of theoretical basis, use of behavior change techniques, and mode of delivery on efficacy.
J Med Internet Res 2010;12(1):e4
State of the Art eHealth intervention?

**NO**

- It makes no sense, in my opinion, attempting to define a Best Practice or State of the Art for eHealth interventions
The black box problem

eHealth Treatment → Improved outcome
The black box problem

Typically, eHealth researchers have compared packaged multi-component interventions to a control condition.
The black box problem

How do we learn from, improve, or even replicate, such treatments?
How to open the black box?

• Explicating & professionalizing design
  – Careful (written) planning, make intervention, revise and update
  – Recommend: The Intervention Mapping approach
  – Publish better descriptions of the content and rationale
    • E.g., in a separate peer-reviewed journal article

• Meta analysis

• Process evaluation
  – Qualitative designs
  – Log-data

• Test component(s) & concepts
  – Rather than packaged interventions
Explicating what?

• All those choices you make in designing a particular eHealth intervention!
Intervention mapping

- **Manualized framework** to develop interventions
  - Framework to support decision making
- **A set of guidelines**, concepts and other tools for each step and task in the development
- Attempt to define a **best practice** of intervention development
- The treatment rationale is explicated
- If more researcher start to use Intervention Mapping this contributes to professionalizing intervention design
### Performance Objectives: What do the participants in the program need to do to reach the program goal? (Replaces 1, 2, 3 etc. in table above)

### Determinants: variables that influences the relevant behavior. (Replace letters)

### Change Objectives: What need to change related to the determinant for the program participants to do the performance objective? (At each intersection of determinant and performance objective. Should be formulated to be measureable.)

**The matrix of change Objectives** is a specification of the Program Objective – a roadmap to the solution. Defines pathways for program effects.

<table>
<thead>
<tr>
<th>Performance Objectives</th>
<th>Determinants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>1</td>
<td></td>
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<tr>
<td>2</td>
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<tr>
<td>3</td>
<td></td>
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<tr>
<td>...</td>
<td></td>
</tr>
</tbody>
</table>
Change objectives and evaluation

- What needs to change related to the determinant for the program participants to do the performance objective?
- Each change objective should be operationalized such that it is measureable within an evaluation
  - Enable advanced comparative evaluation of different mediating mechanisms
Example: Balance

• An internet-based early intervention
• Program objective: reduce risky and harmful drinking
Performance Objectives for the Self-Regulation of Alcohol Consumption

• Continued self-observation and self-evaluation of drinking behavior and its antecedents

• Implement the change attempt

• Uphold the change attempt over time
  – Avoiding lapses by coping adaptively with the antecedents of drinking (e.g. cravings and negative emotions)
  – Avoiding relapses by resuming the change attempt after a lapse
**Table 2. Change Objectives**

<table>
<thead>
<tr>
<th>Performance Objectives</th>
<th>Determinants</th>
<th>Awareness &amp; knowledge</th>
<th>Attitudes and cognitions</th>
<th>Norms</th>
<th>Planning</th>
<th>Self-efficacy</th>
<th>Skills and behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>3a. Avoiding lapses by coping adaptively with the antecedents of drinking</td>
<td></td>
<td>Awareness of own vulnerability and the antecedents of own drinking</td>
<td>Positive attitude towards using tools and therapy to change alcohol habits</td>
<td>Feel personally responsible for adaptive coping</td>
<td>Make implementation intentions about activating tools and strategies to handle craving.</td>
<td>Coping self-efficacy</td>
<td>Implement selected coping plans during craving episodes Emotion-regulation skills</td>
</tr>
<tr>
<td>3b. Avoiding relapses by resuming the change attempt after a lapse</td>
<td></td>
<td>Know the psychological consequences of having a lapse and distinguish between a lapse and a relapse</td>
<td>Attribute failures to situational factor and achievements to own self</td>
<td>Starting to drink more heavily after a lapse is a deliberate choice – not something that became inevitable after the lapse</td>
<td>Make an action plan, immediately after a lapse, about reducing drinking</td>
<td>Recovery self-efficacy Focusing on what’s achieved rather than failure</td>
<td>Report drinking truthfully to the program</td>
</tr>
</tbody>
</table>

Note. The left column contains the performance objectives (in red), while the determinants are entered across the top of the matrix (in blue). The intersecting cells contain either learning objectives or change objectives (in green), describing what the participants in the intervention program need to learn (related to the determinant) to accomplish the performance objective.
Table 3. Personal Determinants, Theoretical Methods, Practical Strategies, and Considerations for use.

<table>
<thead>
<tr>
<th>Personal Determinant</th>
<th>Theoretical Method</th>
<th>Practical Strategy: What should be done?</th>
<th>Considerations for Use: How should it be done?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitudes and cognitions</td>
<td>Cognitive restructuring (Cog. Beh. Therapy)</td>
<td>Identify and change counter productive thoughts. Provide list of typical such thoughts related to reducing alcohol consumption</td>
<td>Changing cognitions about causes and consequences of behavior (i.e., craving, the fear of failing etc.)</td>
</tr>
<tr>
<td></td>
<td>Operant conditioning</td>
<td>Inform clients about the short term positive consequences of reduction of alcohol consumption</td>
<td>Important to be aware of the short term positive consequences of reduced drinking, because they represent positive reinforcement of the new behavior. Timing is important, and optimal timing will vary with the specific information.</td>
</tr>
<tr>
<td></td>
<td>Self-reward</td>
<td>Encourage self-reward</td>
<td>The plan should include a concrete reward, a clear criterion for acquiring the reward, and it should be formed in advance.</td>
</tr>
<tr>
<td></td>
<td>Reattribution (Attribution theory)</td>
<td>Teach clients to explain setbacks and successes in terms of adaptive attributions</td>
<td>Requires unstable and external attributions for failure, and stable and internal attributions for mastery. Timing: optimistic attribution pattern should be primed early, and reinforced after lapse (just-in-time).</td>
</tr>
</tbody>
</table>
Information Architecture

Matrix design

Hierarchical design

Tunnel design

Crutzen et al., 2012

• Found that having less user control (tunnel) had “a negative effect on users’ perception of efficiency, but a positive effect on number of pages visited, time on the website, and [most importantly] knowledge gained from the site.”
  • The Role of User Control in Adherence to and Knowledge Gained from a Website: Randomized Comparison Between a Tunneled Version and a Freedom-of-Choice Version.
  • *Journal of medical Internet research*, 14, e45
Chronology

• Single session interventions
• Multi session interventions
  – Freedom of choice: sessions organized hierarchical or in matrix or hierarchy
  – Recommended chronology
  – Forced chronology
    • Available for a limited time window or no limits?
    • one new session available each day
Wait a minute….
Did you say one session every day for weeks?

• Does people actually use these interventions for extended periods at all?
Balance vs Happy Ending
Just-in-time therapy

- Lapse management systems
  - Monitoring of target behavior
  - Lapse management therapy
Relapse = Lapse + X

- Lapse
  - Comes early
  - Rule rather than the exception
  - Intermittent episodes rather than clean start
  - Not all lapses lead to a full-blown relapse!
  - The difference between lapse and relapse is about how you think about the lapse episode
Relapse = Lapse + Time + Bad Coping Strategies + Low Self-Efficacy + Zero Tolerance Belief + No Treatment + Taking the wrong decision

- Lessons for interventions purposes:
  - Features that may prevent lapses
    - Support coping skills, build self-efficacy etc.
  - Support lapsers soon after slip
    - Just-in-time therapy to help people cope with the lapse
      - Re-attribute (external & unstable cause)
      - Increase self-efficacy
      - Reconceptualize to learning experience
      - Decision is now
Lapse management systems

• Monitoring target behavior regularly
• Participants are asked whether or not they have been smoke free during the day
  - “Yes”: he/she is congratulated and wished a good night
  - “No”: a lapse management therapy is activated
How to select and orchestrate tools?

• Technological toolbox
  – Type of app, media
  – Social media, gaming, sensors, AI, machine learning, speech synthesis & recognition
  – Information architecture; proactive/reactive
  – Usability

• Psychological toolbox
  – Behavior change techniques
  – User experience

• Intervention Mapping
  – A planning tool for intervention developers
Implementation / Marketing / Recruiting

Native app

• How do you get your clients to the app store, and to download?
  – App store optimization
  – Ads / snowballing?
  – Internet visibility?

• Potential barriers between application and marketing procedure?

Web app

• How do you get your clients to your web-page, and to register?
  – Search engine optimization
  – Ads / snowballing?
  – Internet visibility

• The application and the marketing is in the same “sphere” (the web)
  – never depends on switching device