Unlocking the black box: how technology can make eHealth interventions more persuasive and productive

Lisette Van Gemert-Pijnen
25-02-2013
to intensify cooperation with (inter)national research centres and healthcare institutes

to contribute to the solution of global health problems, like ageing and chronic care, via persuasive designs and business modelling

multidisciplinary development & implementation approach (social sciences & technology)

http://ehealthresearchcenter.org
Outline Presentation

- eHealth: the Good, the Bad and the Ugly
- The Black Box phenomenon
- Unlocking the Black Box
- Holistic Approach
- Persuasive Technology
- Productive Technology
- Comprehensive evaluations Uptake & Impact
Bad Technology; low uptake, low impact
Weight LossTech

Look and feel of a self-help book
Women–driven
Not-interactive
Low uptake
High drop-out
Tsunami of Happy Feeling & Well-being Tech high drop out, low impact

Preacher-Technology
Text Driven
Fixed program
Diaries and Lessons
Cognitive Focus
Lower impact than expected

Overestimation of self-tracking

The quantified self

Counting every moment

Technology and health: Measuring your everyday activities can help improve your quality of life, according to aficionados of “self-tracking”

Mar 3rd 2012 | from the print edition

THE idea of measuring things to chart progress towards a goal is commonplace in large organisations. Governments tot up trade figures, hospital waiting times and exam results; companies measure their turnover, profits and inventory. But the use of metrics by individuals is rather less widespread, with the notable exceptions of people who are trying to lose weight or improve their fitness. Most people do not routinely record their moods, sleeping patterns or activity levels, track how much alcohol or caffeine they drink or chart how often they walk the dog.

But some people are doing just these things. They are an eclectic mix of early
No diversity

High educated, conscientious women
Low added value Tech eConsult
Medisch A-Z

Blaasonsteking?
Milascien hepi dit

Fit uit het vliegtuig
 Doe aan flight-fitness

Slaap beter...
 en onthoud meer

ill-driven
no profit for client
Inadequate business model

log-in ID password
Identify your complaint on the virtual body
Tsunami of ePortals & ePlatforms

Lower Uptake than expected; Low Adherence

Information-overload
No incentives for usage
Not sexy

Data management challenge
Interoperability and inter-usability problems
Ugly Tech
Tech for Frail People

Engineering Driven
Not Human centered

ADL support
Sleep/Wake support
Data make no sense for HCWs

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<td>30.0</td>
<td>17.9</td>
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</table>

Traffic light system:
- **Red** (danger)
- **Yellow** (slightly danger)
- **Green** (no danger)
- for every specific sensor -
Uptake problems

- Technical interruptions
  - No data received (server)
  - Overload phone line
  - Sensor too sensitive

- Data hard to understand due to unclear interface
  - The presentation of data (graphs) was hard to read

- Data hard to interpret due to technical calibration (safety industry)
  - The value of data was disputable, activity patterns (deviations) are not traceable to medical evidence, standards, treatment programs
Ugly Tech

No Impact

Industrial Driven

Top down Initiative

Not well thought concept

Electronic Patient Record (EPD), 1994-?

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eHealth, a struggle ..

- A tsunami of failed products
- Lack of long-term effects
- Rock Solid Healthcare
- Inadequate business models
- How to survive?
Black Box Phenomenon
Does IT work? Can IT help? Is IT productive? For whom?

Black Box phenomenon

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Black box phenomenon

- Technology developed in an ad-hoc manner
- Technology considered as a by-product
- Technology not articulated in research-designs
- No smart data collection
- No comprehensive evaluations
VALUE added

SHIFTS PARADIGM

CO-DESIGN

Helping your patients stick to their therapy!
Unlocking the Black Box
Holistic approach  eHealth Roadmap

CONTEXTUAL INQUIRY

VALUE SPECIFICATION

DESIGN

OPERATIONALIZATION

SUMMATIVE EVALUATION

USER REQUIREMENTS

PROTOTYPING

FORMATIVE EVALUATION

VALUE DRIVERS

BUSINESS MODEL

CEHRES ROADMAP

Center for eHealth and Disease Management
http://www.ehealthresearchcenter.org
**Good Tech, High Uptake, High Impact**

- Cooperation Designers and Healthcare professionals
- Stakeholder dialogues in early stage of development
- Design for adherence; Persuasive technology
- Co-creation users and designers
- Implementation interwoven with development
- Comprehensive evaluation; smart data collection; robust methods
Stakeholder dialogues

- An early-stage-development debate among stakeholders is a prerequisite to determine the added values for implementation.

- It’s the “preservatives” — the incumbent healthcare players. That is, the preservatives are trying to protect the status quo, rather than focusing on how to sincerely address the **Triple Aim** *(improve outcomes, reduce cost, improve patient experience)*. In every healthcare organization I’ve talked with, whether they are a provider, pharma, or health plan, there are transformers internally who know what to do but are stymied by preservatives. Forbes, Healthcare's Trillion-Dollar Disruption 1/17/20
Values medical models & Tech

- Patient centred care
- Consumer engagement
- Prevention models
- Population-Health-management models
- Smart Homes
- Just in time and Personalized care
- *Nudging healthier lifestyle via persuasive technology*
- ....

“The current system is stuck on fee-for-service, and it’s a barrier to a better healthcare model. But I think we’re at a historic time, with a growing consensus that it’s time to move away from fee-for-service. Once freed from that tyranny, creativity is unlocked.

George Halvorson chairman and CEO of Kaiser Permanente
Nudging lifestyles via Persuasive Technology Designs
Background

Persuasive eHealth Technology is initially created to influence or change the health and well-being of people via persuasive e-designs. Persuasive Designs include techniques that aim to facilitate attitudinal and behavioural change on a voluntary base. They result from a holistic development approach of eHealth technologies (CeHRes Roadmap). In this approach, a social science perspective on the role of technology in health and health care is empirically developed. Persuasive eHealth technology development transcends an instrumental approach to designing a technical product, a service or a stand-alone device. We recognise the social dynamics and significance of eHealth technologies and their potential for improving health care. Therefore, the central position of the people involved and the values they pursue are consequently accounted for.

Goals

- **Persuasive designs.** The focus is on the development of persuasive design techniques to increase adherence and reduce costs for people with complex health care or social care needs. Leading questions are the following. How can persuasive design techniques improve the capacities of technology so that they are better attuned to user profiles and usage situations? Which persuasive designs have more benefits than others, and for whom? What are the benefits over time?
- **Business modelling** via continuous participation of stakeholders to create eHealth technologies that have added values and that make sense for different stakeholders. Leading questions are: How to realise the optimal balance between usual care and eCare? What are the critical factors for implementing eHealth and which business models are feasible for sustainable implementation?

Perspectives

Improving self-management (online persuasive therapies, lifestyle programs, domotica) and supporting patient safety (eDecision aids, infection control, prudent use of antibiotics).
What Causes Behavior Change?

My Behavior Model shows that three elements must converge at the same moment for a behavior to occur: Motivation, Ability, and Trigger. When a behavior does not occur, at least one of those three elements is missing.
Design for Adherence

PSD-Model: Oinas-Kukkonen

Persuasive system design-model

- **Primary Task Support**: Reduction, Tunneling, Tailoring, Personalization, Self-monitoring, Simulation, Rehearsal
- **Dialogue Support**: Praise, Rewards, Reminders, Suggestion, Similarity, Liking, Social role
- **Credibility Support**: Trustworthiness, Expertise, Surface credibility, Real-world feel, Authority, Third-party, Verifiability
- **Social Support**: Social learning, Social comparison, Normative influence, Social facilitation, Cooperation, Competition, Recognition

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Medical Protocols translated into decision aids

EursafetyHealth-net Platform

Task support; Simple and Smart
Decision support; reduction of needless info; tailored to tasks HCWS
Bed side tech; right moment, right format
Reduces errors, saves time
Persona for Personalization
ePublic Health  Risk Prevention

- no one-size-fits-all

Persona to create a userprofile

Mark is 54 years old and planning engineer for a construction company. He lives together with his wife. Together, they have two children (21 and 19 years old) that live on their own by now. They don’t live completely alone though, together they take care for their dog: Tommy.

Fortunately, Mark has never been bitten by tick. But he does know some things about the bug. He knows that it’s an insect that bites and sucks your blood. He also knows it can give you Lyme disease. Finally, he thinks that ticks fall down on you from trees, and that if you’ve bitten you should visit your GP to get the tick removed. Mark has seen ticks before. Tommy takes them home now and again. Then, Mark or his wife remove them with tick pliers.

Mark does not visit nature very often. In the summer he likes to sit in his backyard, and when they go on vacation he and his wife like to make long walks through the forests or the mountains. He does not take preventive measures to prevent a tick bite then. He also doesn’t check for tick bites afterwards. It simply does not cross his mind.

His digital skills are perfectly fine. Mark thinks: After all, he thinks it’s fun to try out new technology and he has numerous apps on his iPhone 4g. He takes his phone everywhere and never turns it off. Mark will only start to search for information about ticks on the Internet or on his iPhone when he notices he’s been bitten by a tick. In that case, he will Google first, but will also check out the website of his Local Health Authority.

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**Dialogue Support**

**PROJECT QUIT: High-Tailored Smoker's Story**

- **Why did you decide to quit?**
  - I had several good reasons for quitting. First, we needed to save money to put towards a car that would actually work. Second, my husband wanted me to. Third, I didn't like leaving the fun when I'd have to stop outside to smoke at places that didn't allow smoking indoors. It made me feel inferior. Plus, it wasn't really fair to the kids for me to tell them not to smoke while I did. "Do as I say, not as I do" isn't such a great example to set.

- **How did you prepare for the change?**
  - I had heard that you have to change what you do and how you think to stop smoking. So, I wanted to try something I actually thought I could do to help me quit. So about two weeks before I was going to quit, I began to walk first thing in the morning. I normally smoke right before or after exercising, so that helped me delay my first smoke of the day.

- **Did you try anything else as your quit day approached?**
  - Yes, I usually smoked about a pack and a half a day, but started cutting a few out each day just to see how I'd do. I'd make a game out of it by trying to drive to work without a cigarette. There, I really needed it. I'd have one on the way from the parking lot to the office. I'd cut back on going to the bar and parties where I knew there would be a lot of smoking. And I began to skip my "dessert" cigarette before bed.

- **Did these things help?**
  - Definitely, by the time I quit, I was walking four mornings a week and beginning to feel better already.

- **Did you ask for help?**
  - I told my cousin Jason that I was going to need some help. If I say I'm going to do something, he doesn't let me much slack until I do it, which is exactly what I needed. We spent a lot of time at the movies, sitting in non-smoking sections of restaurants, and hanging out at other places that wouldn't tempt me. Of course, all really needed to do was taking one good look at my kids to make the feel good about my decision.

**Tailoring Variables Used:**
- Stage of Change
- Name
- Age
- Gender
- Ethnicity
- Marital status
- Smoking status of spouse
- Child in home
- Physically active
- # of cigs smoked
- Job status
- Barrier
- Social Support
Persuasion, no manipulations or coercion

- Verifiability
- Praise
- Rewards
- Reminders
- Suggestion
- Similarity
- Liking
- Social role

Master persuaders
Impact: Persuasive system design does matter
Systematic review of adherence to web-based interventions
(Kelders, Kok, Ossebaard, Van Gemert-Pijnen, JMIR, 2012)

- We included 101 articles on 83 interventions.
- 19 chronic condition; 16 lifestyle behavior; 48 mental health

55% variance explained:

**Significant predictors:**
- more frequent intended usage,
- more frequent updates content
- more frequent interaction with a counselor
- more extensive employment of dialogue support

Interventions studied with a RCT-design (instead of an observational study),

Block wise enter: 1 context, study design, 2 interaction mode, 3 system&content&interaction mode, RCT, 4 PSD
Conclusion Review

- Persuasive design does matter!!
  - DS sign predictor
  - SS trend towards sign
  - PTS not at all sign => more related to effectiveness?

- System&Content&Interaction matter
  - update, dose, duration, intended usage, interaction mode

- Methodology
  - Practical way to assess adherence objectively and comparably
  - Predictive model to compare web-based interventions
Impact Persuasive Features

- Automated vs Human Support
- Reminders
- Self-monitoring
- Social learning
- Social facilitation

Fractional factorial design; effects individual factors, what matters most...

Personalization

Tunneling

Welkom Test1, je hebt de lesstof van de hele cursus afgerond!
Dialogue Support

- It can be concluded that support is important in computer-based treatments for depression. This supports the wisdom that a blended approach is preferable, the more successful programs usually incorporate some therapist/human support, whether that is online, or by phone, or in person.”

Richards & Richardson (2012)
Computer-based psychological treatments for depression: A systematic review and meta-analysis

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Experiment: Interaction support (living to the full)

Interaction support
automated support vs human support

Outcomes
CES-D
HADS-A

Baseline/post-follow up
Automated vs Human support

- Reduction in depression and anxiety CES-D;HADS-A (post/follow up)
  - Resp. with human support improved more during intervention; improvement stagnated between post-followup-time
  - Resp. with automated support showed less improvement during intervention, improvement carried on between post-followup time
- Automated vs Human support no difference in adherence, effect (follow up)
Design for experience; different cues; what matters?

Mickael Boulay
More and more people report feeling overwhelmed by the omnipresence of online activities and the expectation to be constantly accessible. It's wreaking havoc on schedules, ruining a full night's sleep and disrupting relationships.

"slow tech" movement is gaining momentum, pushing people to rethink how we approach technology from the ground-up. Instead of being obsessed with an overarching drive towards efficiency in our technology, slow tech thinkers advocate a more livable, mindful relationship between consumers and devices.
Productive Technology
Activity pattern web-based Mental health- depression 12 weeks treatment (intended usage 3 times a week)

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|   | 540 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1 | 1027 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 |
| 2 | 794  | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | 519  | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 0 |
| 4 | 635  | 2 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| 5 | 913  | 2 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 6 | 918  | 2 | 1 | 1 | 0 | 1 | 1 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 1044 | 2 | 3 | 2 | 3 | 3 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 | 1030 | 2 | 1 | 1 | 0 | 1 | 1 | 2 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| 9 | 1075 | 2 | 2 | 1 | 2 | 3 | 1 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10| 1122 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11| 1126 | 2 | 2 | 3 | 3 | 3 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12| 633  | 3 | 1 | 1 | 1 | 0 | 1 | 1 | 2 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13| 553  | 3 | 1 | 1 | 1 | 0 | 1 | 1 | 2 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14| 1159 | 3 | 1 | 1 | 1 | 0 | 1 | 1 | 2 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15| 1178 | 4 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 |
| 16| 799  | 4 | 2 | 2 | 2 | 2 | 4 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17| 541  | 4 | 2 | 2 | 2 | 2 | 2 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 18| 949  | 4 | 2 | 2 | 2 | 2 | 2 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 19| 1066 | 5 | 3 | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20| 679  | 5 | 3 | 0 | 1 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21| 883  | 5 | 1 | 0 | 3 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Drop outs: week 4/5 critical points for persuasion*

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Diabetes eCoach
logfile to identify drop outs and usage patterns

Appendix X. Overview of activity patterns in months:

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<thead>
<tr>
<th>Patient number</th>
<th>Activity Patterns</th>
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<tr>
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<td>H=highly active</td>
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<tr>
<td>H24</td>
<td>1</td>
</tr>
</tbody>
</table>

Start & Restart prompts for persuasion

Column 1: H=highly active, L=low active, I=inactive
Column 2: Patient number

- active
- nonactive
Productive Mental Health …

POSTS

Occupy Mental Health! Countering the "Business Model" of psychology
Posted on 08 Nov | 1 comment

The medical model draws a significant amount of critique in clinical psychology these days, especially from existential and humanistic psychologists, and for good reason. The medical model is deeply flawed in its basic assumptions, including its construction of mental illness and conceptualization of what it means to be human. Although ongoing critique of the medical model is needed, it is increasingly evident that another disconcerting model is also in need of our attention and critique: the business model.

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Productive therapies  Blended Approach

- Integration of online and face-to-face therapy

- Objective = increase efficient and effective treatment

- Not applied systematically in health care
Productive Blended Approach

What dose, intensity, timing, mode of online and face to face support?
50% FACE-TO-FACE & 50% ONLINE

ASSIGNMENT CLIENT

FIRST SCREENING CLIENT

INTAKE

FACE-TO-FACE 1

ONLINE 1

FACE-TO-FACE 2

ONLINE 2

FACE-TO-FACE 3

ONLINE 3

FACE-TO-FACE 4

ONLINE 4

FACE-TO-FACE 5

ONLINE 5

FACE-TO-FACE 6

ONLINE 6

FACE-TO-FACE 7

ONLINE 7

FACE-TO-FACE 8

ONLINE 8

AFTERCARE

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ASSIGNMENT CLIÉNT

FIRST SCREENING CLIENT

INTAKE

FACE-TO-FACE 1

ONLINE 1

ONLINE 2

ONLINE 3

ONLINE 4

ONLINE 5

ONLINE 6

ONLINE 7

FACE-TO-FACE 2

ONLINE 8

FACE-TO-FACE 3

ONLINE 9

ONLINE 10

ONLINE 11

FACE-TO-FACE 4

ONLINE 12

AFTERCARE

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Blended treatment approach

- Blended approach has the potential to improve therapy outcomes if:
  - Therapists and clients are involved in the development of technology
  - Technology and content of the therapy are integrated

- More systematic research is needed to show the effects of blended treatment
  - Adherence
  - Influence on depression
  - Influence on treatment process
  - Influence on costs
  - Etc.
Comprehensive evaluations
Comprehensive evaluation

- Performance & Productive (system, content, service)
- Stakeholders perspectives
- Continuous evaluation cycles
- Mixed methods
<table>
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<th>Performance System&amp;Content</th>
<th>Productive</th>
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<td>What is the reach and adherence rate?</td>
<td>What values are achieved?</td>
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<tr>
<td>What usage patterns emerge?</td>
<td>How service oriented is the eHealth intervention?</td>
</tr>
<tr>
<td>What features are used?</td>
<td></td>
</tr>
<tr>
<td>What aspects of use provide more benefits?</td>
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</tbody>
</table>

| Who are the hard-core users? Who are the drop outs? Who are the re-starters? | What are the net benefits according to the stakeholders? |
| What user profiles can be identified? | Health and well being; QOL, Knowledge, Insight in healthier living |
| |
| Productivity (utilization costs; just in time care; adequate use of care) | |

| Is the technology easy to use? | What kinds of business models can be developed to achieve the added values? |
| Is the technology persuasive? (triggers to support self-management) | |
| Is the technology inter-usable with other devices in use? | |
| Is the technology interoperable with other information systems in use by the users? | |
Toolkit Research

- Mixed methods
  - Dose and exposure rate via log-ins (engagement)
  - Usage, user patterns via logfiles (understanding of the black box)
  - Usability tests and interviews (does IT work)
  - Persuasiveness and Personality assessments (what works for whom)
- Innovative analytic techniques (what IT-benefits most for whom)
- Business modelling (what is productive)
- Continuous measurement and regular evaluations
eHealth challenges

- Patient centred and stakeholder driven interventions
- Persuasive design for engagement, adherence and experience
- Emphatic interaction with users
- Blended approach for productive tech
- Advanced analytics for understanding black box, to optimize interventions
Thanks..

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