Unified Health Gamification Can Significantly Improve Well-Being in Corporate Environments

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ZuidZorg
GGzE
Finaps

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/pvgorp
Mainstream Health Challenges:

Only step(s) count...

10,000 STEPS A DAY THIS JUNE
What if I log other sports types (Rowing, ...)

Endomondo

SPORTS TRACKER
What if I prefer to focus on healthy food?
What if I am older and cognitive training is more fun & relevant?
Summarizing: existing trackers & games

- So far: too much focus on specific physical activities (e.g., steps)
- So far: only gamification on social islands
  - specific activities are worth predefined points
  - people with disabilities are excluded for sure
  - results are shown in apps/leaderboards per activity type
  - social bonds are often superficial
- So far: no infrastructure to prototype gamification experiments
- So far: no repositories with data needed for P4 medicine

Gamification Defined

“a process of enhancing services with motivational affordances in order to invoke gameful experiences and further behavioral outcomes” (Hamari, Koivisto & Sarsa, 2014)

- **Motivational affordances**
  - Points
  - Leaderboards
  - Achievements/badges
  - Levels
  - Story/Theme
  - Clear goals
  - Feedback
  - Rewards
  - Progress
  - Challenge

- **Behavioral outcomes**
  - Participation
  - Learning
  - Response patterns
  - Task completion
  - Contribution
  - Exploration
  - Behavior change
  - Time management
  - Task performance
  - Increased knowledge

- **Psychological outcomes**
  - Enjoyment
  - Engagement
  - Attitude
  - Satisfaction
  - Motivation
  - Added value
  - Social motivation
  - Recognition
  - Task involvement
  - Happiness

- **Health Outcomes**
  - Physical Wellbeing
  - Mental Wellbeing
  - Social Wellbeing

WHO Inspired
Traditional Health Gamification
Towards Unified Health Gamification (UHG)
UHG Mission

To let people **perform** the **activities** they **enjoy** truly as an **individual** in such a way that they are part of an integrated **social** interaction.
Traditional Data Flow

Choose what you like → PLAY! → DATA

WIN Challenge

Stay in touch

MATCH TO CHALLENGE
Unified Flow
This paper: study user perceptions & health effects of UHG

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**User Perceptions**
- Usefulness
- Usability
- Intentions to use

**Health Outcomes**
- Physical Wellbeing
- Mental Wellbeing
- Social Wellbeing

**TAM Based**

**WHO Inspired**

Requires Experiments
GameBus: Connected Health Data Sources (WHO based)

Physical Activities:
- Running, Biking
- Walking, Location Visits
- Comply to Diet
- Measuring BP, ...

Available properties
- Duration
- Distance
- Avg Heart rate

Cognitive Activities:
- Red Cherry picking
- Memory
- Sudoku variants
- Mood Logging

4 Medically Grounded Games

Available properties
- Time to Solve
- Errors made
- Mood score

Social Activities:
- Visiting Relatives
- Citizen Feedback
- Colleague Feedback
- Selfies
- Charity Donations

Available properties
- Location
- Duration
- Amount Pledged
Methods for 2 Key Pilots (ZuidZorg & GGzE Trials)
SF-36 validated surveys [16]–[18], plus focus groups and interviews

SF-36 output: Physical (PCS) and Mental (MCS) health status score, based on 8 health dimensions:

- **PF** = Physical Function
- **RP** = Role limitations due to physical problems
- **BP** = Bodily pain
- **GH** = General health
- **VT** = Vitality
- **SF** = Social function
- **RE** = Role limitations due to emotional problems
- **MH** = Mental Health

Figure 1: Study Design Graph
Data Analysis

1. Health Effects:
   - QualityMetric Health Outcomes Scoring Software 4.5
     Each score of a SF-36 scale with five points delta is indicated as a significant change
     - SF-36v2 Mean & Std Dev are 50 and 10 respectively [23]
     - Half std dev considered good MCID [24]
   - SPSS & Excel:
     - “average change”-based MCID anchoring
     - notched box-plots

2. User Perceptions
   - Simple quantitative analyses (TAM based coding)
Results (1/2)

1. Health Effects:
   - SF-36, at the level of complete pilot samples
     - At pilot B: statistically significant improvement in the mean mental health (MCS) [27]
     - At both pilots:
       - Statistically significant improvement in the mean Role-Emotional (RE) scores
       - Statistically non-significant improvement in the Mean Physical health (PCS) scores
   - SF-36, at the level of individuals
     - PCS scores increased significantly* for 17% of all participants (13..23 points)
     - MCS scores increased significantly* for 28% of all participants (10..19 points)

2. User Perceptions
   - (see next)
2. User Perceptions (cont.)

- **Usefulness:**
  - 1+1 drop-out @kick-off, but 100% positive results at pilot end*
  - Appreciated Increased use of stairs, gym, puzzles and successful conversion from coffee to water intake

- **Usability (of the 2015 GameBus prototype):**
  - Too long loading times (2/8 and 5/8 resp.)
  - Lack of Manual or tutorial (1/8 and 1/8 resp.)
  - Lack of iOS and Web versions

- **Intentions to Use**
  - 75% intention at pilot A**
  - From the other 25%: 63% would recommend it to friends/family/colleagues
  - Others were held back by the aforementioned usability issues

*Resolved
Conclusions:

- Significantly positive results achieved for mental outcomes
- Other outcomes to be strengthened
- Leveraged qualitative feedback
- Larger pilots active
Experiments w.r.t. UHG in Various Settings (esp. corp.)

Theory-based Experiments:

- Self-Determination Theory [7]
  - Competence (role-specific points)
  - Autonomy (free to choose)
  - Relatedness (multiple teams)
- Know-Check-Move paradigm [1]–[3]:
  
  UHG tool GameBus also aims to
  1. raise awareness,
  2. support goal-setting and
  3. provide feedback on progress.
Why Corporate Setting?

**Extra Promising:** UHG can connect employees/friends with intrinsic motivation (the red ones in the figure) for healthy activities with those who have quite different interests.

**Feasible:** corporate setting allows the control that is essential at this stage of the evaluation process.
GameBus-connected Cognitive Game Examples

4 Medically Grounded Games

19 Sudoku-style puzzle Games, from easy to quite complicated...
UGH Leaderboard & Points Table

ZUIDZORG COCKTAIL (1-1-2016)

1. ZuidZorg Team 1 3688.8
2. TU/e IS Student Gang 2728.8
3. ZZ Trial, big team 2697.9
4. ZuidZorg Tea! 589.8
5. ZuidZorg Tea! 1405
6. TU/e IS 935.7
7. Ponder DWP 373
8. Team 2 356.7
9. Team 4 265
10. PES 56

ZuidZorg Cocktail (1-1-2016)

Minimum team size: 2
Maximum team size: 15

ACTIVITIES AND SCORE POINTS

<table>
<thead>
<tr>
<th>ACTIVITIES</th>
<th>CHILD</th>
<th>YOUNG</th>
<th>ADULT</th>
<th>ELDER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sport (&gt;= 500m)</td>
<td>+40</td>
<td>+20</td>
<td>+20</td>
<td>+60</td>
</tr>
<tr>
<td>Sport (&gt;= 2500m)</td>
<td>+200</td>
<td>+100</td>
<td>+100</td>
<td>+300</td>
</tr>
<tr>
<td>Zumba (30min)</td>
<td>+150</td>
<td>+75</td>
<td>+75</td>
<td>+300</td>
</tr>
<tr>
<td>Spinning (30min)</td>
<td>+150</td>
<td>+75</td>
<td>+75</td>
<td>+300</td>
</tr>
<tr>
<td>Aerobics (30min)</td>
<td>+150</td>
<td>+75</td>
<td>+75</td>
<td>+300</td>
</tr>
<tr>
<td>Fitness (30min)</td>
<td>+150</td>
<td>+75</td>
<td>+75</td>
<td>+300</td>
</tr>
<tr>
<td>Stepcount (4000)</td>
<td>+150</td>
<td>+75</td>
<td>+75</td>
<td>+300</td>
</tr>
</tbody>
</table>

Created by ZuidZorg
### Sample Characteristics

**Table 1: Characteristics of study participants in both trials**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Trial A (N=9) n(%)</th>
<th>Trial B (N=9) n(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>5 (56)</td>
<td>7 (78)</td>
</tr>
<tr>
<td>Female</td>
<td>4 (44)</td>
<td>2 (22)</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21-30</td>
<td>2 (22)</td>
<td>6 (67)</td>
</tr>
<tr>
<td>31-40</td>
<td>2 (22)</td>
<td>1 (11)</td>
</tr>
<tr>
<td>41-50</td>
<td>3 (34)</td>
<td>1 (11)</td>
</tr>
<tr>
<td>51-60</td>
<td>2 (22)</td>
<td>1 (11)</td>
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</table>
## Norm based SF-36 scores

<table>
<thead>
<tr>
<th>Health Dimension</th>
<th><strong>Trial A</strong></th>
<th><strong>Trial B</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-test: score (SD)</td>
<td>Post-test: score (SD)</td>
</tr>
<tr>
<td><strong>Physical Health Component</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCS</td>
<td>54.4 (3.2)</td>
<td>56.0 (3.4)</td>
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<tr>
<td>PF</td>
<td>54.8 (16.4)</td>
<td>55.2 (13.8)</td>
</tr>
<tr>
<td>RP</td>
<td>52.2 (11.6)</td>
<td>54.6 (9.1)</td>
</tr>
<tr>
<td>BP</td>
<td>52.4 (14.1)</td>
<td>54.6 (9.3)</td>
</tr>
<tr>
<td>GH</td>
<td>53.1 (14.0)</td>
<td>52.5 (20.5)</td>
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<tr>
<td><strong>Mental Health Component</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MCS</td>
<td>49.3 (9.8)</td>
<td>49.7 (9.4)</td>
</tr>
<tr>
<td>VT</td>
<td>53.9 (16.6)</td>
<td>55.6 (11.6)</td>
</tr>
<tr>
<td>SF</td>
<td>50.1 (20.8)</td>
<td>51.7 (17.0)</td>
</tr>
<tr>
<td>RE</td>
<td>51.9 (16.0)</td>
<td>50.1 (18.2)</td>
</tr>
<tr>
<td>MH</td>
<td>48.3 (21.2)</td>
<td>50.2 (19.2)</td>
</tr>
</tbody>
</table>
### TABLE I. INDIVIDUAL NORM BASED SF-36v2 SCORES

<table>
<thead>
<tr>
<th>#</th>
<th>Trial A</th>
<th>Trial B</th>
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<tbody>
<tr>
<td></td>
<td>Pre: PCS</td>
<td>Post: PCS</td>
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<tr>
<td>1</td>
<td>56.27</td>
<td>60.45</td>
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<tr>
<td>2</td>
<td>47.91</td>
<td>48.87</td>
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<td>3</td>
<td>54.65</td>
<td>54.64</td>
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<tr>
<td>4</td>
<td>56.95</td>
<td>56.95</td>
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<tr>
<td>5</td>
<td>56.08</td>
<td>55.58</td>
</tr>
<tr>
<td>6</td>
<td>57.08</td>
<td>57.67</td>
</tr>
<tr>
<td>7</td>
<td>57.21</td>
<td>57.81</td>
</tr>
<tr>
<td>8</td>
<td>52.71</td>
<td>55.91</td>
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<tr>
<td>9</td>
<td>51.06</td>
<td>55.99</td>
</tr>
<tr>
<td>Mean</td>
<td>54.44</td>
<td>55.99</td>
</tr>
<tr>
<td>SD</td>
<td>3.24</td>
<td>3.16</td>
</tr>
</tbody>
</table>

*a* Dark colored cells indicate significant improvement on individual level.
## Internal Consistency Reliability

<table>
<thead>
<tr>
<th>Health Dimension</th>
<th>Trial A</th>
<th></th>
<th>Trial B</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-test α</td>
<td>Post-test α</td>
<td>Pre-test α</td>
<td>Post-test α</td>
</tr>
<tr>
<td>Physical Health Component</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PF</td>
<td>0.905</td>
<td>0.867</td>
<td>0.919</td>
<td>0.896</td>
</tr>
<tr>
<td>RP</td>
<td>0.344</td>
<td>0.538</td>
<td>0.938</td>
<td>0.821</td>
</tr>
<tr>
<td>BP</td>
<td>0.192</td>
<td>-0.276</td>
<td>0.772</td>
<td>0.755</td>
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<tr>
<td>GH</td>
<td>0.686</td>
<td>0.941</td>
<td>0.826</td>
<td>0.911</td>
</tr>
<tr>
<td>Mental Health Component</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VT</td>
<td>0.769</td>
<td>0.653</td>
<td>0.691</td>
<td>0.855</td>
</tr>
<tr>
<td>SF</td>
<td>0.540</td>
<td>0.777</td>
<td>0.926</td>
<td>-0.333</td>
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<tr>
<td>RE</td>
<td>0.970</td>
<td>0.974</td>
<td>0.667</td>
<td>0.850</td>
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<tr>
<td>MH</td>
<td>0.912</td>
<td>0.897</td>
<td>0.783</td>
<td>0.692</td>
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</table>