Persuasive Technology

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Influencing behavior, attitudes, thinking

Jaap Ham

Human-Technology Interaction

Eindhoven University of Technology
Introductions

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Persuasive Technology

- Persuasion: Overview
  - Persuasion/Communication matrix
  - Less effortful persuasion
  - Dual process models
- Persuasive Technology
- Ambient Persuasive Technology
- (A)PT and Allocation of Control
Persuasion
Persuasive technology and persuasive communication

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- (A)PT and Allocation of Control
## Simplified Persuasion/Communication Matrix

Standard persuasion variables relevant for messages:

<table>
<thead>
<tr>
<th>Source</th>
<th>Message</th>
<th>Channel</th>
<th>Receiver</th>
<th>Context</th>
</tr>
</thead>
</table>

(Based on McGuire, 1985, 1989)
Persuasion Process: Steps that individuals must be persuaded to take for message to have impact:  (McGuire, 1985)

- exposure
- attention
- liking, interest
- comprehension
- generating related cognitions
- acquiring relevant skills (learning how)
- agreeing with message position (attitude change)
- storing change in memory
- retrieving relevant material from memory
- decision making using retrieved material
- acting in accord with decision
- postaction consolidation of new pattern
Simplified Persuasion/Communication Matrix

Steps that individuals must be persuaded to take for message to have impact:

<table>
<thead>
<tr>
<th>Outputs (dependent variables)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attention</td>
</tr>
<tr>
<td>Understanding</td>
</tr>
<tr>
<td>Attitude change</td>
</tr>
<tr>
<td>Intention</td>
</tr>
<tr>
<td>Behavior</td>
</tr>
<tr>
<td>Consolidation</td>
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(Based on McGuire, 1985, 1989)
Simplified Persuasion/Communication Matrix

<table>
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<td></td>
<td></td>
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(Outputs (dependent variables))

(Based on McGuire, 1985, 1989)
# Simplified Persuasion/Communication Matrix

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</thead>
<tbody>
<tr>
<td>Attention</td>
<td></td>
<td>fear arousal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Understanding</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Attitude change</strong></td>
<td></td>
<td>credibility, attractivity, Internalized social influence</td>
<td>Discrepancy message-receiver Argument strength</td>
<td>Involvement</td>
<td></td>
</tr>
<tr>
<td>Intention</td>
<td></td>
<td>Social norm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Behavior</td>
<td></td>
<td>Instruction</td>
<td></td>
<td></td>
<td>Situational barriers</td>
</tr>
<tr>
<td>Consolidation</td>
<td></td>
<td>Goal-feedback</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
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(Based on McGuire, 1985, 1989)
Persuasive technology and persuasive communication

Persuasion: Overview
- Persuasion/Communication matrix
- **Less effortful persuasion**
- Dual process models

Persuasive Technology

Ambient Persuasive Technology

(A)PT and Allocation of Control
Less effortful persuasion

- conditioning
- activated associations and feelings
- mood
- mere exposure
- bodily feedback
- ease of retrieval,
- trustworthiness
- consensus cues
- message from ch
- ...

[Image]
Persuasive technology and persuasive communication

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Dual processing models

- **Family of models** (Chaiken & Trope, 1999)
  - continuum of processing effort with
  - two prototypical modes of persuasion
  - ability, motivation and opportunity variables influence depth of processing
  - persuasion on basis of issue relevant arguments will be more persistent, behavior predicting, resistant
Elaboration Likelihood Model
(Petty & Cacioppo, 1986)

Elaboration Likelihood Model

Petty & Cacioppo 1986
Source: Vaughn & Hogg.
Elaboration Likelihood Model
(Petty & Cacioppo, 1986)

Persuasive Message

Elaboration Likelihood Model

Petty & Cacioppo 1986
Source: Vaughn & Hogg.
Persuasive technology and persuasive communication

- Persuasion: Overview

**Persuasive Technology**
- Definitions
- Advantages of PT
- Functional triad:
  - PT as a Tool
  - PT as a Medium
  - PT as a Social Actor
- Credibility and Trust
- Psychological mechanisms
- Conclusions

- Ambient Persuasive Technology
Persuasive Technology
What is it?

- Persuasive technology is any interactive computing system designed to change people's attitudes or behaviors (Fogg, 2003).

- A class of technologies that are intentionally designed to change a person’s attitude or behaviour (IJsselstein et al., 2006).
Persuasive technology and persuasive communication

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Current societal problems

Environment  Health  Safety
Effectiveness = Technology x Behavior

Environment  Health  Safety
Advantages of PT

- persistent
- anonymous
- manages huge volumes of data
- many channels and modalities (e.g. games)
- scale easily
- go where humans cannot go
Domains (selection)

- education, training
- safety
- environmental preservation
- healthcare (e.g., fitness, therapy)
- occupational productivity/effectiveness
- disease management (e.g., asthma)
- personal finance (budget management)
- self-improvement (e.g. goal setting)
- citizen behavior (e.g. tax paying, voting)
- commerce
- .....
Persuasive technology and persuasive communication

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The functional triad (Fogg, 2003)

Tool
Increases capability

Social actor
Creates relationship

Medium
 Provides experience

from: Persuasive Technology, Using Computers to Change What We Think and Do
The functional triad (Fogg, 2003)

**Tool**
*Increases capability*

- Making target behavior easier to do
- Leading people through a process
- Performing calculations or measurements that motivate

**Social actor**
*Creates relationship*

- Rewarding people with positive feedback
- Modeling a target behavior or attitude
- Providing social support

**Medium**
*Provides experience*

- Allowing people to explore cause-and-effect relationships
- Providing people with vicarious experiences that motivate
- Helping people rehearse a behavior
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Types of tools

- **Reduction**
  - concept: make it easier and simpler:
  - mechanism: change cost-benefit ratio; efficacy
  - example: one click shopping

- **Tunneling**
  - concept: define pathway
  - mechanism: reduction mental effort; foot in the door
  - example: registration on web forum

- **Tailoring**
  - concept: making it personal
  - mechanism: enhance information processing and argument strength
  - example: personal fitness advisor; take account of user’s mood or task.

- **Suggestion**
  - concept: choose the right moment
  - mechanism: enhance relevance and usefulness
  - example: offer anti-virus software software product when experiencing a virus; RFID/GPS in education
Tools (2)

- **Self-Monitoring**
  - concept: assess goal achievement
  - mechanism: personal outcome feedback and goal setting
  - example: fuel management

- **Surveillance**
  - concept: observe your persuadee overtly
  - mechanism: normative control, social facilitation (?),
  - example: webcam for using public services; (auto watch)

- **Conditioning**
  - concept: incentives schemes help
  - mechanism: operant conditioning; shaping
  - example: gaming; learn procedures
PT as a tool that gives Interactive feedback

- Using user interface of systems
- User specific
- Action specific
- Immediate and interactive
Fitness stimulator
Calorie monitor
Medication adherence tool

- Printable charts are easy to create and update
- Get reminders to “take your meds” by text or email
- Refill reminders for your prescriptions
- Monitor medications, strengths, dosage and purpose
- Inform your physician of the meds you’re taking
- Print your charts in English or Spanish
- Wallet sizes to carry with you

MyMedSchedule.com

View a demo and sign up for this FREE program at www.MyMedSchedule.com
Persuasive technology and persuasive communication

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Ambient Persuasive Technology
Technological media provide experience

- **Simulated cause-and-effect scenarios**
  - concept: what-if simulations explore potential consequences
  - mechanism: change beliefs
  - example: phobia therapy; learning social skills; risk taking

- **Simulated environments**
  - concept: create situations that reward and motivate
  - Mechanism:
    - practice target behavior
    - exposure to frightening situations
    - Role playing
  - examples: virtual fitness; fuel efficient driving; experience flood, manage asthma

- **Simulated objects**
  - concept: virtual objects in real environment
  - mechanism: direct experience of object
  - example: drunken driver simulation
Effects of Immersion and a Virtual Coach on Motivation and Presence with a Home Fitness Application

An object frequently encountered at yard sales, or gathering dust in the attic is the stationary exercise bike.
Bronkie: Teaching how to deal with asthma
Persuasive mirror

- visual behavioral feedback for experiencing highly self-relevant effects of unhealthy behavior
- use activity and behavioral sensoring
- morphing technology
Experiencing future risks

- Lack of awareness and direct experience may be compensated by simulated experience
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Systems as Persuasive Social actors

- rewarding people
- modeling behavior or attitude
- providing social support

Can a system be social and what makes it social?
Social actor?
Persuasive Social Actors
PT as a tool that gives Social Feedback

Ham & Midden, 2008a, 2008b, 2009
Study 1 (Midden & Ham, Persuasive 2009)
When doing the laundry, which type of (interactive) feedback will influence energy consumption behavior most?

→ Factual Feedback or

→ Social Feedback
### Feedback condition: **Factual feedback**

Participants in the factual feedback condition received interactive factual feedback about their electricity use through the energy meter.

The energy meter gave participants factual feedback.
Social Feedback

Feedback condition: High-agency social feedback

This is Victor, an advanced robot with a mind of his own. He will provide you with feedback on your electricity use.
Social Feedback

Fantastic!
Social Feedback

Gruesome!
Hypothesis 1: Social feedback from artificial persuasive agent promotes behavioral change

- Social praise and compliments operate as positive incentives (Bandura & MacDonald, 1963).
Negative information can be useful

- Positivity paradigm underrates negative feedback > most studies focus on praise
Hypothesis 2: Negative information enhances behavioral change

- Information on relevant aversive consequences more valuable for adaptation (e.g. Baumeister et al, 2004)
- Self-regulation based on negative feedback control and discrepancy reduction mechanism (Bandura, 1989).
- Negativity bias (Rozin & Royzman, 2001)
  - attention (Aarts & Dijksterhuis, )
  - diagnostic value gives more weight
- Negative info has larger impact when judgment concerns person’s morality (Martijn et al, 1992; Skowronski, 2002)
Energy Consumption with Social Feedback vs. Factual Feedback

47% lower energy consumption!
Energy Consumption with Positive Feedback vs. Negative Feedback

Lowest energy consumption!
Feedback modes: Speech rulez!

Energy consumption effects by feedback modes

Speech + facial expression + lights
Facial expressions + lights
Lights
Conclusions

Social feedback leads to stronger behavior change than factual feedback

Negative feedback, in particular, enhanced saving behavior

Social cues need further exploration
Study 2

Social feedback

Evaluative feedback
Social Feedback

Fantastic!
Social Feedback

Gruesome!
Social Feedback
Social-evaluative feedback leads to stronger behavior change than factual-evaluative feedback, $F(1, 976) = 19.78, p < .0001$. 
Results

Negative feedback saves more energy than positive feedback.
Negative feedback is especially effective when it comes from a social feedback source, $F(1, 976) = 12.12, p < .01$. 

Results
Energy Consumption with Social Feedback vs. Factual Feedback

47% lower energy consumption!
A robot that stimulates dieting

Hello, my name is autom™

I'm a personal coach and I would love to help you lose weight by improving your eating and exercise habits.

Meet me at myautom.com

Intuitiv
Hey, you’re too drunk to drive, you maniac !@#$!!
Paro: therapeutic robot
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Trusting technology

- Shared values
- Competence
- Experience

Trust

Allocation of Control

Confidence
Persuasive technology and persuasive communication

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Ambient Persuasive Technology
Employ psychological mechanisms of influence

- weight mirror: anticipated regret
- calorie monitor: behavioral feedback
- bronkie video game: training self-efficacy
- ....
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  - Properties of Ambient PT
  - Processing effort
  - Ethical questions
You have to take your pills now!
Disadvantages of traditional PT

- Traditional PT
  - needs focal attention
  - takes away cognitive resources
  - users must be motivated to pay attention to it

- A challenge to traditional Persuasive Technology:
  - In real-life situations, people do not have these cognitive resources available!
  - Persuasive technology might even give rise to reactance
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- (A)PT and Allocation of Control
Recently, technology can be integrated into the environment unobtrusively

APT can attempt to influence user behavior

- By getting 'out of the box', and becoming a part of the environment
- Influence without effortful processing
- Influence at a low level of conscious cognitive attention
- Without reactance?
Implicit feedback

- For example:
  - Wattson provides feedback about energy use in relatively implicit ways.
Some other examples

Tatsuo Nakajima, Waseda University, Tokyo
Ambient Persuasive Technology
perFrames: Persuasive Picture Frames for Proper Posture

(Obermair et al., 2008)
Is this ambient or focal?
Persuasive technology and persuasive communication

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Implicit feedback

- For example:

  
  - Wattson provides feedback about energy consumption in relatively implicit ways.
Factual feedback
Ambient feedback
Daily life
Ambient Persuasive Technology
### Study

<table>
<thead>
<tr>
<th>Distraction</th>
<th>No distraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient feedback</td>
<td><img src="image1.png" alt="Green light bulb" /> <img src="image2.png" alt="Red light bulb" /></td>
</tr>
<tr>
<td>Factual feedback</td>
<td><img src="image1.png" alt="Green light bulb" /> <img src="image2.png" alt="Red light bulb" /></td>
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1241 Watt

1241 Watt

1241 Watt
Method

- 10 tasks
- Program the thermostat
- E.g., “Tomorrow morning grandma will visit you…”
Programmable thermostaat
Ambient feedback
Ambient feedback
Ambient feedback
Ambient feedback
Ambient feedback
Programmable thermostat

1241 Watts
## Study

<table>
<thead>
<tr>
<th>Afleiding</th>
<th>Geen afleiding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient feedback</td>
<td>![Ambient feedback Icon] ![Ambient feedback Icon]</td>
</tr>
<tr>
<td>Feitelijke feedback</td>
<td>![Feitelijke feedback Icon] ![Feitelijke feedback Icon]</td>
</tr>
<tr>
<td>1241 Watt</td>
<td>1241 Watt</td>
</tr>
</tbody>
</table>
Results

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Energy consumption

- Ambient feedback
- Factual feedback

1241 Watts

27% more savings than (interactive) factual feedback!
Programming time

![Bar chart showing programming time in seconds with ambient and factual feedback.](chart.png)

- **Ambient feedback**
  - Cognitive load: 45 seconds
  - No cognitive load: 40 seconds

- **Factual feedback**
  - Cognitive load: 55 seconds
  - No cognitive load: 50 seconds
Ambient medication adherence
Rapid diffusion of ambient persuasive technology

Great potential for serving human wellbeing, e.g. health, sustainability, social responsibility, empowerment.

Need for ethics and regulation, e.g. in commercial and ideological domains.
The automaticity of social responses to robots.

(see e.g., Reeves & Nass, 1996)

In collaboration with
Social Robotics Lab – National University of Singapore
Prof. dr. Sam Ge
Dr. John-John Cabibihan
Media Equation

- People respond to technology using social automatic responses.

→ No direct evidence?
Social behavior:
Interpersonal distance

Colleagues -- one of the social cues is posture
Interpersonal distance

Friends
Interpersonal distance

Automatic social behavior

So: When people behave automatically / ‘on automatic pilot’ → more interpersonal distance behavior
## Hypothesis

<table>
<thead>
<tr>
<th>Interpersonal distance</th>
<th>Cognitive load</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Absent</td>
</tr>
<tr>
<td><strong>Robot posture</strong></td>
<td></td>
</tr>
<tr>
<td>Approachable</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>Non-approachable</td>
<td>MEDIUM</td>
</tr>
</tbody>
</table>
‘On automatic pilot’: Cognitive load

Please remember correctly:

- No cognitive load → 1234567890
- Cognitive load → 8362937509
Robot Posture

Less approachable          More approachable
Task: read C’s on robot

Figure 1: Schematic overview of the experiment set-up
Results

**Interpersonal distance**

**user--robot**

- Approachable
- Less approachable

---

<table>
<thead>
<tr>
<th></th>
<th>No cognitive load</th>
<th>Cognitive load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approachable</td>
<td>42</td>
<td>48</td>
</tr>
<tr>
<td>Less approachable</td>
<td>38</td>
<td>46</td>
</tr>
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Related conferences:

- Persuasive 2014, Padova, Italy.
Persuasive Technology
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Influencing behavior, attitudes, thinking

Jaap Ham
Human-Technology Interaction
Eindhoven University of Technology