Using Mobile Phones as a Persuasive Technology to Affect Daily Transportation Practices

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America is addicted to oil.

- President George W. Bush
State of the Union Address, January 2006

Metschies, Gerhard. Prime Numbers: Pain at the Pump, *Foreign Policy*, July/August 2007
CO$_2$ Emissions (Mt/yr) from Household Consumption

- Education
- Health
- Communications
- Clothing/Footwear
- Misc. Goods/Services
- Rec/Culture
- Utilities/Energy
- Furnish, Equip, Maint
- Housing
- Private Transport
- AlcBev, Tobacco
- Restaurants, Hotels
- Food/Bev at Home

26% of CO$_2$

persuasive technology

technology that intentionally changes attitudes or behaviors through persuasion and social influence


we’re interested in studying how mobile phones can be used as persuasive technologies to affect daily transportation practices
why mobiles?

1. always with you
2. always on
3. always connected
4. highly available display
5. sensing capabilities
6. advanced input/output
• fitness monitoring application
• automatically senses activity
• at-a-glance determination of
  – active or inactive week
  – variety in routine
  – this week’s goal met
  – recent goal met


*Runs on the background screen of mobile phones, so it’s frequently seen by the individual*
effectiveness of the ubifit glanceable display

Study occurred over Thanksgiving, Christmas, and New Years.
ubi
green combines sensors and user feedback to track transportation activity & “reward” green transit behaviors through ambient imagery on mobile phone.
transit activities

Drive Alone | Train | Carpool | Bus | Walk | Bike

“not-green” | “green”
values icon bar

Money savings  Relaxation  Exercise  Do other things
3 data sources

1. msp
2. cell towers
3. user

- Drive Alone
- Walk
- Bike
- Bus
- Train
- Carpool

minimum activity duration: 7 minutes
mobile sensing platform (msp)

- automatically track physical actions throughout the day
  - walking, bicycling, going up stairs, elevator, etc.

  - 2-sided sensor board with
    - 3D acceleration
    - digital compass
    - audio (8kHz, 16bit)
    - barometric pressure/temperature
    - light: HF, ambient, IR
    - humidity/temperature

- packaged w/ processor, storage, Bluetooth
- ~90% accuracy detecting actions real-time

raw sensor data to transit activity

- collect raw sensor readings
- calculate features
- produce margins

mean, median, range, etc.
measure of confidence for particular activities

generated at varying rates
generated at ¼ second intervals

smooth margins into meaningful actions
Send margins to phone via Bluetooth

smoothing is defined by the application, not the MSP

3 data sources

1. msp
2. cell towers
3. user

Drive Alone  Walk  Bike  Bus  Train  Carpool
gsm sensing

Travel Survey

It looks like you just took a trip. If this is correct, please fill out a short travel survey. If not, you can dismiss this survey notification.

What type of trip did you take?
1. I did not take a trip
2. I drove in a car alone
3. I carpooled
4. I took a bus
5. I took a train/trolley
6. I walked
7. I biked
8. I ran

Approximately how long did this trip last (in minutes)?

15
3 data sources

1. msp

2. cell towers

3. user

Options:
- Drive Alone
- Walk
- Bike
- Bus
- Train
- Carpool
Manual Survey

It looks like your last trip was made 'walking.' It was recorded automatically and lasted for approximately 11.5 mins ending at 03/31/08 6:56:34 PM. If you've traveled since then, please press OK to fill out a survey.

What type of trip did you take?
1. ○ I did not take a trip
2. ○ I drove in a car alone
3. ○ I carpooled
4. ○ I took a bus
5. ○ I took a train/trolley
6. ○ I walked
7. ○ I biked
8. ○ I ran
3-week field study

• obtain preliminary feedback on prototype
  – visual design
  – engagement
  – potential for social use
  – ideas for future designs

• evaluate sensing algorithms for recording transit activities
  – the eventual goal is to reduce/eliminate the need for explicit user feedback
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<th>Condition</th>
<th>Days</th>
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Participants had a pre-established interest in being “green”
equipment
data collected

- two online questionnaires
- pre- and post-interview data
- 8.4 million logged sensor events
- 1,129 travel events (72% green)
- 4.2 travel events per participant per day
- average trip length: 18 minutes
  - 23 minutes for green trips
observed transit

# of Observed Events

- Walk: 350
- Drive Alone: 300
- Carpool: 200
- Bus: 150
- Bike: 50
- Run: 10
- Train: 0

Pie Chart:
- Walk: 31%
- Bus Rides: 19%
- Carpool: 19%
- Drive Alone: 22%
- Bike Rides: 6%
- Run: 1%
- Train Ride: 2%
source of data

- Manual
- GSM
- MSP

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<tr>
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<tr>
<td>Walking</td>
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<td>Runs</td>
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<td>Bus</td>
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</tr>
<tr>
<td>Biking</td>
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<tr>
<td>Driving Alone</td>
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<tr>
<td>Total</td>
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visual design

“I liked the tree because it was, to my mind, a pretty progress bar. There was enough of a clear distance between each state that I could tell the difference at a glance.”

- Participant 11

“I would like to see some graph or raw data. Even some sort of notification of this is how often you took the bus this week. Something that provides some utility back to me.”

- Participant 13

“I would like more information about carbon emission savings.”

- Participant 15

Participants liked visual design but requested more quantitative data and interfaces to explore that data
engagement

“It’s omnipresent”  
- Participant 9

“I liked that we didn’t know what it was going to do. Like when your phone turned from leaves into flowers and then apples.”  
- Participant 15

“I want to have different stories every week ... to maintain curiosity in the app”  
- Participant 8

“If you opened it up, people would generate their themes online and share them. It would be cool”  
- Participant 10

How do we design for long-term engagement?
One participant complained that when a trip hadn’t been automatically recorded, “I felt like I was being cheated out of my ‘points’”

- Participant 15

“I think negative reinforcement would also be good. I think maybe my polar bear should drown though if I am bad.”

- Participant 14

Future designs could incorporate more overt gaming models
“Some people at work knew about the polar bear and every day they asked me about it. ‘Did you get a seal today?’”

- Participant 14

“I would show my friends, ‘look at my tree, isn’t it cool, look at the flowers...’ They thought it was pretty cool.”

- Participant 9

How can we leverage online social networks to tap into social influence?

Mankoff, J, et al.. (2007). Leveraging social networks to motivate individuals to reduce their ecological footprints. HICSS ’07
real-time recommendations

• post-study survey, “what could help you take more green trips”
  – Reliable transportation (76.8%)
  – Financial incentives (71.4%)
  – Knowledge about alternatives (56%)

• future designs could suggest alternative forms of transit based on trip history

• recommendations could also come in form of neighborhood:
  – “42% of the people who live in your neighborhood and work in Capitol Hill take the bus.”
potential for behavior change

“The motivation for me is more of the tracking and kind of seeing how I am doing and just the reminder factor of it.”

- Participant 11

“It really encourages you to analyze your own performance”

- Participant 8

“I feel I already travel in a relatively eco-friendly way and the study did not change that”

- Participant 15

“This can be connected with government incentives somehow... For example, government could encourage people with tax refund.”

- Participant 7
future work

• longitudinal deployment focused on studying behavior change
• interfaces for self-comparison
• exploring social sharing/influence
• real-time recommendations
• quantitative carbon-tracking features
  – ability to project footprint into the future
• new types of story boards/themes
  – ability to navigate story board in non-linear fashion
• what about reward and punishment?
After installation, Ecorio runs in the background on your phone, keeping track of when you're moving in a car or a bus and tallies up the trips that you take each day.

When you first start Ecorio, you will see a summary of your activity and the current trip that Ecorio is tracking.
How many generations in all of human history have had the opportunity to rise to a challenge that is worthy of our best efforts. A challenge that can pull from us more than we think we can do.

-Al Gore
TED Conference, March 2008
thank you!

http://dub.washington.edu/projects/ubigreen
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Behavior-based energy efficiency poster at a bus stop outside conference hotel.

Acknowledgements: We would like to thank Intel Research for providing financial support for this project and Microsoft Research for funding Jon Froehlich.