Using Mobile Phones to Track and Influence Multimodal Travel Behavior

Encouraging individuals to modify how, when and where they commute helps reduce traffic congestion, decrease emissions, and reduce reliance on fossil fuels. Following the adage that you cannot improve something if you cannot measure it, we have developed and tested several global positioning system enabled mobile phone applications to track travel by car, bus, bicycle or foot. This session will highlight two applications. TRAC-IT collects travel behavior data with minimal user interaction required. In exchange, TRAC-IT provides personalized feedback and/or updates on traffic conditions relevant to their current location and travel patterns. The second application, the patented Travel Assistant Device (TAD), helps individuals with special needs such as physical or mental disabilities navigate the transit system through just-in-time alerts of their bus stop. Online transit trip plan allows a parent or guardian to create the trips to specific bus stops that download to the phone. Travel monitoring feature allows them to track the location of the rider in real-time.

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Overview

- Use of cell phone applications to track travel behavior in the context of social marketing
  - Travel Assistance Device
  - TRAC-IT
- Case study using personalized approach to travel behavior change
- Questions for you

Why Manage Demand for Transportation

**Public Sector**
- Reduce traffic congestion
- Improve air quality
- Decrease energy consumption
- Reduce costs
- Create more livable communities
- Improve mobility

**Employers**
- Reduce overhead costs
  - Parking
  - Telework
- Attract and retain employees
- Decrease onsite congestion

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Transportation Demand Management
A set of specific strategies that fosters increased efficiency of the transportation system by influencing travel behavior by mode, time, frequency, trip length, cost or route

Source: Center for Urban Transportation Research, University of South Florida

Tools in the Toolbox to Alleviate Congestion and Improve Mobility
• Change how people travel
  – Transit, carpool/vanpool, bike, carsharing, etc.
• Change when people travel
  – Flextime, compressed work weeks, telework, etc.
• Apply innovative financing and pricing approaches
  – Pay-as-you-drive insurance, value pricing, pre-paid transit, U-PASS, etc.
• Influence where people live
  – Transit Oriented Development, land use

Tools in the Toolbox to Alleviate Congestion and Improve Mobility
• Influence the route people choose to travel
  – 511, advanced traveler information, HOV lanes, HOT lanes, etc.
• Engage businesses in the addressing the problem
  • Federal qualified transportation fringe benefits, shared use parking requirements, etc.
• Provide substitutes for the need to travel
  – Telework, webinars, etc.
Behavior Change = **Action**

- We want people to perform a behavior
  - Ride the bus, carpool, bike to work, etc.
  - Avoid congested times of day or routes
- If we do not get them to take action, our marketing program has failed
  - Awareness isn’t an action
- Begin by defining and promoting a specific, simple observable action for the target audience to perform.

**Activity**

**IDENTIFYING OBSERVABLE ACTIONS**

Which of the following phrases describe an action?

1. Be aware of transit agency name
2. Call 234-RIDE
3. Visit the transit agency website
4. Understand the importance of reducing energy consumption
5. Sign up for emergency ride home program
6. Buy a transit pass
7. Believe that reducing emissions is important
8. Tell a friend that reducing emissions is important
9. Know that carpooling can save $xx per year
10. Join a vanpool
Which of the following phrases describe an action?

1. Be aware of transit agency name
2. Call 643-RIDE
3. Visit the transit agency website
4. Understand the importance of reducing energy consumption
5. Sign up for emergency ride home program
6. Buy a transit pass
7. Believe that reducing emissions is important
8. Tell a friend that reducing emissions is important
9. Know that carpooling can save $xx per year
10. Join a vanpool

Behavior Change Theory

• Change is easiest if:
  – Suits our lifestyle and fits our core values
  – There is a wide range of choices
  – We gain tangible, personal benefits
  – We believe we have the power to easily make the change
  – We get positive recognition of our efforts and achievements
  – We see others also making the change

Seven Steps of Behavior Change

Developed by Les Robinson of Social Change Media

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Knowledge

- Target audience must:
  - Know there is a problem
  - Know there is a practical, viable solution
  - Be able to identify the personal costs of inaction and the benefits of action

Desire

- Change involves imagination...
  - Target audience must be able to visualize a different future for themselves
  - Desire to change can be stimulated by evoking a future life that is more satisfying, healthy, attractive, and safe
Skills

- Knowing what to do...
  - People learn best by seeing someone else do it
  - Best way to teach the necessary skills is to break the actions down into simple steps and use illustrations

Is riding a bus a simple action?

- How many skills does it take to ride a bus?

23 Skills Needed to Travel Independently On a Bus

1. Leave the place of origin and arrive at the bus stop on time.
2. Demonstrate appropriate street crossing skills.
3. Travel to and from the bus stop using his/her route of choice.
4. Stand at the bus stop or terminal in an appropriate place.
5. Look in the direction of bus travel.
6. Carry a bus pass and take out the correct fare.
7. Identify the correct bus (through number, color, style, inquiry).
8. Signal to the driver the desire to board.
9. Board the front entrance in consecutive turn.
10. Show the driver the bus pass or transfer and deposit the correct fare on the box.
11. Communicate any special needs to the driver.
12. Know how to board the lift and be secure.
13. Ask the driver for a bus transfer, if needed.
14. Select a seat or a proper place to stand.
15. Obey the rules of the bus and exhibit appropriate bus behavior.
16. Recognize a landmark near the desired bus stop.
17. Signal for exiting at the proper time.
18. Exit the bus through the proper door.
19. Travel to any necessary transfer points or destinations through the most direct or the safest route.
20. Dial or ask for assistance when utilizing the phone.
22. Read the bus schedule and/or find routes.
23. Read the bus schedule and/or find routes.

Source: Curriculum to Introduce Travel Training to Staff Who Work with People with Disabilities. The Kennedy Center, Inc., for Easter Seals/Project ACTION. 1993
Product to Enhance Bus Riding Skills
Travel Assistant Device (TAD)

- TAD is a mobile app that helps individuals with physical or mental disabilities successfully navigate the transit system through real-time location-based cues
- Reduces cost of providing service for transit agencies to a fraction of the $27+ per trip for door-to-door service

Travel Assistance Device to Help Transit Riders

PROBLEMS FACED BY RIDERS:

- Individuals with cognitive disabilities have problems with quick actions required by fixed route transit so most rely on door-to-door
- Hardest skills to master to use transit independently:
  - watching for landmarks,
  - recognizing landmark near the desired bus stop, and
  - signaling to driver at the proper time when desire to exit the bus
- Accessibility and independence is limited

How TAD Works

1. Plan trip online. Download to phone.
2. TAD alerts the rider with real-time auditory, visual, and tactile prompts such as “Get Ready...” and “Pull the Cord Now!” when it is time for the rider to exit at the right bus stop.
3. Automated alarms can remotely alert travel trainer and/or parent/guardian if a rider deviates from their predetermined path.
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**Method of Providing a Destination Alert to a Transit System Rider**

- Controls when to tell the user to exit the bus
- Early alert desired for rider, but not too early!
- Bus stops can be very (too) close together
- Bus stop locations are always in flux/errors in bus stop inventories

Riders prompted to “Get Ready” then “Pull the Cord now!” with verbal, visual and vibration cues

*Patent No.: US 8,169,342
Date of Patent: May 1, 2012*

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**4 P’s**

**Product**

- Travel Assistant Device (TAD) – cell phone that alerts users of approaching bus stop

**Price**

- Sold to transit agencies on a cost-savings sharing model
- Free to user

**Promotion**

- Targeting largest transit agencies to in turn reach clients
- Promoted at conferences of travel trainers

**Pipeline**

- Plan is to distribute through local transit agencies

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**Optimism**

- The belief that success is probable or inevitable
- Strong political, community, and employer leadership is an important factor
- A sense of powerlessness, exacerbated by the lack of effective leadership, can lead to inaction
Facilitation

- Having the outside support necessary to act
  - People need accessible services, infrastructure and support networks to overcome practical obstacles

Stimulation

- Sometimes people need a kick start
  - Inspiration
  - Threats

Reinforcement

- Effective social marketing is about continuous recruitment and reinforcement
  - Report back on the success of their efforts and the next steps that are expected of them

Fairfax County (VA) recognizing county employers that received Best Workplaces for Commuters designation in 2010

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HOW DO WE CHANGE TRAVEL BEHAVIOR?

What Determinants Influence Change?

• Before one is able make a decision about the interventions needed, one must know which determinants are important to the behavior

External Determinants that Influence Behavior

<table>
<thead>
<tr>
<th>The forces outside the individual that affect his or her performance of a behavior</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skills and Abilities</td>
<td>Know how to ride a bike or how/where to board a bus</td>
</tr>
<tr>
<td>Access and Availability</td>
<td>Bus stop amenities, bicycle helmets</td>
</tr>
<tr>
<td>Policies, Laws and Regulations</td>
<td>Employer provides free parking but no transit benefits</td>
</tr>
<tr>
<td>Culture, Customs and Lifestyles</td>
<td>Work hour (in)flexibility</td>
</tr>
<tr>
<td>Actual Consequences after performing behavior</td>
<td>Carsharing eliminated need for an extra vehicle</td>
</tr>
<tr>
<td></td>
<td>Pay as you drive insurance cut bill by 25%</td>
</tr>
</tbody>
</table>

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**Internal Determinants that Influence Behavior**

<table>
<thead>
<tr>
<th>Forces inside the individual's mind that affect how he or she thinks or feels about a behavior</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>Where to get ridematching services, basic understanding of how to ride a bike</td>
</tr>
<tr>
<td>Attitudes</td>
<td>Self-efficacy (believe he or she can do it), perceived risks</td>
</tr>
<tr>
<td>Perceived social norms</td>
<td>People like me don't ride the bus. All drivers should be treated equally (no HOV lanes)</td>
</tr>
<tr>
<td>Perceived consequences</td>
<td>Save money, save time, leave work on-time. Arrive late, get mugged</td>
</tr>
<tr>
<td>Intentions</td>
<td>Pledge cards</td>
</tr>
</tbody>
</table>

**Internal barrier to overcome: Tragedy of the Commons**

- Situation where a behavior makes sense from the individual point of view but when repeated by enough individuals leads to disastrous consequences for society

**Social Norms**

- Injunctive norms
  - Behaviors perceived as being approved by other people
- Descriptive norms
  - Perceptions of how other people are actually behaving, whether or not approved of
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Persuasive messages are more successful if injunctive and descriptive norms agree.
- Keeping with this theory, some messages we use suffer from incompatible injunctive and descriptive norms
- We tell commuters to “do not drive alone” (injunctive norm) which disagrees with the descriptive norm of what we know others are doing (and generally perceived), for example, “85% of all commuters drive alone” (descriptive norm).

Commuting Norms

Injunctive Norm (behaviors approved by others)

- Driving alone to work
- Riding transit
- Carpooling
- Bicycling for recreation
- Working from home

Descriptive Norms (perceptions of how other people ARE behaving)

- Everyone drives alone
- Only poor people ride the bus
- Bicycling is dangerous
- Teleworkers likely goofing off

Intention

- Making a commitment (pledge)
- When the norms are in agreement, the intervention is more likely to be successful.
Barriers Facing Travel Behavior Change Programs

- Change to travel behavior hindered by
  - External barriers – limited access to transit, long commuting distances, economic constraints
  - Internal barriers –
    - (mis)perceptions of alternatives to the car,
    - negative attitudes to some options,
    - lack of understanding of their travel consumption and those associated costs
  - Habitual nature of decision process

Engagement Is Essential

- Information campaigns without participative involvement components are not strong enough to produce substantial changes
- Obtain self-awareness of travel patterns before pushing “intervention” options and seeking a commitment
- TRAC-IT seeks to engage the commuter and household

Challenges of Tracking Travel Behavior

- Paper activity diary problems
  - Many data omissions/errors
  - Requires extensive manual data entry
  - Misses advanced trends and patterns
  - Covers a limited time period (usually only 1 to 7 days)
  - Discrete travel patterns not recognized by human analysis
- Vehicle-based GPS
  - Misses trips made by transit and non-motorized modes
  - Limited data storage, or expensive wireless connection required
  - Need method to improve the quantity and quality of travel behavior data
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**TRAC-IT**

- Mobile software for GPS-enabled cell phones
  - Like an iPhone App
  - It's OPT-IN
- Features:
  - Runs on low to high tier phones
  - Records a person's travel behavior (an electronic activity diary)
  - Collects origin/destination and route information via GPS for all modes
  - Increases quality and quantity of collected information
  - Provides "hyper-personalized" real-time travel information services such as traffic alerts
    - Based on travel history
    - Based on real-time location

**TRAC-IT**

- Two modes for TRAC-IT:
  - PASSIVE
    - No interactions with user, runs in background
    - Records GPS path, provides real-time services
  - ACTIVE
    - Also ask questions at the end of their trips:
      - Name for location
      - Mode of Transportation
      - Purpose of Trip
      - Occupancy of Vehicle

Assisted GPS data from TRAC-IT
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Walking trip

Turning Data to Actionable Steps

Data Collected
- Path – which roads are used
- Travel time
- Travel distance
- Travel speed
- Travel purpose
- Intermediate stops (e.g., day care)
- Frequency of travel to a specific location
- Frequency of non-motorized travel
- Behavior of others in household

Information Provided in Return
- Identified available bus routes
- Identified potential non-motorized trips based on trip purpose and distance
- Opportunities for trip chaining (consolidation of multiple trips in a single string of trips)
- Opportunities for sharing rides
- Providing estimates of savings, etc.

Case of TravelSmart in Western Australia

PROMISE OF PERSONALIZE INTERVENTION
TravelSmart - The Conversation

- Guided conversation either over phone or in person
- Multi-person households
- Provided tools to help make changes that appealed to them and consistent with their values or motivations

The Conversation

- Through conversation, TravelSmart staff encouraged householders to think about negative aspects of car use with questions such as:
  - When were you last in the car and wished you weren’t?
  - What bothers you about getting around in the car?
  - Have you thought about using your car a bit less?
  - Do you use your car the same, more, or less than this time last year?
- Staff coached them and worked together to devise a solution where reducing car use led to personal benefits

The Conversation

Approach

- Took into account people’s different stages of readiness for change
- Demonstrated an understanding of conditions that are more likely to facilitate change

Examples

- Solving a current problem related to car travel
- Providing practical solutions to improve an individual’s desired lifestyle
- Reducing car use, rather than focusing on broader environmental goals
- Using a household-based approach so that other family members could support and reinforce each other’s behavior
- Encouraging people to think of short and long term changes
- Telling others about changes they made
Results
Tapping into the Potential

Participants reduced car travel both on weekdays and weekends

Participants
• Decreases in distance travelled over the study period of 10.4 km per household per day (18% reduction)
• Decrease of car travel by 36 km

Non-Participants
• Increase in distance travelled over the study period of 14 km on weekdays and
• Increase in car travel of 4.5 km on weekends

Summary
• Opportunities abound for using mobile phones to influence travel behavior for personal and societal gains
• These opportunities don’t exist in a vacuum; social marketing approach is critical to their success
Thanks to the following sponsors and partners

- Florida Department of Transportation
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- HART
- Transit Cooperative Research Program

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Questions for the Audience

- How would you distribute TAD?
- How would you price TAD? And who should pay?
- What other markets might benefit from TAD (help disabled ride the bus)?
Questions for the Audience

• What are barriers to TRAC-IT (tracking trips)? How could they be overcome (4Ps)?
• Would you trade-off tracking your trips if:
  – You received traffic alerts automatically tailored to your trip patterns
  – You received commercial discounts automatically tailored to your trip patterns and preferences (e.g., Starbucks)
  – Only if you could turn it off whenever you wanted
  – Your data was made anonymous
  – You received a small cash payment
  – Provided you with estimates of dollars saved, calories burned, and emissions reduced