Context Aware Computing

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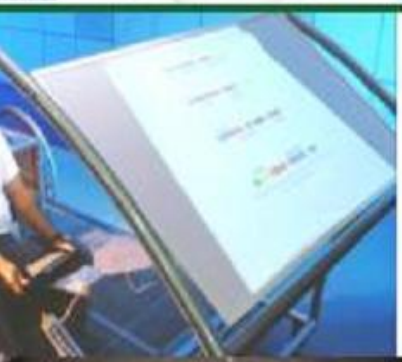
- We say many things …Its what we do that counts
- Memory and sensing not keyboards and voice
  - Transcription is overhead
- Dynamic models of
  - Task
  - System
  - User



- Things become what they should be

Visualizing better driving?

- A tool improves what a human can do
  - Started with cooking 190,000 years ago
- Assistants -vs.- advisors: “teach someone to fish”
- Speak to peoples strengths
  - Improve peoples awareness
  - Engage them
  - Teach them

Static Demonstrations

- Exercar: pedal to accelerate.
  - Drive like the Flintstones … and don't go to sleep
- 4 Windshield display scenarios
  - Community display while parked
    - Information
    - Advertising
    - Homeland security
  - Internet while stopped
  - Movie while reclined
  - Driving annotations

Adaptive Driving Aids

- Scenarios
  - Mixed vehicle awareness
    - Truck,bike, car
  - We are all good drivers
    - Remind us to drive our best
- Adaptation
  - Smart use of feedback helps

Mind full of intentions

Learning by watching

- I look around
  - Interest Tracker, Invisior
- Eye aRe Personal gaze
  - Looking for a sign?

- Robot seeks work as fuel tank inspector

USPS: the 2½ Ton Delivery Truck

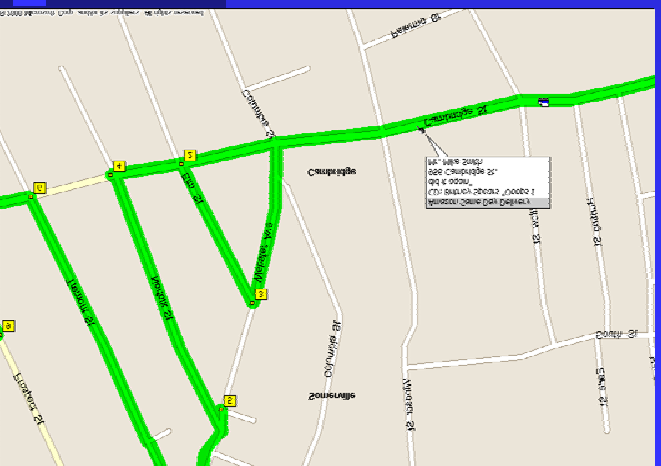
Media Lab, USPS, Lear

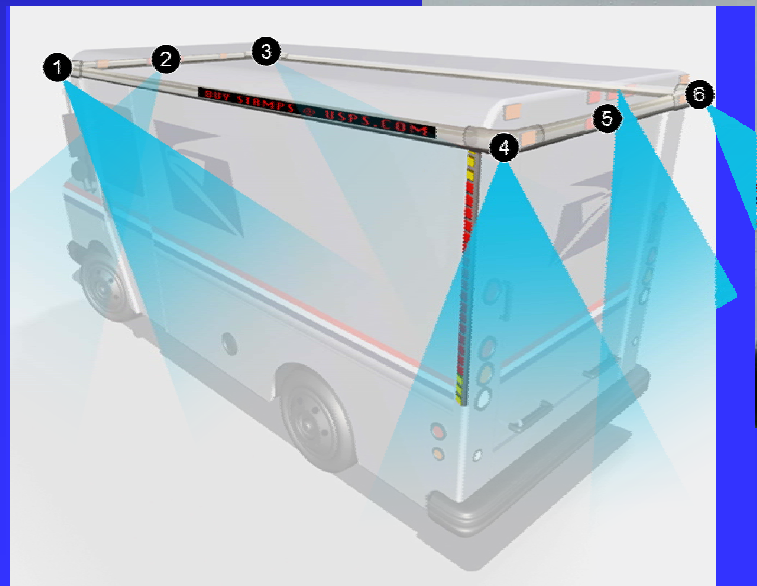
Business models:

GPS/ 802.11 map delivering everything
package, inventory, handling

Safety

Sonic, vibration and LED for blind spots
Automatic emergency break
Lear anti whiplash seat
Cameras surround vehicle





Safety for cars near parking cars

- 17 approaches considered
- Existing sensors:
  - Seat occupied +
  - Neutral or Park
- Weird blink on left

Walter's Bike Helmet

- Mediates Information
  - Coming from Outside world
    - Sound … when to intrude on stereo *
    - Car coming from behind *
    - Pothole coming
  - Coming from rider
    - "See me"…turn signals*
    - Listening and saying
- Layers of connectedness
  - Sensor & effector, My world, Environment, net

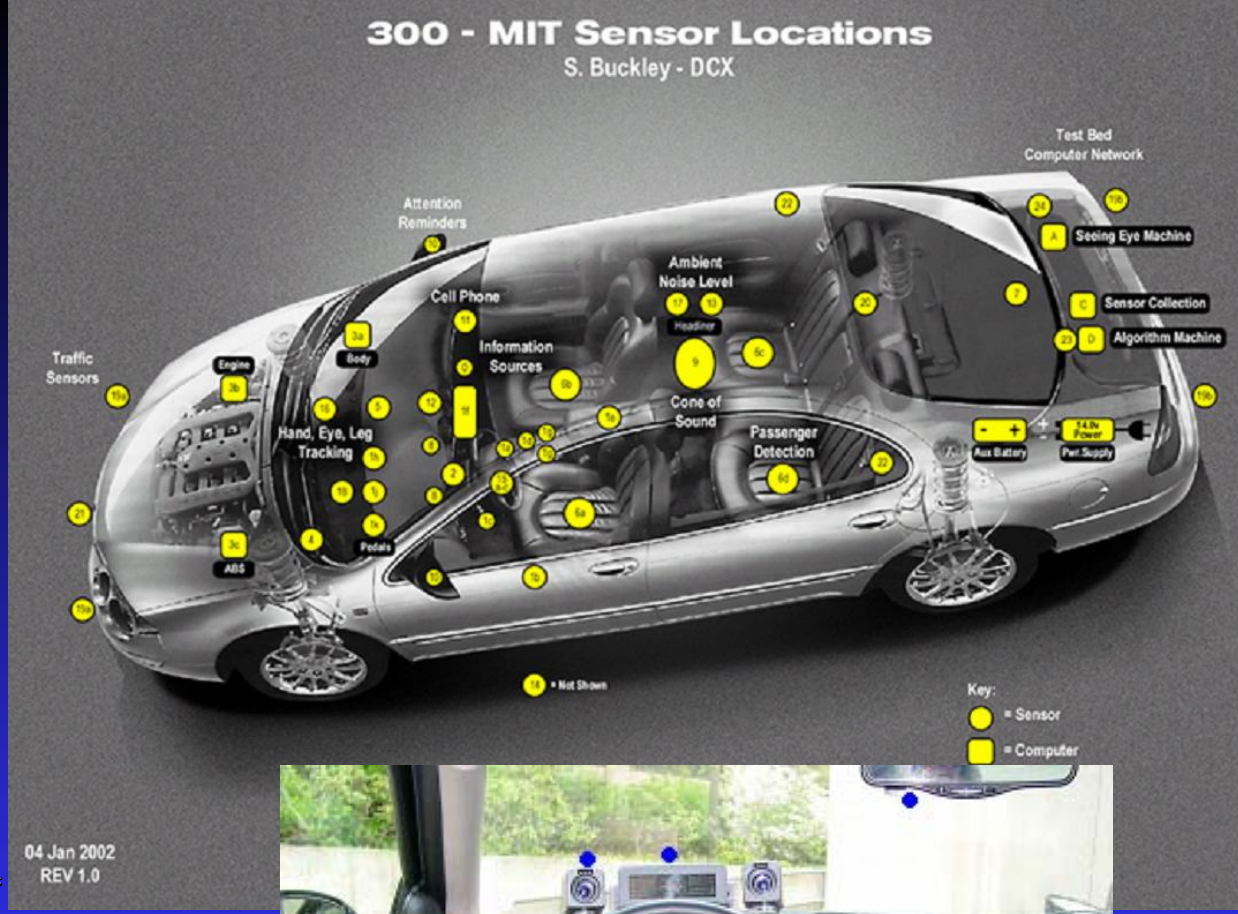
300M Platform and Research

Ted Selker	CarCoach and feedback research
Shawn Sullivan	Conflict resolution based Coach
Steve Buckley	Project management and funder++
Taly Sharon	Flesh out 300MIT, study feedback
Ernesto Arroyo	CarCoach study
Miguel Amaya	CarCoach study
Lars Wagner	“Busy” light
	parking brake,turn hot spots
	Warning/delay
Jim Kemp	Engineering
Chip Wood	Engineering
Betty Lou McClanahan	Administrator
Dan Williams	design discussions
Ros Picard	design discussions/sensors
John Hansman	design discussions

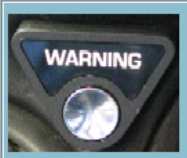
DAIMLERCHRYSLER

MOTOROLA
intelligence everywhere™

- Sensors++*
  - steering *
  - Arm wrests
  - Grip pressure
  - Shift knob pressure
  - Consol sensor array
  - CO sensor
  - Phone *
  - Blue eyes
  - Seeing machines
- Feedback ++
  - Vibrating control surfaces *
  - Audio *
  - LED affirmation, criticism *
  - Warning and Busy control lights
  - Potato head
  - Audio spotlight
  - Mirror LED's
  - Extra displays (rear deck, consol, visor)



Chrysler 300M IT Edition - Remote Controller



Left LED

Right LED

Center LED

- Drv Left Arm
- Left Rear Psg
- Right Rear Psg
- Drv Right Arm
- Drv Cupholder
- Psg Cupholder

- Psg Front Seat
- Warn Button
- Busy Button
- Brake Left
- Dead Pedal
- Brake Right

- EL 1
- EL 2
- Warn R
- Warn Y
- Busy
- Cell off
- Low fuel

- Roll
- Pitch
- Accel Y
- Yaw
- Accel X
- Accel Z
- CO
- Brake
- Steering

START

EXIT

Connect

Car COACH (Cognitive Adaptive Computer Help)

Ted Selker
Context Aware Computing Group MIT Media Lab

- When to comment on driving?
  - When driver is open to comment
  - When driver is doing a good job
  - When driver is making mistakes:
    - Driving smoothly*
    - Signaling turns, lane changes*
    - Gas, break, steering *
    - Honking
    - Gas mileage
    - Visually checking instruments
    - Scanning scene
    - Checking blind spots
    - Finding controls easily

Tactile Feedback

- Conflict resolution
  - Blackboard
  - Rules
  - Learning (HMM)
- Feedback
  - Steering wheel
  - Throttle
  - Brake
  - Seat
  - A,F Controls
  - Potato head

CarCoach Feedback

Action	Feedback	Type
Over exerting the car	Throttle vibrates Audio: “Easy on the gas”	Criticism
Strong braking	Brake vibrates Audio: “Brake gently”	Criticism
Low gear (not Drive)	Audio: ”Gear is low” Audio: “Easy on the gas”	Criticism
Turn without signaling	Steering vibrates Audio: “Please signal”	Criticism
Turn with signaling	Seat vibrates Audio: “Thank you for signaling”	Affirmation
Erratic steering	Steering vibrates	Criticism
smooth acceleration,braking	Seat vibrates	Affirmation

CarCoach Sensor Effects

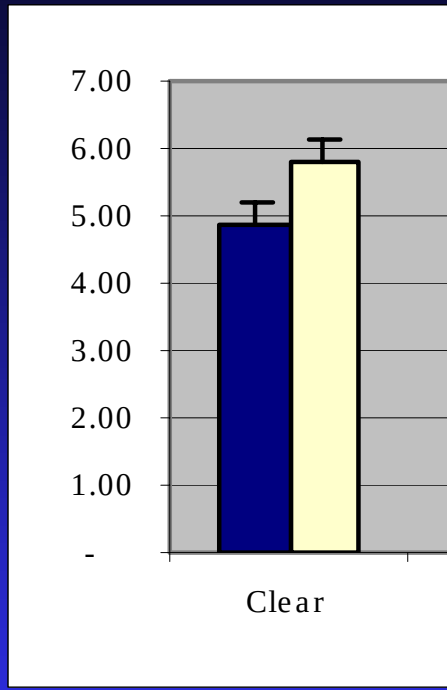
Sensor	Effect
Setup knobs – criticism off	No criticism feedback
Setup knobs – affirmation off	No affirmation feedback
Cell phone is in active call	Eliminates audio messages
Reverse gear	Busy light turns on, no feedback
Many mistakes this drive	Warning light turns on?
Drinking from cup	Eliminates feedback

Delayed feedback in 300M IT

- Learn driving skill
  - Accelerating in with rpm 2500 to 4500
- 30 people 21 to 72, 14 M 16 F
- Will delayed feedback:
  - Less distracting delayed
  - Relying more on task-intrinsic feedback
  - be clearer (less noise cognitive load)

Delayed feedback helps

- Increased performance
- Better message understanding



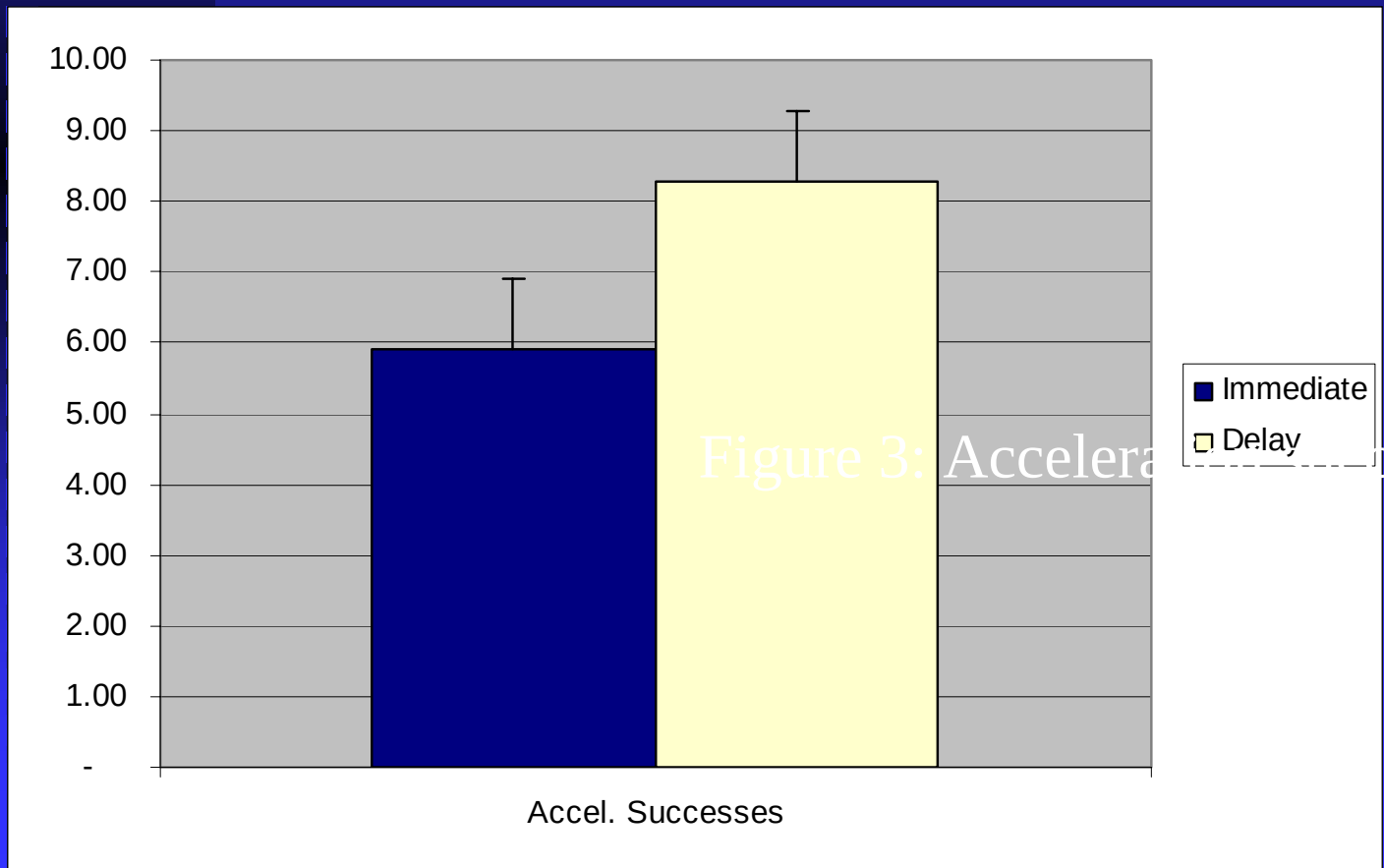
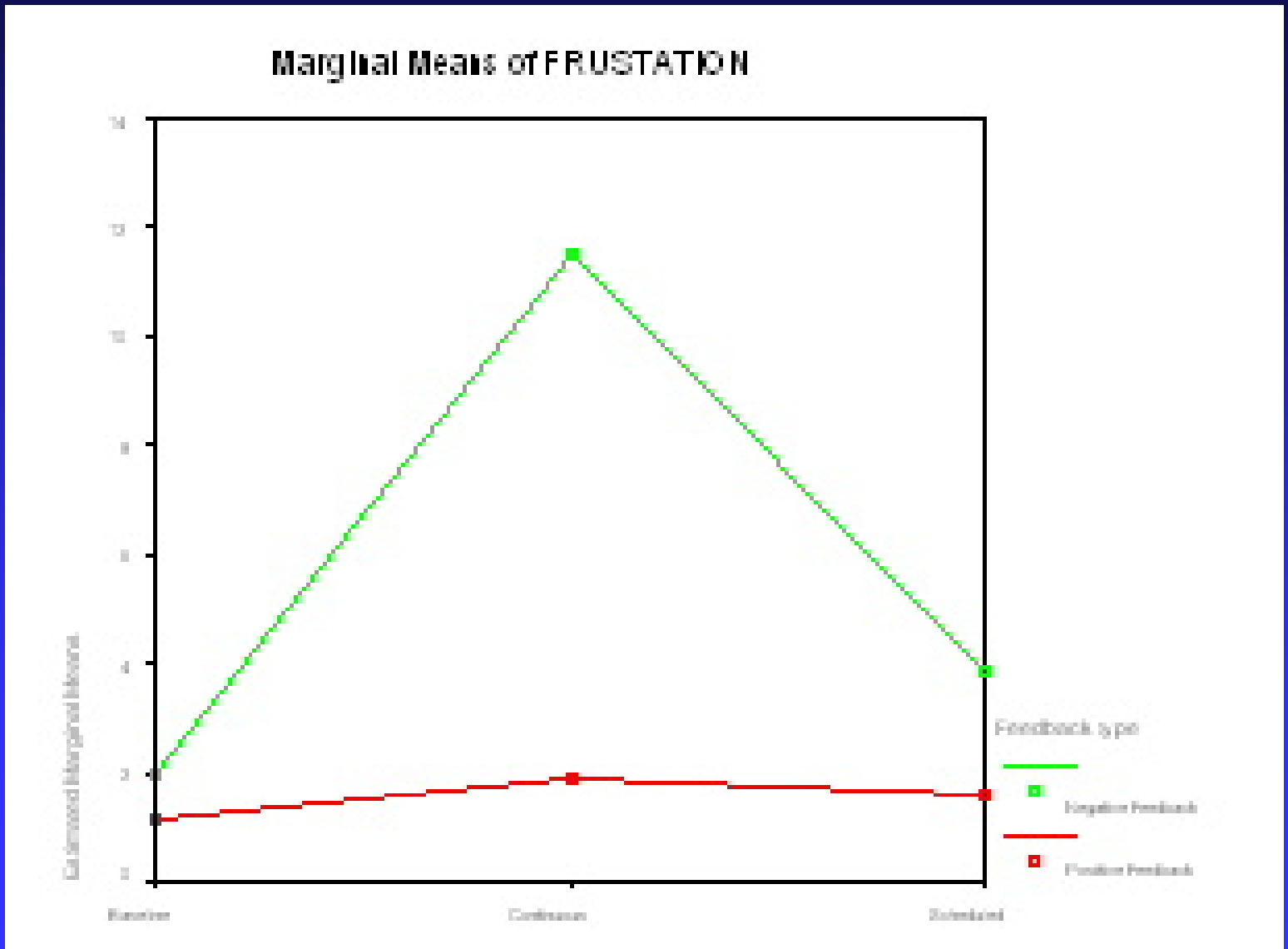
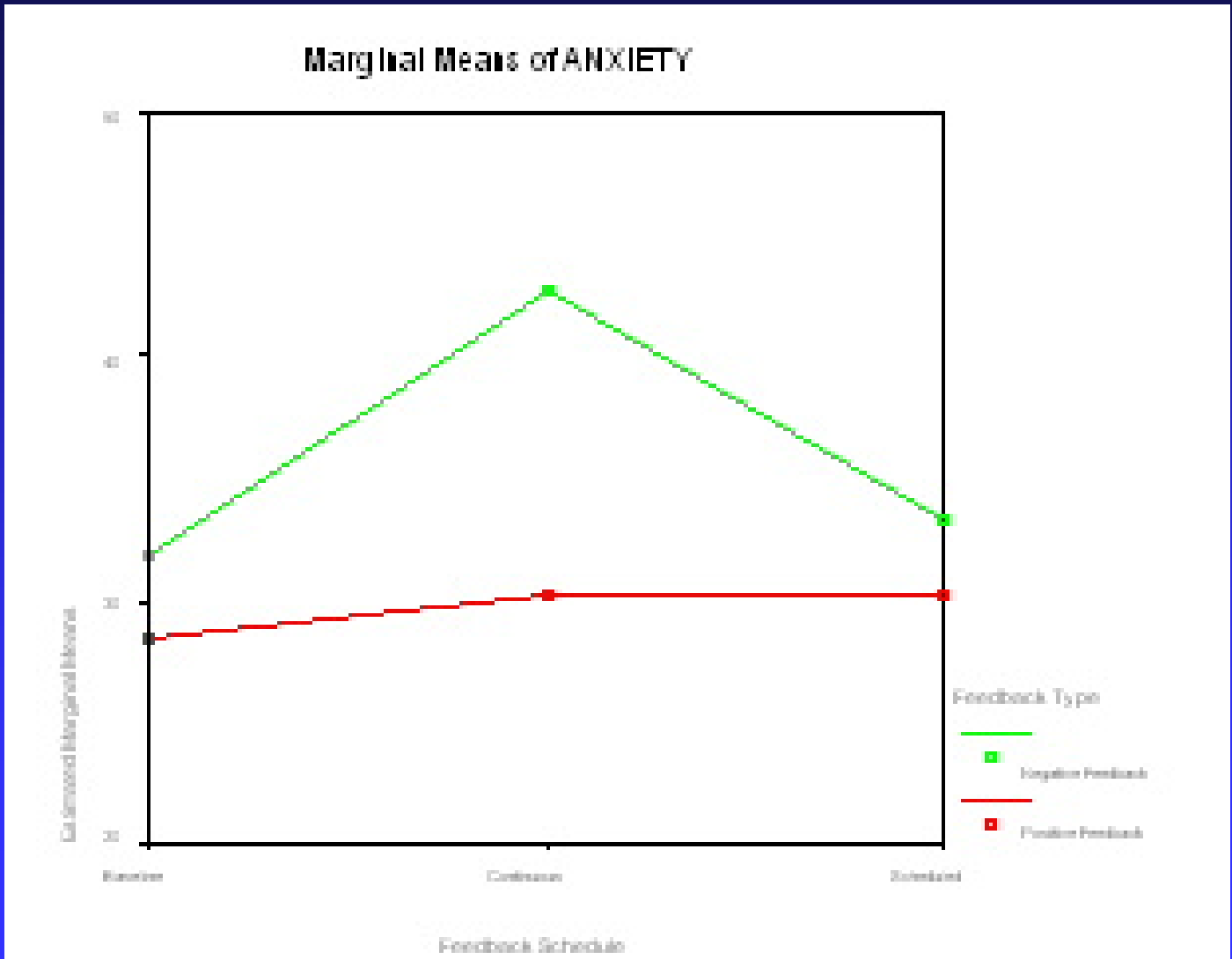


Figure 3: Accelera[illegible]esses averages

Scheduled or constant feedback

- 21Subjects
- Driving 25 to 35 minutes
- 40 turns residential path
- Repeated measures 2 way ANOVA
  - intervals Feedback valance


Marginal Means of FRUSTATION
Feedback type
Negative Feedback
Positive Feedback


Marginal Means of ANXIETY
Feedback Type
Feedback Schedule

Coach feedback helps?

- People change some behaviors immediately
- Positive feedback reduced driving errors
- Scheduled feedback reduced driving errors
- Negative feedback not good

Adaptive Driving Aids

- Scenarios
  - Mixed vehicle awareness
    - Truck, bike, car
  - We are all good drivers
    - Remind us to drive our best
- Adaptation
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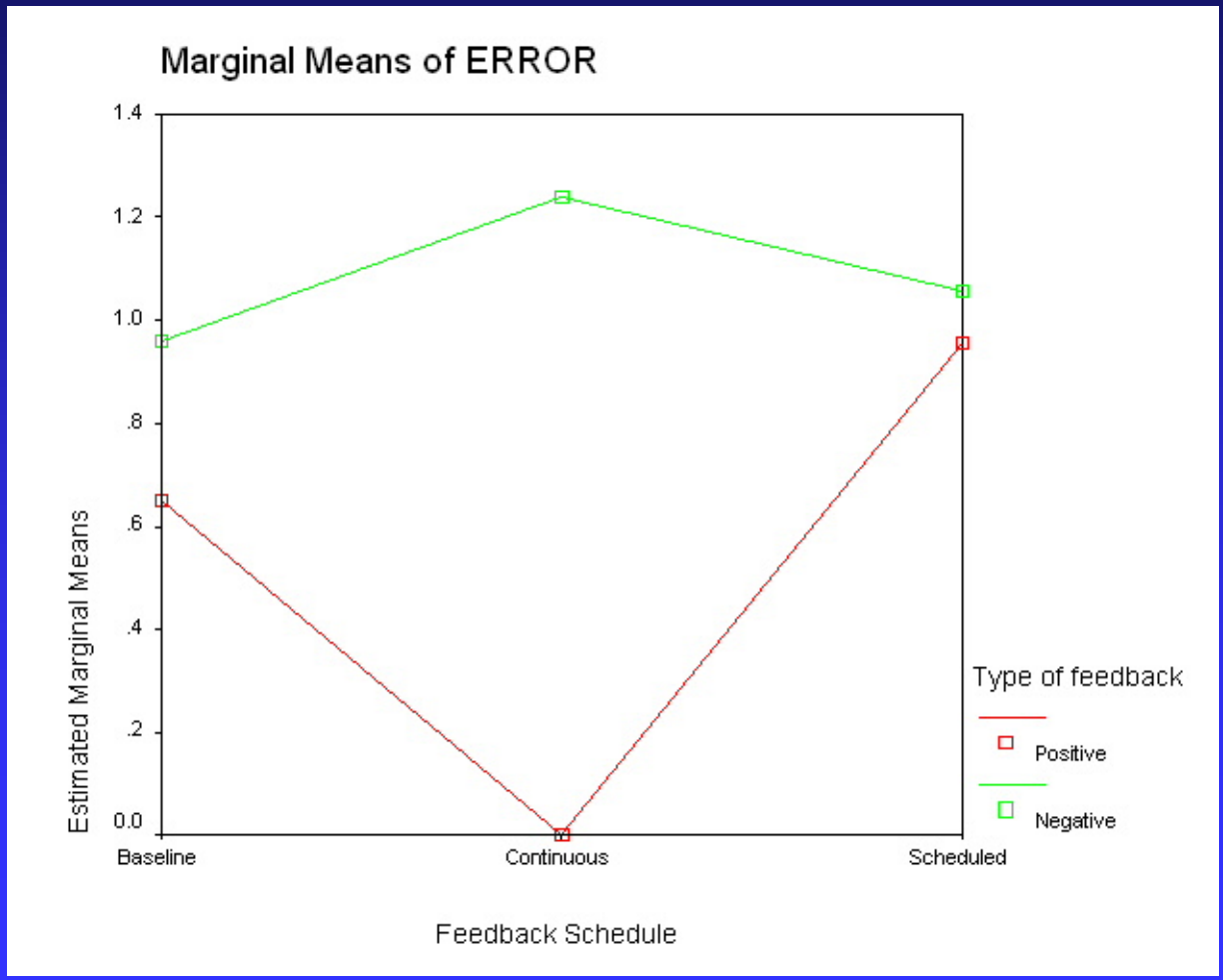
Scheduled or constant feedback

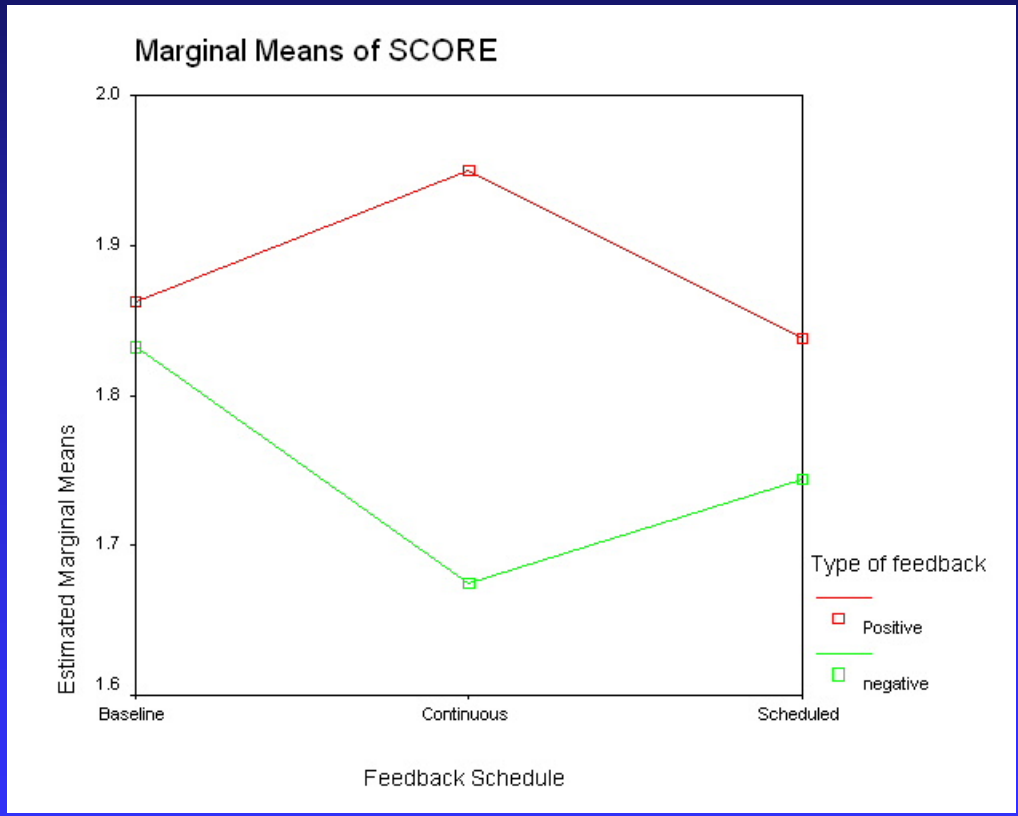
- 21Subjects
- Driving 25 to 35 minutes
- 40 turns residential path
- Repeated measures 2 way ANOVA
  - intervals Feedback valance

- 25 Missing data
- 21
- Repeated measures 2 way ANOVA
- Different intervals
- Feedback type and
- Between iv positive or negative
- Interaction significant p.001
- Driving 25 to 35 minutes residentental 2 full loops
- 40 turns
- Base line
- Randomized

Contents

- 300M
- CarCoach
- Study – delaying feedback


Marginal Means of ERROR
1.4
1.2
1.0
.8
.6
.4
.2
0.0
Estimated Marginal Means
Baseline
Continuous
Scheduled
Feedback Schedule
Type of feedback
Positive
Negative


Marginal Means of SCORE
2.0
1.9
1.8
1.7
1.6
Estimated Marginal Means
Baseline
Continuous
Scheduled
Feedback Schedule
Type of feedback
Positive
negative