

Development of a Protocol to Classify Drivers' Emotional Conversation

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Introduction

- Desire to study cognitive distraction using naturalistic driving data
- Inability to directly measure it requires surrogates
- One surrogate is emotional conversation

Objective

- Develop a reduction protocol to identify emotional cell phone conversation in naturalistic driving data
- Allow quantification of
 - How often it occurs (exposure)
 - It's associated safety-critical event risk

Requirements

- Can only use video of drivers' face and torso
- Must be done quickly (< 30 s)
- Cannot depend on having audio recording
- Must be adequately reliable

Foundation for Protocol

- Facial Action Coding System (FACS) (Ekman, 1978)
 - Categorizes facial behaviors by coding the activation of facial muscles
 - 1 minute video takes 3 hours to code
- FACS identifies muscle activation, not emotion
- EMFACs developed to code facial expression
 - Assumes facial expressions have communicative function and convey human emotion
 - Requires FACS certification to be performed

EMFACS

- People can reliably assign facial expression to seven categories of emotion (Hager, 2003)
 - Happy
 - Sad
 - Anger
 - Surprised
 - Fear
 - Disgust

Intensity

- When applying FACS, raters also assess the intensity of each muscle activation
 - Trace
 - Slight
 - Marked or Pronounced
 - Severe or Extreme
 - Maximum

Identify Emotion

Emotion	Definition
Unable to Determine	<ul style="list-style-type: none">• Cannot tell what emotion the driver is showing
Neutral/No Emotion Shown	<ul style="list-style-type: none">• The driver has a straight face, does not smile or laugh, does not gesture
Happy	<ul style="list-style-type: none">• The driver smiles or laughs• The driver gestures in excitement
Angry/Frustrated	<ul style="list-style-type: none">• The driver lowers/squeezes eyebrows, wrinkling forehead• The driver clenches his/her teeth• The driver yells (opens mouth wide with eyebrows lowered)• The driver gestures in anger/frustration• The driver raises his/her upper lip or tightens lips
Sad	<ul style="list-style-type: none">• The driver has droopy eyebrows (raises inner eyebrows, lowers outer eyebrows)• The driver frowns by lowering the outer corners of his/her lips
Surprised	<ul style="list-style-type: none">• The driver's eyebrows raise• The driver's mouth opens• The driver jerks body or nods head back
Other	<ul style="list-style-type: none">• Emotional reaction that does not fit into any other category• Please define in the Notes section on the Excel Log

Identify Emotion Intensity

Intensity	Definition
Unable to Determine	<ul style="list-style-type: none">• Cannot tell the intensity of the emotion
Neutral/No Emotion Shown	<ul style="list-style-type: none">• The driver has a straight face, does not smile or laugh, does not gesture
Slight (Emotion Somewhat Shown)	<ul style="list-style-type: none">• The driver no longer has a straight face• However, no gesturing or head movement is observed
Marked or Pronounced (Emotion Very Much Shown)	<ul style="list-style-type: none">• The driver no longer has a straight face• The driver gestures one time in a reserved manner• The driver moves his head one time
Severe (Emotion Extremely Shown)	<ul style="list-style-type: none">• The driver has wide eyes and a wide open mouth• The driver is screaming• The driver gestures wildly, or the driver moves his head frequently

Passenger Vehicle Results

- Protocol applied to 6-s samples of drivers conversing on a cell phone in Fitch et al. (2013)
- Drivers exhibited at least marked or pronounced emotion in 3.8% of the cell phone conversations (35 of 921 samples)
 - 83% Happiness (29 of 35)
 - 14% Anger (5 of 35)
 - 3% Surprise (1 of 35)

Commercial Vehicle Results

- Protocol applied to 6-s samples of drivers conversing on a cell phone in Olson et al. (2009)
- Drivers exhibited at least marked or pronounced emotion in 5.3% of the cell phone conversations (62 of 1172 samples)
 - 94% Happiness (58 of 62)
 - 6% Anger (4 of 62)

Exposure Results

- Emotional cell phone conversation 0.3% of random samples
 - Found in 7 (0.3%) of 2,308 random samples from Fitch et al. (2013)
 - Found in 62 (0.3%) of 19,888 random samples from Olson et al. (2009)
 - None were Safety-Critical Events

Reliability

- Inter-rater tests performed using 20 samples and 16 reductionists
- Average of 94% agreement when rating emotion
 - Discrepancies between happy and neutral
- Average of 93% agreement when rating intensity
 - Discrepancies between slight emotion and neutral

Conclusion

- Developed a protocol to quickly assess drivers' emotional state during cell phone conversation
- Can be applied when video of face and torso is available
 - To assess road rage
- Emotional cell phone conversation while driving occurs 0.3% of the time when moving above 8 km/h
- Applied to SCEs, but not emotion was found
 - If assessing SCE risk, important to apply to data prior to SCE unfolding

Limitations

- Emotional conversation required driver to overly express emotion
 - Possible to feel emotion but not express it
- Did not interview drivers to ask what emotion they were expressing

Questions



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Quality Control

- Each reductionist attends training session
- 100% of work reviewed by senior reductionists for 1-2 weeks
- If not >90% agreement, 100% review continues
- When >90%, reviewed samples drops to 50%
- Highly accurate reductionists dropped to 25%
- All reductionists review senior reductionists notes and only make changes they agree with
- Disagreements reviewed by another senior reductionist
- Reviewers rotate reductionists
- Inter-rater test done using 20 samples

Using Machine Vision

- Constrained Local Model
 - Sension's tool looks at 78 points on the face, including the center of the pupil, the arch of the eyebrow and corners of the mouth.