

Two-stage Location Scale Mixed Modeling of EMA Data & Future Patterns of Dual Use of Cigarettes & E-Cigarettes in US Adults

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That was such a long & complex thesis title :(

Don't worry, we'll declutter it together! :)

6 Parts

Let the decluttering begin!

CHAPTERS

- **Problem & Importance**
- **Research Design & Dataset Description**
- **Research Methodology (Statistics!)**
- **Results (p-values and effect sizes)**
- **Discussion & Significance**
- **Q & A**

Problem & Importance

Problem

DID YOU KNOW?

Cigarette smoking causes **480,000** annual **deaths** in the US!!

Need solutions for **smoking cessation / quitting !**

Is **Vaping** (E-Cigarette Smoking) a solution - **terminus/closing** substance?

Research shows E-Cigarettes are less harmful than Cigarettes!

Some researchers say **E-Cigarettes may not work!**

So more exploratory research needed to understand this!

That's where we come in! :)

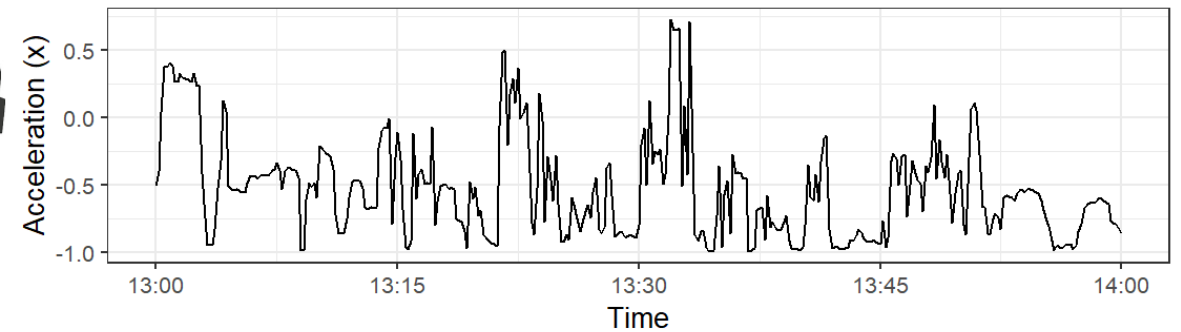
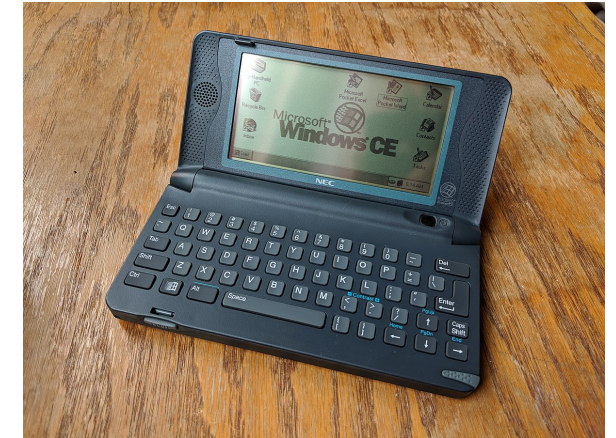
Decluttering #1 : “Dual Use” - Co-existent Cigarette and E-Cigarette use. Viola!



Problem

Decluttering #2 : “EMA” - Ecological Momentary Assessment Data

- A subject's Real-time data in real-world using a hand-held computer device (eg. smartphones)
- Repeated-measures on various outcomes during events
- Individual Variation + Multidimensional information for a single event
- Higher ecological validity (accuracy) while experience is fresh in subject's mind
- A type of Intensive Longitudinal Data



Before going into my **Research Question** or **Methodology**....

Some important context on **Research Design** first!
decluttering #3

Research Design

“Ecological Momentary Assessment (EMA)” (1 week)

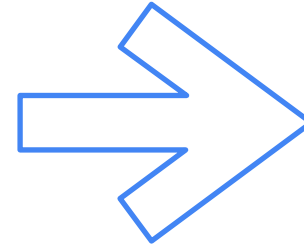
W0 : —Day 1 XXX — Day 2 XXXXXXX—...— Day 7 XXXX

Binary outcomes: (Self-initiated + Randomly prompted)

- CIG events
- ECIG events

Continuous outcomes:

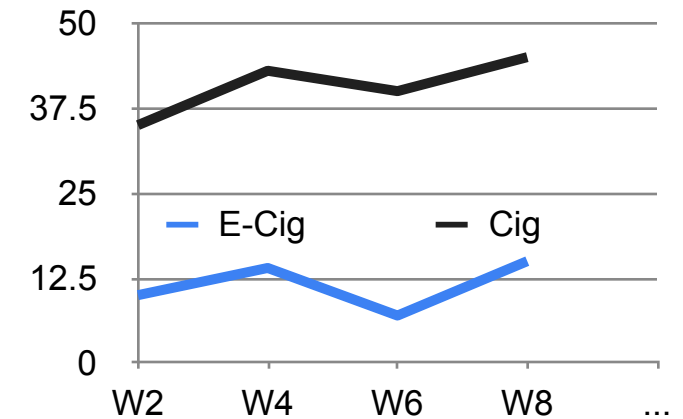
- URGE
- POSITIVE AFFECT CHANGE
- NEGATIVE AFFECT CHANGE



How?

“Biweekly surveys” (1 year)

W2 * W4 * W6 * W8 * W10 * W12 ... * W26



Dataset Description

Dataset Description

Data on N = **279** Dual users early in their uptake of E-Cigarettes

- at least 1 Cig and E-Cig event report during EMA week
- at least 1 biweekly cigarette & e-cigarette use response

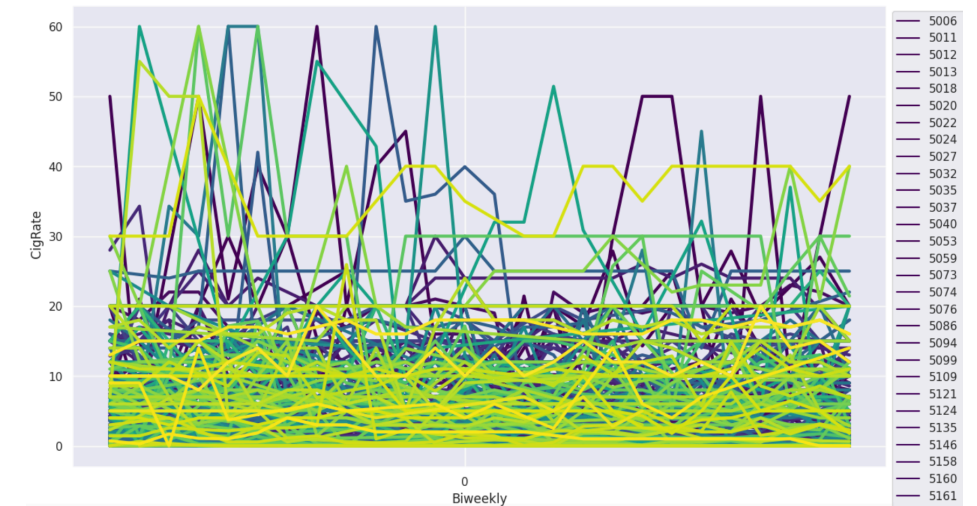
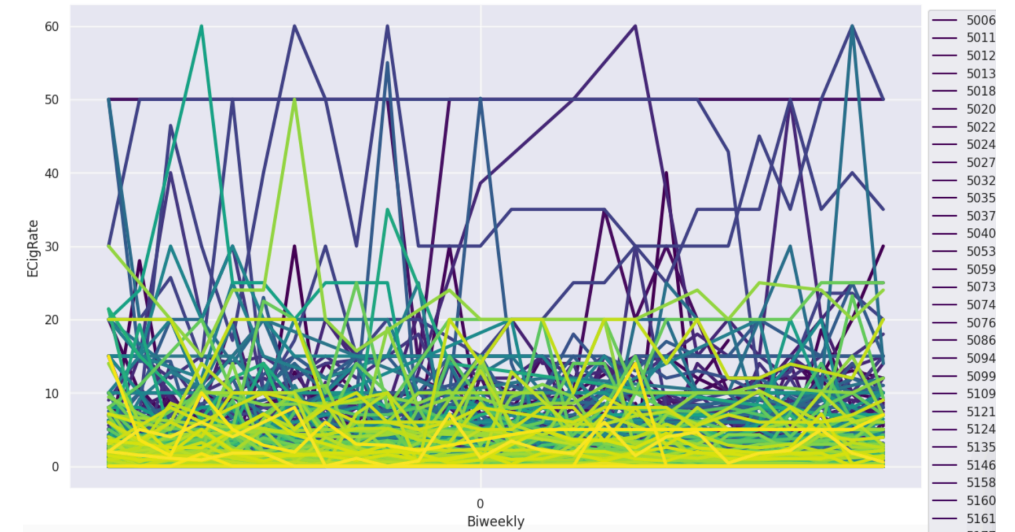
During EMA week:

- **6217** Cig events
- **2606** ECig events
- Subject mean = 21.1 reports

POST EMA week (biweekly reports of daily Cig & ECig use):

- total **5884** observations of each Cig and ECig
- subject mean = 21.1 reports

URGE , Positive Affect Change, Negative Affect Change



Research Methodology (Statistics!)

(Final) Decluttering #4.....

Mixed-effects (Multilevel) Location Scale Model :

- Developed by Don Hedeker as an extension of linear mixed-effect model with an added subject random effect to individual variance specification.
- Models between-subject variance in subject means
- But also Models between-subject variance of intra-individual variance.

Random Location effects : subject-specific random effects influencing subject means

Random Scale effects : Subject-specific random effects that influence intra-individual variability in outcomes

Variance of Variances. That's so cool!

Research Methodology

(Final) Decluttering #5 "TWO STAGE" Modeling:

Stage 1:

Estimate subject random location and scale effects with respect to URGE, Positive Affect Change, & Negative Affect Change

Empirical Bayesian Estimates of these random effects are supplied to a **second stage**

Stage 2:

Multilevel model that uses these EMB estimates as regressors along with age, gender, and time

Predictors are Future daily Cig & ECig Use modeled separately

Analysis done in MixWILD Software.

Results

Higher mean URGE, PAC, and NAC during EMA CIG events -> **lower average ECIG** use post EMA.

Higher intra-individual variability in **URGE** and **PAC** during EMA -> **lower average ECIG** use post EMA.

Higher mean NAC -> **higher average ECIG** use post EMA

Intra-individual variability in NAC - statistically insignificant predictor of average ECIG use post EMA.

Higher mean URGE and PAC during EMA CIG events -> **lower yearly trends** in biweekly rate of **ECIG** use post EMA

Higher intra-individual variability in **URGE** and **PAC** during EMA -> **lower yearly trends** in biweekly rate of ECIG use post EMA

Higher mean NAC during EMA CIG events -> **higher yearly trends** in biweekly rate of **ECIG** use post EMA

Higher intra-individual variability in **NAC** -> **higher yearly trends** in biweekly rate of ECIG use post EMA

Results

Higher intra-individual variability in NAC -> lower yearly trends in biweekly rate of **CIG** use post EMA at the subject-level.

Means and intra-individual variances of URGE, PAC, and NAC X -> future mean CIG use post EMA.

Means and intra-individual variances of URGE and PAC -> yearly trends in biweekly rate of **CIG** use post EMA.

Some of these statistically insignificant results could be due to the fact that participants in this study were still early in their uptake of ECIGs relative to CIGs which means that it would have been harder for them to change their CIG use behavior relative to ECIGs.

Indeed, stage 1 results show that subjects who smoked CIGs more often than ECIGs during EMA week also reported higher mean levels of URGE and NAC which are both factors typically associated with strong nicotine dependence.

Age was found to be a universally statistically significant moderating factor in all the examined relationships between EMA subjective factors and future biweekly rates of dual CIG and ECIG use post EMA.