



University of California
San Francisco

Using participants' own mobile phones for Ecological Momentary Assessment – *insights from a study with young adult smokers*

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Acknowledgements



- Anneke Bühler, PhD
- Stuart G. Ferguson, PhD
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- Dr. Ferguson was supported through a fellowship from Cancer Council Tasmania (Australia)

Overview

- What is EMA?
- How do mobile phones come in?
- Feasibility data
 - Discussion of results – lessons learned
- Application of EMA data
 - Analysis of situational antecedents of smoking in light and heavy smokers
- General discussion, Q&A

Ecological momentary assessment (EMA)

- Aim: Assessments of behavior in natural environment, high ecological validity
- Multiple assessments with short questionnaires
- Default gold standard:
Electronic diaries
- Procedure:
 - Time sampling: Participants are prompted at random time-points and complete assessment
 - Event sampling: Participants report events, e.g. smoking
(Shiffman et al., 2008, Annu Rev Clin Psychol; Ferguson & Shiffman, 2011, Subst Use Misuse)



Electronic diaries

■ Advantages

- Can be pre-programmed
- Random prompts and event sampling
- Time- and date-stamp observation (time-series analyses)



■ Disadvantages

- Costs
- Long-term monitoring of large groups of people difficult

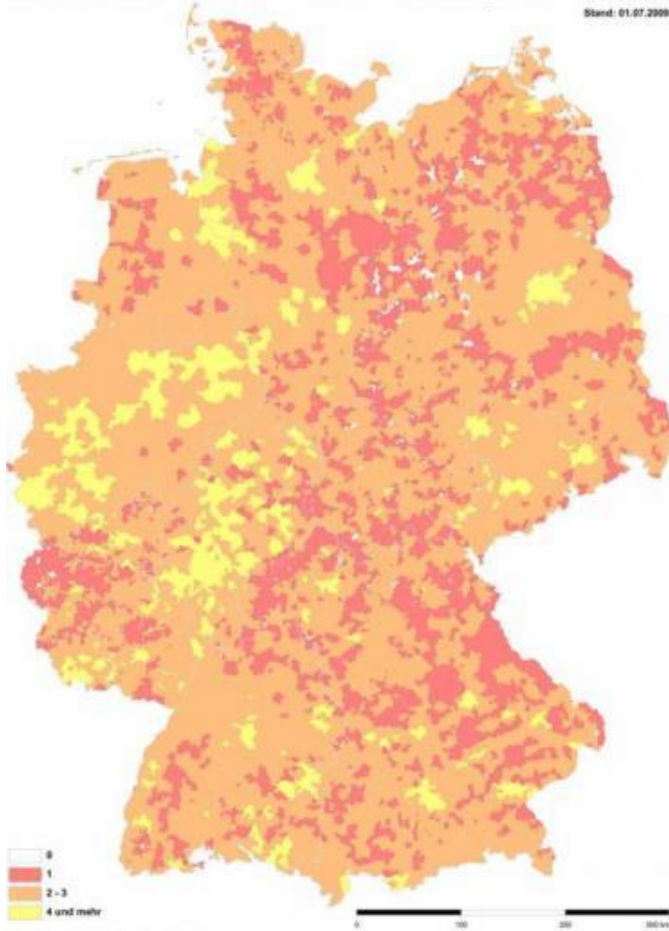


Mobile Internet

Breitbandatlas

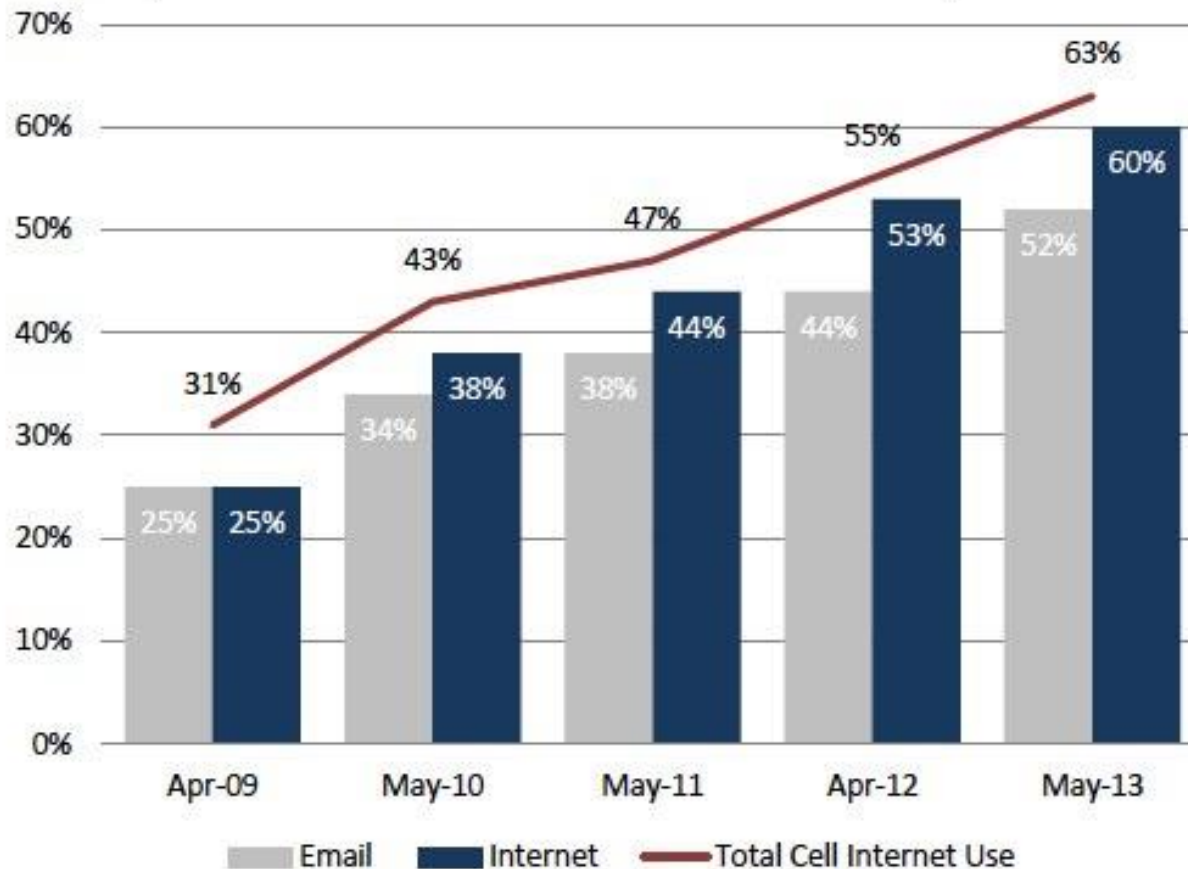
Anzahl der verfügbaren Techniken

Stand: 01.07.2009



Almost two-thirds of cell owners go online using their phones

Among cell phone owners, the % who use the internet or email on their phone



Source: Pew Internet & American Life Project Spring Tracking Survey, April 17-May 19, 2013. N=2,076 cell phone owners ages 18+. Interviews were conducted in English and Spanish and on landline and cell phones. The margin of error for results based on cell phone owners is +/- 2.4 percentage points.

Recent developments



Contents lists available at SciVerse ScienceDirect

Addictive Behaviors



Distinct coping strategies differentially predict urge levels and lapses in a smoking cessation attempt

Jeannette Brodbeck*, Monica S. Bachmann, Hansjörg Znoj

University of Berne, Department of Clinical Psychology and Psychotherapy, Gesellschaftsstrasse 49, CH-3012 Berne, Switzerland



ICAT: Development of an Internet-Based Data Collection Method for Ecological Momentary Assessment Using Personal Cell Phones

Emmanuel Kuntsche^{1,2} and Florian Labhart¹

European Journal of Psychological Assessment 2013; Vol. 29(2):140–148

DOI: 10.1027/1015-5759/a000137

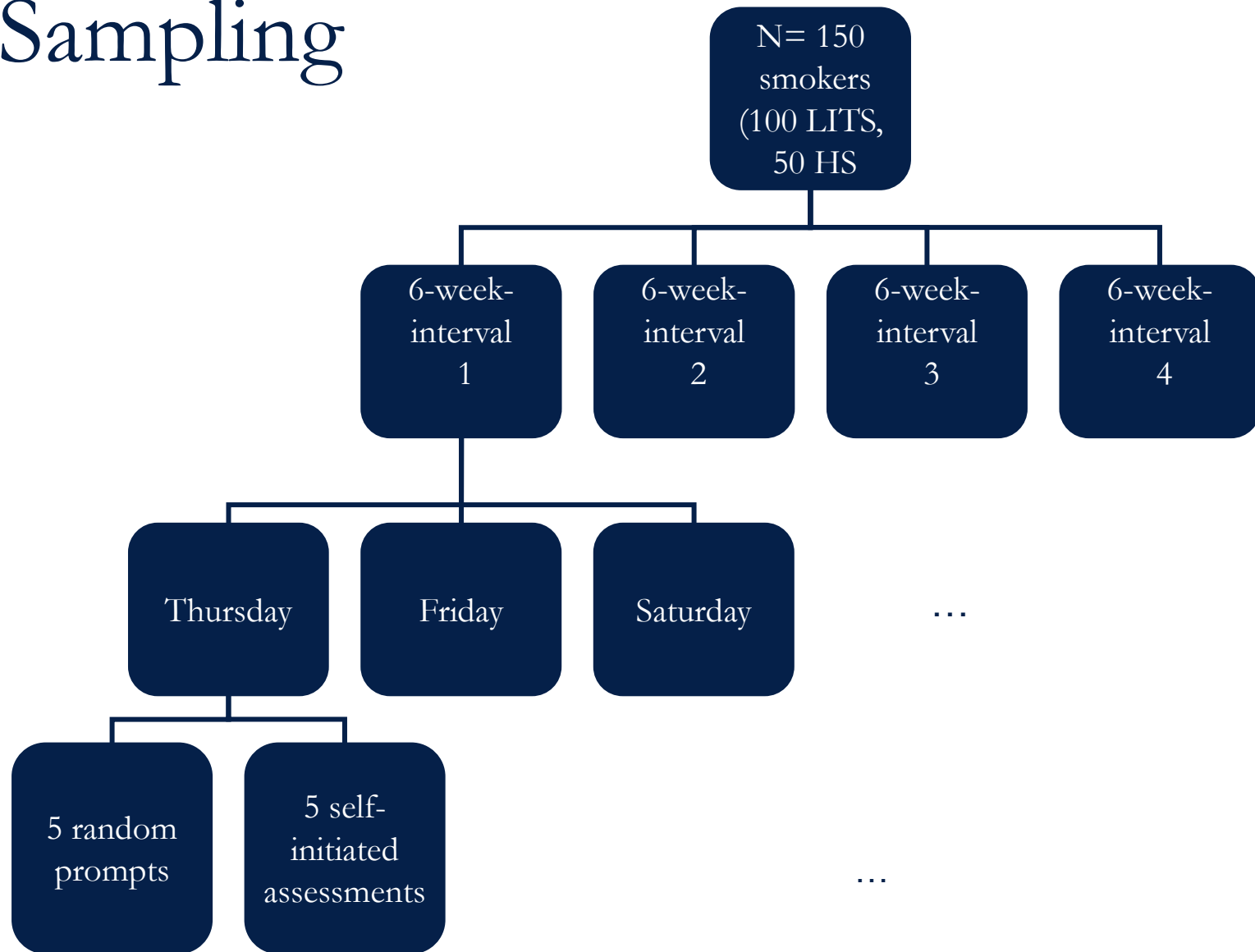
Key questions: Feasibility

- Can time- and event-based sampling schemes be replicated in Internet-based EMA studies?
- Can compliance with study protocols be maintained?
- How do we issue random prompts?

The Smokebook study



Sampling



Technology

- Browser-based questionnaires
 - Usable with every Internet-enabled phone
 - Advantage: no app, independent of particular platform/device (e.g., iOS, Android, Windows)
- Centrally accessible system
 - Highly flexible
- Automatic online SMS system for random prompting



Inclusion criteria

- 18 to 25 year
- Men and women
- Own a smartphone
- Intention to quit or reduce smoking
 - Sampling of smoking cessation events
 - Generalizability of results: Smokers looking for professional support are motivated to quit
- > 100 cigarettes/lifetime
 - LITS: ≤ 5 cig/day, min. 21 day smoked (out of last 30)
 - HS: ≥ 10 cig/day, daily smoking

Sample

- Recruitment through Facebook ads and postings
- Sample characteristics
 - $n = 92$
 - Age: 21.2
 - 39 women (42.4%)
 - 71 students (77.2%)
 - 45 LITS (48.9%): 3.5 cigarettes/day
 - 47 HS (51.1%): 16.1 cigarettes/day



Baseline (20 min)

- Sociodemographics
- Past smoking behavior
- Nicotine dependence
- Self-efficacy
- Quit motivation
- Personality
 - Trait self-control
 - Trait affect



EMA (20 questions - 2 min)

- Smoking or non-smoking
- Internal
 - Affect & arousal
 - Craving
- External
 - (Smoking) people
 - Activity, place (smok. ban)
 - Food, drink, alcohol

... to improve retention and compliance

- Reminder-SMS and questionnaire on Wednesday
- Incentives: Smokebookpoints for completed EMA questionnaires (50 Cent per questionnaire - max. 5€ per day, 60€ total)
- Enter lottery for an iPad at the end of study
- Additional adjustments during the study
 - SMS reminders with instructions Wednesday
 - Reminder calls with instructions Wednesday

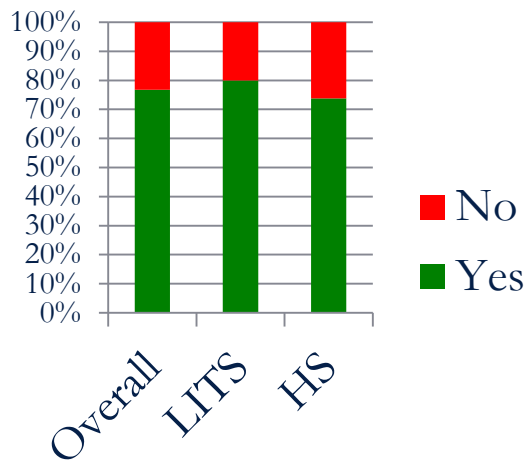
Results

	Total sample (n = 92)	LITS (n = 45)	HS (n = 47)
Total reports completed	885	456	429
Reports/participant/day	4.17 (2.77)	4.47 (2.56)	4.44 (3.13)
Total random prompts	708 (50.2%)	386 (54.8%)	322 (45.7%)
Random prompts/participant/day	3.56 (1.98)	3.75 (1.92)	3.35 (2.03)
Total self-initiated reports	177	70	107
Self-initiated reports/participant/day	1.90 (1.22)	1.71 (1.21)	2.06 (1.23)

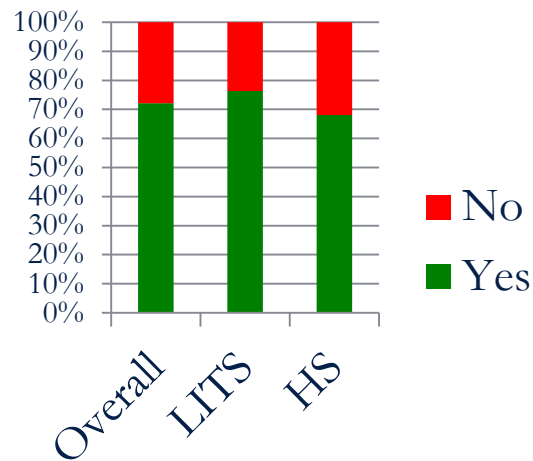
Results

■ Total days of with observations = 276

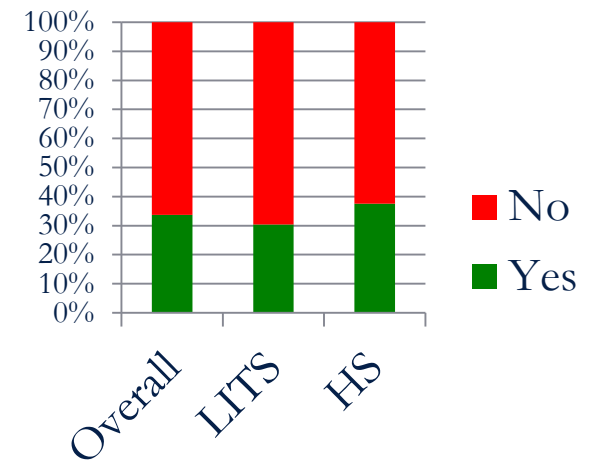
Days with any EMA data



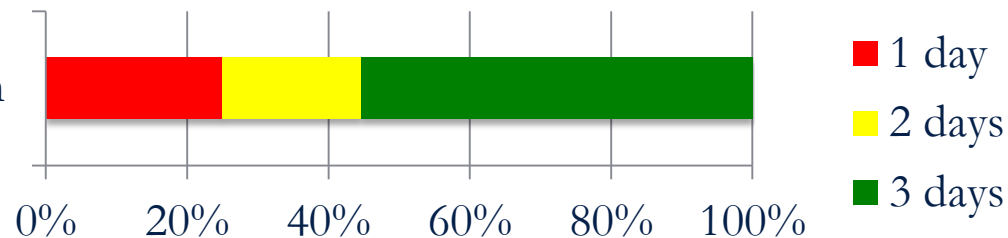
Days with any random prompt assessments



Days with any self-initiated assessments



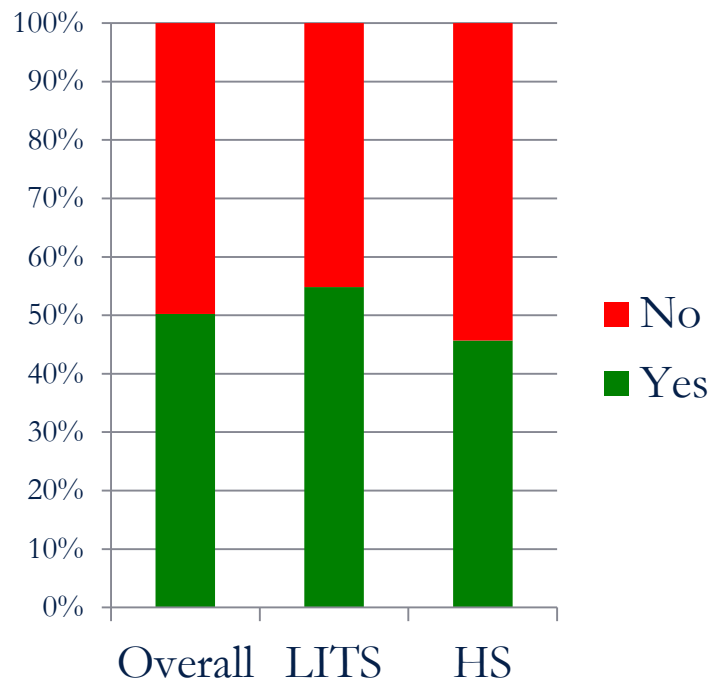
Participation



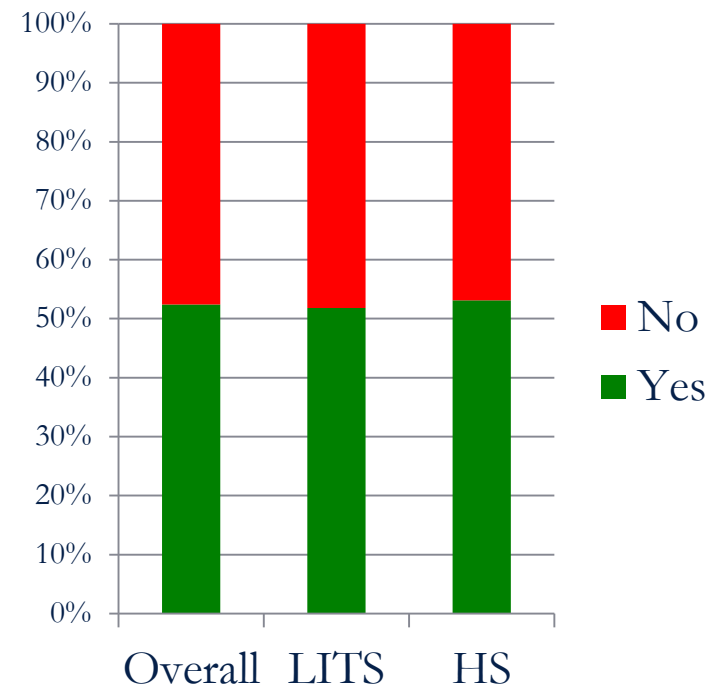
Results – random prompts

- Total SMS sent 1410

Total completed



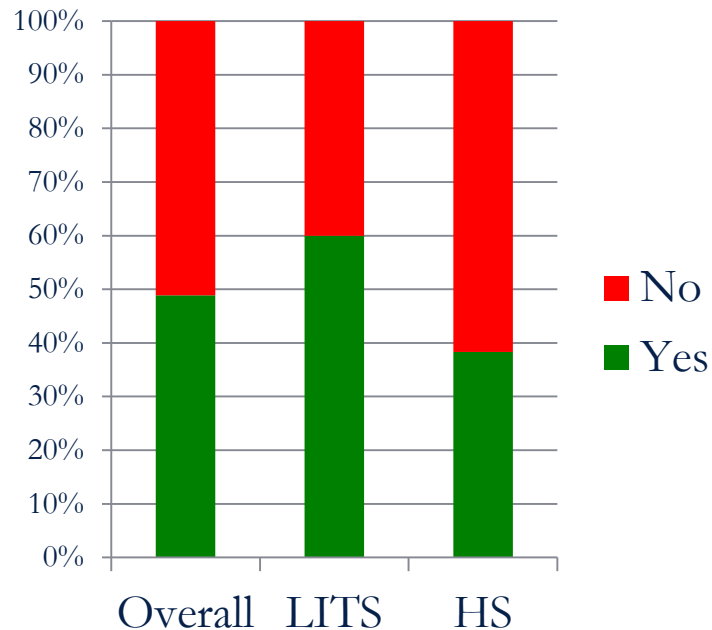
Completed within 10 minutes



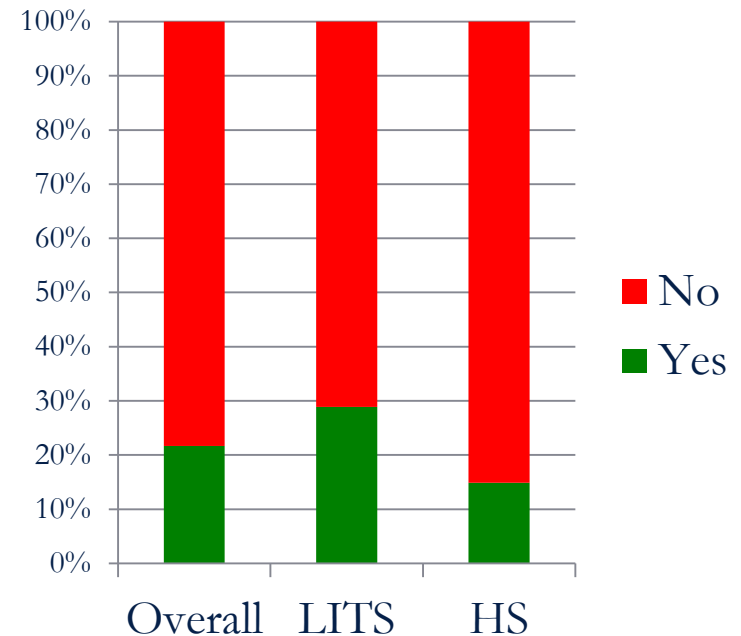
Results – random prompts

- Participants responding

To over 50% of RPs



To over 80% of RPs



Results – predicting compliance

- Age, gender, and baseline smoking status were used to predict number of assessments
- Age was related to more assessments
- Female gender associated with fewer assessments
- Smoking status did not predict number of assessments

Discussion - reasons

- 20 interviews with participants after end of study
 - Too many assessments, too frequent
 - Repetitiveness (same questions over and over)
 - Time interval during the day (morning, evening, and weekend)
 - Problems with incentives (display)
 - No overview over personal statistics
 - Problems with reception/Internet on the go
 - Not able to react promptly because too busy, or other reasons (work, school, etc.)

Discussion – replenishment sample (N=15)

- Participants initially contacted before the first wave of EMA assessment
- Reminded of importance of completing prompted assessments (within 10 min) and instructed to self-initiate prompts
- Reminded of incentives
- Improved compliance
 - EMA data on 95.6% of days
 - Completed 72.0% of random prompts (54.9% <10 min)
 - Completed self-initiated reports on 35.6% of days

Discussion - lessons learned

- Involvement of participants
 - Increase personal contact with study staff
- Communicate importance of compliance!!!
- Tailored questionnaires (skip rules)
- Different incentive scheme
- Display of personal statistics after every assessment
- More options to customize time-interval
- Different approach for event-based sampling

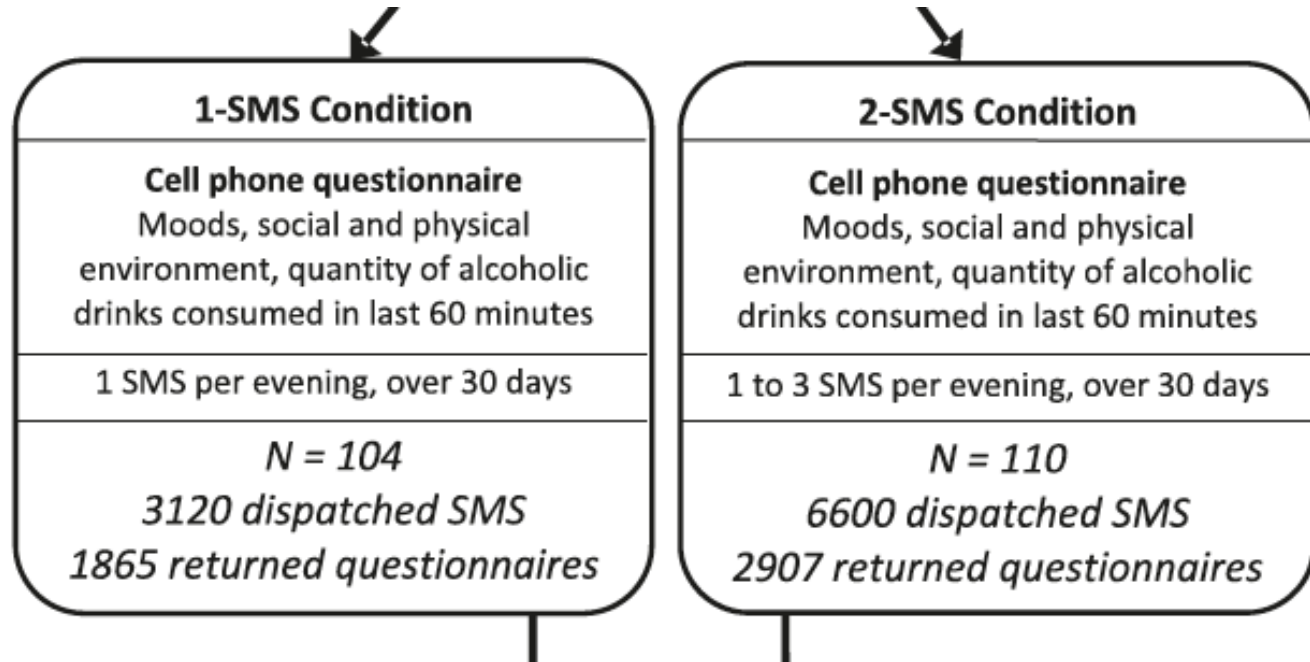
(Shiffman et al., 2002, J Abnorm Psychol)

Discussion

- **Comparison with other EMA studies** (Shiffman, 2009, Psychol Assess)
 - From ED studies: compliance with prompts varied widely across studies from 90% to as low as 52% (college students)
 - Unclear what causes this variation (sample, incentives, training, feedback)
 - Possibly more difficult to engage young adult participants in compliant behavior
 - Compliance with recording of events more difficult to assess

Discussion

EMA



- Median response time 25 minutes

(Kuntsche & Labhart, 2012, Drug Alcohol Depen)

(compared to 10 minutes in our study)

Conclusion

- Internet based EMA procedures relying on participants' phones are technically feasible
- Especially interesting for studying young populations in countries with good availability of mobile Internet
- Potentially useful for long-term and large-scale monitoring
- Problems with participant compliance have to be overcome

Using EMA data for an applied research question...

- Comparison of situational smoking antecedents among light and heavy smokers

Light and intermittent vs. heavy smoking

- Subtypes of smokers have been characterized by means of surveys, lab studies, and observational studies
(Coggins et al., 2009, Psychopharmacology)
- Differences between LITS and HS
 - LITS smoke for positive reinforcement
 - LITS react with less craving to smoking related cues
 - LITS' smoking more associated with risky drinking
- Another key difference: Age – LITS are younger on average

LITS vs. HS – previous EMA results

- Two studies have compared situational antecedents between LITS and HS
 - Older adults $M_{age} = 40$ (Shiffman & Paty, 2006, J Abnorm Psychol)
 - College students (Cronk & Piasecki, 2010, NTR)
- Some conflicting results (regarding the roles of craving, type of activity, consumption of food, drinks, and alcohol)
- In general: LITS are more influenced by other persons' smoking and location type
- Mood not associated with smoking

Research question

- Examine situational predictors of smoking in young adult LITS and HS
- Examine different predictors related to
 - internal situational aspects (e.g., mood, craving)
 - external situational aspects (e.g., location, activity, food, smoking by others)
- Do situational predictors of smoking differ between young adult LITS and HS?



Baseline (20 min)

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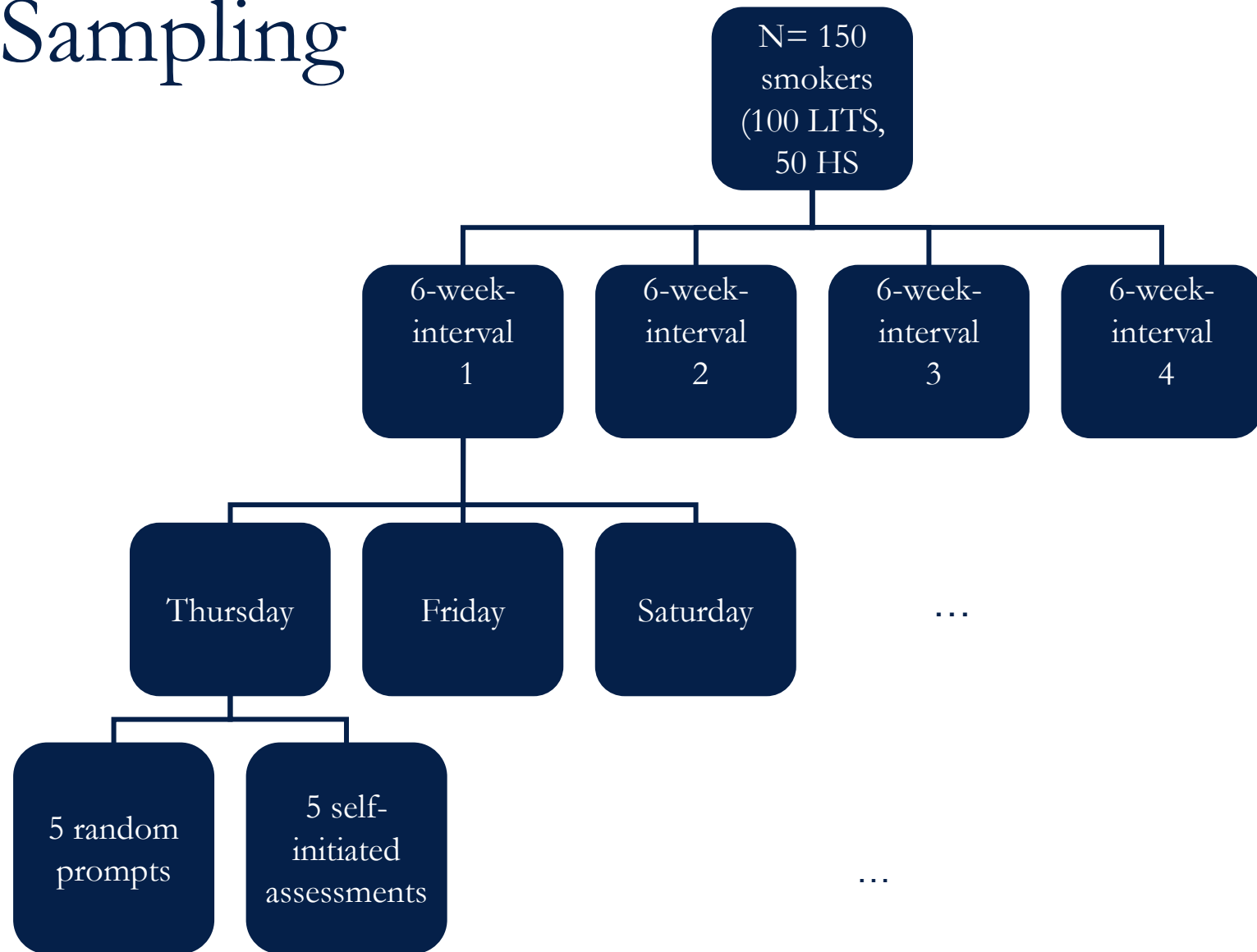
EMA (20 questions - 2 min)

- Smoking or non-smoking
- Internal
 - Affect & arousal
 - Craving
- External
 - (Smoking) people
 - Activity, place (smok. ban)
 - Food, drink, alcohol

Inclusion criteria

- 18 to 25 year
- Men and women
- Own a smartphone
- Intention to quit or reduce smoking
 - Sampling of smoking cessation events
 - Generalizability of results: Smokers looking for professional support are motivated to quit
- > 100 cigarettes/lifetime
 - LITS: ≤ 5 cig/day, min. 21 day smoked (out of last 30)
 - HS: ≥ 10 cig/day, daily smoking

Sampling



Sample selection

- 203 participants fulfilled inclusion criteria
- 155 completed the baseline assessment
- 138 reported any EMA assessment
 - 68 excluded because they did not provide retrospective data on their smoking behavior for more than 1 wave
 - 29 excluded because they transitioned between groups during course of the study
- Analytical sample:
n = 41 participants (23 LITS, 18 HS)

Sample characteristics

	LITS (n=23)	HS (n=18)
Age	21.3 (2.2)	22.6 (2.6)
Gender female	47.3%	61.1%
Currently students	100%	77.8%*
Smoking rate (cig per day)	3.6 (1.1)	16.2 (3.1)***
Smoking pattern for 12 months or more	43.5%	77.8%*
Nicotine dependence (HONC)	5.0 (2.1)	7.1 (2.4)**

Available data

- Only assessments within 60 min after issuing of the prompt were considered
- 1543 EMA assessments analyzed (37.6 per participant)(602 smoking situations)
- 65.6% of random prompts responded to in the first 10 minutes after issuing
- Average response time 12.5 min

Data analysis

- Generalized estimating equations (GEE)
- Characteristics of the situation (e.g., mood, activity, ...) were used to predict smoking (vs. non-smoking) as categorical dependent variable (like logistic regression)
- Adjusted for potential covariates (e.g., location was adjusted for smoking bans and smoking by others)
- Interaction effects (smoking status x predictor) to test if relationships between predictors and smoking differ between LITS and HS

Results

Table 1. Situational predictors of smoking situations

Variable	LITS (n = 23)				HS (n = 18)				Group interaction: OR (LITS vs. HS × S- vs. NS-Sit) (95% CI)
	NS-Sit (M, SD; %)	S-Sit (M, SD; %)	OR S- versus NS-Sit (95% CI)	AOR S- versus NS-Sit (95% CI)	NS-Sit (M, SD; %)	S-Sit (M, SD; %)	OR S- versus NS-Sit (95% CI)	AOR S- versus NS-Sit (95% CI)	
Internal									
Affect	6.10 (1.88)	6.05 (1.99)			6.37 (1.86)	6.32 (1.69)			
Linear			0.99 (0.83–1.19)	0.98 (0.79–1.21) ^a			0.98 (0.86–1.10)	0.97 (0.85–1.10) ^a	1.02 (0.85–1.26)
Quadratic			1.02 (0.98–1.07)	1.02 (0.97–1.07) ^a			0.95 (0.90–1.00)	0.95 ^a (0.90–1.00) ^a	1.00 (0.99–1.02)
Arousal	4.07 (1.70)	4.35 (1.72)			3.69 (1.84)	4.00 (1.82)			
Linear			1.09 (0.92–1.30)	1.05 (0.87–1.28) ^a			1.10 (0.98–1.23)	1.09 (0.97–1.23) ^a	0.99 (0.81–1.21)
Quadratic			1.00 (0.95–1.06)	0.99 (0.92–1.05) ^a			0.97 (0.94–1.01)	0.98 (0.94–1.02) ^a	1.01 (0.98–1.03)
Craving	14.8	74.5	16.47*** (9.48–28.60)	15.87*** (8.99–28.01) ^a	23.3	63.2	5.22*** (3.07–8.87)	5.10*** (3.06–8.51) ^a	3.12*** (1.46–6.63)
External									
Smoking ban	37.3	13.5	0.26*** (0.15–0.45)	0.25*** (0.13–0.47) ^b	31.7	13.7	0.37** (0.18–0.76)	0.37** (0.18–0.77) ^b	0.72 (0.30–1.73)
Location									
Work	1.7	3.1	2.01 (0.77–5.27)	1.57 (0.43–5.72) ^c	8.4	14.5	1.93* (1.04–3.59)	1.96* (1.11–3.44) ^c	1.07 (0.34–3.39)
Car	7.3	4.5	0.58 (0.24–1.41)	0.94 (0.45–1.97) ^c	7.4	2.1	0.27* (0.07–0.97)	0.36 (0.10–1.38) ^c	2.12 (0.44–10.10)
Bar	2.4	4.0	1.65 (0.87–3.13)	0.95 (0.50–1.80) ^c	2.8	3.2	1.11 (0.49–2.51)	1.11 (0.62–2.02) ^c	1.44 (0.52–3.99)
School	10.6	10.3	0.95 (0.57–1.57)	1.03 (0.59–1.82) ^c	8.4	5.0	0.56 (0.22–1.44)	0.76 (0.37–1.53) ^c	1.66 (0.59–4.75)
Home	66.0	52.5	0.59*** (0.45–0.76)	0.66 (0.43–1.01) ^c	55.1	59.6	1.18 (0.82–1.71)	0.86 (0.56–1.31) ^c	0.51** (0.33–0.80)
Others' home	5.5	12.1	2.30** (1.42–3.73)	1.88* (1.01–3.49) ^c	12.9	9.5	0.71 (0.50–1.03)	0.99 (0.47–2.05) ^c	3.14*** (1.72–5.71)
Other place	6.2	12.6	2.10** (1.20–3.68)	1.22 (0.73–2.06) ^c	4.8	6.1	1.22 (0.61–2.47)	1.23 (0.63–2.43) ^c	1.66 (0.68–4.04)
Activity									
Working	19.9	14.8	0.69 (0.42–1.14)	0.87 (0.53–1.45) ^c	21.6	22.2	1.09 (0.68–1.77)	1.17 (0.71–1.93) ^c	0.64 (0.33–1.27)
Talking	15.0	26.0	1.96** (1.27–3.04)	1.46 (0.85–2.51) ^c	20.1	24.5	1.27 (0.95–1.69)	1.29 (0.94–1.76) ^c	1.52 (0.90–2.55)
Doing nothing	25.2	21.5	0.84 (0.53–1.31)	0.88 (0.55–1.43) ^c	12.7	19.0	1.64* (1.05–2.53)	1.58 (0.94–2.65) ^c	0.53* (0.28–0.98)
Relaxing	32.5	27.8	0.80 (0.46–1.38)	0.83 (0.48–1.42) ^c	30.2	27.2	0.82 (0.58–1.17)	0.82 (0.57–1.18) ^c	0.96 (0.51–1.81)
Waiting	13.4	12.6	0.89 (0.53–1.49)	1.03 (0.55–1.94) ^c	11.4	15.0	1.37* (1.05–1.77)	1.37* (1.03–1.82) ^c	0.63 (0.35–1.13)
Other activity	16.6	13.9	0.83 (0.59–1.17)	0.70 (0.45–1.07) ^c	19.5	11.9	0.58 (0.28–1.21)	0.56 (0.29–1.11) ^c	1.47 (0.67–3.26)
Food									
Any food or drink	51.6	63.7	1.66** (1.20–2.30)	1.46* (1.07–1.99) ^c	49.2	60.4	1.55* (1.09–2.22)	1.47* (1.04–2.07) ^c	1.07 (0.67–1.72)
Food	29.8	29.2	0.98 (0.69–1.41)	0.95 (0.67–1.34) ^c	21.6	27.7	1.36 (1.00–1.85)	1.47** (1.11–1.95) ^c	0.73 (0.45–1.16)
Coffee	8.2	9.4	1.20 (0.69–2.10)	1.04 (0.59–1.84) ^c	8.9	9.5	1.07 (0.54–2.12)	0.99 (0.53–1.87) ^c	1.16 (0.49–2.67)
Alcohol	0.9	11.7	13.63*** (5.51–33.69)	8.69*** (3.08–24.53) ^c	3.1	4.8	1.44 (0.66–3.16)	1.46 (0.67–3.17) ^c	8.24*** (2.58–26.34)
Smoking by others									
Anyone	18.1	46.2	3.78*** (2.19–6.53)	3.92*** (2.33–6.58) ^c	16.5	26.7	1.74*** (1.36–2.22)	1.75*** (1.32–2.34) ^c	2.08* (1.15–3.77)
Unknown person	4.9	11.2	2.37** (1.32–4.25)	2.62** (1.45–4.73) ^c	5.1	9.5	1.77 (0.96–3.28)	1.97* (1.04–3.75) ^c	1.28 (0.55–2.95)
Family	2.2	6.7	3.11*** (1.69–5.72)	3.24** (1.61–6.52) ^c	2.8	3.4	1.13 (0.65–1.94)	0.98 (0.58–1.65) ^c	2.64* (1.19–5.85)
Friends	7.3	23.8	3.85*** (2.24–6.63)	3.54*** (1.99–6.29) ^c	7.1	12.9	1.99** (1.33–2.96)	2.02** (1.32–3.10) ^c	1.91 (0.98–3.71)

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$. ^aORs adjusted for smoking by others and drinking alcohol. ^bORs adjusted for smoking by others. ^cORs adjusted for smoking ban and smoking by others. Caution: Please note that some of the statistical significances changed in the sensitivity analysis (see Supporting Information Table S1). Particularly the results of the sensitivity analysis suggest that the role of alcohol in smoking among HS may be underestimated. Importantly, however, all reported relationships remained in the same direction. AOR, adjusted odds ratio; CI, confidence interval; HS, heavy smokers; LITS, light and intermittent smokers; NS-Sit, non-smoking situation; OR, odds ratio; S-Sit, smoking situation.

Multivariate result (increased odds of smoking)

- Both groups:

- Craving (LITS: OR=16; HS OR=5)
- Being in a location where smoking is allowed
- Any food or drink, smoking by others/unknown persons/friends

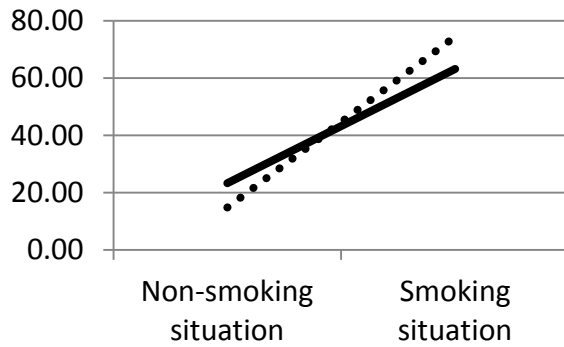
- LITS:

- Home of others, alcohol (!), smoking by family

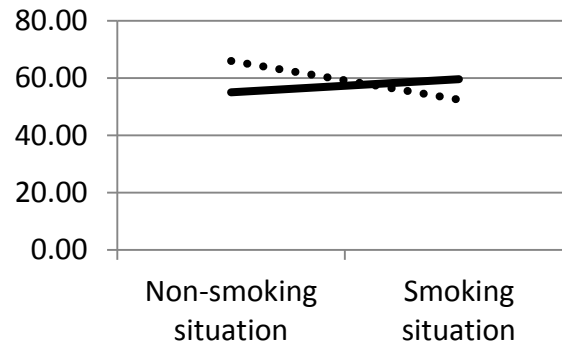
- HS:

- Medium range affect, being at work, waiting, food only

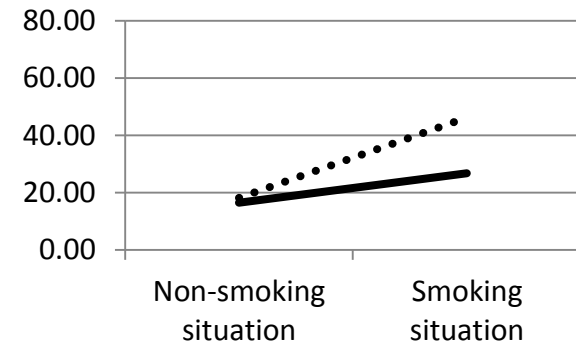
Craving



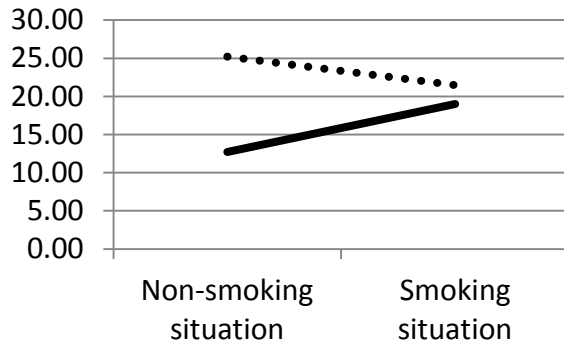
Home



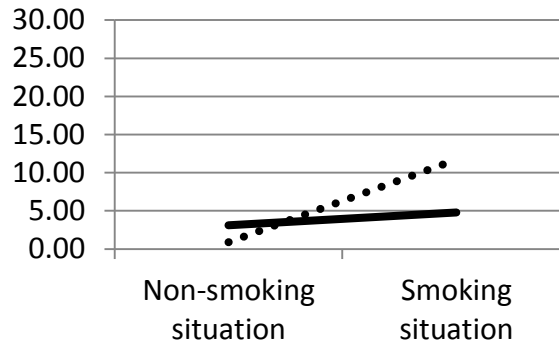
Smoking by others



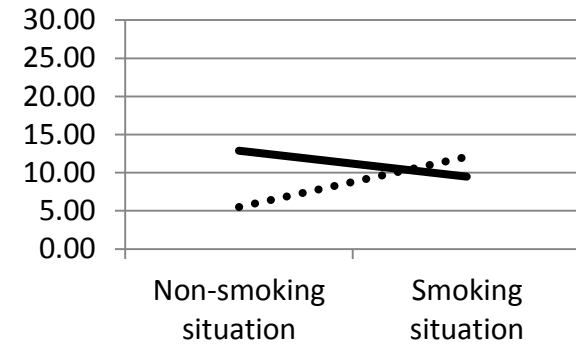
Doing nothing



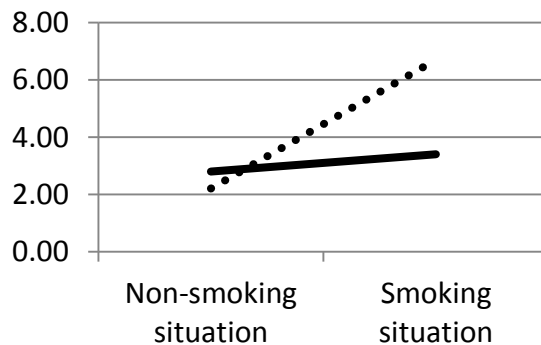
Drinking alcohol



Others' home



Smoking by family



Discussion

- Results suggest that cue-associated smoking plays a bigger role for LITS than for HS
- Several situational antecedents (e.g., craving, drinking alcohol, smoking by others) seem to be more important for triggering smoking in LITS
- Consistent with previous research, we found no strong associations between situational mood and smoking
- Evidence for the effectiveness of smoking bans based on event-level data

Limitations

- Reported relationships are correlational
- Participants did not respond to all random prompts, mean delay of 12.5 minutes for response was rather large
- We only collected data on a subset of smoking situations and underreporting was an issue
- Data are not representative
(inclusion criteria, small sample size, sampling of specific weekdays)

Conclusions

- Already among young adult smokers at an early stage in their smoking career, differences between LITS and HS emerged
- LITS may smoke to make an already pleasurable situations more enjoyable
- Social smoking may be one of the key explanations to characterize the smoking behavior of young adult LITS
- Smoking behavior of HS may be more habitual and automatic, used to cope with boredom, or to kill time

Next steps: Analysis of Smokebook data

- Compare HS and LITS on baseline characteristics
 - Role of smoking restraint strategies (e.g., count cigarettes, limit daily number of cigarettes)
- Analyze transitions in smoking behavior over time
 - Does amount of stimulus control predict changes in smoking longitudinally?

Next steps: Postdoc

- Develop easy to use and easy to adapt software for EMA assessments
- Use EMA to examine environmental influence factors on smoking behavior
 - Exposure to points of sale
 - Exposure to advertisements

For more information...

- ... come talk to me!
- Methods and development paper:
Thrul et al., 2015, European Addiction Research
- LITS vs. HS paper:
Thrul et al., 2014, Drug Alcohol Review

An Internet-Based Ecological Momentary Assessment Study Relying on Participants' Own Mobile Phones: Insights from a Study with Young Adult Smokers

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Situational and mood factors associated with smoking in young adult light and heavy smokers

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... Thank you!

