Nicotine Delivery and E-Cigarette Puffing Behaviour

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Declarations

- Conducted research for e-cigarette companies (2010-2013)
- Consultant for pharmaceutical industry (2014)
- Expert witness in e-cigarette patent infringement case (2014)
- No funding from tobacco industry

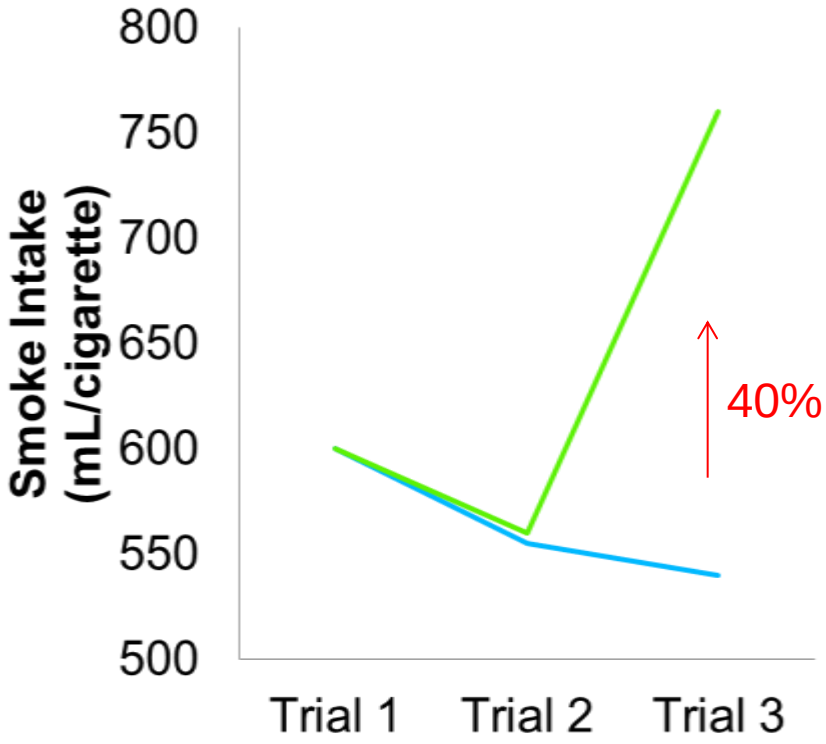
Self-Titration Hypothesis

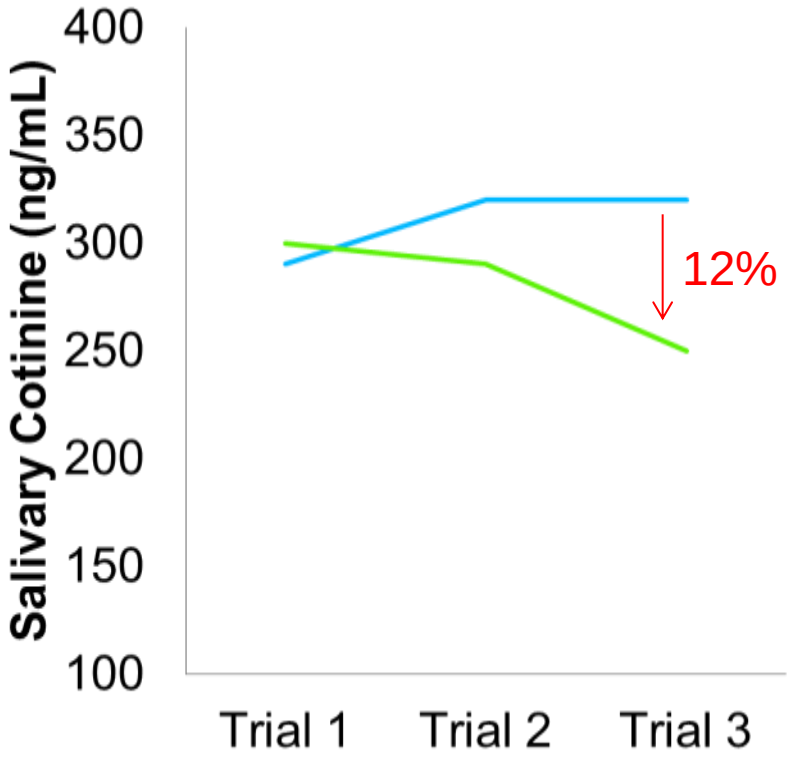
Smokers adjust their nicotine intake to maintain a personal optimal level.

	% difference from usual brand	
	In cigs	In blood
High nicotine cig	30-40%	10%
Low nicotine cig	50%	15%

Smokers compensated for about 2/3 of the difference in nicotine yields (Ashton et al., 1979, BMJ)

Compensatory Puffing



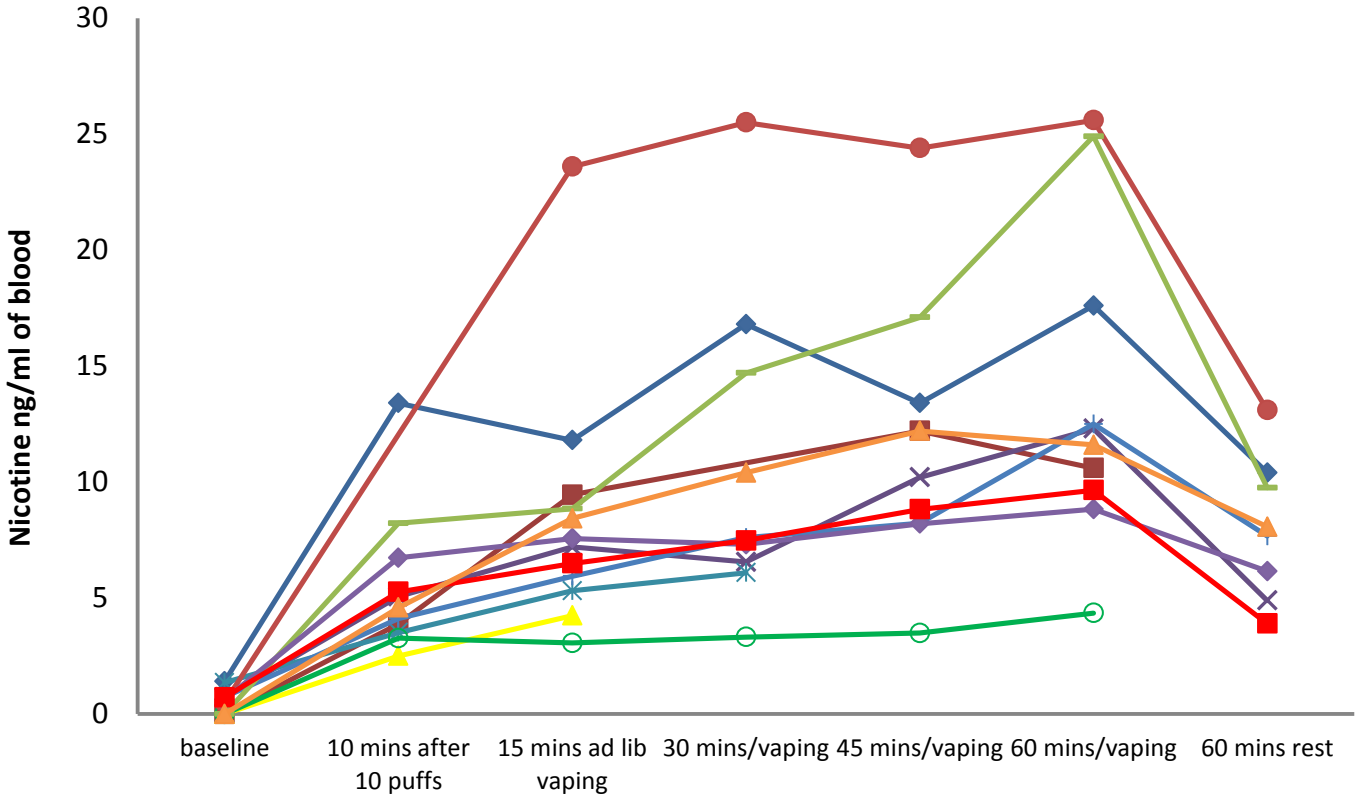


Usual brand
Low Yield (38%)
Switch at Trial 3

Hammond et al. (2005) *Cancer Epidemiol Biomarkers Prev*

- Smokers can achieve approx. 60-80% of the nicotine yield via compensatory puffing behaviour (Scherer & Lee, 2014)
- Mainly via taking longer, harder drags and more frequent puffs
- Switching to ‘light’ or reduced nicotine containing cigs doesn’t appear to reduce toxicant exposure and may even increase it.

E-cigarette nicotine delivery



14 experienced users took 10 puffs followed by 60min *ad lib* vaping

Dawkins & Corcoran (2014)

TPD Article 20

- Limit on nicotine concentrations > 20mg/mL
- 9% use above 20mg/mL (ASH, 2016)
- 1/5th of e-cig users *initiated* vaping with >20mg/mL nicotine concentration (Farsalinos et al., 2013)

Aims

To explore:

1. the extent to which e-cigarette users self-titrate when given a lower nicotine concentration liquid
2. subjective effects (craving, withdrawal symptoms, positive and negative effects) and plasma nicotine concentrations between conditions (high vs. low nicotine concentration liquid)

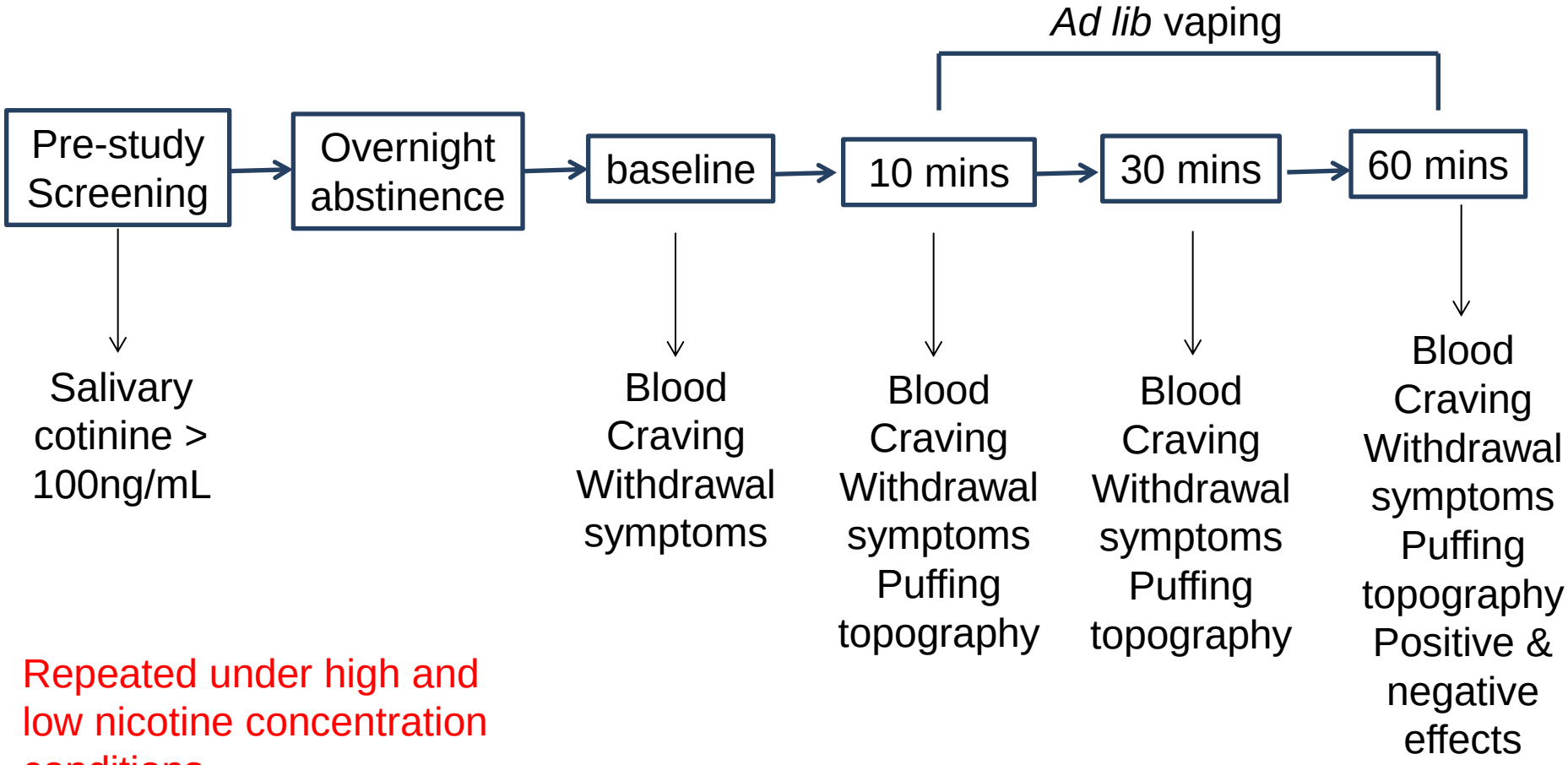
Methods

- Participants: 11 male experienced e-cig users
- E-cigarette: eVic Supreme (Joyetech) with Aspire tank (Nautilus)
- E-liquid: 6 & 24mg/mL tobacco flavour (Halo Smokers' Angels)
- Double-blind, counterbalanced

Measures

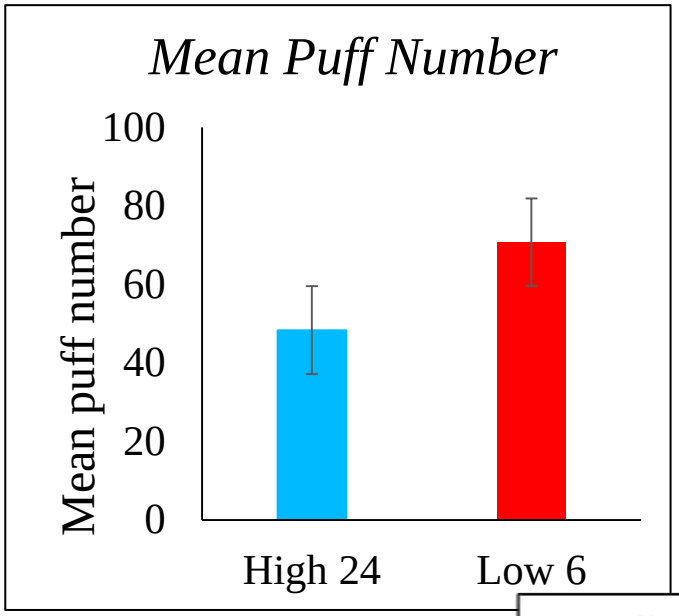
- Puffing topography: puff number, puff duration, mL consumed
- Mood & Physical Symptoms & Urge to Vape (West & Hajek, 2004)
- Positive Effects (e.g. hit, satisfaction on VAS)
- Negative Effects (e.g. nausea, dry mouth on VAS)

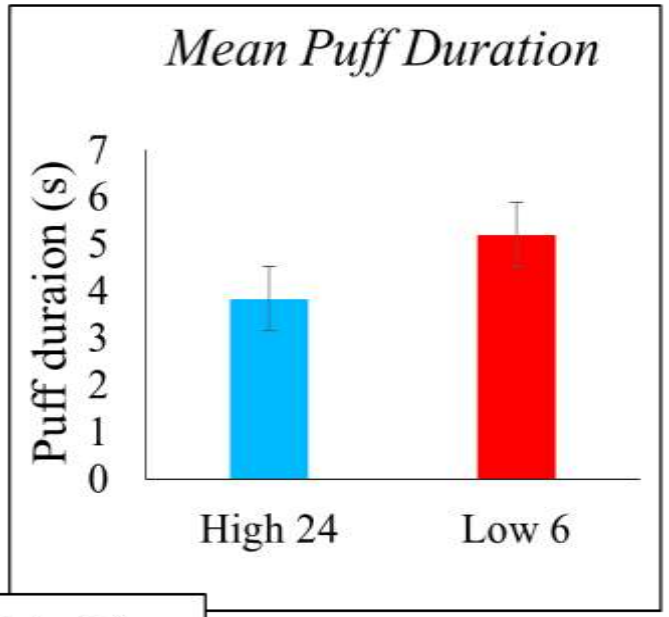
Procedure

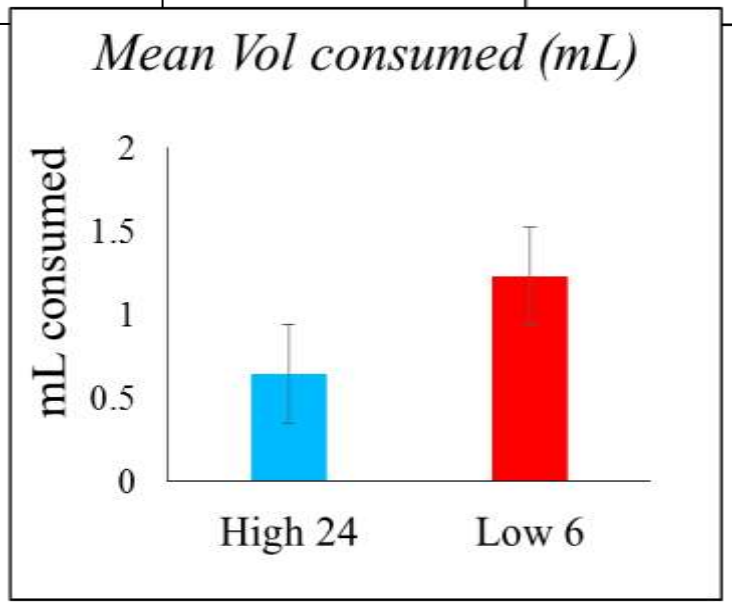


Repeated under high and low nicotine concentration conditions

Puffing topography

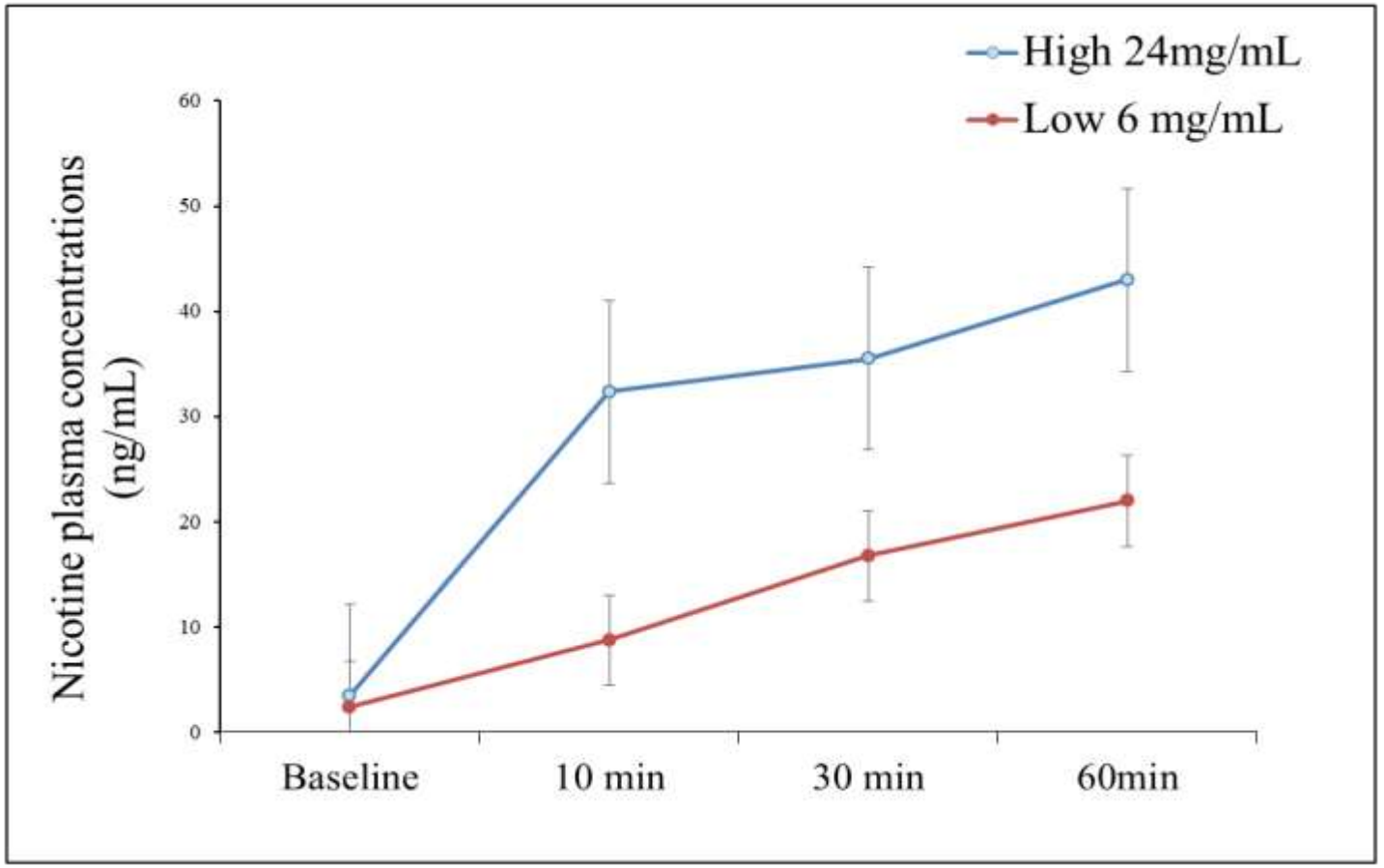






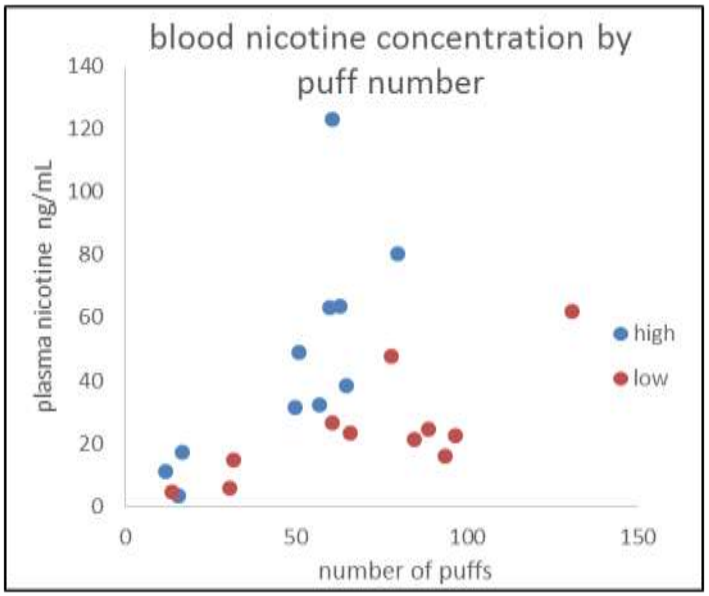
More puffs, longer puffs and more liquid consumed in the low (6mg/mL condition ($p < 0.05$)

Blood nicotine delivery

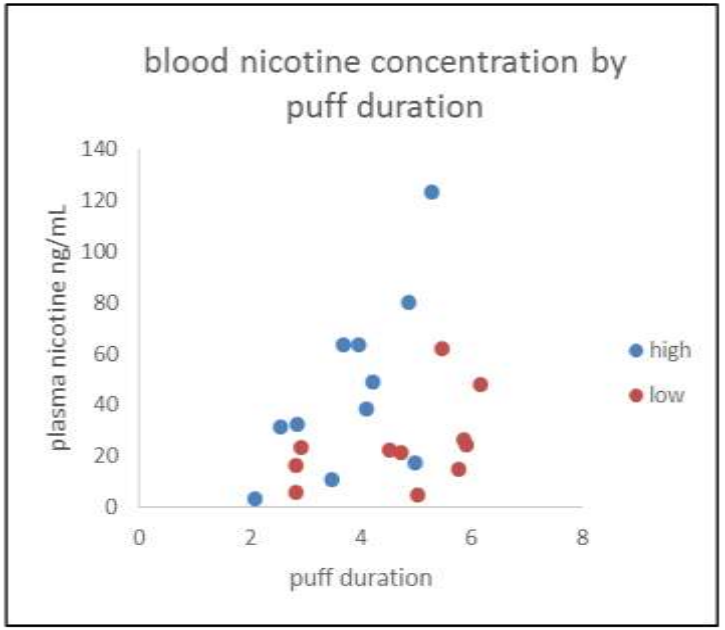


Incomplete self-titration from compensatory puffing

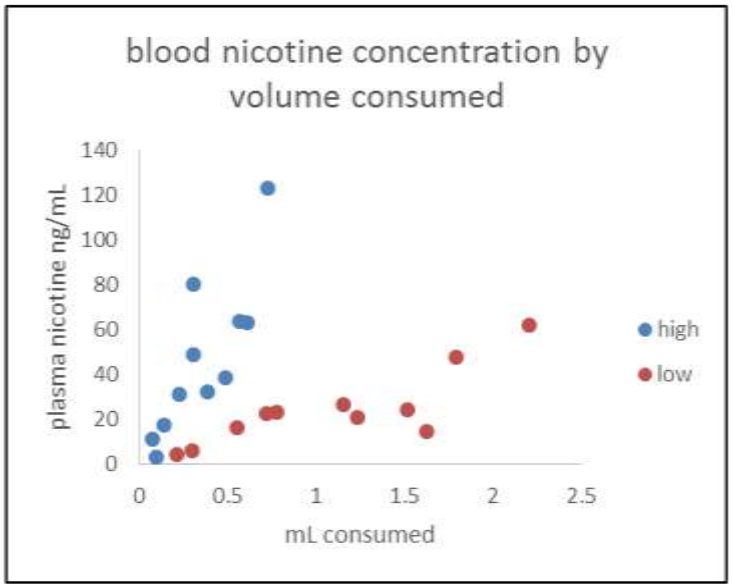
Blood nicotine/puffing topography correlations



High: *r = 0.85**;* Low: *r = 0.75***



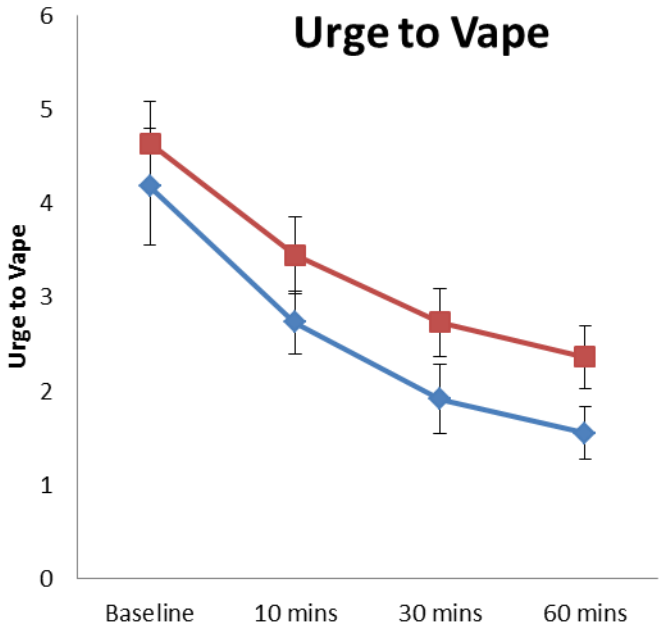
High: *r = 0.56*;* Low: *r = 0.22*

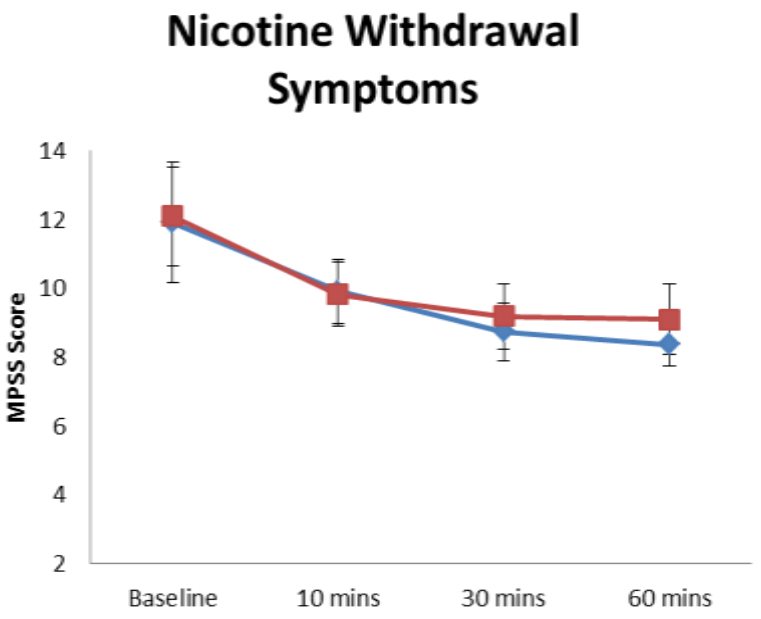


High: *r = 0.85**;* Low: *r = 0.75***

** p < 0.01; * p < 0.05

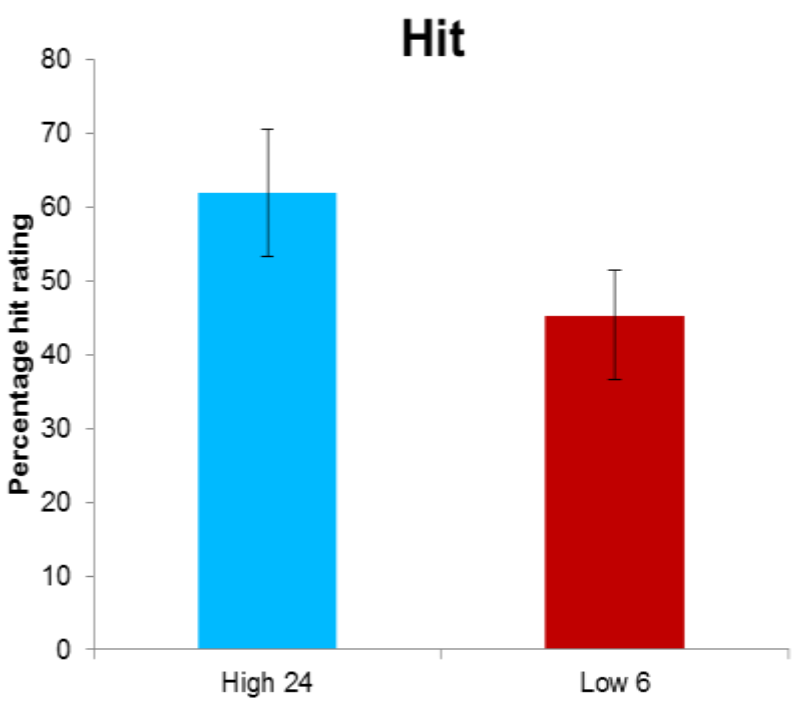
Subjective effects

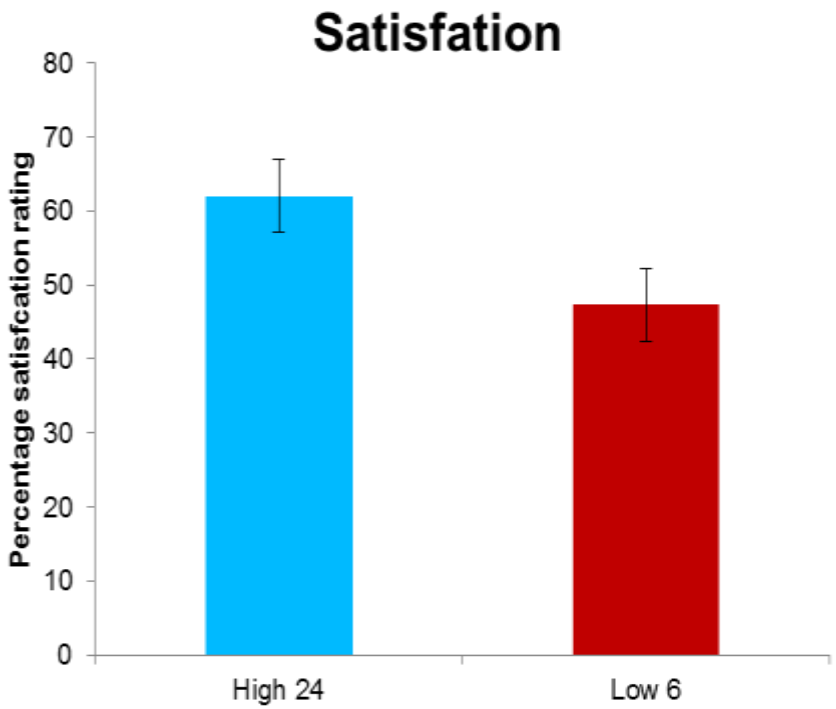




No significant differences between conditions in urge to vape or withdrawal symptoms

Positive Effects





Trend for higher ratings of hit and satisfaction in the high nicotine condition ($p = 0.11$ & $p = 0.09$)

Conclusions

- Clear evidence of compensatory puffing with lower nicotine concentration e-liquid
- Self-titration was partially effective…
- … equivalent reduction in urge to vape and withdrawal symptoms across conditions…
- …but significantly higher levels of blood nicotine in the high condition
- Very high levels of nicotine can be achieved very quickly (equivalent to smoking) under certain conditions

Question

More vaping with less nicotine or less vaping with more nicotine?

Does it matter?

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