CORESTA Joint Meeting
Seville, Spain
29 September 2013 – 3 October 2013

Prediction of smoke exposure from smoking time

Xavier Cahours,
Stéphane Colard,
Thomas Verron,
Rémi Julien,
Steve Purkis

Background

CORESTA Congress, 2012

Stéphane Colard, Thomas Verron, Steve Purkis, Xavier Cahours

Cigarette burning and alternative smoking regimes

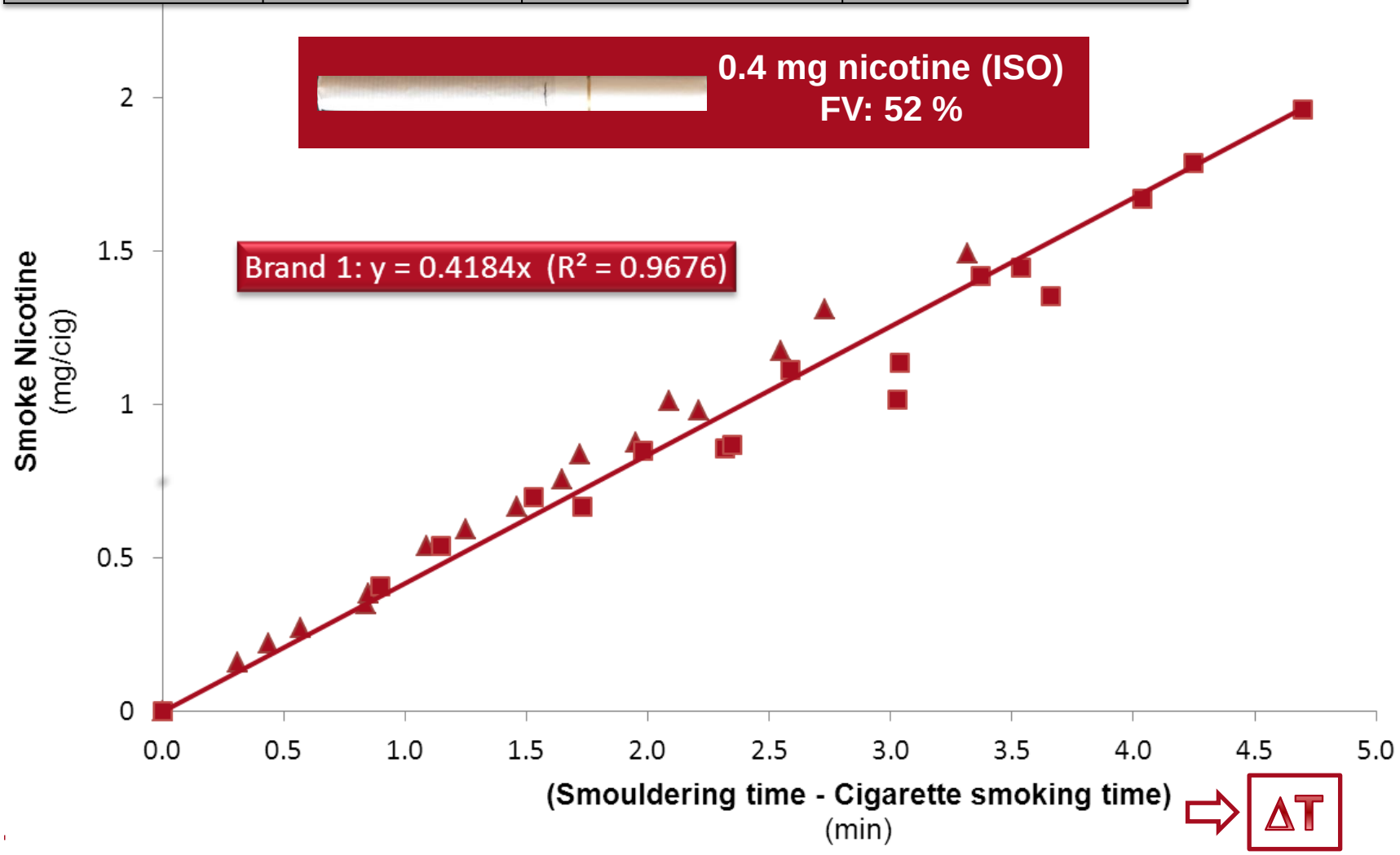
Conclusions

1. The burning of a cigarette smoked under various regimes can be described by a simple general sequential model
2. The cigarette smoke yield (TNCO) depends linearly on the difference of the time of smoking and smouldering, when either the ventilation is blocked or not
   - Smouldering rate and ISO smoking regime yield enable the characterisation of this link

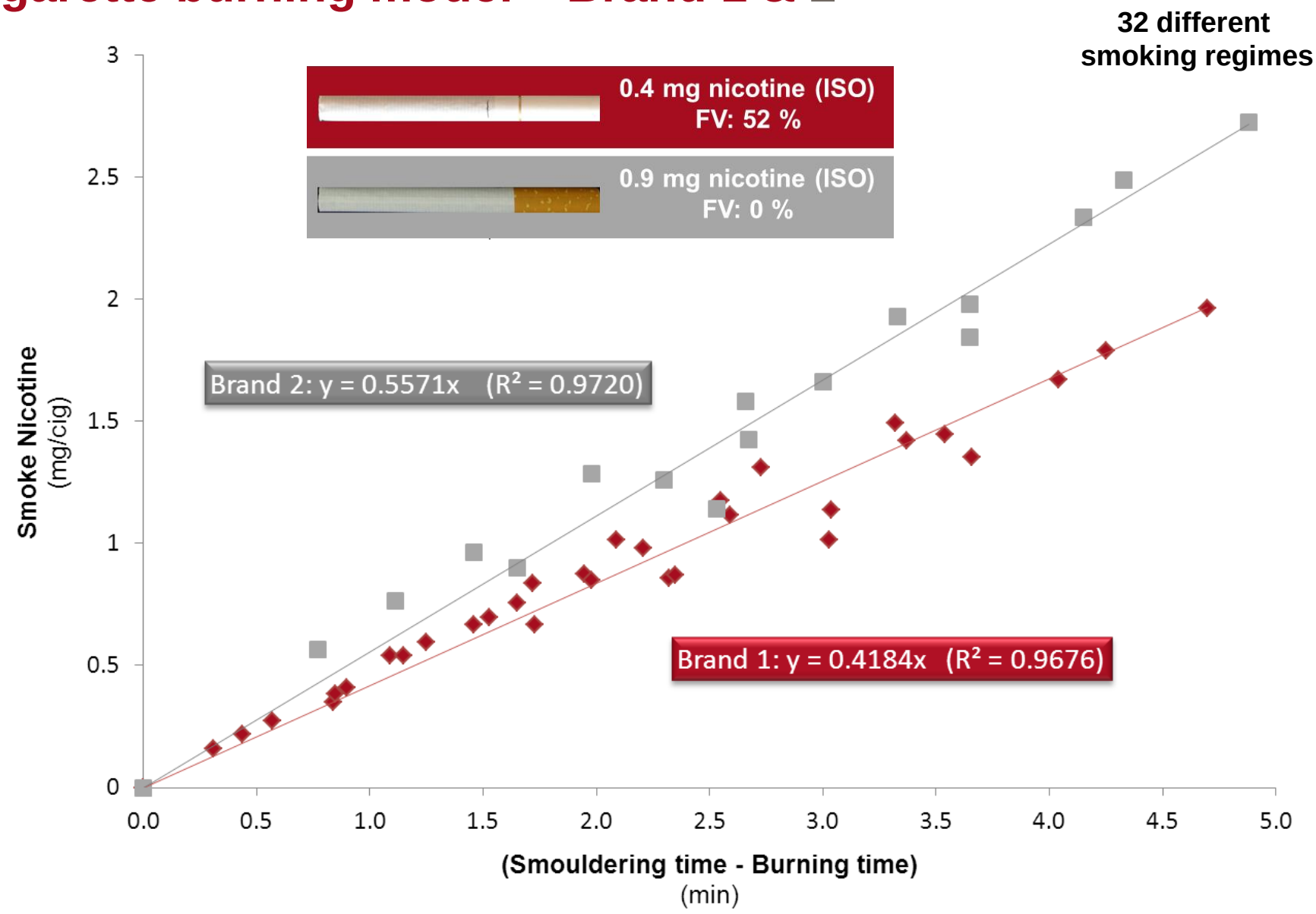
Cigarette burning model – Brand 1

32 different smoking regimes

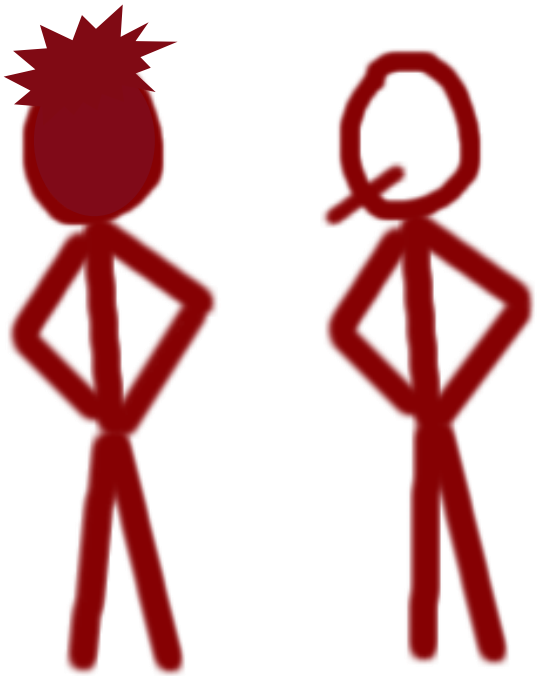
Puff interval (s)	Puff duration (s)	Puff volume (ml)	Filter Ventilation
20, 30, 40, 60	2s	17.5, 35, 55, 70	Unblocked & blocked



Cigarette burning model – Brand 1 & 2



What about the smokers?



What is the relationship between Human Smoking Nicotine yields and smoking time ?

Previous study

Qiwei Liang and al.

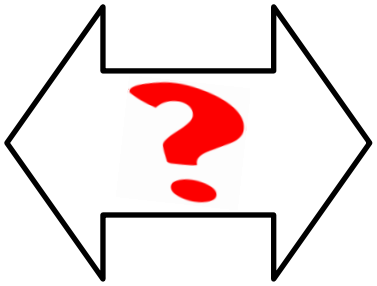
The effect of cigarette burn time on exposure to nicotine and carbon monoxide in adult smokers

Regulatory Toxicology and Pharmacology 50 (2008) 66–74

“Cigarette burn time (CBT), conventionally defined as the time a cigarette burns during smoking, can be affected by cigarette design and smoking behavior. CBT showed a negative correlation with nicotine equivalents and COHb, meaning that a longer burn time would result in lower exposure to nicotine and carbon monoxide.”

Purpose

Smoke Exposure

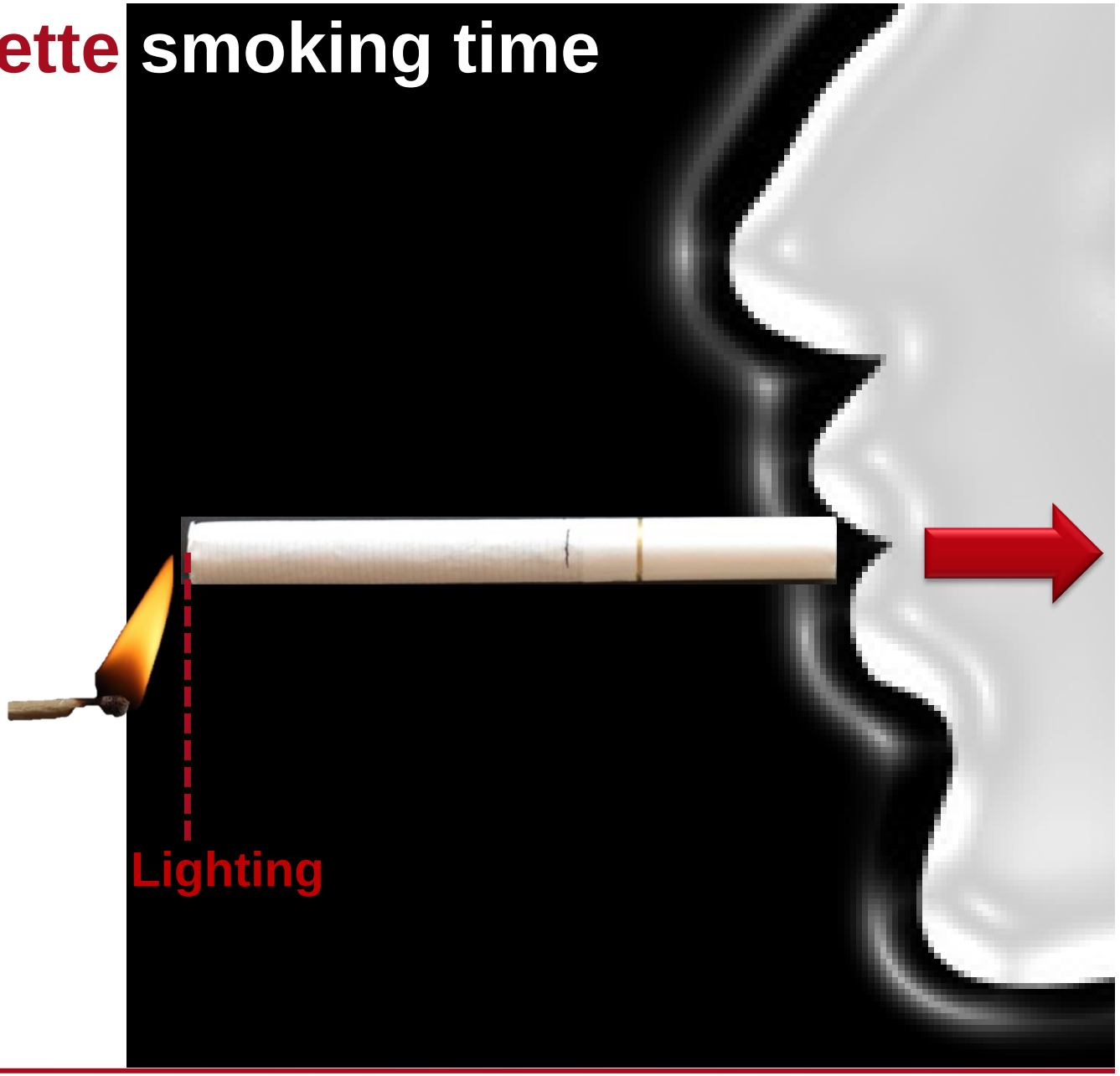


Smoking time

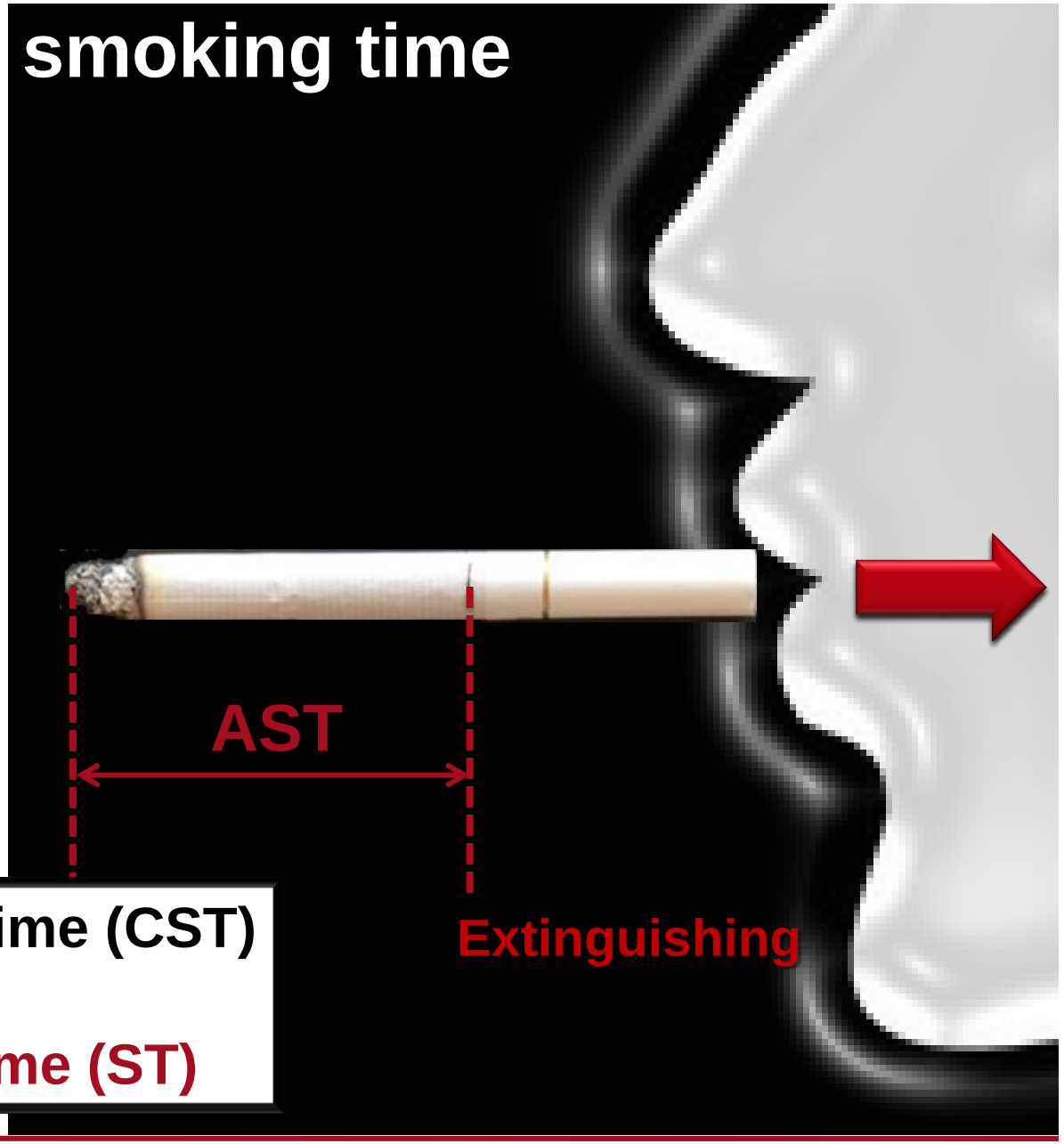
Human Smoking Nicotine yields

Smouldering time – Cigarette Smoking Time

Cigarette smoking time



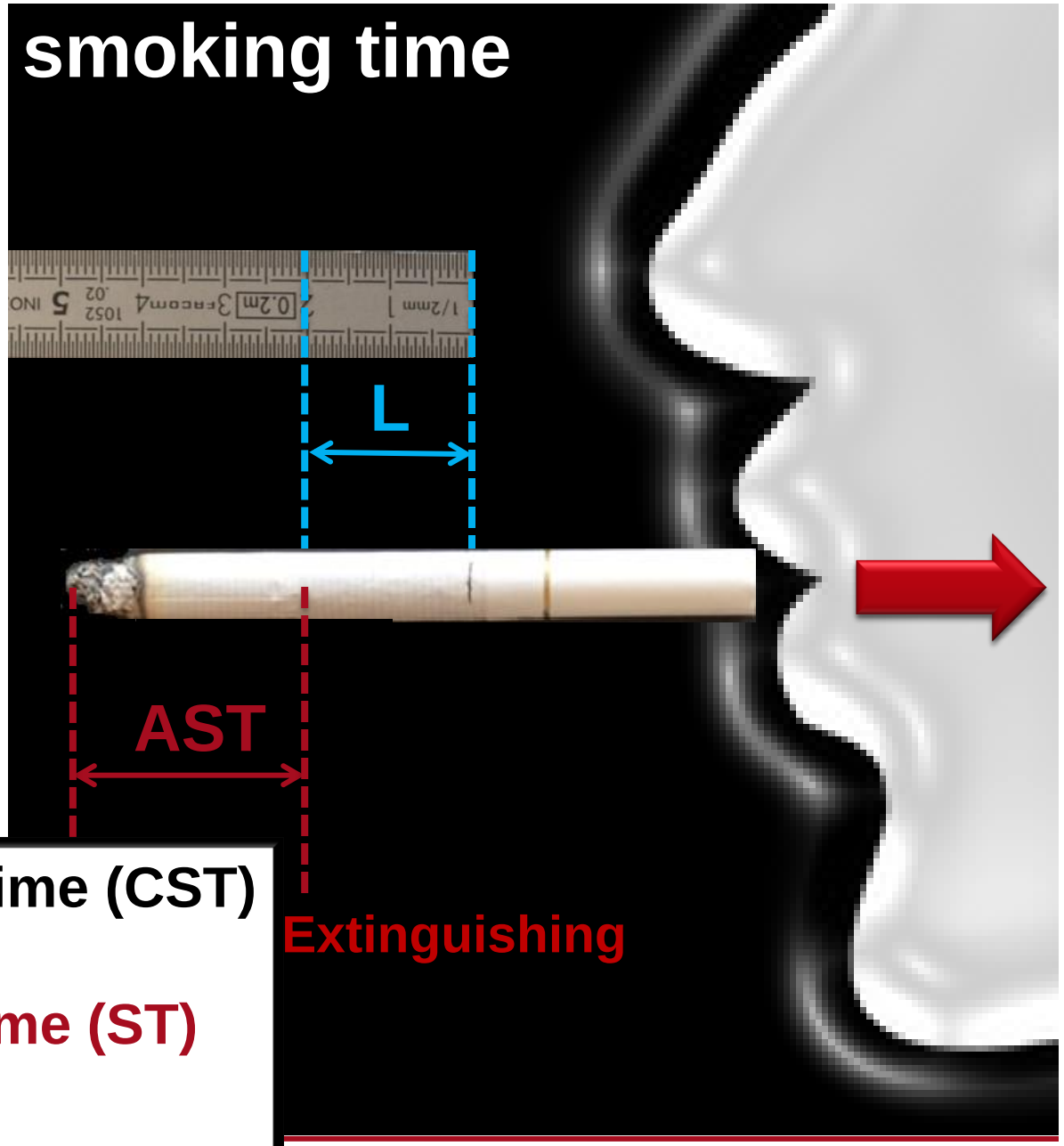
Cigarette smoking time



Cigarette Smoking time (CST)
=
Active Smoking time (ST)

AST: Smoking time (min)

Cigarette smoking time



Cigarette Smoking time (CST)

=

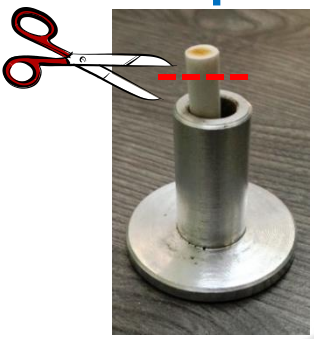
Active Smoking time (ST)

+

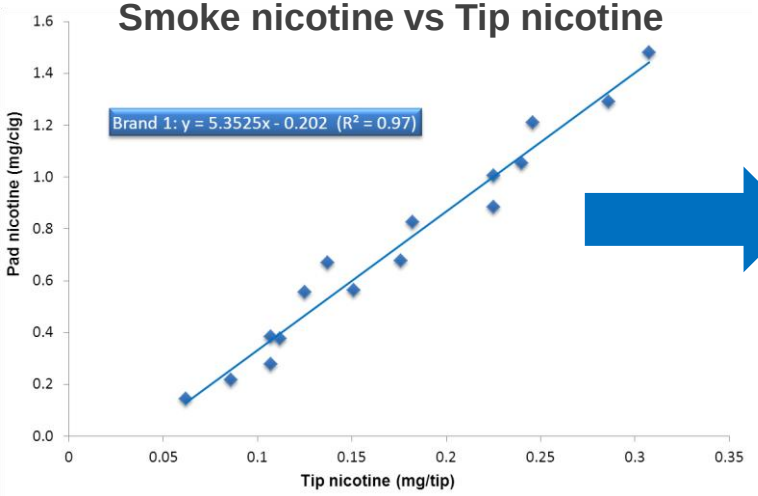
SR . L

HS Nic yield estimation

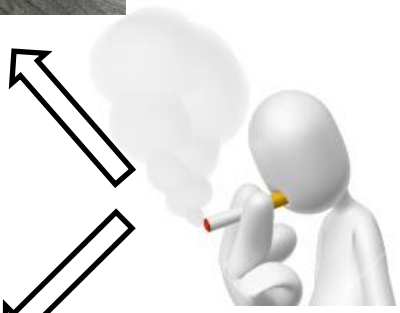
Tip



Tip nicotine

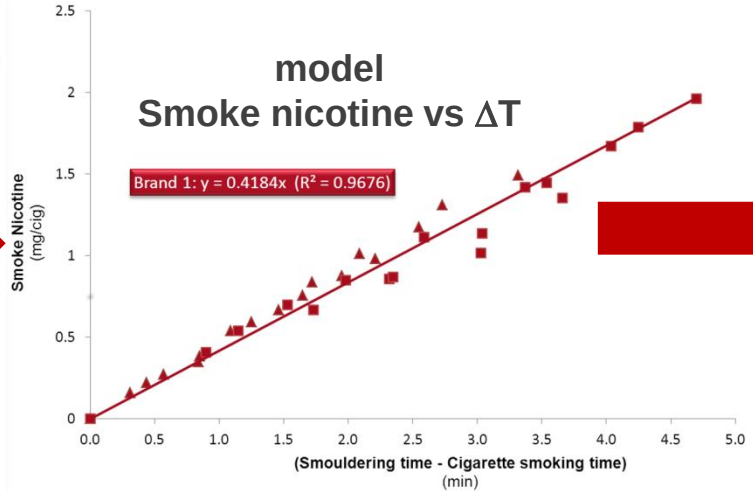


HS Nicotine yield $(HS\text{-}Nic)_{tip}$



?

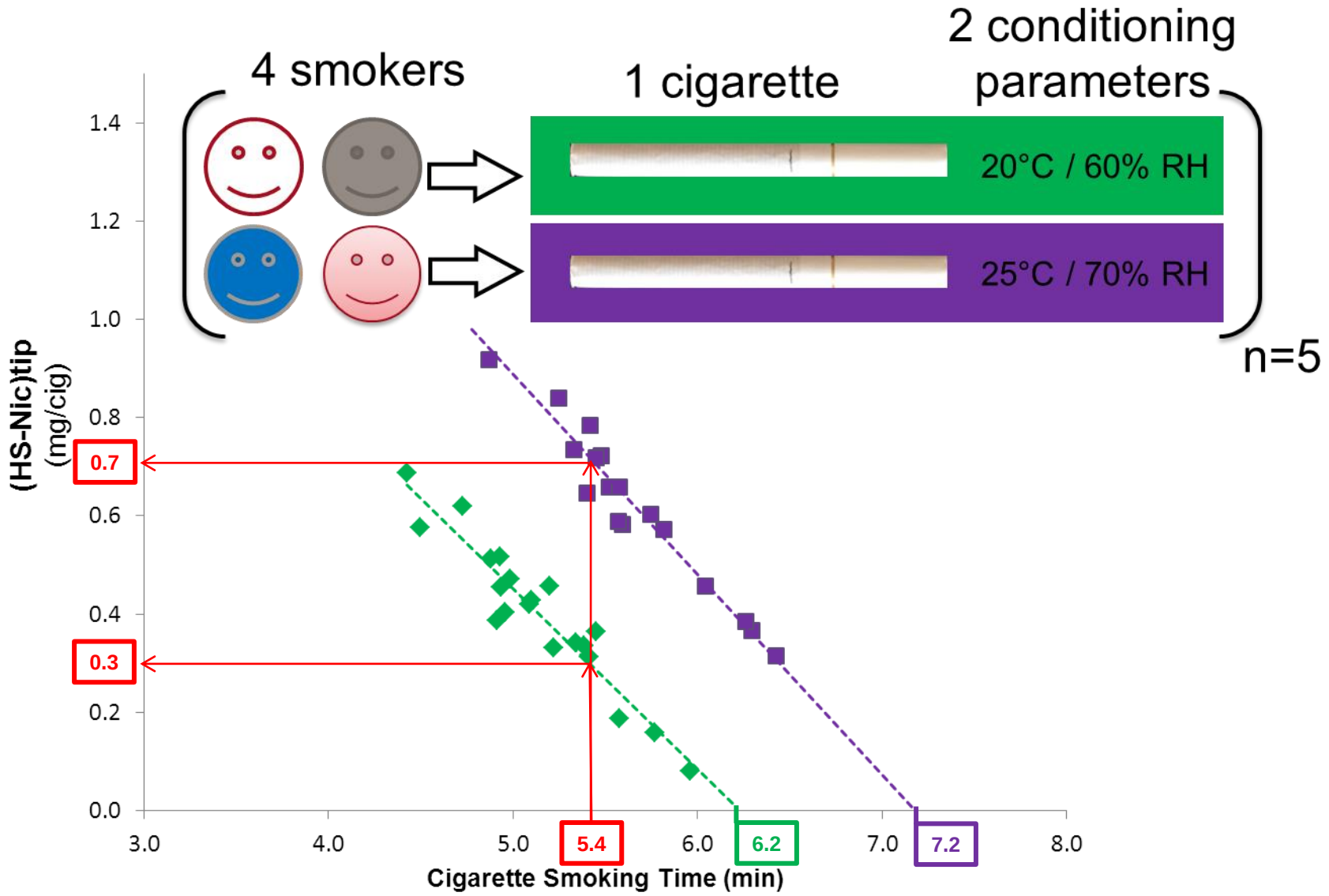
ΔT



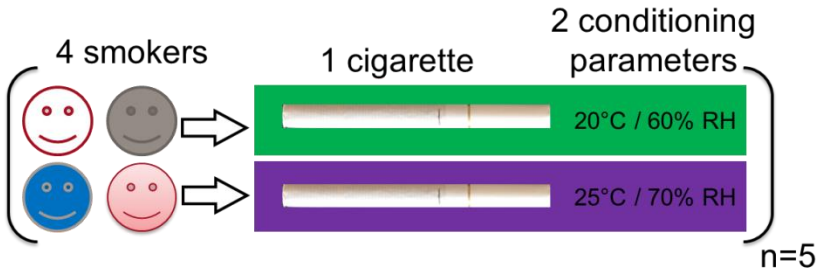
HS Nicotine yield $(HS\text{-}Nic)_{Time}$

Cigarette Smoking Time

$(HS\text{-}Nic)_{tip}$ vs Smoking time *(Smoker)*

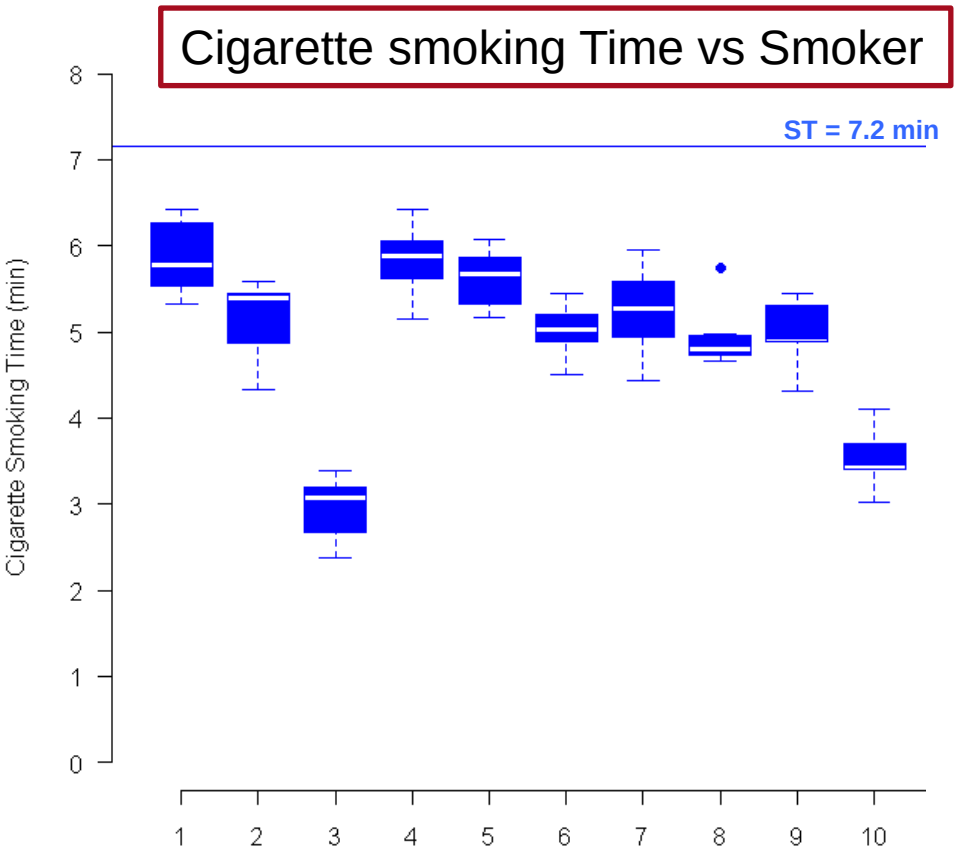


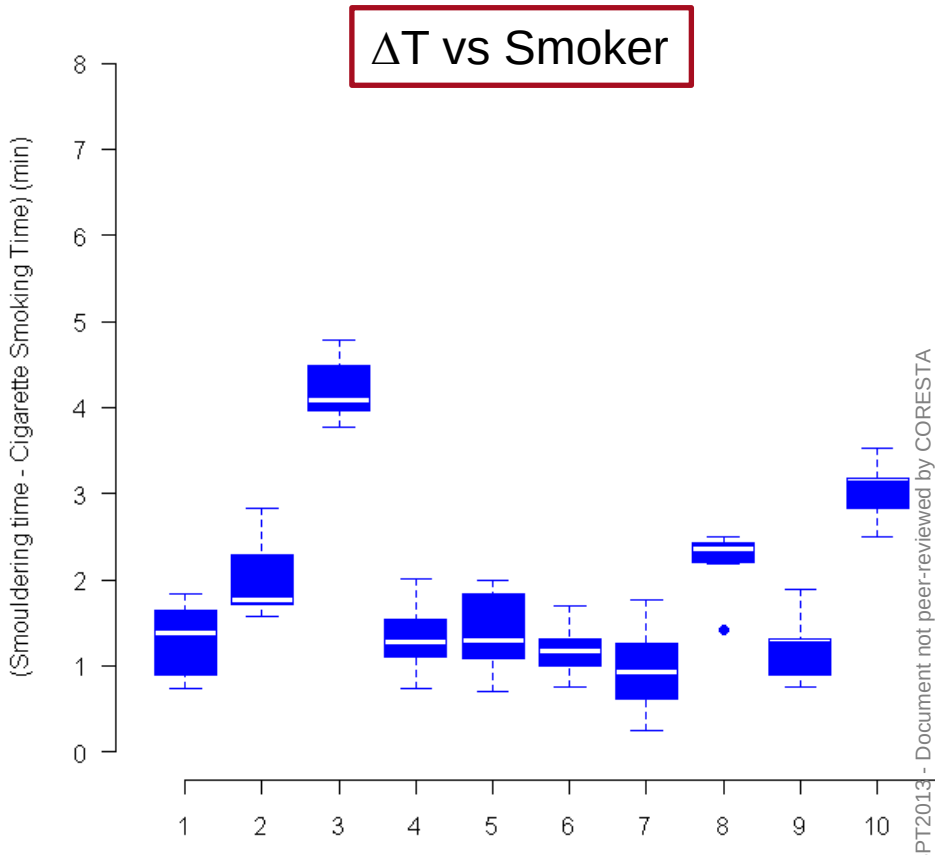
$(HS\text{-}Nic)_{tip}$ vs ΔT *(Smoker)*



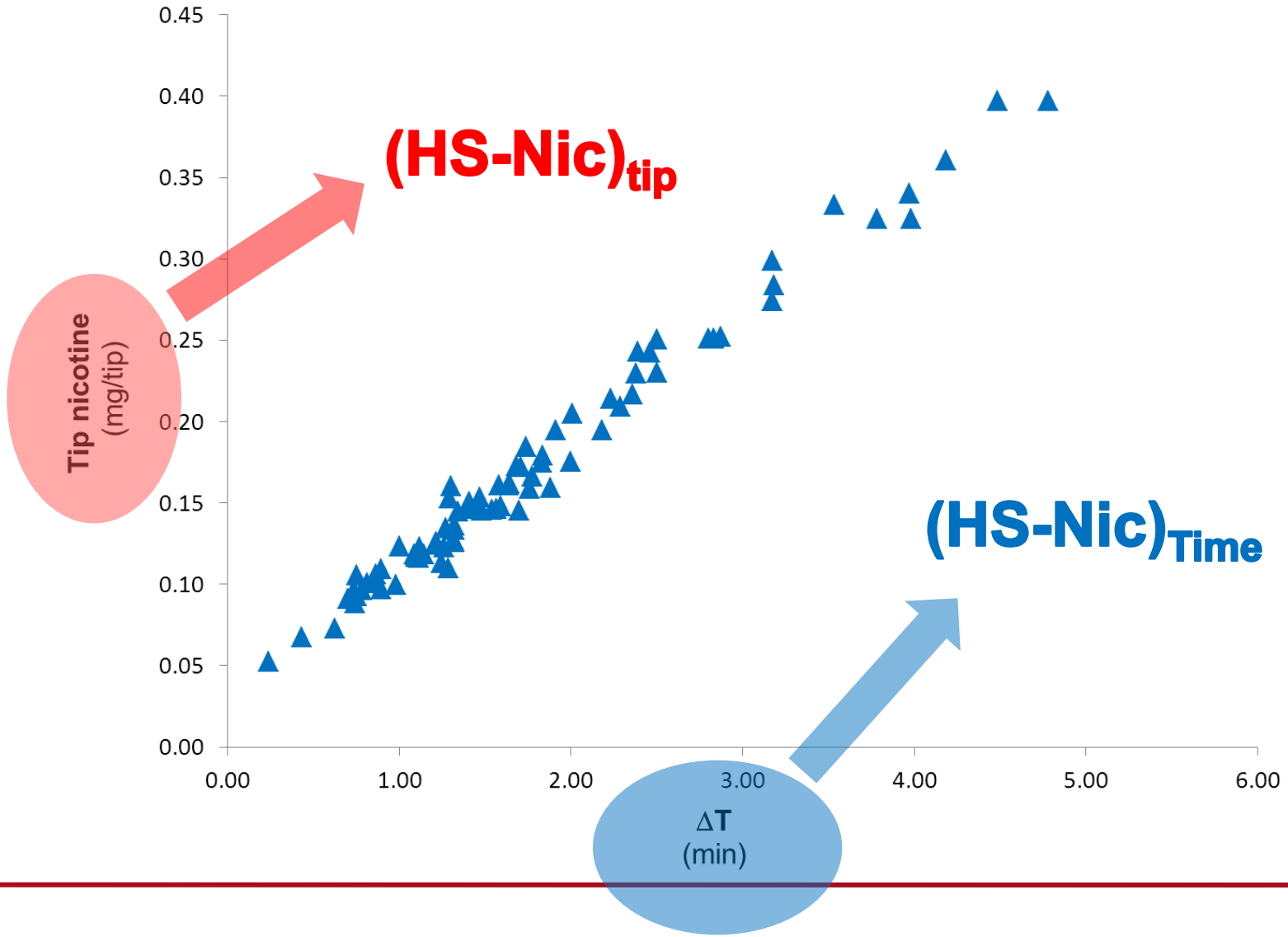
ΔT = (Smouldering time – Cigarette Smoking Time)

Cigarette smoking time *(Smoker)*





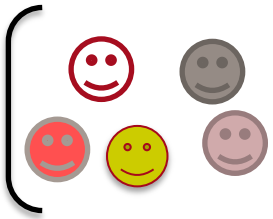
Tip nicotine vs ΔT *(Smoker)*



$(HS\text{-}Nic)_{tip}$ vs $(HS\text{-}Nic)_{Time}$ *(Smoker)*

$(HS\text{-}Nic)_{tip}$ vs $(HS\text{-}Nic)_{Time}$ *(Smoker)*

5 additional smokers



1cigarette (brand 1)

n=2
(different days)

Smoker	Replicate	$(HS\text{-}Nic)_{tip}$ (nic/cig)	$(HS\text{-}Nic)_{Time}$ (nic/cig)	Accuracy (%)
1	1 2	0.59 0.63	0.59 0.62	100.0 98.4
2	1 2	0.93 1.02	0.97 0.95	104.3 93.1
3	1 2	1.26 1.14	1.33 1.17	105.6 102.6
4	1 2	0.65 0.60	0.64 0.59	98.5 98.3
5	1 2	0.30 0.32	0.32 0.32	106.7 100.0

Intermediate conclusion

- **Cigarette smoke exposure (defined in this study as human smoking nicotine yield) can be assessed by measuring the cigarette smoking time**

Limitations

- Cigarette smoking time (CST) is dependent of Smouldering time (ST)

  ☞ Comparison of smokers must be carried out in controlled conditions (T°C and humidity)

  ☞ Comparison of cigarettes must be carried out using ΔT (CST-ST)

- Smouldering time must be measured

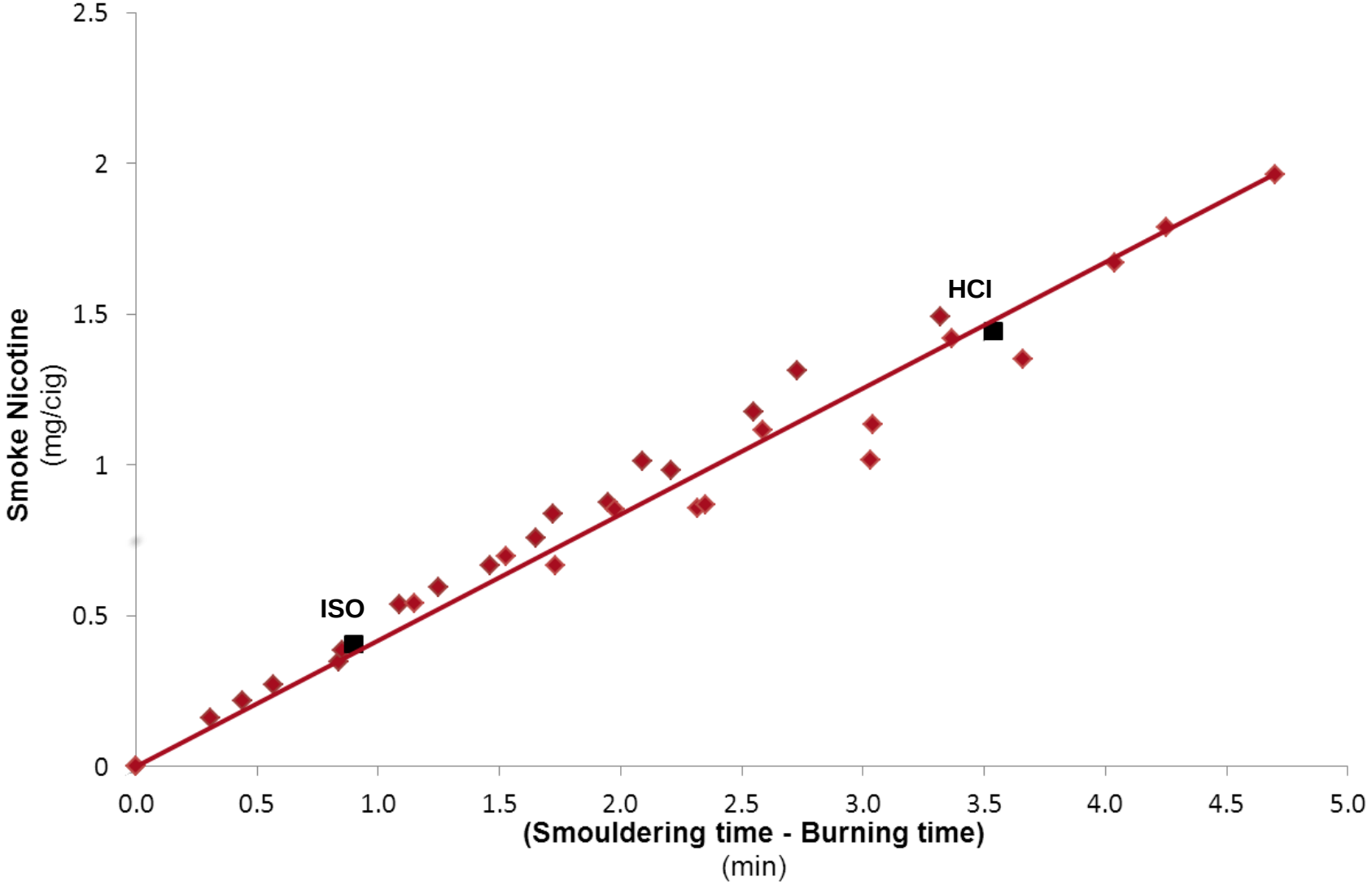
- Machine yields versus ΔT must be performed (only ISO?)

Advantages

- CST is relatively easy to measure and seems to capture aspects of puffing behavior relevant for exposure to nicotine
- We do not need to collect and analyse filter tip

Nicotine vs ΔT (Machine)

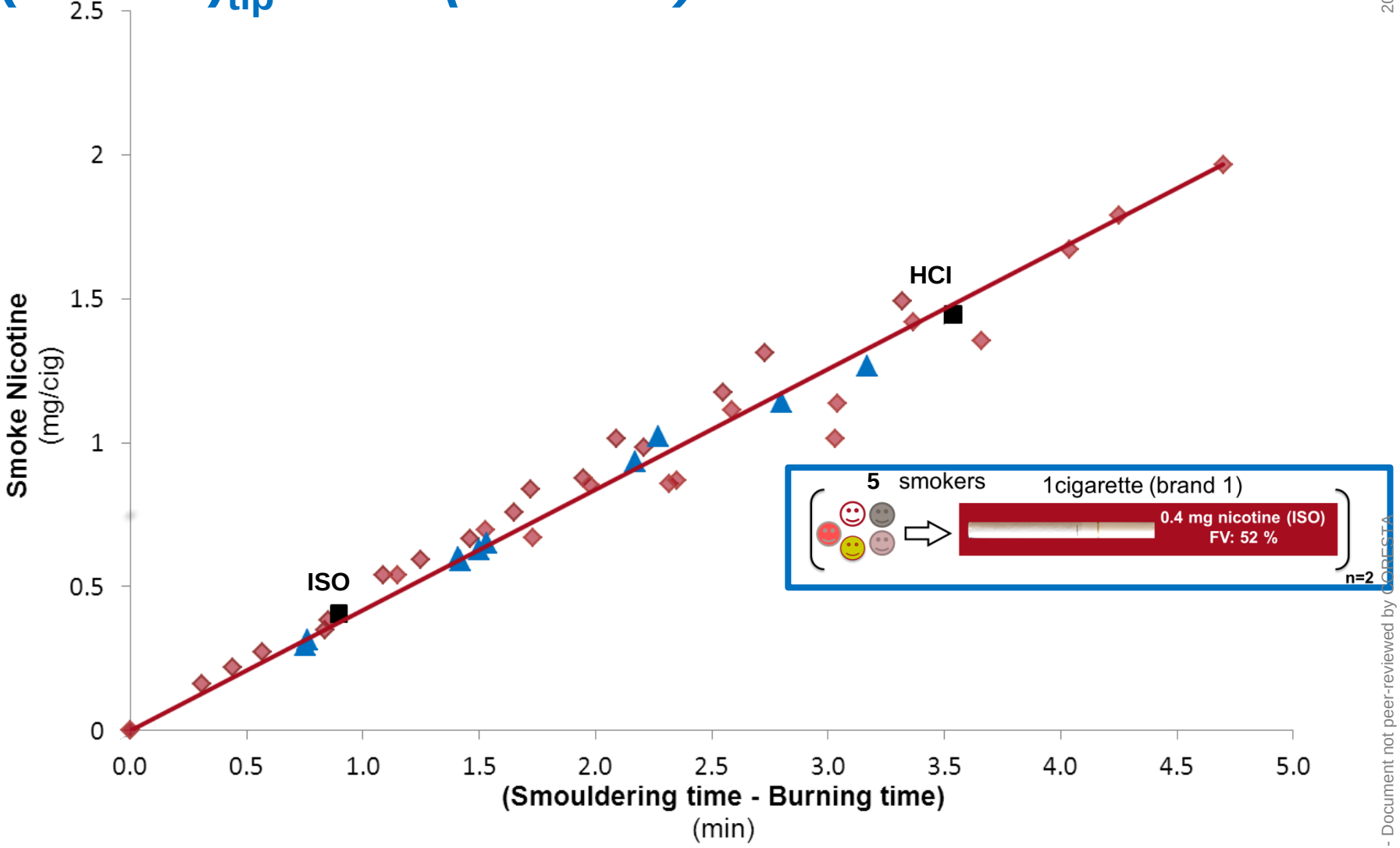
32 different smoking regimes



Nicotine vs ΔT (Machine)

$(HS\text{-}Nic)_{tip}$ vs ΔT*(Smoker)*

32 different smoking regimes



Nicotine vs ΔT (Machine)

32 different smoking regimes

Brand 2: y = 0.5571x (R² = 0.9720)

Smoke Nicotine (mg/cig)

(Smouldering time - Burning time) (min)

ISO

HCI

Nicotine vs ΔT (Machine)

$(HS_3\text{-}Nic)_{tip}$ vs ΔT*(Smoker)*

32 different smoking regimes

Brand 2: y = 0.5571x (R² = 0.9720)

Smoke Nicotine (mg/cig)

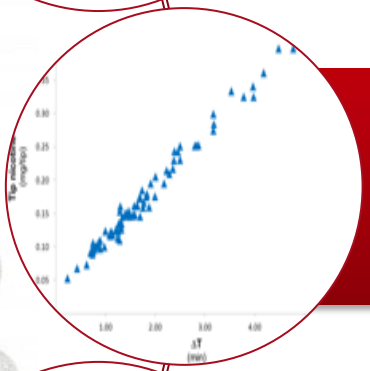
(Smouldering time - Burning time) (min)

ISO

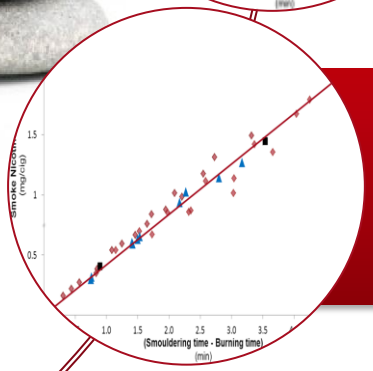
HCI

Conclusion

Whatever the human smoking puffing parameters, human smoking nicotine yield (HS-Nic yield) can be estimated by the difference of smouldering time and cigarette smoking time (ΔT)



Human smoking nicotine yields (HS-Nic yield) is a linear function of the ΔT



The relationship between HS-Nic yield and ΔT is similar for human and machine smoking

Imperial Tobacco

Questions ?

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www.imperialtobaccoscience.com

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