Inhibitory Control Training as a potential behavioural intervention for overweight and obesity.

Andrew Jones

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AIMS

- Background into Inhibitory Control and related cognitive processes, and how they might contribute to appetite regulation

- How can our environment influence our Inhibitory Control

- Can we train inhibitory control to improve healthy eating / reduce unhealthy eating

- Mechanisms, limitations and future research

Inhibitory control

- 'the (in)ability to stop, change or delay a behaviour that is no longer appropriate, in the current environment (Logan et al 1988)'

- *Think of a traffic light*

- Fundamental behavioural component of 'impulsivity' and 'executive functioning'

- Useful endophenotype for
  psychiatric disorders (Aron, 2011)

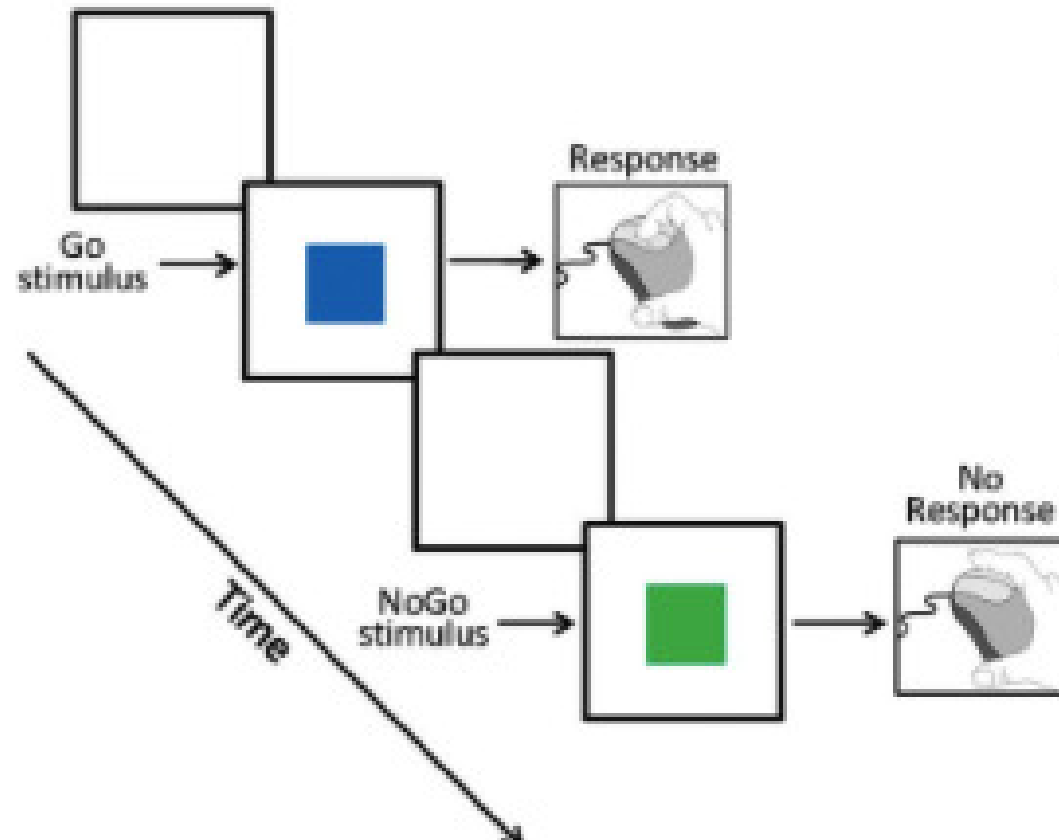"I can resist everything except temptation." - Oscar Wilde

Real world 'disinhibition'

- Substantial overlap with self-control.

- Estimates suggest 80 / 90% of self-regulation requires some form of stopping a response (Baumeister, 2015).

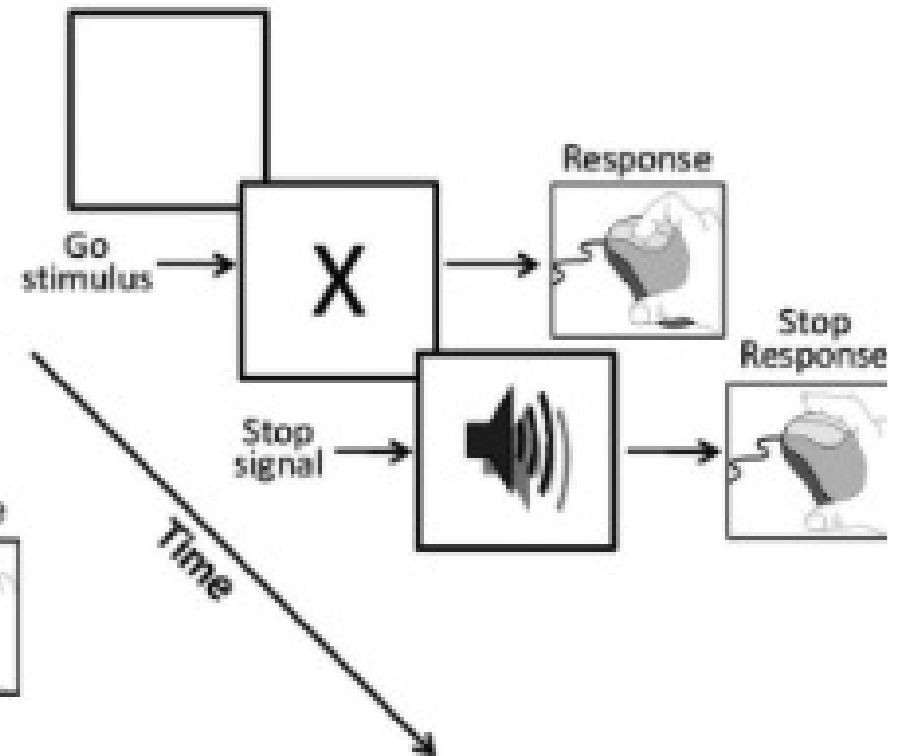- Slaves to our 'obesogenic' environment (Jones et al, in press)

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Measuring inhibition in the lab:

(a) Go-NoGo task

(b) Stop Signal task

Obesity and cognitive biases

- Cognitive profile may confer vulnerability to overweight and obesity, but fortunately these processes may be modifiable (Jansen et al, 2014)

- Inability to inhibit behaviours

- Hyper-valuation of reward stimuli.

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Hyper-valuation

- **Attention**

- Individuals demonstrate attentional bias to food cues when hungry. This bias persists in obese individuals (Castellanos et al, 2009).

- Food cues capture the attention more quickly in obese individuals (Werthmann et al 2013)

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Hyper-valuation

- **Approach**:

- Obese individuals are faster to pair food-related words with approach (Kemps et al 2015).

- Approach biases for chocolate are correlated with chocolate craving (Kemps et al 2013)


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Fluctuations in disinhibition

- There is an interaction between inhibitory control and hyper-valuation of reward stimuli.

- Attention and inhibition compete for resources.

  - Houben et al (2014) – cue-specific disinhibition predicts BMI
  - Loeber et al (2012) – not specific to obese individuals
  - Jones and Field (2015) – unique disinhibition

- These fluctuations in inhibitory control may put individuals 'at risk' for substance use / overeating (c.f. Guerrieri et al 2009; Jones et al 2011a , b)

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The effects of cues are strong
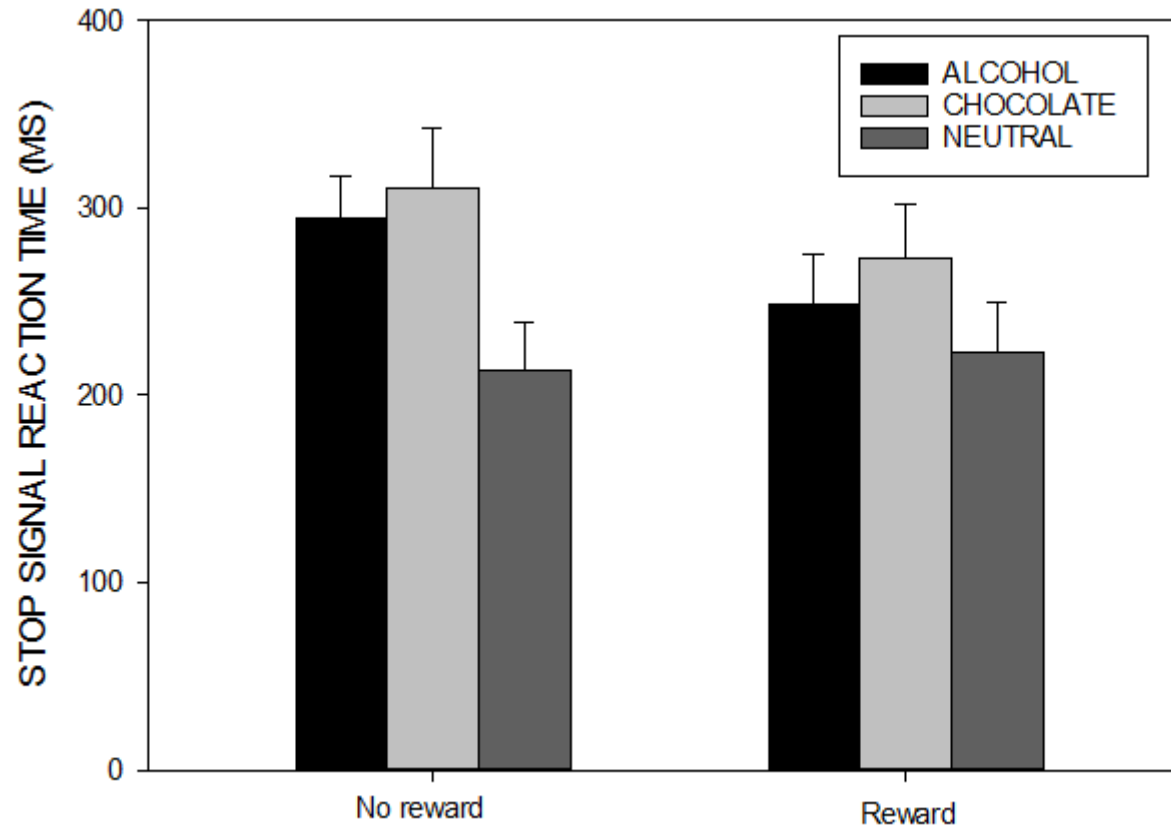
Main effect of cue – no interaction with reward (Jones et al, in preparation)

Potential pathways and moderators
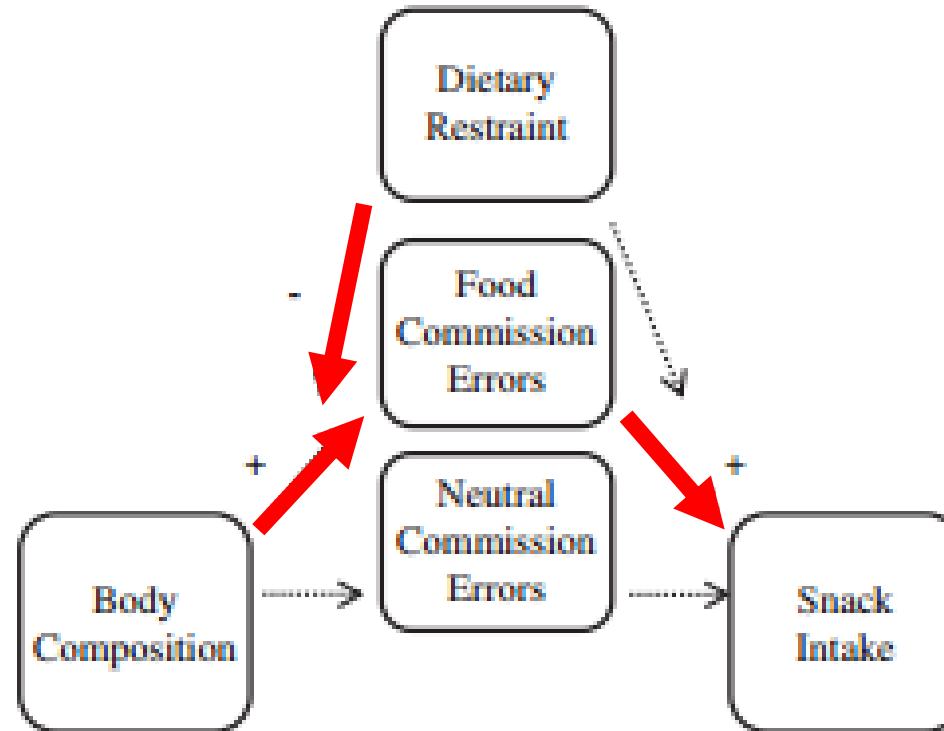
Figure 4. Significant pathways in the moderated-mediation model for the food-based and neutral go/no-go tasks (controlling for baseline hunger, gender and alcohol consumption). Significant pathways are denoted by solid arrows ($P < 0.05$), and nonsignificant pathways are denoted by dotted arrows. The +/− symbol denotes the direction (positive or negative) of the relationship.

Price et al (2016)

So far.....

- We know inhibitory control is not stable. It is responsive to the environment and internal signals.

- It can automatically engaged
  - Verbruggen et al (2008) – inhibition easier and more effective following STOP primes.

- Can it 'train' automatic inhibition?

Inhibitory control training

Premise: Appetitive stimuli cause transient impairments in the ability to control behavior. Can we train individuals to exert control to appetitive cues.

Cue specific inhibition training

The Effects of Cue-Specific Inhibition Training on Alcohol Consumption in Heavy Social Drinkers

Andrew Jones and Matt Field
University of Liverpool, Liverpool, United Kingdom

Associatively pair inhibition responses with alcohol related cues.

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Typical ICT study

	Mostly stop	**Mostly go**
Inhibition training condition		
	Mostly go	**Mostly stop**
Control training condition		
	Always go	**Always go**
No inhibition condition		
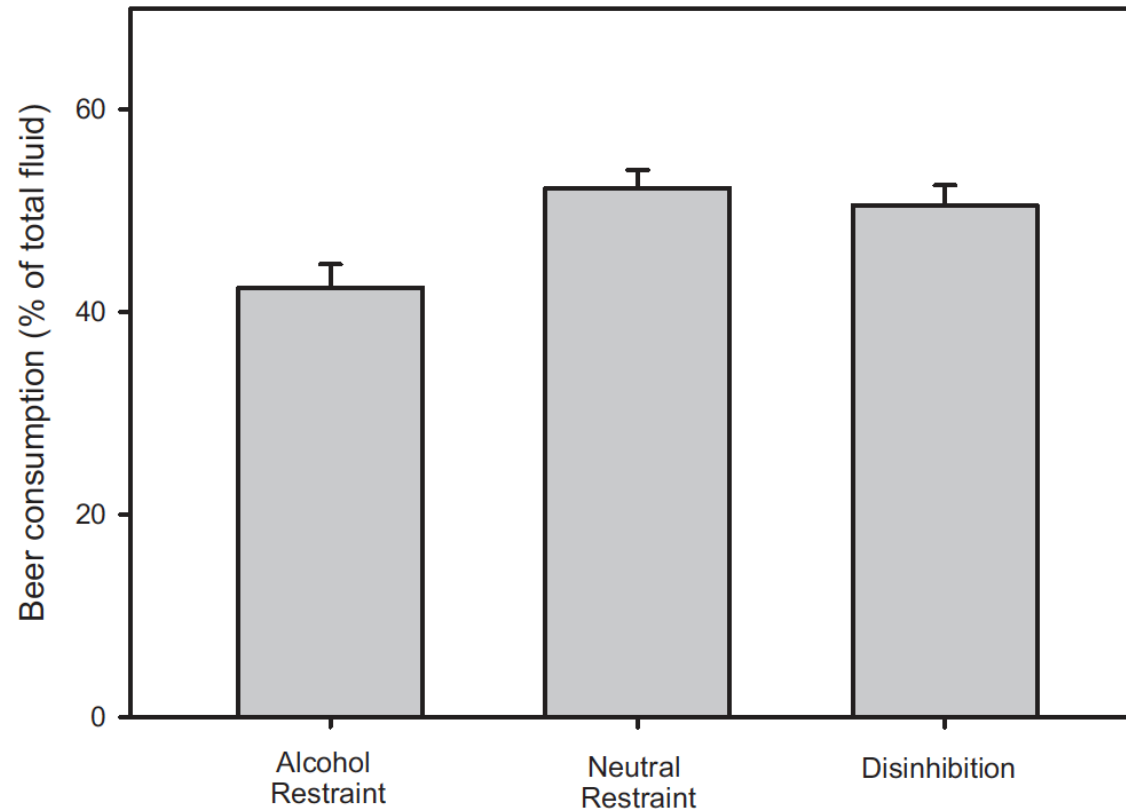
Also demonstrated an **overall reduction in craving.**

No effect on alcohol consumption outside of the laboratory

Similar results in food

Lawrence et al (2015)

Reduction in crisp and chocolate intake. *Stop Signal task*

Houben et al (2015)

Inhibitory control training reduces chocolate intake. *Go/No-Go task*

Werthmann et al (2013)

Reduction in chocolate intake. *Anti-saccade task.*

33% reduction
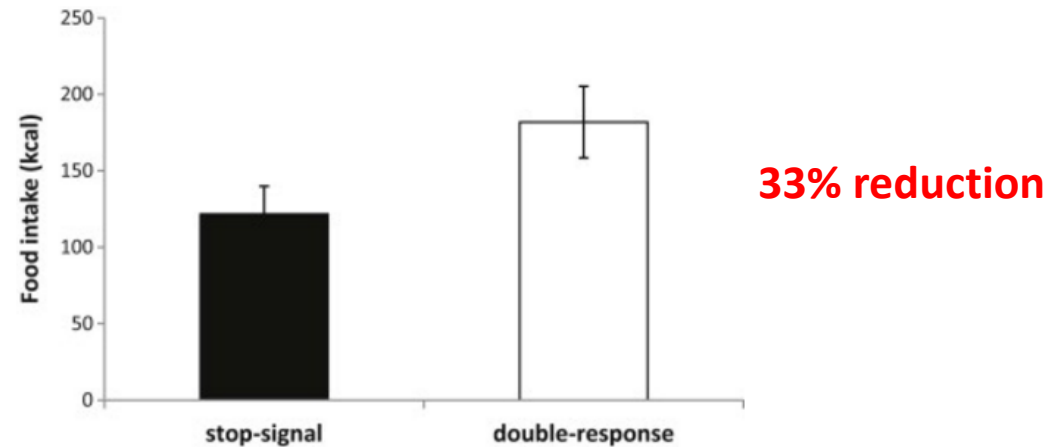
Fig. 3.
Crisp consumption in participants performing a food-related stop-signal task (Experiment 1) relative to those performing a food-related double-response task. Graphs display group mean intake ± standard errors.

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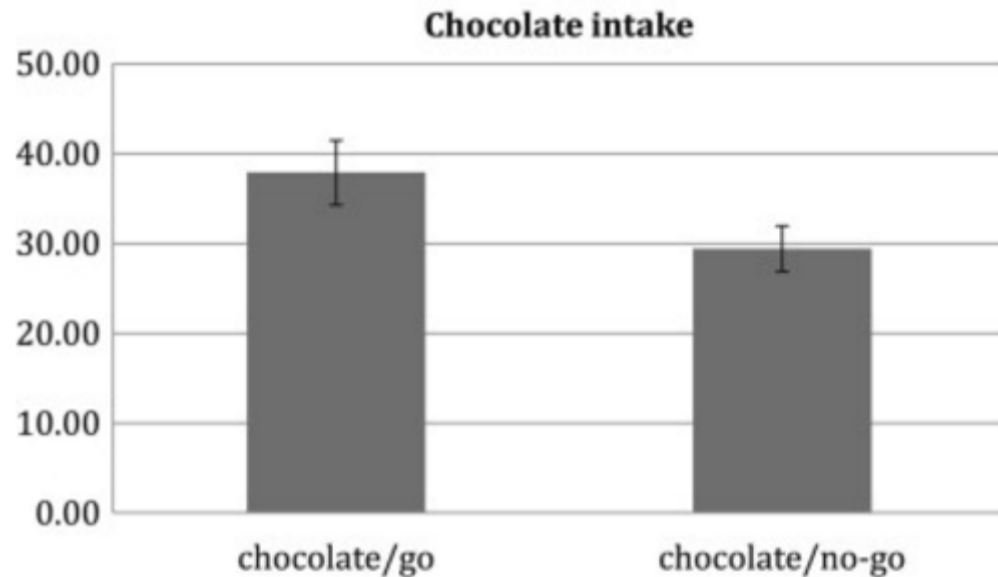
Are the effects of ICT robust?

Research review

Inhibitory control training for appetitive behaviour change: A meta-analytic investigation of mechanisms of action and moderators of effectiveness

Andrew Jones [a,b,*], Lisa C.G. Di Lemma [a,b], Eric Robinson [a,b], Paul Christiansen [a,b], Sarah Nolan [c], Catrin Tudur-Smith [c], Matt Field [a,b]

[a] Department of Psychological Sciences, University of Liverpool, Liverpool, United Kingdom
[b] UK Centre for Tobacco and Alcohol Studies, Liverpool, United Kingdom
[c] Department of Biostatistics, University of Liverpool, Liverpool, United Kingdom

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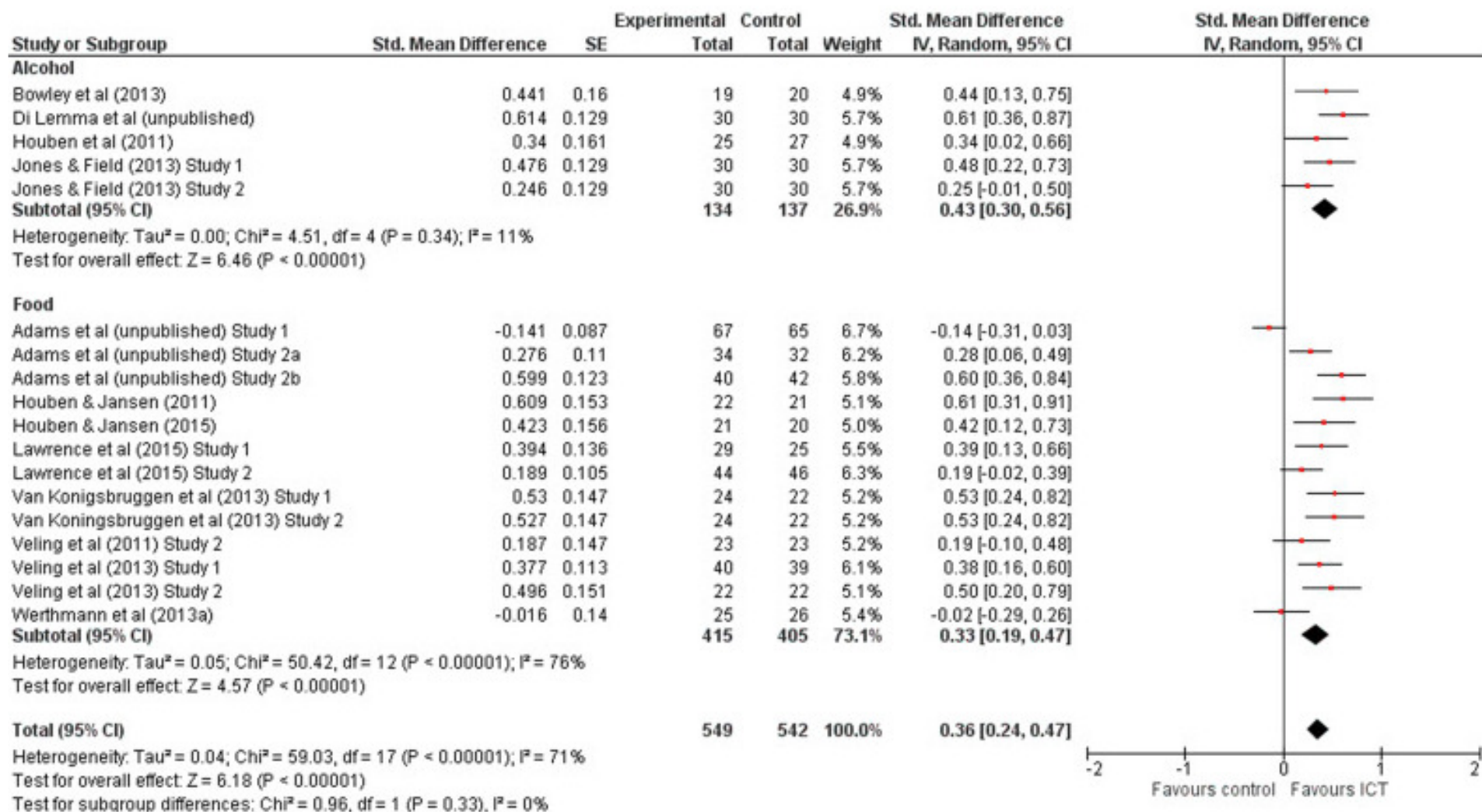| Study or Subgroup	Std. Mean Difference	SE	Experimental Total	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI	Std. Mean Difference IV, Random, 95% CI
Alcohol							
Bowley et al (2013)	0.441	0.16	19	20	4.9%	0.44 [0.13, 0.75]	
Di Lemma et al (unpublished)	0.614	0.129	30	30	5.7%	0.61 [0.36, 0.87]	
Houben et al (2011)	0.34	0.161	25	27	4.9%	0.34 [0.02, 0.66]	
Jones & Field (2013) Study 1	0.476	0.129	30	30	5.7%	0.48 [0.22, 0.73]	
Jones & Field (2013) Study 2	0.246	0.129	30	30	5.7%	0.25 [-0.01, 0.50]	
Subtotal (95% CI)			134	137	26.9%	0.43 [0.30, 0.56]	
Heterogeneity: Tau² = 0.00; Chi² = 4.51, df = 4 (P = 0.34); I² = 11%							
Test for overall effect: Z = 6.46 (P < 0.00001)							
Food							
Adams et al (unpublished) Study 1	-0.141	0.087	67	65	6.7%	-0.14 [-0.31, 0.03]	
Adams et al (unpublished) Study 2a	0.276	0.11	34	32	6.2%	0.28 [0.06, 0.49]	
Adams et al (unpublished) Study 2b	0.599	0.123	40	42	5.8%	0.60 [0.36, 0.84]	
Houben & Jansen (2011)	0.609	0.153	22	21	5.1%	0.61 [0.31, 0.91]	
Houben & Jansen (2015)	0.423	0.156	21	20	5.0%	0.42 [0.12, 0.73]	
Lawrence et al (2015) Study 1	0.394	0.136	29	25	5.5%	0.39 [0.13, 0.66]	
Lawrence et al (2015) Study 2	0.189	0.105	44	46	6.3%	0.19 [-0.02, 0.39]	
Van Konigsbruggen et al (2013) Study 1	0.53	0.147	24	22	5.2%	0.53 [0.24, 0.82]	
Van Koningsbruggen et al (2013) Study 2	0.527	0.147	24	22	5.2%	0.53 [0.24, 0.82]	
Veling et al (2011) Study 2	0.187	0.147	23	23	5.2%	0.19 [-0.10, 0.48]	
Veling et al (2013) Study 1	0.377	0.113	40	39	6.1%	0.38 [0.16, 0.60]	
Veling et al (2013) Study 2	0.496	0.151	22	22	5.1%	0.50 [0.20, 0.79]	
Werthmann et al (2013a)	-0.016	0.14	25	26	5.4%	-0.02 [-0.29, 0.26]	
Subtotal (95% CI)			415	405	73.1%	0.33 [0.19, 0.47]	
Heterogeneity: Tau² = 0.05; Chi² = 50.42, df = 12 (P < 0.00001); I² = 76%							
Test for overall effect: Z = 4.57 (P < 0.00001)							
Total (95% CI)			549	542	100.0%	0.36 [0.24, 0.47]	
Heterogeneity: Tau² = 0.04; Chi² = 59.03, df = 17 (P < 0.00001); I² = 71%							
Test for overall effect: Z = 6.18 (P < 0.00001)							
Test for subgroup differences: Chi² = 0.96, df = 1 (P = 0.33), I² = 0%							

-2   -1   0   1   2
Favours control   Favours ICT

d = 0.36 – small to medium effect size.

Similar effects on both food and alcohol consumption

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Other findings?

- Effects were larger in individuals who were motivated to reduce food intake (Current dieters, those high in dietary restraint).
- ***Important***

- Effect sizes were similar to other brief interventions (implementation intentions, BAI).
  - Not driven by control conditions approaching appetitive cues

- Number of trials / Length of training didn't influence the effect size.
  - Suggests high compliance, and feasibility outside of the lab

Moving past proof-of-concept stage

- Small but robust effects of one session of ICT in the lab.

- Repeated sessions?
  - Veling et al (2014): four sessions over one month lead to reductions in body weight.
  - Lawrence et al (2015): up to four sessions in one week led to reductions in weight, snaking frequency but also 'liking' of snack foods
  - Allom and Mullan (2015): mixed findings
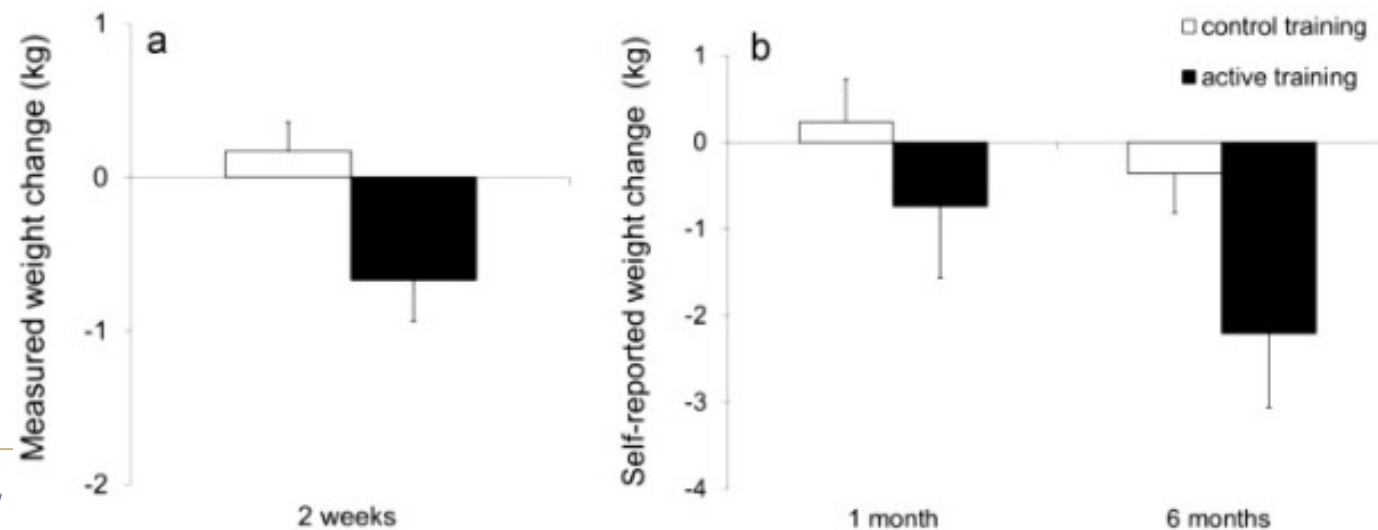
Science

🏠 › Science

Lose weight without dieting: simple 10-minute game retrains brain to avoid junk food

Can YOU train your brain to lose weight? Play the online game that claims to help you shed 0.7kg in ONE WEEK

- Researchers at Exeter and Cardiff University claim the game can help some people eat 220 fewer calories a day

EveningStandard. News   Football   Going Out   Lifestyle   Showbiz   Homes & Property   Food Month
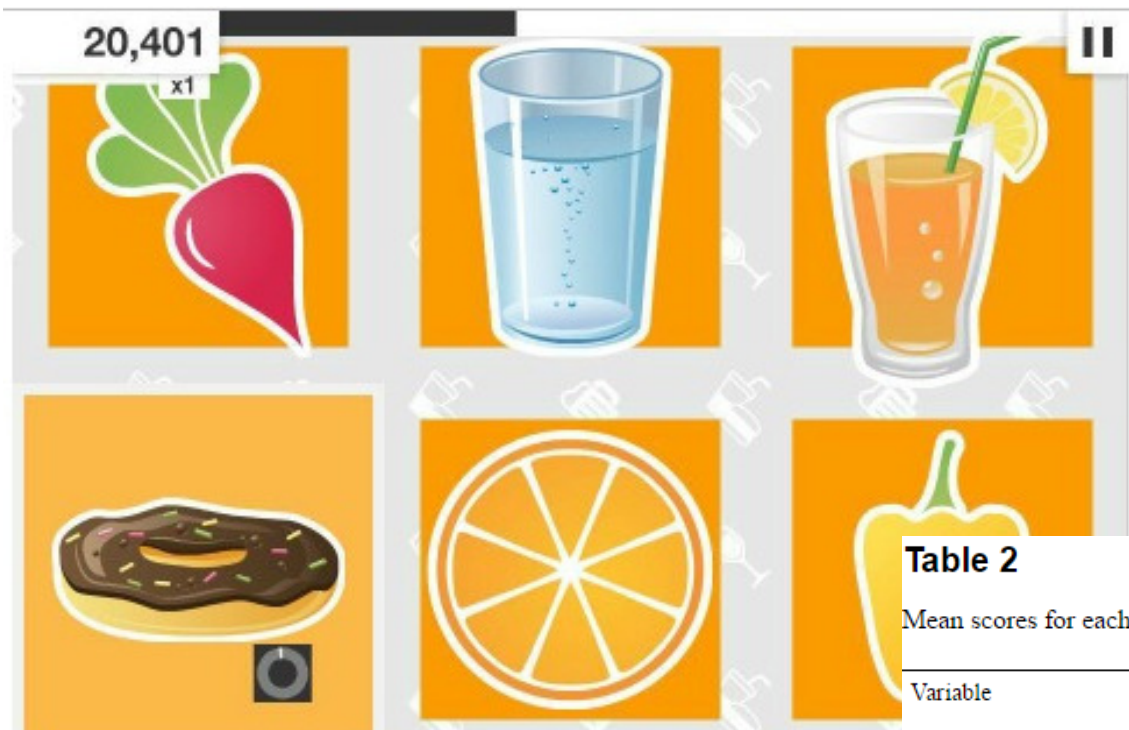
Lifestyle

This new app thinks it can train your brain to stop craving unhealthy foods

The app is called FoodT and is currently available only on Android and online

Smartphone and web-based 'apps'

Table 2

Mean scores for each outcome; only statistically significant results are shown.

Variable	Participant group			
	Training		Waitlist	
	Baseline	Time 2	Baseline	Time 2
Healthy Eating Quiz	36.96	42.42	39.58	35.88
FCT[a]: healthy food	63.17	31.59	-	-
FCT: unhealthy food	234.68	76.50	-	-
TFEQ[b]: hunger	-	-	5.58	6.88
TFEQ: cognitive restraint	9.27	11.50	-	-

[a] FCT: food consumption test.

[b] TFEQ: Three-Factor Eating Questionnaire.

Blackburne et al (2016)

What do people think of ICT

- *Sample responses to questions about whether participants' felt the training influenced their snacking or was "helpful"*

- *"I feel less inclined to reach for biscuits – they are less appealing." (participant 1)*

- *"The task influenced my snacking – I replaced sweets with strawberries. It is hard to explain why" (participant 6)*

- *"The task made me 'not bothered' about snacking on food – I haven't felt like it. This felt partially conscious but not entirely. I was not eating/seeking snacks." (participant 16)*

- *"I think it influenced me. Someone gave me chocolate yesterday but I didn't get the same taste I normally would." (participant 33)*

- *"It made healthy foods more attractive (salad, carrots) than non-healthy. It made me think more about foods I ate." (participant 38)*

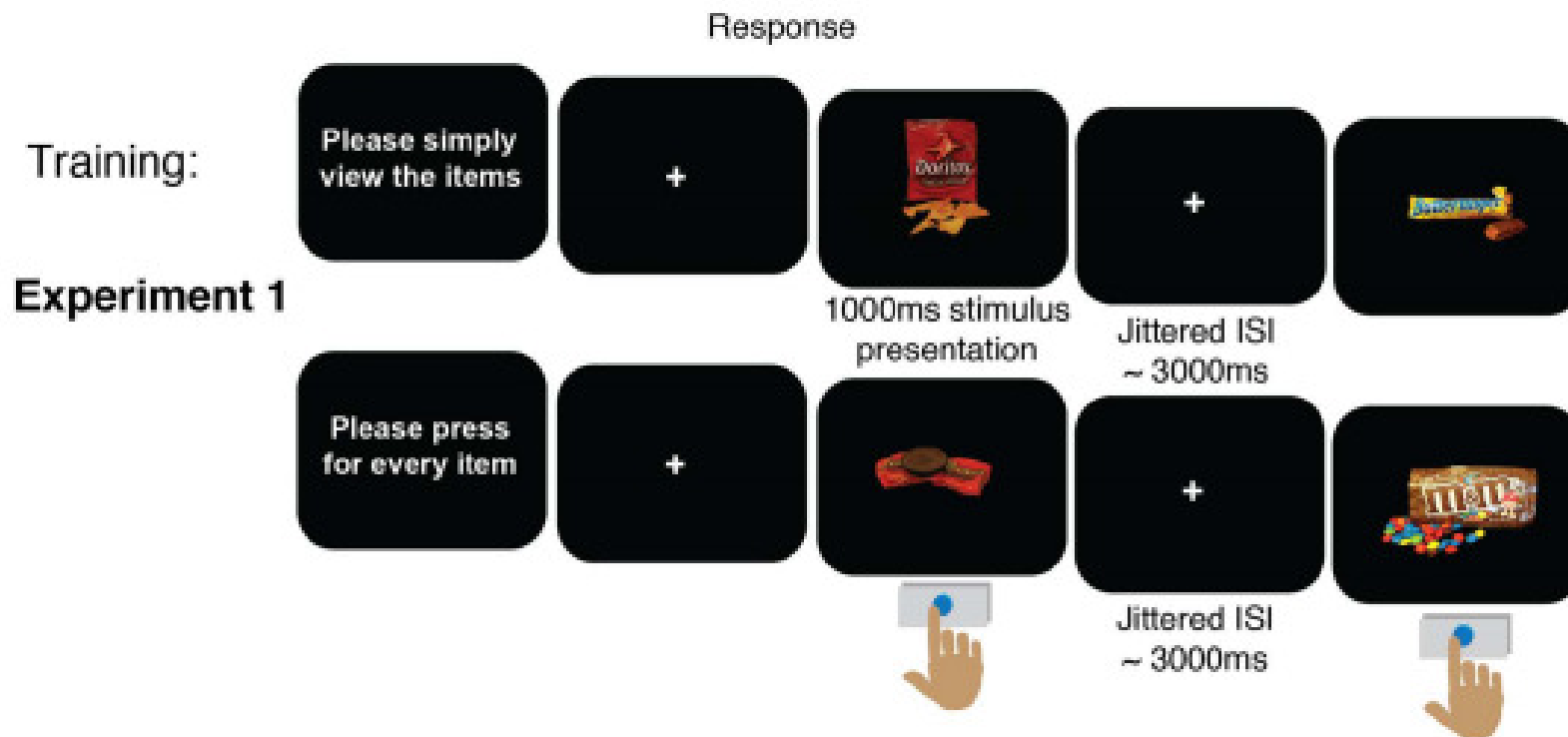*What are the underlying mechanisms of inhibitory control training.*

Stimulus devaluation?

A.

Not at all   Very much

Not at all   Very much
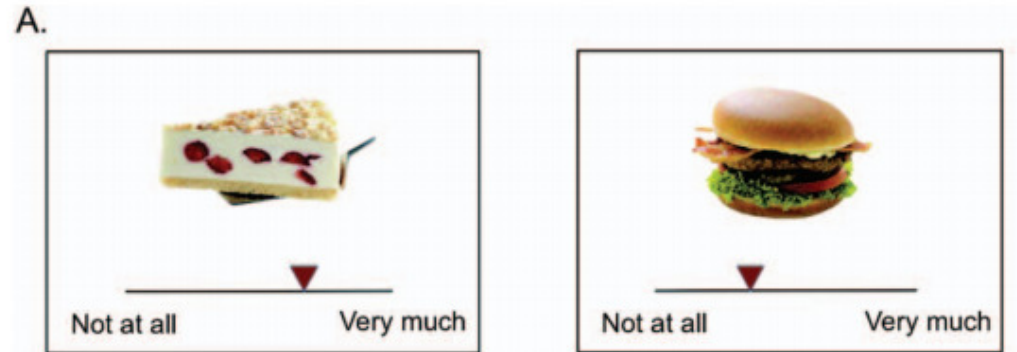
Learning an abstract rule?

'If chocolate, then don't go'
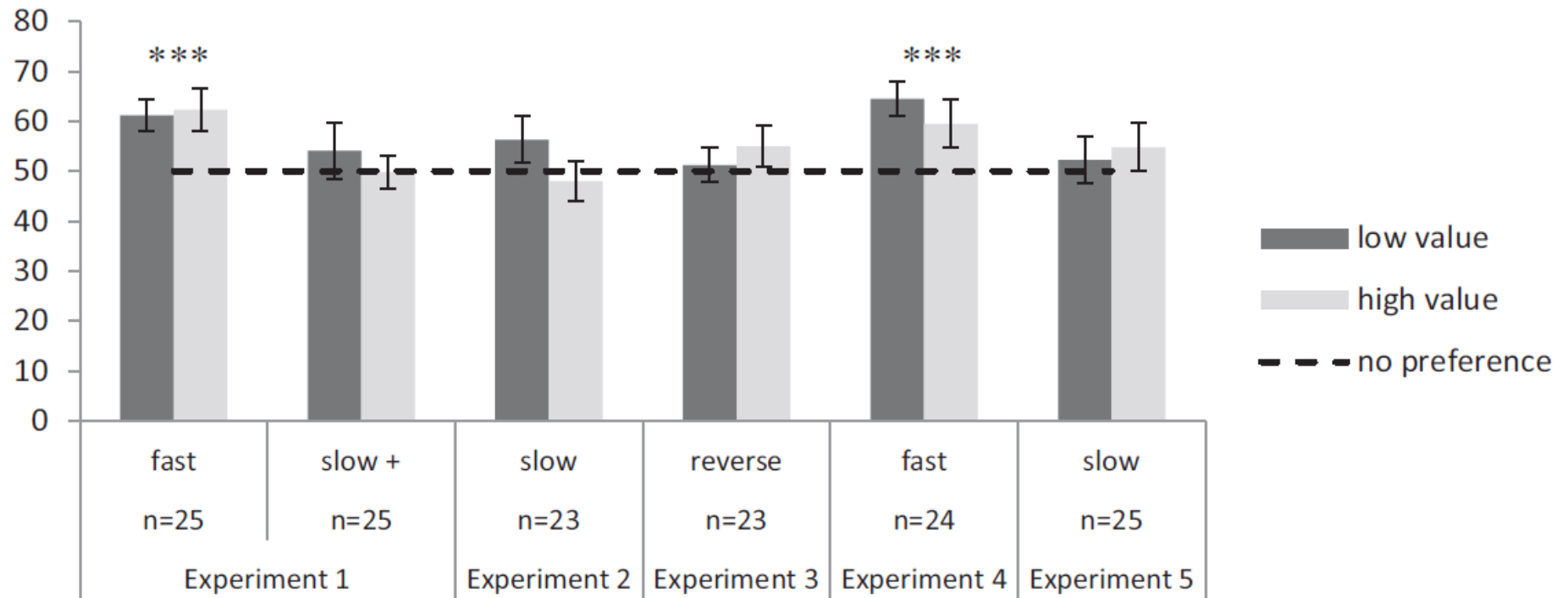
Attentional bias?

Veling et al (2017); Stice et al (2016)

Alternatives to inhibitory control training
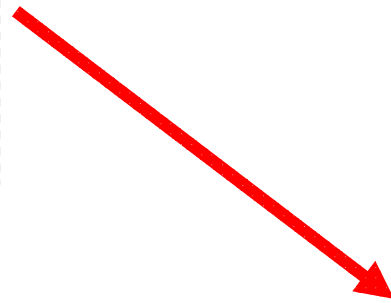
Cue-approach training?

Results of cue approach training

Approach avoidance training

Results of approach avoidance training

Schumaker et al (2016)
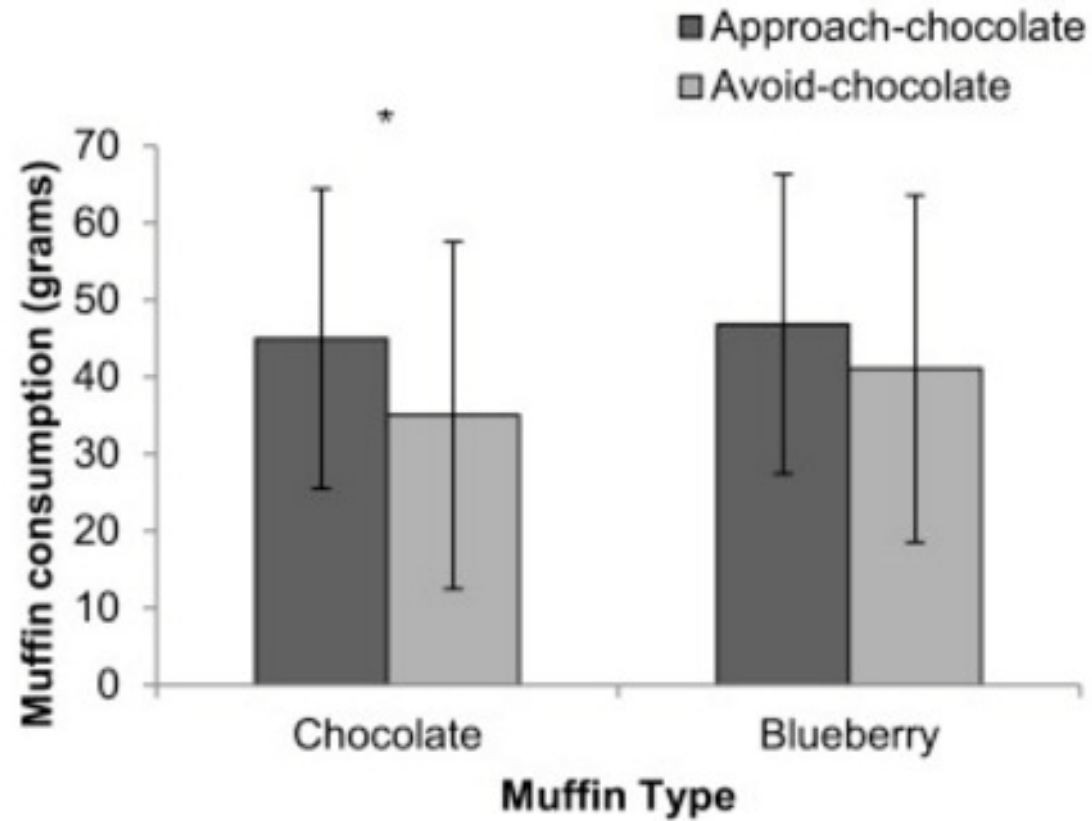
Problems with the current evidence base.

Poorly designed control groups and sampling

Power

Absence of evidence

Future research.

Move away from one-size fits all.

Training in high risk situations.

Jones et al (in press)

Summary

- Obesity has a distinct psychological profile.

- Targeting these mechanisms using ICT (and similar) leads to a reduction in health-risk behaviours in the lab.

- Repeated ICT may be a useful treatment (or adjunct) – however we await results of RCTs.

- If successful ICT may be a cost-effective treatment, delivered over the internet, minimal face-time required.

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ECONOMIC
& SOCIAL
RESEARCH
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