How not to be duped by gateway effect claims

written by Clive Bates | 10 June 2016

DANGER: E-cigarette 'gateway' studies may expose gullible readers to reputational harm

Sometimes studies appear that can create the appearance of the discovery of a 'gateway effect' – the idea that vaping causes young people to progress to smoking.

Update: a 'gateway' study has just been published (13 June) and lots of dupes have duly fallen for it – see "Study published" below.

Beware! Here is an eight-point guide to evaluating such studies and the politically motivated claims that often go with them.

1. Is it clear what is meant by a gateway effect?

Keep in mind a proper problem definition. For example, this is what I would use:

> *...there is harmful gateway effect if young people who would not otherwise smoke take up vaping and, because of vaping, they develop a consolidated smoking habit that they would not otherwise have developed.*

In this definition, the introduction of an option to vape *causes* the more serious problem behaviour, smoking. But you need to know what would have happened in

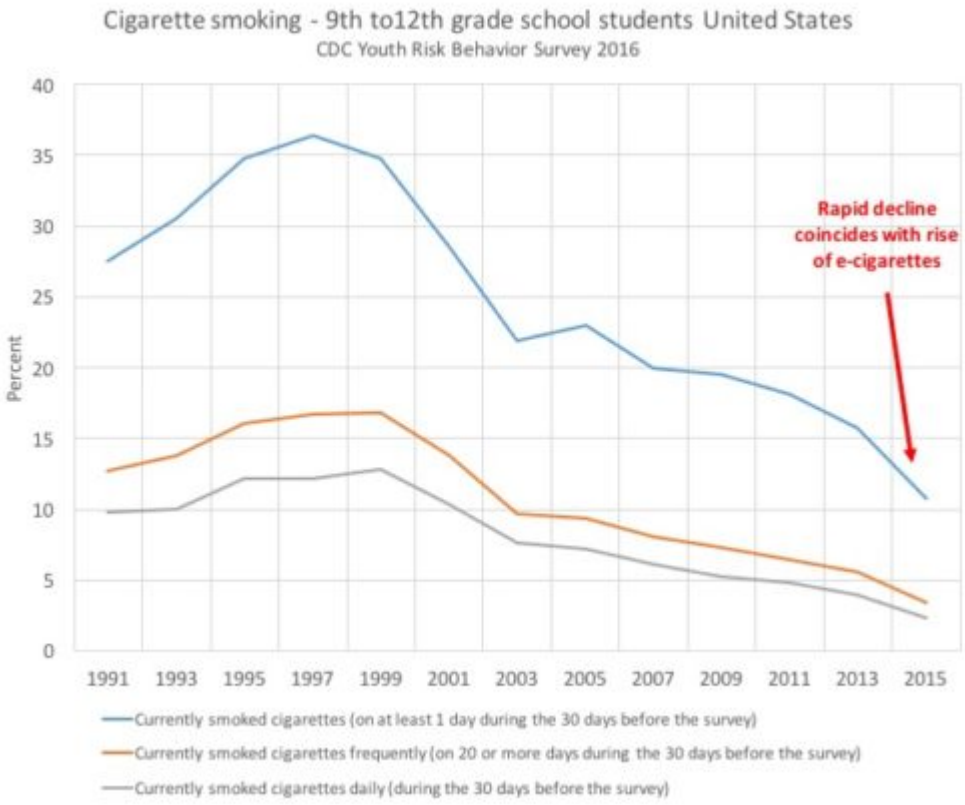
the absence of e-cigarettes – something that is notoriously hard to forecast, and no studies so far have done this – and it is not clear how they can.

Updated. .A further consideration is the *magnitude* of these flows. How many people have to pass through a transition from vaping to smoking caused by vaping before a gateway effect is declared to be real? Is it just one instance of one person in one place somewhere in the world? Or do we need to see a substantial population flow through this route before it a material concern i.e. comparable with other pathways to risky behaviour? So what threshold should be applied, and what test would measure whether such a threshold has been breached?

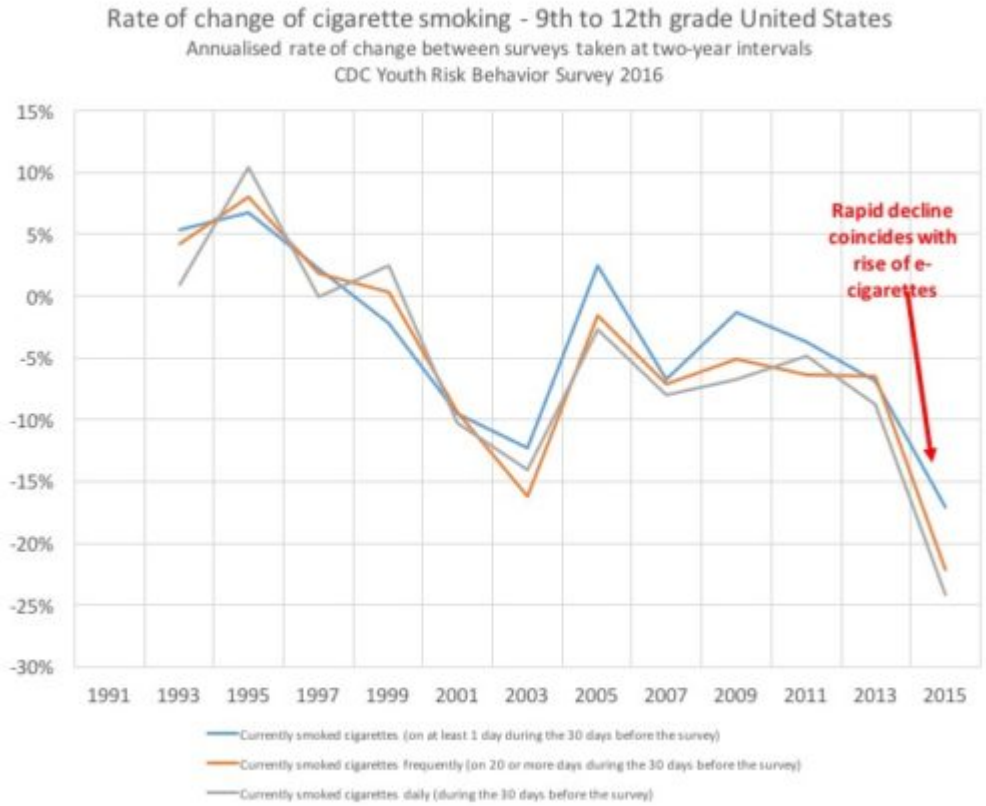
2. Pause for a reality check

If e-cigarettes really are creating a gateway effect, are there lots of young smokers appearing the other side of the gateway? If smoking is declining rapidly, that should reinforce your scepticism about gateway claims.

In fact, teenage smoking in the United states is falling and falling fast. The CDC Youth Risk Behaviour Survey contains revealing data and chart – replotted by me showing rapid declines in smoking prevalence, including the more problematic frequent and daily smoking prevalence.



It might be objected that smoking would have fallen even faster had there been no e-cigarettes. But actually the *rate* of decline (annualised percentage change in smoking prevalence) between 2013 and 2015 is the most rapid in this dataset and coincides with the rise of e-cigarettes.



Maybe the *rate of change* of the decline would be even greater without e-cigarettes…? (and so it could go on). But then some heroic theory is required to explain what is driving the underlying smoking rates down so fast, while e-cigarettes and a gateway effect are somehow pushing them back up? It's just not plausible. Note, I have been careful not to say that these trends conclusively prove that there is no gateway effect. They don't. But they do make it harder to explain why a study purporting to have discovered a gateway effect can be reconciled with a steep downward trend in smoking. If smoking rates were going up or stalling, proponents of the gateway effect would be citing this as *prima facie* evidence.

3. The order in which vaping or smoking initiation happens doesn't matter

It is irrelevant which comes first – the first puff on an e-cigarette or the first puff on a cigarette. It is better to think of a period of experimentation or messing about eventually consolidating into more entrenched habits. The gateway effect

arises if the vaping habit causes a smoking habit that would not otherwise have arisen.

4. What do they mean by ‘smoking’ and ‘vaping’?

If a survey characterises smoking or vaping status by measuring ‘ever use’ – i.e. it counts someone as a vaper if they have taken a single puff ever, and similar for smoking, it is not actually measuring vaping or smoking habits. It is measuring experimentation or ‘*messing about and being a kid*‘. It may be making the amazing discovery that “people who try stuff, try stuff”. Something we have discussed before – see JAMA paper finds some adolescents experiment with stuff – so what?

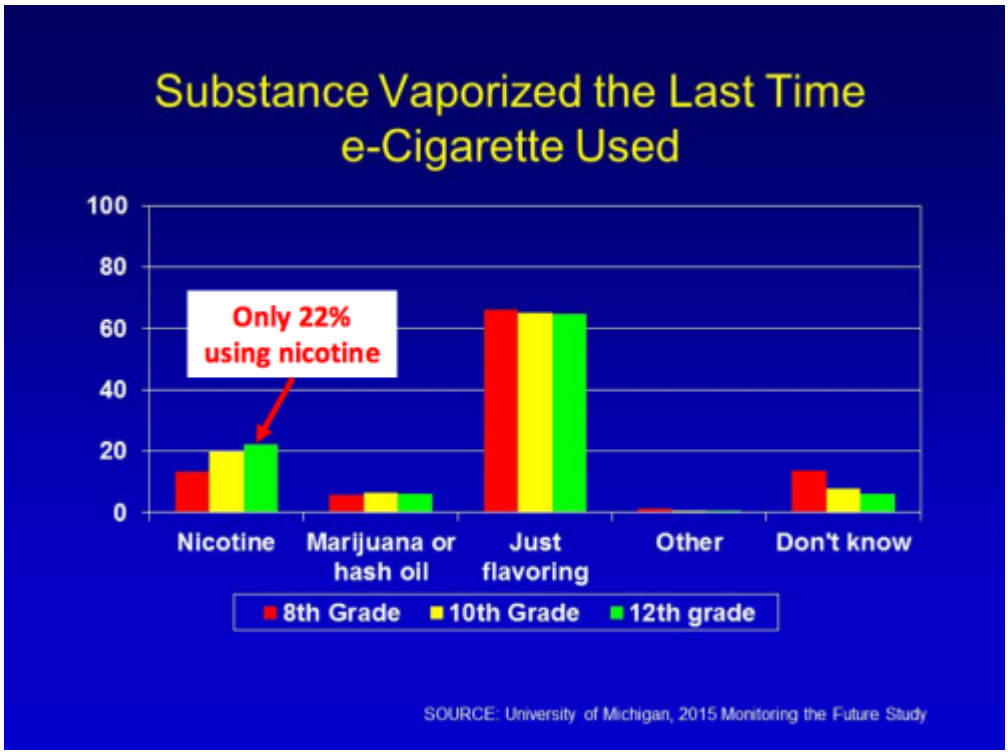
> *@Clive_Bates Impulsivity data suggests whole thing boils down to: People who try stuff, try stuff…*
>
> *— Marcus Munafò (@MarcusMunafo) August 20, 2015*

How is just playing with an e-cigarette supposed to cause anything? A realistic approach would count vaping and smoking habits as frequent use – daily or several times per week.

Ever-use is particularly useless as a measure because it might be that after trying vaping or smoking, the user didn't like it and stopped. How much of a problem is someone who tried vaping, tried smoking and then went on to do neither? If the study just measures ever-use, the authors have no idea how many of the subjects are or were regular vapers. Supposing kids were just messing about with e-cigarettes but didn't become regular vapers and opted for cigarettes instead? Maybe what would have made the difference for them would have been more attractive e-cigarettes designed to appeal specifically to them!

5. Was nicotine used in the e-cigarettes?

Most gateway theories rely on some model of nicotine addiction – i.e. the teenager becomes addicted to nicotine via vaping and then goes on to smoking to achieve a bigger nicotine hit. But we already know that only a small minority of teenagers say they use nicotine in e-cigarettes. The U.S. University of Michigan Monitoring the Future survey suggests as few as 22% may be using nicotine, See this graphic from Monitoring the Future with my annotation in red:



If the study didn't check whether nicotine was used, it probably doesn't tell us

much or anything. Given the difficulty of actually showing whether there is a causal relationship (see below) from usage patterns a further strand of evidence may be to look for proxies for potential causal mechanisms. If they are absent or small, that may give some greater confidence that the study shows no basis for concern.

6. Be clear about association versus causation and confounding

A study finds a pronounced *association* between two behaviours, A (e.g. vaping) and B (e.g. smoking) – for example, the study finds a high chance that someone who vapes or has vaped in the past also smokes or smoked in the past. Three mechanisms are possible to explain this.

1. A causes B: they've found a 'gateway effect'.
2. B causes A: this is what you would see if young smokers were keen to try vaping to quit or reduce their dependence on smoking. The e-cigarette use only happens because they were smoking. This is known as 'reverse causation'.
3. C (a third factor or set of factors) causes *both* A and B: maybe the same things that incline adolescents to smoke also incline them to vape (e.g. parental smoking, rebellious nature, peer group bonding etc). That is sometimes called 'shared liability' or 'common liability' (see Vanyukov MM et al, 2012) . More generally, this effect is known as 'confounding'.

Before anyone can claim that A causes B (a gateway effect) they would need to consider *what would happen in the absence of e-cigarettes* – in the case of explanations 2 and 3, the kids would just smoke: the emergence of e-cigarettes is a diversion from smoking and positive for health. This is discussed is my posting: *We need to talk about the children – the gateway effect examined* in which I show that the most likely pathways that young people will take improve with the addition of e-cigarettes as alternatives to smoking. In an excellent recent paper, *Levy et al* explore similar themes. The third option above is the most common sense plausible mechanism for explaining a strong correlation between vaping and smoking.

7. Are measures of susceptibility to smoking reliable?

Some studies try to get over the confounding problem (3 above) by using measurements of 'susceptibility' – i.e. by measuring personal characteristics that predict for smoking or vaping. If they find a large number of people who would be unlikely to smoke, but they go on to vaping and smoking, they may have found circumstantial evidence for a gateway effect. Well, that's the theory anyway. The problem is that this is a very inexact science, it is actually very hard to predict who will smoke, who will vape and who will do neither.

A common way of measuring susceptibility is to ask a young person if they intend to smoke in the future. Unless they answer "no, never" they are deemed susceptible. But all kind of things change in a teenage life and these commitments are far from binding! A good way to examine the utility of a susceptibility measure is to see how many of those deemed susceptible actually do go on to smoke. If it's only a modest fraction, then the measure probably isn't much good when used the other way around – to show that teenagers who are deemed 'not susceptible' go on to vape and/or smoke.

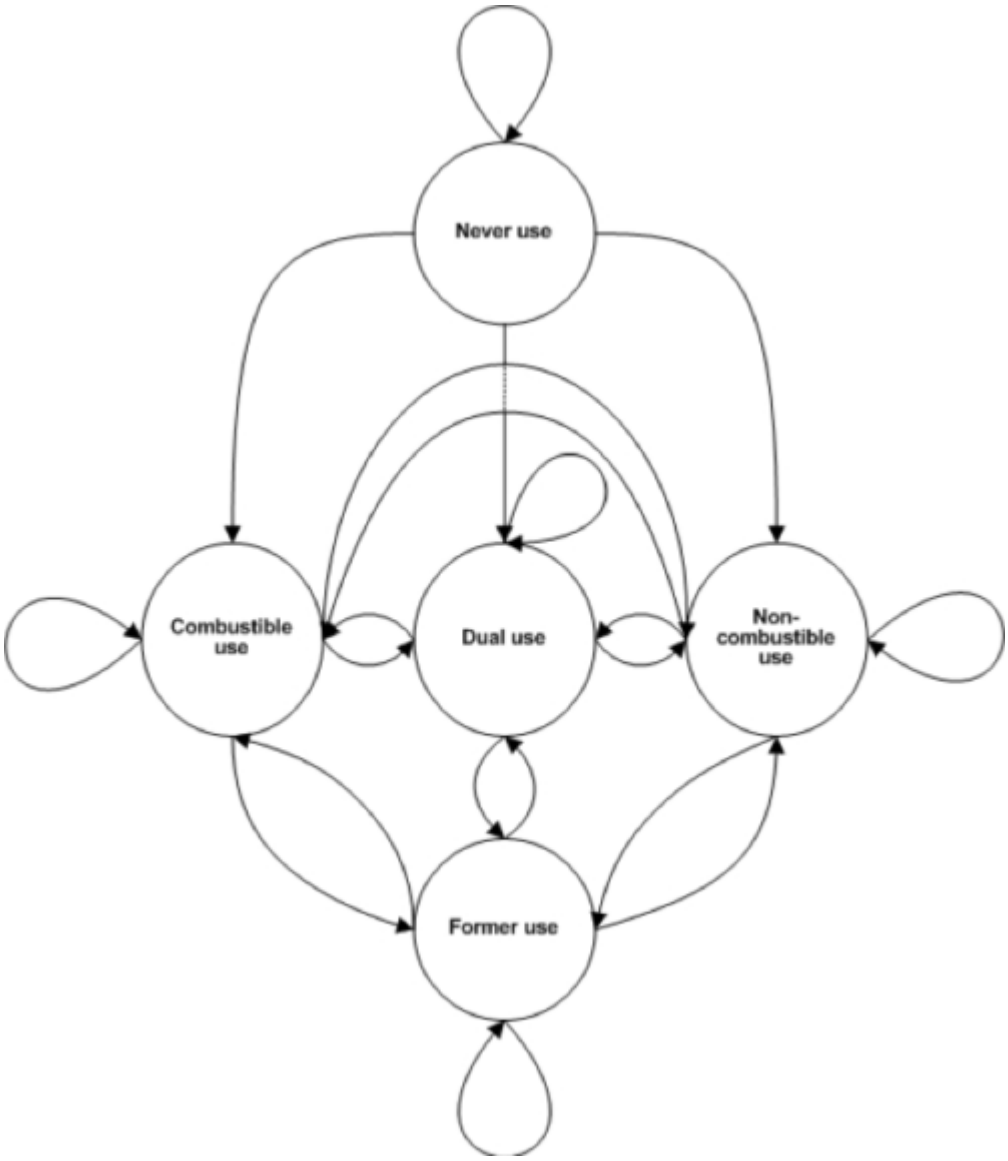
A further obvious fact is that teenagers change all the time – their attitude to smoking might be resolutely against one day, but then a new girlfriend or boyfriend might sway them in the opposite direction the next day.

8. Make sure 'exit gateways' are considered

Does the study look for people who would have smoked but are vaping instead? Are the pathways from smoking to vaping properly explored? Did the study include people who were smoking in the baseline so that we could track what happened to them if they vaped? Maybe they would have become vapers or quit completely via vaping? Presenting only the behaviour change of vapers, and not smokers, at the baseline creates a strong distortion in describing the smoking-vaping interaction.

More broadly, does the study consider all the pathways in and out of combustible (very harmful) and non-combustible (not very harmful) nicotine products? For example using a model like this from Cobb C et al… and if not, why is the study just looking at one part of this system of possible transitions? To do so, is an

implicit admission of investigator bias.



From Cobb C. et al. Markov Modeling to Estimate the Population Impact of Emerging Tobacco Products: A Proof-of-Concept Study. Tobacco Regulatory Science. 2015;1(2):129-141 [link]

Final comment

There are just too many desperately biassed academic papers making ridiculous claims based on data and methods that could never describe a gateway effect. We should be looking at what is happening to the main trends in youth smoking, and this shows rapid declines in smoking and at a faster rate as vaping has risen. When you look at the full picture the data far more consistent with the vaping gateway being an 'exit' from smoking than an entrance. If activists, regulators and politicians realised that vaping was more likely to be reducing teenage

smoking than increasing it, they might be less inclined to pile on extreme regulatory costs, burdens and restrictions and so compromise the options available to adults to switch from smoking to vaping.

Faux gateway studies are part of a wider malaise in 'tobacco control' and public health. Suggested reading and a covert message to the Campaign for Tobacco-Free Kids, CDC, ALA, ACS, etc to 'enter the 21st Century' is here:

- Kozlowski LT, Abrams DB. Obsolete tobacco control themes can be hazardous to public health: the need for updating views on absolute product risks and harm reduction. *BMC Public Health* 2016;16:432. [link]

Further reading

- Counterfactual – We need to talk about the children – the gateway effect examined
- Counterfactual – JAMA paper finds some adolescents experiment with stuff – so what?
- Carl V Phillips – Gateway Effects: Why the Cited Evidence Does Not Support Their Existence for Low-Risk Tobacco Products (and What Evidence Would)
- Carl V Phillips Is "e-cigs are a gateway" the new "addiction"? (i.e., fiercely debated in the absence of defining the term)
- Niaura RS, Glynn TJ, Abrams DB, *et al.* Youth Experimentation With e-Cigarettes. *JAMA* 2014;312:641. [link][PDF]

Study published

And now a study is published and dupes most of the media into believing it's found a gateway effect.

- Jessica L. Barrington-Trimis et al E-Cigarettes and Future Cigarette Use, *Pediatrics*, 2016
- Reuters – Vaping teens more apt to move on to regular cigarettes: U.S. study
- Daily Mail – Vaping IS a gateway to smoking: Teenagers who use e-cigarettes 'are six times more likely to smoke tobacco
- Mike Siegel gets it > New Pediatrics Study Provides Absolutely No

Evidence that E-Cigarettes are a Gateway to Smoking

- Ann McNeill and Peter Hajek via Science Media Centre – expert reaction to study on e-cigarettes and future cigarette use