In February 2014, strikes by staff on London's underground network enabled a sizeable fraction of commuters to find better routes, according to research by **Shaun Larcom**, **Ferdinand Rauch** and **Tim Willems**. Many commuters were forced to experiment and around one in 20 stuck with their new routes after the strike was over.

The upside of London Tube strikes

To what extent do people get stuck behaving in ways that aren't in their best interests - and at what cost? Such 'sub-optimal' behaviour has long been discussed, including by Nobel laureate Herbert Simon (1955) – but until now, it hasn't been studied empirically using a large consumer dataset.

Our study aims to fill this gap by analysing a unique dataset containing all individual travel movements on the London public transport system from 19 January to 15 February 2014. Our data include travel card IDs, through which we can track individual behaviour.

From 4 to 6 February 2014, workers on London's underground network went on strike, as a result of which some (but not all) Tube stations were closed – forcing many commuters to experiment by exploring new routes on those days. We use this event to study how commuters' repeat behaviour changes after a disruption-induced episode of experimentation. We define commuters as those travellers who use the Tube on a daily basis - during non-strike weekdays between 7am and 10am.

The data show that during the strike, a substantial number of commuters were unable to use their usual ('modal') station

and were forced to explore alternative routes. What's more, the strike brought about some lasting changes in behaviour, as the fraction of commuters that made use of their modal station seemingly dropped after the strike. We also have information on journey times: as might be expected, the duration of the average journey increased during the strike, as did the dispersion of journey times.

As the network was only partially closed, some commuters continued to take their normal route to work – thereby making it possible for us to use a 'differences-in-differences' approach

> **Many London commuters failed to find their optimal route until they were forced to experiment**

(comparing the behaviour of 'treated' and 'non-treated' commuters). We define the treatment group in three different ways: those who deviated from their pre-strike modal journey during the strike; those whose pre-strike modal station was closed during the strike; and those whose average travel times to work during strike days were sufficiently different from their average travel times in the pre-strike period.

We find that those who were forced to explore alternative routes during the strike ('the treated') were significantly less likely to return to their pre-strike modal commute in the post-strike period, relative to the non-treated control group.

This suggests that a fraction of commuters had failed to find their optimal journey before the strike. After all, post-strike all routes were available again (including the pre-strike modal one) so a failure to pick the latter option suggests that the commuter had found a better alternative during the disruption. In terms of magnitude, the fraction of post-strike switchers is about five percentage points higher among the treated.

Why did this happen? Our results suggest that 'informational imperfections' play a role in explaining why treated commuters were more likely to switch

post-strike. These come about through the distortions produced by the stylised nature of the Tube map. Using geographical information systems software and a digitised version of the Tube map, we can compare the actual distance between stations with the distance represented on the Tube map. The difference between the actual and the mapped distance provides a measure of the degree of distortion of distances between stations.

Making use of the considerable variation in the degree of distortion represented in the Tube map across different parts of London (something that is unobserved to most commuters), our results suggest that those who live in (or travel to) more distorted areas were less likely to return to their pre-strike modal journey in the post-strike period. This suggests that those living in more distorted areas learned more from the strike.

We also find that treated individuals were more likely to change their journey in the post-strike period if they were commuting on a relatively slow line before the strike (with train speed being another characteristic where imperfect information plays a role, since it remains unobserved by commuters until they try alternative lines).

Our results suggest that a significant fraction of commuters became aware of

The long-lasting benefits of shorter commutes are worth more than the total travel disruptions during the strike

a better route to work thanks to the strike. This is puzzling, since the alternative journey could have also been discovered beforehand through voluntary (as opposed to forced) experimentation.

This finding can be interpreted two ways. The first interpretation is that consumers were acting rationally: they followed the optimal search rule but due to search costs, they (rationally) gave up on finding the best alternative before they had found their 'global maximum'. In the terminology of Baumol and Quandt (1964), commuters under this hypothesis were not maximising but 'optimising' (defined as acting rationally given the presence of search costs).

The alternative interpretation is that people were not adhering to the optimal search rule and experimented less than prescribed by the standard rational model. In other words, they were neither maximising nor optimising. Under this second interpretation, commuters were 'satisficing' in a way suggested by Herbert Simon: they continued to search until 'some satisfactory outcome' was found.

To see which interpretation fits our data best, we use Weitzman's (1979) solution to the problem of optimal costly search (which is consistent with the Baumol-Quandt view). Using conservative numbers for the estimated time saving and its monetary equivalent, we calculate
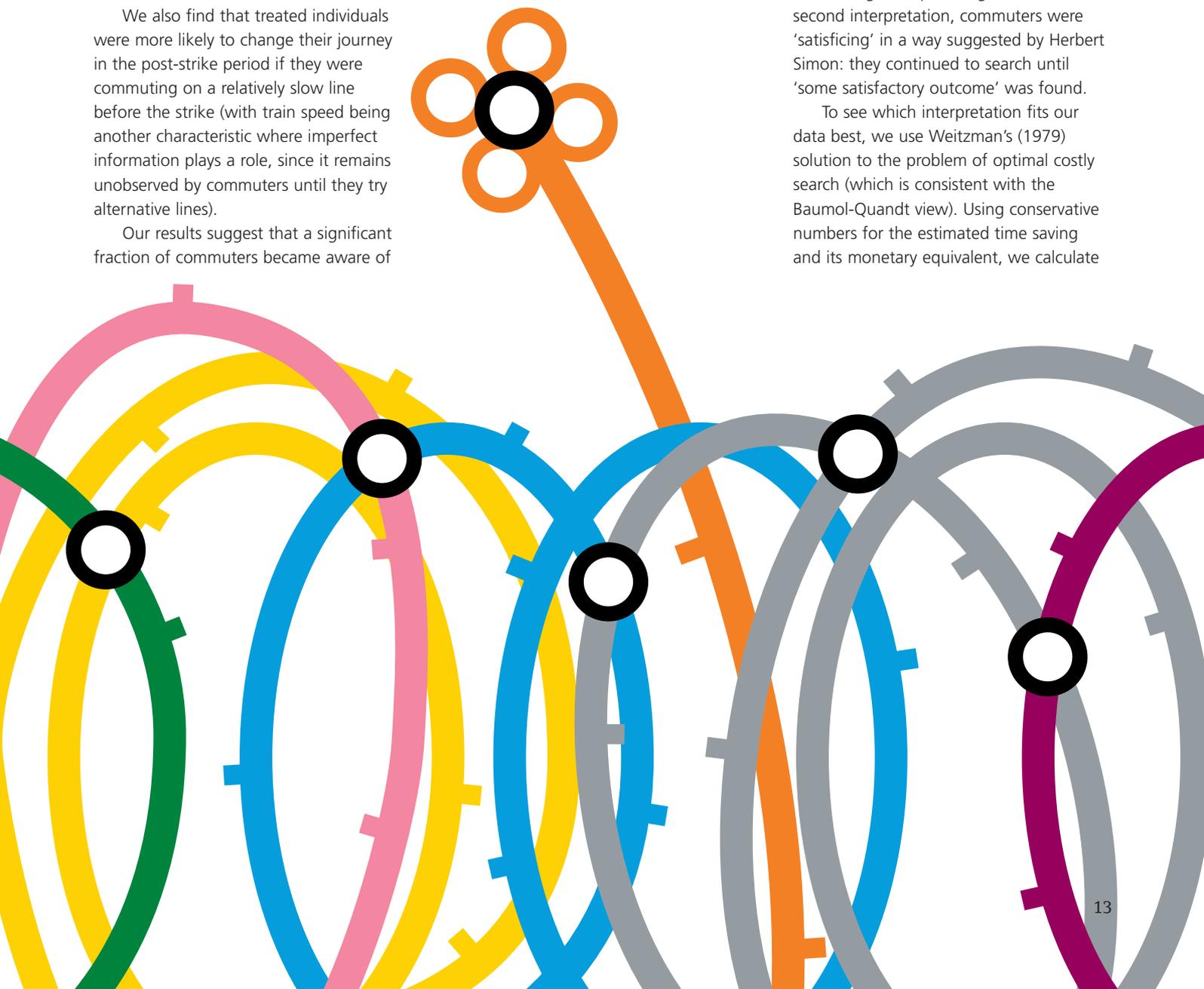
that if commuters were adhering to the optimal search strategy, the cost of trying the most attractive untried alternative would have to be greater than £380.

Given this implausibly large number, it seems that commuters in our dataset were experimenting less than is described by the standard rational model. Instead, people seem to satisfice in a way that is not straightforward to rationalise.

While a subset of commuters found better ways to get to work thanks to the strike, the vast majority (95%) only suffered from travel disruptions. But somewhat surprisingly, when we compare the costs imposed on all treated commuters during the strike with the gains to the subset of beneficiaries, we find that the strike produced net benefits, increasing the overall efficiency of the network (the main reason being that the gains are much longer-lasting than the costs).

Importantly, the net benefit from the strike came from the disruption itself, providing empirical support to Porter's (1991) controversial hypothesis that imposing a constraint on an economic system can enhance efficiency over time (as constraints force people and organisations to experiment, innovate and re-optimise).

Clever use of journey planner apps might 'nudge' travellers to experiment more

In the specific context of the Tube, this implies that commuters could save time given an occasional external encouragement to experiment. Since partial closure of the network is a rather radical way to achieve this, it is worth investigating whether clever use of journey planner apps can 'nudge' travellers to experiment more.

More generally, our findings are relevant to government policies, to business practices and to our personal lives. Given that a significant fraction of commuters on the Tube failed to find their optimal route until they were forced to experiment, perhaps we should not be too frustrated that we can't always get what we want, or that others sometimes take decisions for us.

If we behave anything like the satisficing commuters on the Tube and experiment too little, hitting such constraints may very well be to our long-run advantage. Encouraging ourselves to implement occasional breaks in our routine could actually be beneficial. Therefore, we ask, when was the last time that you did something for the first time?

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Further reading

William Baumol and Richard Quandt (1964) 'Rules of Thumb and Optimally Imperfect Decisions', *American Economic Review* 54(2): 23-46.

Michael Porter (1991) 'America's Green Strategy', *Scientific American* 264(4): 168.

Herbert Simon (1955) 'A Behavioral Model of Rational Choice', *Quarterly Journal of Economics* 69(1): 99-118.

Martin Weitzman (1979) 'Optimal Search for the Best Alternative', *Econometrica* 47(3): 641-54.