Using behavioural insights to improve air quality in the London Borough of Merton

Final report

THE
BEHAVIOURAL
INSIGHTS
TEAM

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Introduction

Air pollution is one of the biggest environmental threats to health in the UK. The Behavioural Insights Team (BIT) was commissioned by the London Borough of Merton to support a project to improve air quality as part of the Local Government Association's (LGA) Behavioural Insights Programme.

The simple and often subconscious act of engine idling can have significant effects on air quality within a local area. As Idling Action has shown, levels of carbon monoxide and nitrogen dioxide pollutants in the vicinity of idling vehicles can be far higher than the average levels of these pollutants in other places with cars.

Engine idling is also an action that does not particularly benefit an individual. Therefore, in theory it is a behaviour which can be influenced and changed without significant resistance. This project tests this using a pre-post trial of an intervention at a level crossing in the London Borough of Merton.

This project began in 2019 with an initial plan to work with primary schools across the borough to trial interventions to encourage drivers to switch off vehicles while collecting or dropping off pupils to and from school. However, the covid-19 pandemic resulted in many schools initially closing and then, once they were open again, adopting different car parking practices for drivers which reduced the need for an intervention.

This led the London Borough of Merton and Behavioural Insights Team to consider other sites that may have similar air quality issues and where the insights learned could potentially be applied elsewhere in the borough, in London and the rest of the country. Given the frequency of level crossings and the engine idling that could result, the project was rescoped to focus on engine idling at a level crossing in the borough in 2021-2022.

The project relied heavily on the data collection - in both very cold and very hot conditions - by local authority staff at the London Borough of Merton, and the sign design and installation by TWM Traffic Control Systems.

What is idling and why do people do it?

Idling means keeping a vehicle engine on while stationary. Although it varies by vehicle type and time length, in most cases idling a vehicle instead of turning off then restarting the engine causes a greater number of harmful emissions.

There is not robust evidence on why people idle, but barriers that often come up in surveys include:

- It doesn't occur to the driver to turn off their engine
- The belief that it is not beneficial for reducing emissions or fuel consumption

- Concerns that the vehicle might not start or it might slow traffic
- The perception that most other people don't turn off their engine

Many drivers appear to turn off their engine when asked or prompted. This suggests that behavioural interventions that provide information or change the environment can help drivers to reduce their habitual idling behaviour.

Ways to reduce idling

Public concern over the negative impact of poor air quality on health, particularly for children and vulnerable groups, has been growing. In response, local authorities are increasingly trying to develop effective anti-idling strategies. The three most common approaches to reduce idling in the UK are:

1. **Fines:** Idling is a Fixed Penalty Offence under the Road Traffic Regulations 2002. Local authorities can use traffic wardens to ask idling drivers to switch their engines off. However, only a handful of authorities have implemented no-idling zones or fine idling drivers. The council issuing the most fines in the UK is Westminster. Their policy is for wardens to ask idling drivers to switch off the car engine, and to issue a fine if after a minute the driver has not complied. **Merton** has trained Civil Enforcement Officers to talk to drivers, but no Fixed Penalty Notices have been issued as it is found that drivers either switch their engine off or move on.

2. **Campaigns:** A more common anti-idling approach is running campaigns such as Idling Action London. Alongside wider comms activities by the council, local authority staff organise action events where volunteers are trained and take to the streets in pairs to talk to idling drivers. **Merton** has delivered a range of action days across the borough at key locations such as schools, town centres and level crossings.

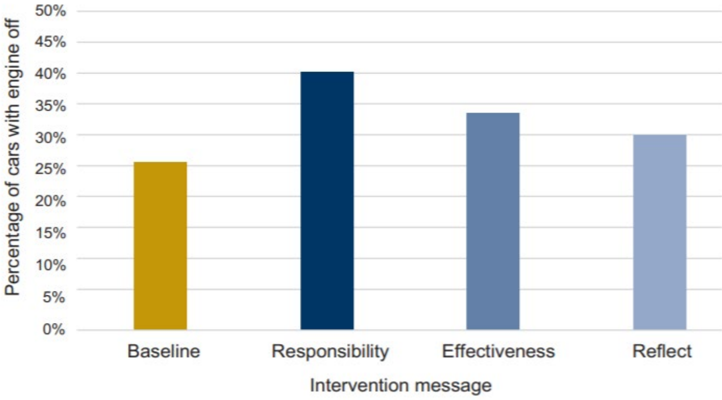
3. **Signs:** Perhaps the most common approach used by councils is to install signs discouraging drivers from idling at key locations such as level crossings, taxi ranks, schools or hospitals. **Merton** has installed over 200 anti-idling signs at hot spots locations including schools, level crossings and taxi ranks.

There is some evidence that signage can reduce idling behaviour. Abrams et al. (2019) conducted a pre-post study at two rail crossings in Canterbury (UK) testing the impact of three different signs (appealing to responsibility; highlighting the impact of switching off; reflecting on one's actions) on idling behaviour. All the signs significantly increased the number of drivers switching off their engines but the message appealing to responsibility was most effective (40.5% switched off) compared to baseline (26.4%).

Responsibility

Effectiveness

Reflect



The table below shows examples from published literature of the type of behaviourally-informed messages that have been used to reduce idling:

Type	Description	Message Example
Outcome efficacy	Believing that turning your engine off will lead to positive outcomes	"You will improve air quality"
Self-regulation	Encouraging people to reflect on and regulate their behaviour	"Think about your actions"
Social Norms	People tend to conform to the norms of their in-group	"Join other responsible drivers"
Self-interest	In social dilemmas, most people make self-interested choices in one-shot encounters	"Save money and turn off your engine"
Reflection on intention	Intention is the closest predictor to behaviour. Depleted cognitive resources can disrupt the link between intention and action	"Do you turn off your engine?"
Normative reputation	Norms can be invoked by signalling the reputational relevance of behaviour	"Show you care"

Intervention design

For this project, we placed an electronic sign at a level-crossing in the London Borough of Merton (West Barnes level crossing). Each time a train passes at this site (around 6-7 times an hour) the barriers are down for an average of 2-3 minutes. Approximately 100-200 vehicles wait here each hour, and approximately two thirds of drivers keep their engine running.

The level-crossing already had a range of (static) signs installed telling people to switch off their engine when waiting. The new sign would aim to be more behaviourally informed and attract people's attention with salience, awareness raising and self-interest messaging.

Based on a literature review we shortlisted several messages. The chosen message: 'SAVE MONEY, SAVE FUEL, TURN OFF YOUR ENGINE' uses salience, self-interest and awareness raising. It highlights the connection between individual behaviour (turning off your engine) and the economic and environmental benefits (saved money and fuel).

Social norms and air quality messaging were also considered, but based on an internal consultation of BIT colleagues and discussions with Merton and the LGA we decided that on balance a self-interest message would likely be most effective. The sign only turns on when vehicles are stationary and has flashing lights in the corners, grabbing the attention of drivers.

Trial design and results

Two methods were considered for measuring the impact of the sign: Measuring air quality and measuring driver behaviour.

Measuring air quality was ruled out after an expert at King's College London confirmed that 1) the changes expected from anti-idling measures are likely not big enough to be picked up by the available equipment, and 2) air quality is affected by many other factors (temperature, wind direction, precipitation), making it very hard to isolate the impact of vehicle exhausts.

Driver behaviour is easier to measure, and less influenced by outside factors. This means we can be more confident that the observed effect was due to our intervention. Merton could provide staff to carry out observations, which meant that this option was within budget. Thus driver behaviour was chosen as the basis for our outcome measure:

> **Outcome measure: Is a vehicle's engine turned off when waiting at the level-crossing?**

Whether a vehicle was idling was determined by an observer, based on whether they could hear the engine (or see exhausts). This means that electrical vehicles or vehicles that automatically turned off when stationary were counted among the vehicles not idling.

Ultimately we are interested in the impact on air quality. We assume that a reduction in idling will lead to an improvement in air quality, which is backed up by evidence. The exact impact is complex and depends on many factors, including the type of car and the length of the wait time.

Pilot measurements: Before the trial began, Merton staff spent 11.5 hours conducting observations at the level-crossing, spread out over 5 days, with 3 observers present at the same time. This helped us with setting the definition for the outcome measure, determining how many hours of observations would be required, and working out the details of the trial.

Power calculations: Based on previous research and the pilot measurements, we (conservatively) anticipated a 7.5 pp increase in vehicles turning off their engine (from 35% to 42.5%). We recommended 42 hours of total observation time, which we estimated would give us a sample size of 1680 and MDES of 6.6pp.

Idling behaviour was measured over a 5-day period before the sign was placed (16-20 May), and again over a 5-day period after the sign was placed (13-17 June). The total number of hours of observations was approximately 40, in which the barrier went down 275 times. A total of 2,064 vehicles were measured.

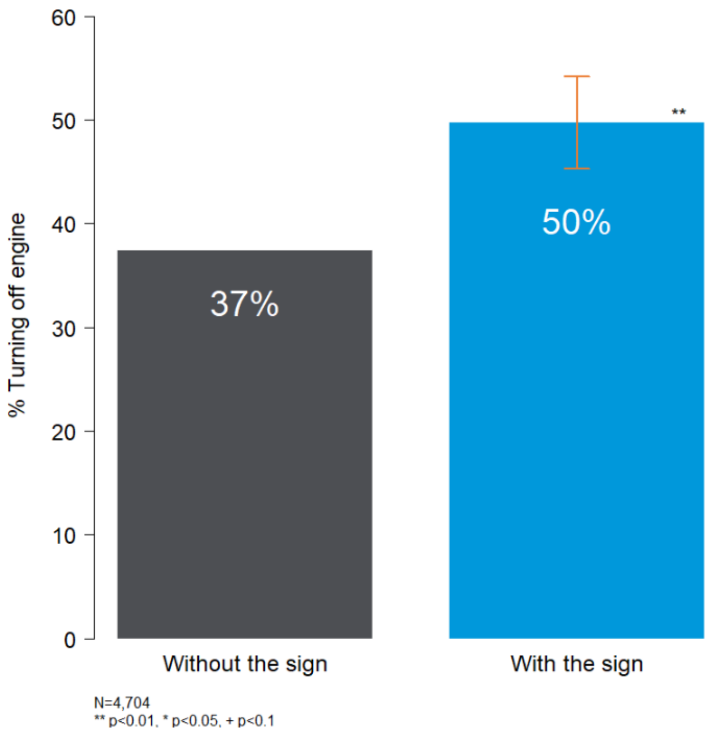
After the pilot measurements, observers noted no difficulties with recognising whether a vehicle was idling or not, as long as they had enough time and the vehicles were not too far away. This gave us the confidence that as long as the number of vehicles that needed to be observed each time the barriers were down was limited, measurements should be robust and thus only one observer was required.

Observations were done in-person by Merton staff using paper collection sheets. Every time the barrier went down, the observer would note the time, and for each of the first eight vehicles in the queue, what type of vehicle it was and whether their engine was on or not (allowing for enough time, ~30 seconds, for the driver to read and act upon the sign).

Vehicle type was captured as previous research has shown it can influence idling behaviour (see for example Abrams et al, 2019), and as it might impact the visibility of the sign for other vehicles.

There were 1,032 observations in the pre-period, and 1,032 in the post-period, 150-250 per day. 97% of vehicles were either cars or vans. The number of observations per measurement group was higher than the 850 we anticipated, due to the better than expected visibility of the sign, which led us to increase the number of observed vehicles per queue from 6 to 8. As a result, our outcome estimates were more precise than expected.

There was 3.5 weeks between the last pre-measurement and the first post-measurement. We can’t rule out that external events, such as the 11% increase in petrol prices during this period, impacted idling behaviour in the post-period.



After the sign was placed, 50% of drivers turned their engine off, compared to 37% before the sign.

This is a statistically significant increase of 13 percentage points.

The base rate of 37% is higher than found in previous similar studies, which usually find pre-intervention rates of 25-30%. This could reflect the impact of the signs that are already present at the level-crossing, a different sampling population, or an overall decrease in idling since the previous studies.

Potential effects

Merton staff observed traffic at the level-crossing from 7.30am to 7pm, during which barriers went down 76 times and around 1,700 vehicles were counted queueing (an average of 22 vehicles every time the barrier goes down). It was noted that the sign was visible for approximately 80-100m, or at least 11 vehicles (assuming average car length and with 1 metre between each vehicle).

Trains run from around 6am until 11pm. However, at less busy times, there may be fewer than 8 vehicles waiting. We conservatively assume here that there are only vehicles between 7.30am and 7pm (which heavily undercounts the number of vehicles on a full day) and that each time the barriers close there are at least 8 vehicles (the number we based the trial on). This assumes approximately 608 vehicles waiting at the level crossing each day. We think that both of these assumptions are very conservative - and that in reality far more drivers will see the sign - but they reaffirm the strength of the findings.

Based on these conservative assumptions:

- Each day, **79 fewer vehicles will idle** at the level crossing site
- Each week - assuming that traffic is halved at the weekend - **474 fewer vehicles will idle** at the level crossing site
- Each month, **2,015 fewer vehicles will idle** at the level crossing site

- Each year, **24,648 fewer vehicles will idle** at the level crossing site

Conclusions and recommendations

Given the effectiveness of the sign, we can draw two conclusions:

- Idling can be reduced through nudging: These results support our theory that habitual behaviour is preventing drivers from turning their engine off when stationary. This means that salient prompts to remind them can be effective.
- Targeting financial self-interest is effective: We suspect this is especially the case in present times, with high fuel prices and the rising cost of living.

Limitations: Due to the trial design, we cannot rule out that external factors other than the sign may have influenced the outcome. In using a pre-post trial design, we have to make the assumption that the idling percentage would have remained the same if the sign wasn't placed. This might not be true. For example, average fuel prices rose by 11% between the pre- and post-measurements. Although we believe it is unlikely, it is possible that as a result drivers already started turning off their engine more often to reduce their fuel consumption. It may also be the case that the intervention performed better as fuel prices had recently risen. However, in the current inflationary context this is likely to benefit the power of the sign, rather than diminish it. Future research can mitigate these limitations by measuring idling at sites where the sign is placed and comparing this to idling at sites with no sign over the same period (a difference-in-difference design).

Recommendations for policymakers

- Salient and behaviourally-informed signs can reduce engine idling at key problems areas. In the current economic climate, the local authority should consider rolling out the sign to other sites.
- Carry out a review of other signs currently in place and whether they can be made more salient and/or have more powerful messages.

Recommendations for future research

- There are interesting questions for future research, which can help us understand how idling can be most effectively reduced, including:
- Will drivers replicate the behaviour elsewhere when not being encouraged by the sign?

- Will idling increase again once the novelty of the sign wears off or fuel prices go down?

Repeated data collection at this and other sites could provide insights to answer these questions and understand the mechanisms at play. The LGA has noted that other local authorities in London are interested in this research. The results suggest that signs could have similar effects at other locations and problem sites in London boroughs.

Annex

We used the following logistic regression to test the impact of the sign on the idling behaviour of cars:

$$Y_i \sim bernoulli\ (p_i);\ logit(p_i)\ =\ \alpha + \beta_i T_i +\ X_i \beta_2$$

Where

- α is a constant
- Yi is a binary outcome variable, equal to 1 if vehicle i turned off their motor, 0 otherwise
- is a constant
- Ti is a binary variable, equal to 1 if vehicle i was observed after the sign was placed, and 0 if they were observed before the sign was placed
- Xi is a matrix of control variables, which includes categorical variables for their position in the queue (1-8), type of vehicle, day of the week and time of day.

```
    Null deviance: 2825.9  on 2063  degrees of freedom
Residual deviance: 2744.5  on 2045  degrees of freedom
AIC: 2782.5
```

Regression table

Term	Coefficient estimate	Standard error	p value
(Intercept)	-0.750	0.197	<0.001
Group (base = Pre sign)			
Post sign	**0.515**	**0.091**	**<0.001**
Position (base = Vehicle 1)			
Vehicle 2	-0.128	0.174	0.462
Vehicle 3	-0.115	0.174	0.511
Vehicle 4	-0.169	0.175	0.333
Vehicle 5	-0.082	0.175	0.641
Vehicle 6	-0.471	0.179	0.009
Vehicle 7	-0.390	0.182	0.032
Vehicle 8	-0.384	0.190	0.043
Time (base = 11-12)			
12 - 13	0.032	0.156	0.838
13 - 14	0.229	0.156	0.142
14 - 15	0.110	0.155	0.478
15 - 16.15	0.003	0.163	0.988
Day (base = Monday)			
Tuesday	0.256	0.143	0.074
Wednesday	0.605	0.142	<0.001
Thursday	0.227	0.147	0.122
Friday	0.629	0.137	<0.001

```
    Null deviance: 2825.9  on 2063  degrees of freedom
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```