

# Using behavioural insights to tackle fly-tipping in Wirral

Summary of second phase work

August 2018

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## Executive Summary

In March 2017 Wirral Council commissioned Behavioural Insights Team North (BIT North) to deliver a project exploring how behavioural insights could be used to reduce fly-tipping in the borough. In May 2017 BIT delivered a Scoping Report with a range of recommendations. These ranged from light-touch changes which we suggested the council implement immediately, to more involved changes which we suggested should be tested and evaluated.

In October 2018 BIT agreed a second programme of work with Wirral Council to help them to implement some of our recommendations. This report summarises this second programme of work, which had two parts:

1. **Setting up a bin reminder service.** We worked alongside Wirral Council to help them set up a new text message bin reminder service (a recommendation of our Scoping Report). We did this by providing light-touch support to design the new service, and by delivering a randomised controlled trial (RCT) to test the effectiveness of different messages in getting people to sign-up for the new reminder service.
2. **Changes to the Wirral Council website.** We supported the council to deliver some light-touch changes to their website, for example to improve the process of booking a bulky waste collection or searching for nearby recycling centres.

### Setting up a bin reminder service

The main part of our work with Wirral Council was supporting the council to set up a new bin reminder service for residents. This new service, designed and delivered by Wirral Council, provides residents with a text message reminder the evening before their bin is due to be collected. It aims to reduce the risk that people forget to put their bins out (and find themselves left with excess waste they are tempted to fly-tip), support the council to increase recycling rates and create a new direct communication route with residents about waste and recycling.

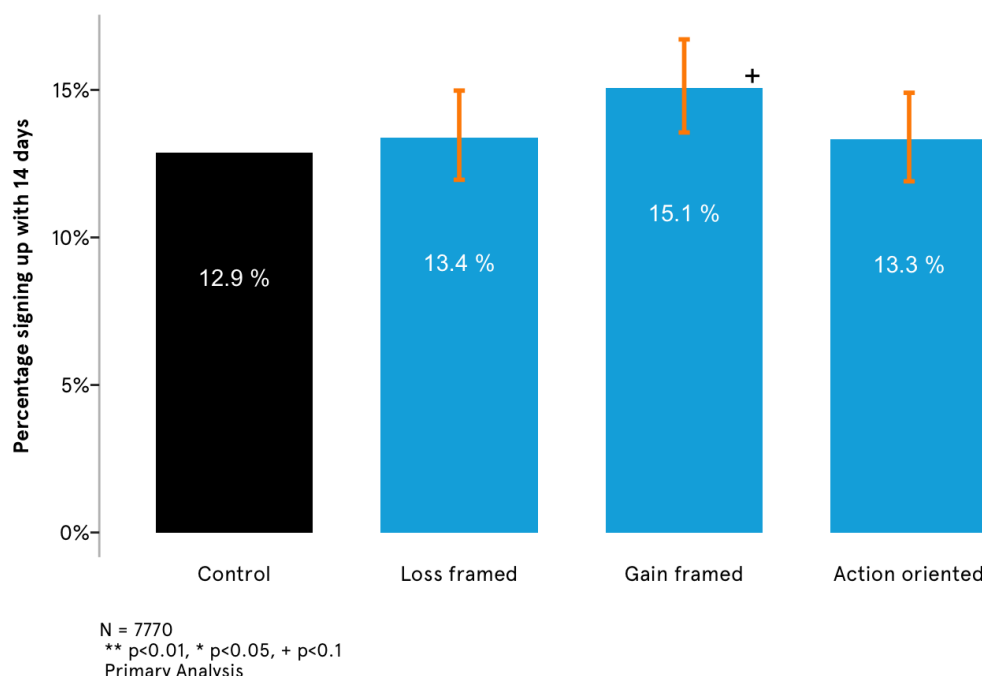
To support the council to launch the new service, we designed and delivered an RCT. This trial tested the effectiveness of different messages in getting people to sign-up for the new service. We tested four different types of message:

- ◆ **Control** – Simple, information only emails;
- ◆ **Loss-framed** – Emails which highlight the potential losses of missing a bin collection (excess waste and no easy way to dispose of it);
- ◆ **Gain-framed** – Emails which highlight the gain of signing up (in terms of having 'one less worry');
- ◆ **Action-oriented** – Emails designed to highlight the intention-action gap (you mean to put the bins out, but do not always do so);

In total, 7,770 people were involved in the trial. Everyone received one of four initial emails advertising the new service. After eight days, those who had not yet signed up received a reminder email encouraging them to sign-up.

Overall, the **gain-framed message** marginally increased sign-up rates by 2.6 percentage points (20% in relative terms) (see Figure 1). This appears to have been largely driven by the **gain-framed reminder**, which performed significantly better than the other messages.

**Figure 1:** Bin reminder service sign-up rates within 15 days



On the basis of this trial, we recommend that the council consider using gain-framed messages in future advertising for the service. We cannot be certain that the results we have seen in this trial will replicate to other forms of communication, but we believe they provide reasonable evidence that gain-framing is more likely to be effective than loss-framing or taking an action-oriented approach. In particular, we suggest adapting the gain-framed reminder message for other channels as it appears to have been significantly more effective.

### Next steps

This report marks the end of our current programme of work with Wirral Council. In this final section, we provide some suggestions about what the council does next.

1. **Continue to roll out the SMS reminder service.** We suggest the council continues to actively promote the service to residents, for example, by encouraging anyone who comes into contact with the Waste and Recycling team to sign-up for the service.
2. **Estimate the impact of the SMS reminder service.** As the service reaches more residents we would encourage the council to evaluate whether it is having an impact on residents' behaviour.
3. **Continue to test and adapt.** Through delivering our RCT, Wirral staff now have the experience of A/B testing different webpages and emails. As our trial results have demonstrated, surprisingly small changes in wording can have disproportionately large effects on behaviour. We encourage the council to continue testing, refining and adapting messages and processes.

## Background

In March 2017 Wirral Council commissioned Behavioural Insights Team North (BIT North) to deliver a project exploring how behavioural insights could be used to reduce fly-tipping in the borough. In May 2017 BIT delivered a Scoping Report with a range of recommendations. These ranged from light-touch changes which we suggested the council implement immediately, to more involved changes which we suggested should be tested and evaluated.

In October 2018 BIT agreed a second programme of work with Wirral Council to help them to implement some of our recommendations. This report summarises this second programme of work. It should be read alongside our Scoping Report for Wirral Council on using behavioural insights to reduce fly-tipping.<sup>1</sup>

## Structure of this report

This report summarises the two parts of our second programme of work with Wirral Council:

1. **Setting up a bin reminder service.** We worked alongside Wirral Council to help them set up a new text message bin reminder service (a recommendation included in our Scoping Report). We supported this in two ways:
  - a. Light-touch support to design the new service, including providing advice on the wording and timing of reminder messages and the sign-up process.
  - b. A Randomised Controlled Trial (RCT) to test the effectiveness of different messages in getting people to sign-up for the new reminder service.
2. **Changes to the Wirral Council website.** We supported the council to deliver some light-touch changes to their website, for example to improve the process of booking a bulky waste collection or searching for nearby recycling centres.

## Setting up a bin reminder service

The main part of our work with Wirral Council was supporting the council to set up a new bin reminder service for residents. This new service, designed and delivered by Wirral Council, provides residents with a text message reminder the evening before their bin is due to be collected. The reminder service aims to help the council to achieve a number of goals:

- ◆ Reminding residents when their bin is due to be collected reduces the risk that people forget to put their bin out and end up with excess waste they need to dispose of themselves (which they may choose to fly-tip).
- ◆ It also supports the council to increase recycling rates by reminding residents when recycling, not just non-recyclable waste, is due for collection.
- ◆ It provides a direct communication route which the council can use for other reasons, for example to highlight changes to collection schedules over Christmas.

<sup>1</sup> BIT, 2017, Using behavioural insights to tackle fly-tipping in the Wirral: Scoping Report

The service is delivered through the Government Digital Service (GDS) Notify platform and is cheap for the council to provide. This means the council can send 25,000 text messages for free, and after that pays just 1.58p (plus VAT) per message. An unexpected, secondary benefit of this work is that the council communications team are now exploring whether they can use the Notify platform for all the text messages they send out (rather than using commercial providers). If this is possible, they expect to save thousands of pounds a year.

### Setting up the new service

From January to April 2018, we worked with Wirral Council's communications and digital teams to design the new service. We recommended that Wirral Council staff lead the development of this service, with BIT providing a small amount of ad-hoc support. This ensured that BIT's time was sharply focussed on providing behavioural science expertise. It also ensured that Wirral staff understood exactly how the service had been set up and could continue to support it beyond the end of our contract.

We provided advice and support on a number of aspects of the new service:

1. We supported Wirral Council to think through the different options for delivering reminder messages (including email, text message and a social media chatbot) and the trade-offs of each. For example, some forms of communication are cheaper than others, but are also much less likely to be read.
2. We worked with Wirral officers to ensure the sign-up process was as smooth as possible, identifying potential 'friction points' where our experience suggested we could lose potential users, and working with the council to find ways to remove such frictions.
3. We quality assured and advised on the content and timing of the reminder messages. This included ensuring they were clear, concise and delivered at a time when we expected them to have maximum impact.

### Testing different ways of encouraging Wirral residents to register

Alongside supporting Wirral to set up the new reminder service, BIT worked with the council to deliver a Randomised Controlled Trial (RCT). This trial tested the effectiveness of different messages in getting people to sign-up for the new service. This is important because reminders cannot be sent without residents first opting in (due to data sharing legislation). The trial served two key functions:

1. **Provide an early 'boost' to the new reminder service** by prompting residents who have already opted to receive information from the council to sign-up for reminders.
2. **Test the effectiveness of different messages** in a way which would not be possible in future promotional activity (e.g. leaflets or adverts on the side of waste trucks). Our goal was to learn lessons which might be applicable to future, non-email advertising of the new service.

## The messages

We worked in collaboration with Wirral Council staff to design four messages we could test. These were designed to be simple, to rigorously test different behaviourally-informed approaches and to be replicable in different forms of future advertising (i.e. we did not use messaging which only made sense when sent by email).

Households selected to take part in the trial received up to two emails advertising the new SMS reminder service and encouraging them to sign-up:

1. The first email advertising the scheme was sent to everyone who was part of the trial (see 'Who we targeted' below)
2. The second, reminder email was due to be sent to those who did not sign-up within eight days of receiving the first email.<sup>2</sup>

Each person in the trial was randomised to one of four groups, which received different messages:

- ◆ **Control** – Simple, information only emails. These provided a baseline to compare against;
- ◆ **Loss-framed** – Emails which highlight the potential losses of missing a bin collection (excess waste and no easy way to dispose of it);
- ◆ **Gain-framed** – Emails which highlight the gain of signing up (in terms of having 'one less worry');
- ◆ **Action-oriented** – Emails designed to highlight the intention-action gap (you mean to put the bins out, but do not always do so);

People randomised into a particular group received both initial emails and reminders with the same 'framing' (e.g. participants in the loss-framed group received an initial loss-framed email, then a loss-framed reminder eight days later if they had still not signed up). The full text of our messages (both initial and reminder) can be found in Annex A.

## Outcome Measure

Our main outcome measure was sign-up for the bin reminder service within 14 days of the initial email being sent (i.e. after both initial emails and reminders had been sent). In addition, we measured three secondary outcomes:

1. Click-through to the registration form from the initial email (regardless of whether the person went on to register);
2. Sign-up for the bin reminder service within seven days of the initial email being sent (i.e. before the reminders were sent).
3. Click-through to the registration form from the reminder email (regardless of whether the person went on to register);

<sup>2</sup> Unfortunately, due to an implementation error reminders emails were only sent to people who did not click-through on the initial email. People who clicked-through from their initial email, but failed to complete the registration, did not receive a reminder. This group might have been especially likely to respond to a reminder, so this may mean that the results for our reminder messages are under-estimated.

We considered trying to measure whether SMS reminders actually helped households to remember to put their bins out on collection day. However, in discussion with council staff, we concluded that the council did not have reliable or comprehensive enough data to measure this.

## Who we targeted

The group of people who were sent emails (our sample) was chosen from a list of people who had previously given the council their email address. Our sample was limited to people who:

- ◆ Had given sufficiently broad permissions for the use of their contact details that we are able to contact them to advertise the bin reminder service;
- ◆ Did not already subscribe to the council's paid-for garden waste service;
- ◆ Lived in areas which the Waste and Recycling team indicated tend to have more fly tipping, lower rates of recycling and fewer households putting their bins out.

This gave us a total sample of 7,770 people. This sample may not be representative of the wider Wirral population (as it only includes people who have given the council their email address). However, we used this sample as it provided a practical opportunity to test different messages.

## Results

This section provides a summary of our results. See Annex B for a more technical description. Table 1 (below) summarises click-through and registration rates for each arm over the course of the trial period. Results highlighted in orange are different enough from our control message that we can be confident they are not due to chance (they are statistically significant). The result highlighted in blue is at the very edge of the conventional academic threshold for statistical significance. However, for reasons outlined below we are also confident it is not due to chance.

**Table 1:** Summary table of outcomes from the trial

	Click-through from initial email	Registration at 7 days	Click-through from reminder email	Registration at 15 days (Primary outcome)
Control	13.2%	9.9%	4.7%	12.9%
Loss-framed	11% *	9.2%	6.1% +	13.4%
Gain-framed	13.4%	9.8%	7.8% **	15.1% +
Action-oriented	12.1%	9.9%	4.7%	13.3%

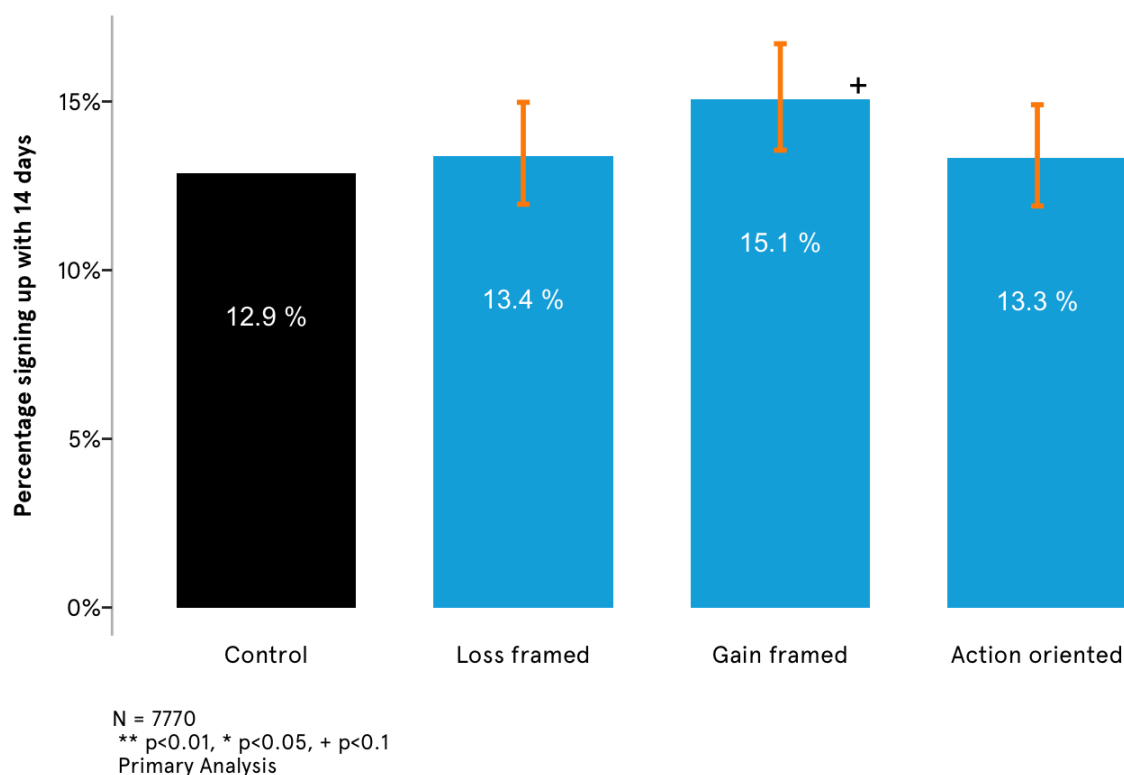
(p<0.1 +, p<0.05 \*, p<0.01 \*\*)

Overall, the **gain-framed message** marginally increased sign-up rates by 2.6 percentage points, which is a 20% increase in relative terms (see Figure 3).

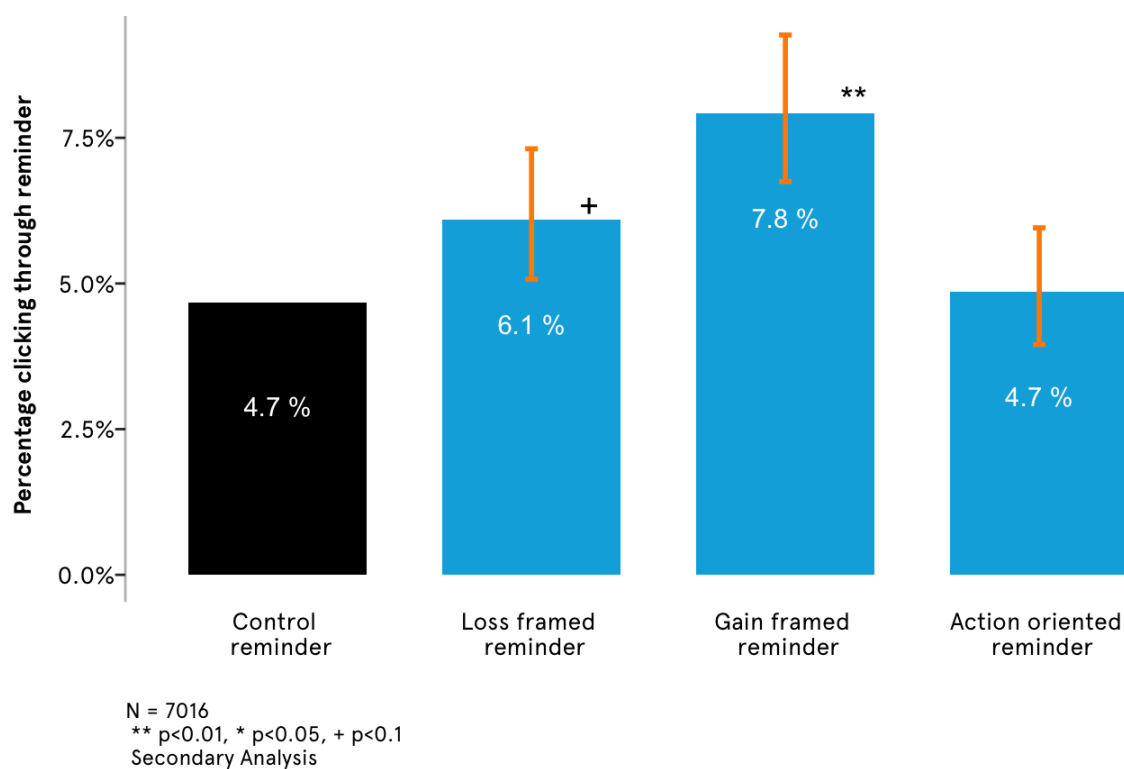
The effect of gain-framing seems to be due entirely to the reminder sent out after eight days. We cannot directly measure whether registrations come from an initial or reminder email. However, the initial gain-framed message does not result in more click-throughs or registrations than the control message. By contrast, the gain-framed reminder increases click-throughs by 65% compared to the control (see Figure 4). This is a very significant effect and is very unlikely to be due to chance. It therefore appears that the **gain-framed reminder** is the message which has driven the overall difference we see at 15 days.



**Figure 3:** Bin reminder service sign-up rates within 15 days

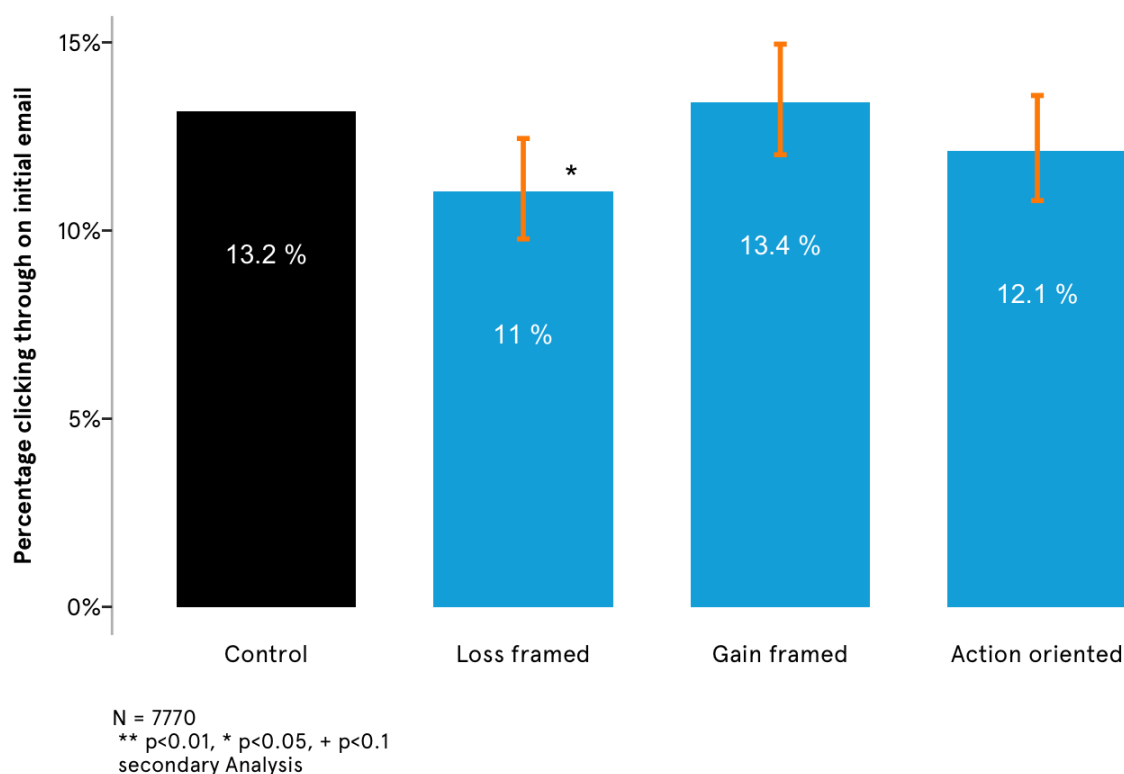


**Figure 4:** Registration page click-through rates from the reminder email



Neither the loss-framed nor action-oriented messages performed better than our information-only control message. In fact, we find that the loss-framed message sometimes backfires (i.e. does worse than an information-only control message). The initial loss-framed message results in click-through rates significantly lower than an information-only control message (see Figure 5) and a reduction (though not statistically significant) in actual registration rates. Meanwhile, the reminder message does appear to potentially increase click-through rates, but this does not translate into more registrations.

**Figure 5:** Registration page click-through rates from the initial email



## Conclusion

On the basis of this trial, we recommend that the council consider gain-framed messages in future advertising for the service. We cannot be certain that the results we have seen in this trial will replicate to other forms of communication, but we believe they provide reasonable evidence that gain-framing is more likely to be effective than loss-framing or taking an action-oriented approach. In particular, we suggest adapting the gain-framed reminder message for us in other communication channels as it appears to have been significantly more effective. If the council does further email advertising for the service, we suggest using the same reminder message but trying to adapt the initial message to increase its effectiveness.

## Light-touch support

In addition to supporting Wirral Council to set up the new SMS reminder service, BIT also supported the council to implement some recommendations from our initial Scoping Report.

To support the council we ran a workshop with Waste and Recycling staff to explore how to implement these recommendations. The workshop brought together staff from across the council (including Waste and Recycling staff, people from corporate communications, IT services and corporate transformation officers). In the session we went through practical customer journey mapping exercises to explore how to improve each process. BIT then followed up this workshop with ad-hoc advice and discussions with Wirral Council IT staff to support them to implement the suggested changes.

The three recommendations we focussed on were:

1. Providing clearer information online about the location and opening hours of household waste recycling centres (tips) and about bin collections;
2. Streamlining the process of booking a bulky waste collection by the council;
3. Making it easier to request a new bin.

Our Scoping Report explores these issues in more depth, but the goal of improving these processes was to reduce the number of 'occasional' fly-tippers by making it as easy as possible for people to get rid of their waste in an appropriate way.

In all three cases, the existing online process was clunky or difficult to complete. Given extensive experience in other domains, we believe it is very likely that making these processes easier to complete this will result in more people completing these activities. In all cases, failing to complete the activity (book a bulky waste collection, request a new bin, or find a tip) will leave residents with excess waste and no easy way to dispose of it. This is likely to increase the temptation to fly-tip.

## Outcomes

All three processes are now significantly improved. While there will always be scope for improvement, simple changes which did not require structural changes in IT systems or suppliers, have made them simpler and easier to complete. For example:

- ◆ Information on the location and opening times of local tips is now consistent across Wirral Council and Merseyside Waste Disposal Authority (MWDA). Residents who visit the Wirral Council website are pointed to a [MWDA Google map of tips](#), allowing them to easily identify their nearest site and plan their journey.
- ◆ Residents are no longer required to choose from a list of over 200 different items when booking a bulky waste collection from the council.
- ◆ The council has streamlined several different processes for requesting a new bin (new bins, lost bins or damaged bins) into a single, clearer process.

## Next steps

This report marks the end of our current programme of work with Wirral Council. In this final section, we provide some thoughts about what we suggest the council does next.

1. **Continue to roll out the SMS reminder service.** We believe there are very good reasons to think that the SMS bin reminder service could have a real impact on recycling rates and the number of households putting their bins out on collection day (given the well-documented effect of reminders in other domains). However, the service will only have a measureable impact across the borough if it achieves significant uptake. Our email trial is the start of this process, but we suggest the council continues to actively promote the service to residents. For example, we know the Council plans to strongly encourage anyone who comes into contact with the Waste and Recycling team (to request a new bin, after being fined for fly-tipping etc) to sign-up for the service. We would also encourage the council to consider additional email campaigns, or even postal campaigns (for example through leaflets delivered alongside Council Tax bills).
2. **Estimate the impact of the SMS reminder service.** At the moment, uptake of the reminder service is too low to feasibly see an impact on overall recycling or the number of households putting their bins out on collection day. However, as the service reaches more residents we would encourage the council to evaluate whether it is having an impact on residents' behaviour. A robust, statistically significant evaluation of this will be difficult. However, the Council could begin measuring the take-up of the service on a round level (i.e. measuring the percentage of households on each collection round who are signed up for reminders). If rounds with a higher proportion of sign-ups see greater changes in recycling rates, or volumes of waste collected, this would be indicative evidence that the service is having an effect. This would also allow the council to conduct a cost-benefit analysis, comparing the cost of reminders against the (potential savings) achieved through an increase in recycling.
3. **Continue to test and adapt.** Through delivering our RCT, Wirral staff now have the experience of A/B testing different webpages and emails. As our trial results have demonstrated, surprisingly small changes in wording can have disproportionately large effects on behaviour. We encourage the council to continue testing, refining and adapting messages and processes.

## Annex A – Interventions

Title	Subject (Initial)	Body (Initial)	Subject (reminder)	Body (reminder)	Reasoning
Control	Sign-up for free reminders to put your bin out	<p><b>Sign-up for free reminders to put your bin out</b></p> <p>There is a new service to help you remember which colour bin to put out and when.</p> <p>Sign-up and we will send you a reminder text message each week the evening before your bin is due to be collected. The service is free and available to all Wirral residents. All we need is your mobile number and address.</p> <p>If you change your mind you can unsubscribe at any time.</p> <p>[button] <a href="#">Sign-up for bin reminders today</a> [/button]</p>	Remember - you can sign-up to receive free reminders to put your bin out	<p><b>Sign-up for free reminders to put your bin out</b></p> <p>Last week we emailed you to tell you about our new bin reminder service.</p> <p>Sign-up and we will send you a reminder text message each week the evening before your bin is due to be collected. The service is free and available to all Wirral residents. All we need is your mobile number and address.</p> <p>If you change your mind you can unsubscribe at any time.</p> <p>[button] <a href="#">Sign-up for bin reminders today</a> [/button]</p>	This is a 'neutral' information-only message. By comparing response rates to this message and to others, we will be able to tell the 'additional' impact we are getting by using behaviourally-framed messages.

<p><b>Action-oriented / bridging intention - action gap</b></p>	<p>Rubbish at putting the bins out? Sign-up for free reminders from Wirral Council</p>	<p><b>Sign-up for free reminders to put your bin out</b></p> <p>You're halfway to work, or still in your pyjamas, when you remember that you forgot to put the bin out. Even though you swore you would remember. Sound familiar?</p> <p>We can help. We've designed a new service to remind you which colour bin to put out and when.</p> <p>Sign-up and we will send you a reminder text message each week the evening before your bin is due to be collected. The service is free and available to all Wirral residents. All we need is your mobile number and address.</p> <p>If you change your mind you can unsubscribe at any time.</p> <p>[button] <a href="#">Sign-up for bin reminders today</a> [/button]</p>	<p>Remember - if you're rubbish at putting the bins out, we can help!</p>	<p><b>Sign-up for free reminders to put your bin out</b></p> <p>Last week we emailed you about our new bin reminder service.</p> <p>By signing up, you can make sure you never have to chase the bin lorry down the street in your pyjamas again.</p> <p>Sign-up and we will send you a reminder text message each week the evening before your bin is due to be collected. The service is free and available to all Wirral residents. All we need is your mobile number and address.</p> <p>If you change your mind you can unsubscribe at any time.</p> <p>[button] <a href="#">Sign-up for bin reminders today</a> [/button]</p>	<p>This message is intentionally designed to be less formal and more humorous. It is also designed to highlight the intention-action gap (you <i>mean</i> to put the bins out, but it is easy to forget).</p>
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<p><b>Loss-framed</b></p>	<p>Don't be left with an overflowing bin - sign-up for free bin reminders</p>	<p><b>Sign-up for free reminders to put your bin out</b></p> <p>We know how annoying it can be when you forget to put your bin out. You end up with an overflowing bin and no way to easily get rid of the waste. That's why we have a new service to help you remember which colour bin to put out and when.</p> <p>Sign-up and we will send you a reminder text message each week the evening before your bin is due to be collected. The service is free and available to all Wirral residents. All we need is your mobile number and address.</p> <p>If you change your mind you can unsubscribe at any time.</p> <p>[button] <a href="#">Sign-up for bin reminders today</a> [/button]</p>	<p>Remember - you can avoid being left with an overflowing bin</p>	<p><b>Sign-up for free reminders to put your bin out</b></p> <p>Last week we emailed you about our new bin reminder service.</p> <p>By signing up, you can make sure you aren't left with an overflowing bin and no easy way to get rid of the waste.</p> <p>Sign-up and we will send you a reminder text message each week the evening before your bin is due to be collected. The service is free and available to all Wirral residents. All we need is your mobile number and address.</p> <p>If you change your mind you can unsubscribe at any time.</p> <p>[button] <a href="#">Sign-up for bin reminders today</a> [/button]</p>	<p>We know that loss-framed messages ('don't risk this negative outcome') are often more effective than gain-frames ones ('make sure you get this benefit'). This message also aims to make the potential regret of missing a bin more salient.</p>
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<p><b>Gain-framed</b></p>	<p>Have one less worry – sign-up for free bin reminders from Wirral Council</p>	<p><b>Sign-up for free reminders to put your bin out</b></p> <p>There is a new service to help you remember which colour bin to put out and when. Join in and make your life that little bit easier, with one less thing to remember in the morning!</p> <p>Sign-up and we will send you a reminder text message each week the evening before your bin is due to be collected. The service is free and available to all Wirral residents. All we need is your mobile number and address.</p> <p>If you change your mind you can unsubscribe at any time.</p> <p>[button] <a href="#">Sign-up for bin reminders today</a> [/button]</p>	<p>Remember – you can have one less worry by signing up for bin reminders</p>	<p><b>Sign-up for free reminders to put your bin out</b></p> <p>Last week we emailed you about our new bin reminder service.</p> <p>By signing up, you can have one less worry and you'll always know which colour bin to put out.</p> <p>Sign-up and we will send you a reminder text message each week the evening before your bin is due to be collected. The service is free and available to all Wirral residents. All we need is your mobile number and address.</p> <p>If you change your mind you can unsubscribe at any time.</p> <p>[button] <a href="#">Sign-up for bin reminders today</a> [/button]</p>	<p>The flip-side of the loss-frames message, this aims to highlight the gain of signing up (in terms of having 'one less worry').</p>
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## Annex B –Technical details on trial design and delivery

### Trial design

Individuals were randomly allocated to a trial arm by BIT, with stratification on MailChimp subscriber rating (1-5 score based on previous click-through and engagement with emails) and IMD. We would ideally have stratified on recycling/waste behaviour but data on these were not available. Recipients would not know which condition they had been allocated to, unless they discussed it with neighbours who were also in the trial. A spreadsheet with treatment allocation was sent to Wirral Council, who then sent the emails out to the sample and collected outcome data.

Sign-up data was collected by requesting a list of all households who had registered from Wirral Council 15 days after emails are sent. Click-through rates from email to registration form were requested for the initial emails 7 days after they were sent, and for the reminder emails 8 days after they were sent. For people who subscribed or clicked through more than once, the first time that they did so was used as the outcome measure. If click-through was 'not available' this was treated as did not click-through. A unique ID was used to merge the data sets.

**Table 2:** Descriptive data on sign-up for the bin reminder service within 14 days of the initial email being sent

	N	Sign-up rate (%)
Control	1943	12.9
Loss-framed	1942	13.5
Gain-framed	1942	15.5
Action-oriented	1943	13.4

### Implementation challenges

During the trial we only came across one major implementation challenge. Of the 7,016 individual who did not sign-up to the bin reminder service within seven days, 6,707 received a reminder email. Through further exploration of the missing 309 individuals, we identified that those who clicked through to the registration page following the initial email, but did not complete a registration, did not receive the reminder email. We decided to include these people in our analysis, even though they did not receive reminders. This means we may have underestimated the effect of our messages (these people may have been more likely on average to respond to a reminder message). However, if we observe a significant result in spite of this, we can be confident in the impact of our messages.

### Primary analysis approach

The primary analysis for this trial is a logistic regression model on the probability of signing up to the bin reminder service within **14 days** of the initial email. This method was chosen over standard OLS regression, due to expected low baseline signup rates (~5%).

$$\text{logit}(\Pr(Y_i = 1)) = \alpha + \beta_0 T_i + \beta_1 \text{IMD}_i + \beta_2 H_i + \beta_3 E_i + \beta_4 I_i + \beta_5 MC_i$$

Where  $\Pr(Y_i = 1)$  is the probability that individual  $i$  signs up for the bin reminder service within 14 days of receiving the initial email.

$T_i$  is a vector of binary treatment indicators.

$\text{IMD}_i$  is the index of multiple deprivation decile for LSOA of individual  $i$  (continuous variable).

$H_i$  is the barriers to housing and services deprivation decile for LSOA of individual  $i$  (continuous variable).

$E_i$  is the barriers to living environment deprivation decile for LSOA of individual  $i$  (continuous variable).

$I_i$  is the income deprivation decile for LSOA of individual  $i$  (continuous variable).

$MC_i$  is the mailchimp score for individual  $i$ .

$\alpha$  is the regression constant

Note: the deprivation covariates are drawn from the indices of multiple deprivation 2015.

### Secondary analysis approach

The first secondary analysis for this trial is a logistic regression model on the likelihood of click through within **7 days** of the initial email.

$$\text{logit}(\Pr(Y_i = 1)) = \alpha + \beta_0 T_i + \beta_1 H_i + \beta_2 Q_i + \beta_3 D_i + \beta_4 M_i$$

Where  $\Pr(Y_i = 1)$  is the probability that individual  $i$  clicks through to the registration page within 7 days of receiving the initial email.

$T_i$  is a vector of binary treatment indicators.

$\text{IMD}_i$  is the index of multiple deprivation decile for LSOA of individual  $i$  (continuous variable).

$H_i$  is the barriers to housing and services deprivation decile for LSOA of individual  $i$  (continuous variable).

$E_i$  is the barriers to living environment deprivation decile for LSOA of individual  $i$  (continuous variable).

$I_i$  is the income deprivation decile for LSOA of individual  $i$  (continuous variable).

$MC_i$  is the mailchimp score for individual  $i$ .

$\alpha$  is the regression constant

Note: the deprivation covariates are drawn from the indices of multiple deprivation 2015

The second secondary analysis is a logistic regression model on the likelihood of click through within **7 days** of the reminder email. This mirrors the first secondary analysis, but with the outcome variable being the probability that individual  $i$  clicks through to the registration page within **7 days** of receiving the reminder email.

The third secondary analysis is a logistic regression model on the likelihood of signing-up to the bin reminder service within **7 days** of the initial email.

$$\text{logit}(\text{Pr}(Y_i = 1)) = \alpha + \beta_0.T_i + \beta_1.H_i + \beta_2.Q_i + \beta_3.D_i + \beta_4.M_i$$

Where  $\text{Pr}(Y_i = 1)$  is the probability that individual  $i$  signs up for the bin reminder service within 7 days of receiving the initial email.

$T_i$  is a vector of binary treatment indicators.

$IMD_i$  is the index of multiple deprivation decile for LSOA of individual  $i$  (continuous variable).

$H_i$  is the barriers to housing and services deprivation decile for LSOA of individual  $i$  (continuous variable).

$E_i$  is the barriers to living environment deprivation decile for LSOA of individual  $i$  (continuous variable).

$I_i$  is the income deprivation decile for LSOA of individual  $i$  (continuous variable).

$MC_i$  is the MailChimp score for individual  $i$ .

$\alpha$  is the regression constant

Note: the deprivation covariates are drawn from the indices of multiple deprivation 2015

## Results

### Primary outcome – sign-up within 14 days of the initial email

We found that the gain-framed message had a marginally significant positive effect of 2.6 percentage points (20% in relative terms) on sign-up rates. Neither the loss-framed nor action-oriented messages performed better than our information-only control message (see Figure 1). In addition, we observe a significant difference in click-through rates between the loss-framed treatment and control group, with an 18% relative decrease in click-through rates in the treatment arm. This effect is significant at the 5% level.

**Table 3:** Effects of treatment on sign-up rate within 14 days of the initial email

Treatment name	Sign-up rates (Binary)
Loss-framed	0.046 (0.097)
Gain-framed	0.183 + (0.095)
Action-oriented	0.041 (0.098)
Imd_decile	-0.066 (0.054)
Income_decile	0.062 (0.054)
Housing_decile	0.024 (0.022)
Living_decile	-0.012 (0.021)
Member_rating	0.359** (0.026)
Constant	-3.13 (0.252)
Observations	7,770

Robust standard errors in parenthesis.  $p < 0.1$  +,  $p < 0.05$  \*,  $p < 0.01$  \*\*

### Secondary outcome – click-through rates seven days after initial email

Table 4, below, provides the results of the first secondary analysis of click-through rates to the registration page on treatment assignment, within seven days of the **initial** email being sent (i.e. just before the reminder email is issued).

We observe a significant difference in click-through rates between the loss-framed treatment and control group, with an 18% relative decrease in click-through rates in the treatment arm. This effect is significant at the 5% level.

We observe no significant effect of the other treatment arms, gain-framed and Action-oriented, on click-through rates.

**Table 4:** Effects of treatment on click-throughs within 7 days of the initial email

Treatment name	Click-through rate (Binary)
Loss-framed	-0.202* (0.102)
Gain-framed	0.020 (0.098)
Action-oriented	-0.100 (0.100)
Imd_decile	-0.074 (0.057)
Income_decile	0.075 (0.056)
Housing_decile	0.013 (0.023)
Living_decile	-0.008 (0.022)
Member_rating	0.422** (0.027)
Constant	-3.291 (0.260)
Observations	7,770

Robust standard errors in parenthesis.  $p < 0.1$  +,  $p < 0.05$  \*,  $p < 0.01$  \*\*

### Secondary outcome – click-through rates from the reminder email

Table 5, below, provides the results of the second secondary analysis of click-through rates to the registration page on treatment assignment, within eight days of the **reminder** email being sent.

We observe a significant difference in click-through rates between the gain-framed treatment and control group, with a 66% relative increase in click-through rates in the treatment arm. This effect is significant at the 1% level.

We observe a marginally significant difference in click-through rates between the loss-framed treatment and control group, with a 30% relative increase in click-through rates in the treatment arm. This effect is significant at the 10% level.

We observe no significant effect of the action-oriented treatment on click-through rates.

**Table 5:** Effects of treatment on click-throughs within eight days of the reminder email

Treatment name	Click-through rate (Binary)
Loss-framed	0.280+ (0.153)
Gain-framed	0.560** (0.147)
Action-oriented	0.038 (0.161)
Imd_decile	-0.082 (0.084)
Income_decile	0.047 (0.084)
Housing_decile	0.048 (0.034)
Living_decile	0.014 (0.031)
Member_rating	0.341 (0.039)
Constant	-4.351 (0.394)
Observations	7,016

Robust standard errors in parenthesis.  $p < 0.1$  +,  $p < 0.05$  \*,  $p < 0.01$  \*\*

### Secondary outcome – sign-up rates from the initial email

Table 6, below, provides the results of the third secondary analysis of sign-up rates for the bin reminder service on treatment assignment, within seven days of the **initial** email being sent out.

Across all treatment arms, we observe no significant difference in signups within seven days of the initial email.

**Table 6:** Effects of treatment on sign-up rates within seven days of the initial email

Treatment name	Sign-up rate (binomial)
Loss-framed	-0.079 (0.112)
Gain-framed	0.009 (0.110)
Action-oriented	0.020 (0.110)
Imd_decile	-0.065 (0.063)
Income_decile	0.067 (0.062)
Housing_decile	0.021 (0.025)
Living_decile	-0.011 (0.024)
Member_rating	0.391 (0.029)**
Constant	-3.562 (0.290)
Observations	7,770

Robust standard errors in parenthesis.  $p < 0.1$  +,  $p < 0.05$  \*,  $p < 0.01$  \*\*