

UBC-DIBS Working Paper 2024-CBI-03

Using Salience to Encourage Small Appliance Recycling

Ellen Engelsbel, Megha Khurana, & Jiaying Zhao



Knowledge Summary: This project aimed to increase recycling of small appliances. New “Behavioural Insights informed” messages were designed to make it easier to find key information, like locations and hours of local recycling depots. A control message was tested against the BI message on Google Display, Facebook, and Instagram. Although there was no measurable change in recycling rates, the BI message increased some types of online engagement. Based on these results, the project team recommend further research as well as other possible next steps.

Keywords: *behavioural insights, nudge, salience, sustainability, recycling*

Suggested citation: Engelsbel, E., Khurana, M., & Zhao, J., (2024). *Using salience to encourage small appliance recycling*. (UBC-DIBS Working Paper 2024-CBI-03).



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Box 1: About Our Partners

Canadian Electrical Stewardship Association (CESA; <https://www.cesareporting.ca/>) is a federally incorporated organization led by industry members whose products are stipulated in the Government of British Columbia’s Recycling Regulation. To satisfy its members mandates under the regulation, CESA runs the ElectroRecycle program.

ElectroRecycle (<https://www.electrorecycle.ca/>) is Canada’s first small appliance and power tool recycling program in B.C. The organization accepts more than 400 types of small appliances for recycling at select depots, recycling centers, thrift stores, municipal facilities, retailers and community events.

Product Care Recycling (<https://www.productcare.org/>) is a federally incorporated not-for-profit organization providing recycling services across nine Canadian provinces, including B.C. Product Care Recycling encourages individuals and businesses to reduce their waste and reuse when possible, providing recycling solutions for post-consumer products.

Executive Summary

Project Objective: To increase the number of small appliances being recycled in B.C.

Background: Sending small appliances to the landfill is a significant problem due to its impact on the environment, wasted resources, energy consumption to manufacture new appliances, and taking up landfill space. These small appliances could be sold, donated, or repaired. Anything beyond repair could be recycled to reduce the landfill burden. Plus, using materials recovered through recycling is more energy efficient than harvesting virgin materials. A program run by our project partner organization, ElectroRecycle, can recycle 95% of the material in more than 400 types of small appliances in B.C.

Research Question: Can the recycling rate of small appliances be increased by addressing the behavioural barriers faced by consumers?

Hypothesis: Reducing friction by making the process easier and reducing the number of steps using behaviourally informed messaging online will lead to more engagement and encourage recycling behaviour.

Methods: To test our hypothesis, we conducted an experiment with messaging on social media (Meta: Facebook and Instagram) and Google Display using geo-targeting to reach people within a two-mile radius of eight recycling depots. These eight sites were randomly assigned into two groups with four sites to receive control message and four sites to receive the intervention (behaviourally informed or BI message). This message included depot information (name and address nearest to their home and hours of operation) to remove a step in the recycling process that is to find the depot address and hours of operation. The message was the independent variable. The dependent variables were the weight (measured in kilograms) of objects recycled and the digital metrics of the paid messaging. We aimed to measure the difference from the baseline kilograms to the post intervention kilograms for control and intervention sites then compare the differences between them.

Implications and Projected Impact: Considering that many barriers to recycling are behavioural in nature, a BI intervention could possibly reach more people through digital media channels. Recycling small appliances is an infrequent and complex behaviour and a BI trial may require a longitudinal study to see an increase in recycling. Considering all of this, our hope was to see a small increase in the monthly weight of appliances recycled at the intervention sites and increased engagement across digital media channels.

Results: The team was able to work with our partners (see Box 1) to trial a BI solution using digital media channels. Although the team did not find significant results with the weight of appliances recycled, null results are helpful to identify BI solutions that don't work. Digital media engagement, however, had significant results for the BI message. Based on these results, we recommend additional research to be conducted for an improved BI solution for further experimentation.

Part A. Problem Background

The big picture problem relates to the environment: reducing objects going into landfills as well as recovering valuable materials, which are far more energy efficient than using virgin materials.

The limited uptake of small appliance recycling has significant negative impacts on the environment. Improper disposal and lack of small appliance recycling lead to detrimental effects on the environment, health and safety of local communities (Song & Li, 2014). The disposal and recovery of plastics from waste electrical and electronic equipment are of considerable importance from both environmental and economic perspectives (Müller et al., 2011). The disposal of small household items with high-temperature applications like curling irons and hair dryers can lead to concentrations of hazardous substances in waste, contributing to environmental pollution (English et al., 2016).

Small appliances are being sent to the landfill when they could be sold, donated, repaired or recycled. All of these activities are preferred to sending objects to landfills. The ElectroRecycle Program accepts 400+ types of these items for free at more than 220 locations in B.C. and 95% of the material in items collected are recycled through their program. Appliances covered under the program include items with plugs on kitchen countertops, used in personal grooming, to clean floors, to exercise, etc. What's not included are items with a screen that are categorized as e-waste.

Pollution Prevention Hierarchy

Our partners strive to manage collected materials through the Pollution Prevention Hierarchy (CESA Annual Report to Director, 2022, p. 18). This means, wherever and whenever feasible, the first order of priority is for working appliances to be donated or sold, or for those with minor issues to be repaired (reuse and repair). Anything beyond repair should be recycled so as to reduce landfill space and recover valuable materials (recycle and recover).

Behavioural Insights Approach

Dealing with unwanted small appliances is an infrequent behaviour with several alternatives. A behavioural insights approach is a good fit for this problem because it can help with common barriers around the behaviour, such as a lack of awareness or knowledge around the process of recycling, inconvenience and forgetfulness. Recycling small appliances isn't as straightforward as recycling bottles and cans. People might not know how or where to recycle small appliances and recycling infrequently used items can easily be forgotten.

Additionally, our partners are looking to improve people's responsible consumption and disposal of small appliances. For our partners, behavioural insights can provide an additional way to approach the problem, complementing their existing efforts.

Part B. Behaviour & Context

There are several options for a behavioural intervention as unwanted small appliances can be sold, given away or donated, repaired or recycled.

Target Behaviour

The chosen behaviour for this project is **recycling** even though it is the last behaviour outlined in the Pollution Prevention Hierarchy. With current processes, 'recycling' is the only behaviour that has measurable data available that meets the **MISFIT** criteria. The behaviour of interest is for residents to drop off their broken or obsolete small appliances at one of the 220-plus depots throughout B.C. Diverting objects from the landfill has positive impacts on our environment by preventing pollution and slowing the need for harvesting of virgin materials in production. And while our partner's existing efforts are in place to encourage recycling, we aim to increase further recycling.

Recycling small appliances meets the **MISFIT criteria**:

- **Measurable** - Recycling outcomes are quantifiable through existing data collection methods like kilograms (KG) of materials collected from depots. However, detailed item categorization data collection is inconsistent.
- **Impactful** - Recycling small appliances reduces landfill waste and reliance on virgin materials. Behavioural interventions can nudge people towards recycling. ElectroRecycle has tracked recycled material volumes since 2013, providing a solid data baseline.
- **Sizable** - With over 4 million adults in B.C. (2021 Census), the sample size is substantial. Most adults own at least one small appliance or power tool.
- **Feasible** - Securing resources and approvals for a behavioural intervention is practical. Data on collected materials is available two to three weeks post-month-end. Conducting the intervention within the project framework is achievable and offers valuable insights for future scaling.
- **Identifiable** - The target population is clearly defined as adult residents of B.C.
- **Touchpoints** - Effective channels include the ElectroRecycle website and social media. An annual budget supports public education initiatives, enabling rapid and targeted digital marketing campaigns. However, digital targeting excludes those not online.

Key Barriers

As a part of our exploratory research, we started out with detailed conversations followed by interviews with our clients who are the key stakeholders in the project. We analyzed historical data from a biennial survey done by ElectroRecycle. In addition, we reviewed evidence reported in academic literature and by behavioural insights groups across other jurisdictions.

To build on this research, we conducted interviews with ten local residents to learn about current barriers that are likely to impact recycling behaviour. We visited a few recycling depots across the Lower Mainland in B.C. to look at the set-up and understand the drop-off process. We also looked at ElectroRecycle's social media channels to assess current messaging used to spread awareness.

Two key barriers that emerged through our research were a lack of awareness or knowledge in regards to specificity and complexity. Both barriers relate to cognitive overload.

1. **Lack of awareness or knowledge.** From their latest biennial survey, ElectroRecycle has data showing that approximately 88% of the population knows that small appliances can be recycled (CESA Annual Report to Members, 2022). Furthermore, 85% of households had obsolete or broken appliances and power tools. That said, only 43% had taken the items to a recycling depot the year prior. Our interviews with residents helped us understand why there was an **awareness-action gap**. Most of the interviewees were aware that small appliances are recyclable, however, there was a lack of awareness specifically about what can be recycled and where can these appliances be recycled. For instance, people may not know *where* their nearest location is or they may not know the specifics around *which*

400+ products can be recycled.

2. **Complexity.** Recycling small appliances is more difficult than alternative recycling behaviours, such as putting hard plastics in blue bins for curbside pickup. Also, it is easy to toss objects into the garbage. Reducing complexity, for instance, by reducing the steps for people, could ease restraining forces around the behaviour. Steps for recycling small appliances include knowing if an unwanted appliance is recyclable, finding out what to do with it or where to go, and going to the location to drop the item off.

We reviewed ElectroRecycle’s existing digital campaigns and the process to find information about small appliance recycling and we discovered the process required multiple steps:

1. Messaging through the campaign directs the consumer to ElectroRecycle’s website with a click, taking them to the list of accepted products.
2. Once the consumer finds the accepted item from the list of more than 400 appliances, they are then required to find the nearest location that would accept the item. All recycling depots are independently owned and not all depots will accept all items, thus this step is crucial.
3. After finding this information the consumer is expected to perform the desired behaviour of dropping off the item. Some depots may be as far as a thirty-minute drive in urban areas and a forty-five-minute drive in rural areas.

To understand these barriers, we reviewed literature further and learned about ‘value-action gap’ that refers to the observed disparity between individuals’ reported concerns or attitudes about certain issues, such as environmental, social, economic, or ethical concerns, and the actual behaviours or actions they exhibit in practice (Flynn et al., 2009). This gap highlights the discrepancy between individuals’ awareness or attitudes towards a particular issue and their corresponding actions or behaviours in response to that awareness (Chai et al., 2015). The concept of value-action gap has been identified in various contexts, such as sustainable energy practices, climate change, and sustainable tourism, where individuals may express concerns or values and awareness but fail to translate them into concrete actions or behaviours. Other literature term the phenomenon as ‘attitude-behaviour gap’, ‘awareness-behaviour gap’, ‘attitude-action gap’, or ‘**awareness-action gap**’ (Yin & Liu, 2013). Closing this gap is crucial for promoting sustainable behaviours and addressing societal challenges by aligning values, intentions, and awareness with their actual behaviours and actions (Chaplin & Wyton, 2014). As recycling is simply not a priority for many individuals, efforts should be placed on providing greater scaffolding to make the process of recycling less tedious, less confusing, and more habitual (Roy et al., 2022).

Making the process easier has been recognized as an effective behavioural tool to increase recycling behaviour. By making recycling processes more straightforward and accessible, individuals are more likely to engage in recycling practices. To sum up, our findings from the academic literature and primary research suggest the process of small appliance recycling is complex and there may be merit in simplifying the process.

Part C. BI Solution

Overall, interviews, site visits, and our literature review indicated that the process of recycling could be made easier. To address the key barriers mentioned, lack of awareness or knowledge and complexity, we propose one BI solution: **salience**. We expand on this tool borrowing from the EAST framework (Behavioural Insights Team, 2014), applying it to our BI solution by reducing cognitive load and making the process easy.

How to Make It Easy

Our first step in looking at the behaviour was to map out the steps along with potential barriers people had to go through when they had an unwanted small appliance.

Steps to Recycle Small Appliances

Steps to close	(1) Have an unwanted, obsolete or broken small appliance	(2) Item can be recycled	(3) Item needs to be dropped off	(4) Dropping item off
Questions and Barriers	WHAT Can the object be recycled? → Lack of awareness or knowledge	HOW How to recycle? E.g. blue bin, pickup, or drop off → Lack of awareness or knowledge → Complexity	WHERE Where to recycle? When? → Lack of awareness or knowledge	WHEN Bring items to the depot. → Lack of awareness or knowledge → Complexity
Possible intervention	Show an array of small appliances that can be recycled with a link to find out all.	Add a call to action. “Drop off your XXX”	Highlight specific nearby depot location and address and hours of operation with a link to the specific depot website.	

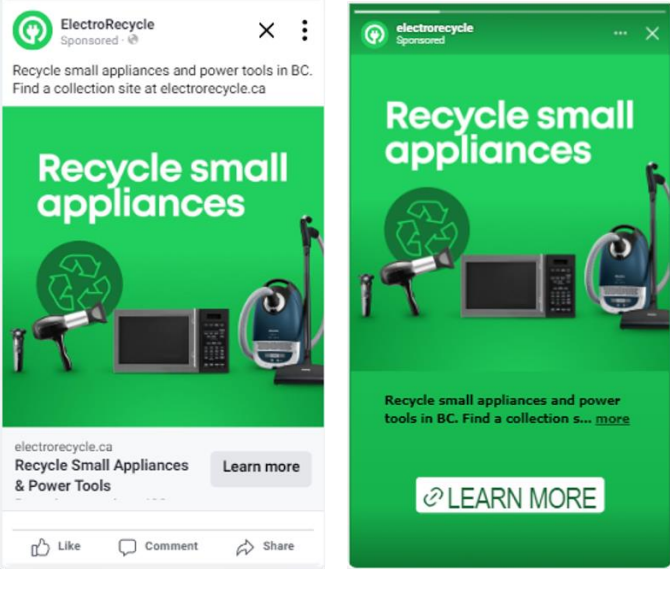
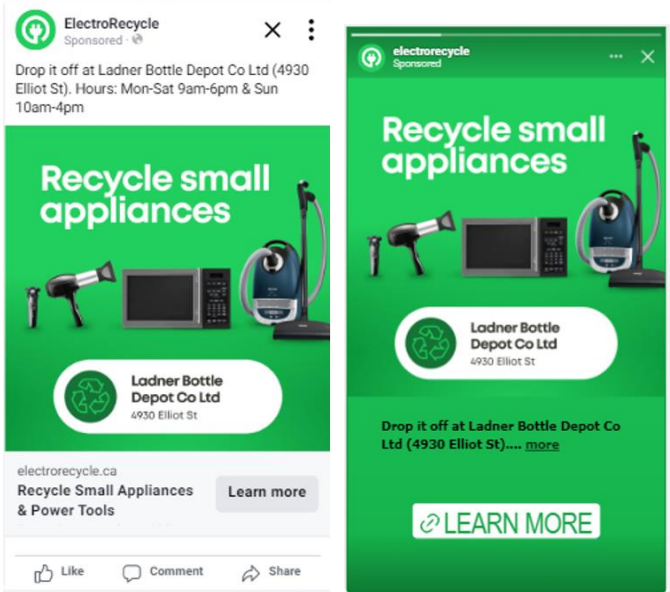


After mapping the steps of the recycling behaviour, we then looked at the touchpoints where we could apply an intervention. The entire ElectroRecycle program is designed to provide awareness of recycling the objects in their purview and to simplify the steps to recycling by providing extensive resources to help people know what, how, and where. They do this through many channels including social media with links to their website.

Why Salience

From our research, we learned that making small appliance recycling easy can significantly increase recycling rates and contribute to environmental sustainability. Research suggests that convenience plays a crucial role in influencing recycling behaviour (DiGiacomo et al., 2018). Furthermore, having to make extra effort becomes a barrier, and good intentions to recycle will be set aside. The act needs to be made as easy as possible to maximise the behaviour (Roy et al., 2022). Simplifying the recycling process by using interventions such as improving the design of signage on recycling bins by simplifying the texts, can act as a nudge to promote recycling behaviours (Luo et al., 2022). Making recycling depot locations salient can increase recycling behaviour by enhancing individuals’ awareness and accessibility to recycling facilities. When recycling locations are made salient, individuals are more likely to notice and remember their existence, leading to increased utilization of these facilities (Rhodes et al., 2014). Additionally, research has shown that the proximity of recycling depots plays a crucial role in individuals’ recycling behaviour.

Considering all of the above, our BI solution involved improvement of ElectroRecycle’s existing online messaging campaigns. In using salience, we aim to provide exact details on where and when to go (depot name and address along with the hours of operation of the location nearest to their residence). This will reduce friction by reducing a step in the process and making information easily available.

Control and BI Messaging

Control	BI
Facebook/Instagram - no address	Facebook/Instagram - depot name, address + hours of operation
 <p>The image shows two versions of a Facebook/Instagram advertisement. The left version is the control, featuring a green background with the text 'Recycle small appliances' and 'Recycle small appliances and power tools in BC. Find a collection site at electrorecycle.ca'. It includes images of a hair dryer, a toaster, and a vacuum cleaner. The right version is the BI version, which includes the same text and images but adds specific information: 'Drop it off at Ladner Bottle Depot Co Ltd (4930 Elliot St). Hours: Mon-Sat 9am-6pm & Sun 10am-4pm'. It also features a circular logo with the depot name and address 'Ladner Bottle Depot Co Ltd 4930 Elliot St'.</p>	 <p>The image shows two versions of a Facebook/Instagram advertisement. The left version is the control, featuring a green background with the text 'Recycle small appliances' and 'Recycle small appliances and power tools in BC. Find a collection s... more'. It includes images of a hair dryer, a toaster, and a vacuum cleaner. The right version is the BI version, which includes the same text and images but adds specific information: 'Drop it off at Ladner Bottle Depot Co Ltd (4930 Elliot St).... more'. It also features a circular logo with the depot name and address 'Ladner Bottle Depot Co Ltd 4930 Elliot St'.</p>
Google Display - no address	Google Display - address
 <p>The image shows a Google Display advertisement with a green background. It features the text 'Recycle small appliances' and 'Learn more' with a right-pointing arrow. There is a recycling symbol and an image of a kettle.</p>	 <p>The image shows a Google Display advertisement with a green background. It features the text 'Recycle small appliances' and 'Learn more' with a right-pointing arrow. It includes a recycling symbol, an image of a kettle, and specific information: 'Ladner Bottle Depot Co Ltd 4930 Elliot St'.</p>

Salience Fits

Making the desired behaviour easier can increase the frequency of the behaviour. Our BI solution aims to reduce the number of steps needed to recycle small appliance. This intervention is a channel factor that, while being small, can influence behaviour by facilitating the execution of an intention. These factors help bridge the gap between an individual's intention and their actual behaviour by easing the path to action, reducing obstacles, or providing clear directions.

Channel factors: The concept of channel factors was prominently tested in the Yale studies (Leventhal et al., 1965) of persuasion. The study's objective was to increase the likelihood of students getting tetanus vaccinations. The control group received general information about the vaccination while the test group in addition to general information also received a map with the health centre location. A significantly higher percentage of the test group got the tetanus shot. Simple addition of a map acted as a channel factor.

By including the exact depot name and location as well as the hours of operation we hope this channel factor will facilitate increased recycling.

It is important to keep in mind that even if the behaviour increases, it may not show in the results (i.e., KG of objects recycled) due to the infrequency of the behaviour, the variability in the weight of the objects and the

duration of our trial. And thus, we will also be analysing the impacts of control and BI messaging through digital media engagement.

Part D. Research Design

Our BI solution was paid messaging delivered through digital channels to address cognitive barriers: lack of awareness or knowledge and complexity. Our research design used geotargeting to include populations living within a 2-mile radius of select depots with messaging via Meta (Facebook and Instagram) and Google Display.

Geotargeting has been used in public health efforts. Hunt & Linos (2022) proposed a framework for social media-based public health campaigns that includes tailored messages and targeting them to specific populations based on geotargeting at a city or zip code level. By applying this, researchers can customize their social media ads to reach individuals within a defined radius, enhancing the audience reach.

Recycling Depot Selection

There are currently 220+ depots located across B.C. that accept small appliances for recycling. Data from our partners show that the KG collected at the depots varies dramatically from month to month (same depot) and across depots.

To choose the depot locations for our project we looked at the following criteria:

- Low year-to-year variance in KG of recycled items
- Geographically dispersed to reduce potential contamination across sites
- Comparable population sizes
- Timing of data collection

We decided to focus on locations in the southern B.C. as they had shorter data collection times (two weeks after month end). Eight depots fit the criteria outlined:

- Abbotsford Mission Recycling Depot
- Aldergrove Return-It Depot
- Richmond Recycling Depot
- Surrey Central Return-It Centre
- Ladner Bottle Depot Co. Ltd.
- Metrotown Bottle Return-It Centre
- North Van Bottle and Return-It Depot
- Semiahmoo Bottle Depot

Random Assignment of Depots to Control and Intervention Sites

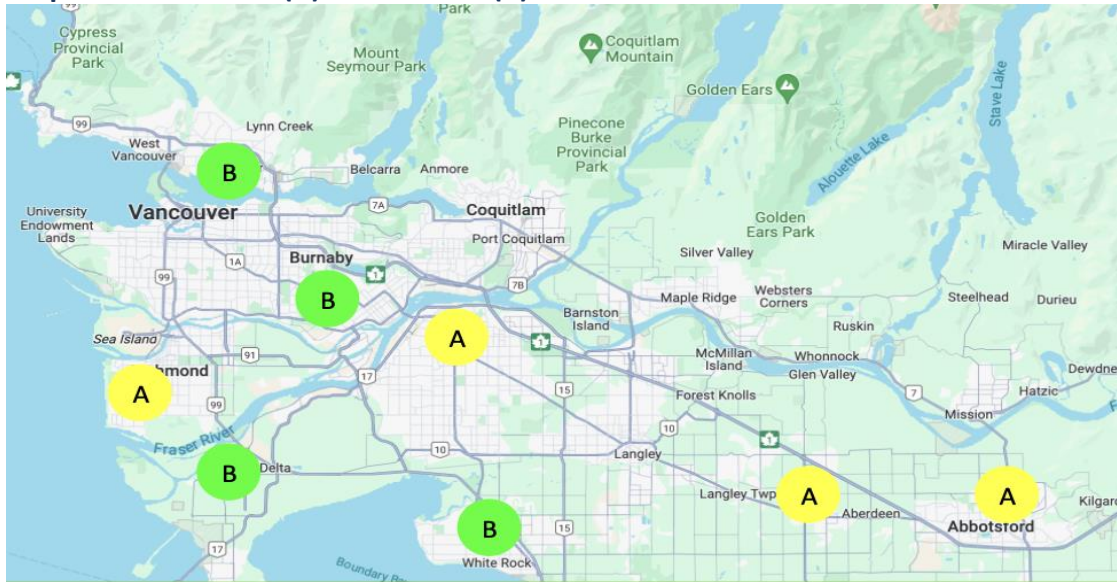
Next, we looked at the target populations within a 2-mile radius that could be reached through our touchpoints. We focused specifically on the reach of Facebook. Facebook provides the minimum and maximum number of people that can be reached through their platform.

Of our eight depot sites, we assigned four depots to control and four depots to intervention condition. The result of our random assignment along with the minimum and maximum target audience reached are provided in the following table and map.

Potential Target Audience via Facebook

Conditions	Total target audience to potentially reach within 2 miles radius of the depots
Control (4 sites, B)	388,100 (min) to 456,500 (max)
Intervention (4 sites, A)	352,800 (min) to 415,000 (max)

Map of Intervention (A) and Control (B) Sites



Touchpoints and Data Collection

Our touchpoints included paid geo-targeted messaging via Meta (Facebook and Instagram) and Google Display to people within 2 miles of each depot. We ran the messaging from February 28 through April 12, 2024 and received the data at the end of April.

Independent Variable: Messaging

Control message vs. BI message

Dependent Variables: Measurements

1. Recycled weight: KG collected per shipment at each site
2. Digital media metrics: # of clicks, click through rates (CTR), conversions for digital media channels, as well as reactions, comments, and shares on Facebook and Instagram

Intervention Timing for Measurement

Conditions	Jan 2 - Feb 27, 2024	Feb 28 - Apr 12, 2024
Control	Baseline	Control message
Intervention	Baseline	BI message

Part E. Research Results

We have separated the analysis of our results into two sections: weight of recycled small appliances (KG collected per shipment) and digital media campaigns. Lastly, we have included a cost-benefit analysis.

Weight of Recycled Small Appliances - KG Collected per Shipment

For both the control and intervention sites, the mean KG of recycled small appliances collected per shipment dropped from the baseline to the treatment periods. See figure below.

At the control sites, the mean went from 675 KG to 598 KG; SD from 521 KG to 374 KG. At the intervention sites, the mean went from 478 KG to 389 KG; SD from 308 KG to 250 KG (Table 1).

The results of performing a two-way ANOVA shows (Table 2):

- A main effect of condition with the control sites having more KG: $F(1)=28.56, p<.001, \eta^2=0.08$
- No effect of period: $F(1)=1.85, p=.17, \eta^2=0.005$
- No interaction: $F(1)=0.20, p=.66, \eta^2<.001$

Overall, there is no effect of the BI message.

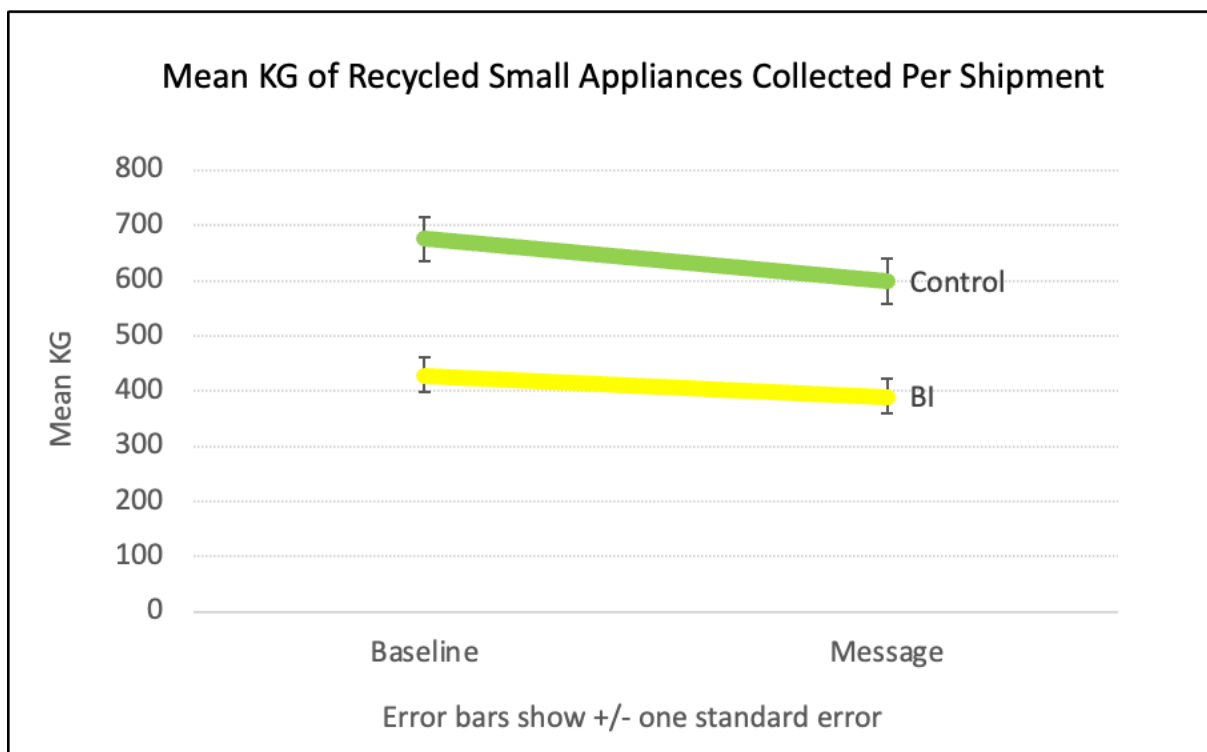


Table 1. Recycled Small Appliances Collected Per Shipment by Condition

Condition	Period	No. of Shipments	Mean	Standard Deviation	Standard Error
Control	Baseline	92	675.18	521.41	54.36
	Message	84	598.07	373.53	40.75
Intervention	Baseline	83	427.82	307.34	33.74
	Message	70	388.5	250.18	29.9

Table 2. Recycled Small Appliances Collected Per Shipment ANOVA

Cases	Sum of Squares	df	Mean Square	F	p	η^2
Condition	4.25×10 ⁶	1	4.25×10 ⁶	28.56	1.72×10 ⁻⁷	0.08
Period	276057.13	1	276057.13	1.85	0.17	5.21×10 ⁻³
Condition * Period	29087.41	1	29087.41	0.2	0.66	5.49×10 ⁻⁴
Residuals	4.84×10 ⁷	325	148875.68			

Digital Media Campaigns

In contrast to the weight analysis, the digital campaigns showed some statistical differences in the results. Definitions for digital metrics as they relate to our specific campaigns are outlined in Box 2.

Box 2: Digital Campaign Metrics Definitions

Apply to Google Display and Meta campaigns:

- Impressions - the number of times an ad was displayed to a user with or without a click
- Click through rate - count of the user clicks on an ad taking them to the ad’s landing page. In this case, the landing page was set to www.electrorecycle.ca.
- Conversions - a conversion was counted when a user, once on the website, clicked on any of the “Find a location” or “Accepted products” buttons or links

Meta campaigns only:

- Reactions - the number of reactions (likes, love, care, haha, wow, sad or angry) to the ads
- Shares - the number of shares of the ads. Users can share ads or post on their own or friends’ timelines, in groups, and on their own pages. This includes Instagram shares to people’s inboxes. It does not count further engagement with the post after it is shared.
- Comments - the number of comments on the ads, including any that were deleted

The costs of running the campaigns from February 28 - April 12, 2024 (52 days) were \$8,483 (Google Display) and \$5,500 (Meta) with half going to the control and intervention sites respectively.

Google Display

For Google Display, each condition gathered around 2.7 million impressions. The click through rate was similar between the two conditions, and there was no significant association there.

However, conversions show a different result. Conversions were counted when the user clicked on www.electrorecycle.ca and then clicked on a subsequent link to find accepted products or find a recycling location. We found a significant association between condition and conversion rate, in that the BI message increased the probability of clicking on more links on the ElectroRecycle website if they already were on the website. It must be noted that BI message for Google display had the address but not the hours of operation so the subsequent click could be to find further information.

Google Display Campaigns Results

Condition	Impressions	Click through rate (clicking the ElectroRecycle link)	Conversions (clicked on two links)	Costs
Control	2,746,505	1,532 (0.06%)	159 (10.38%)	\$4,241
Intervention	2,757,850	1,468 (0.05%)	210 (14.32%)	\$4,242

No significant association between condition and link clicks ($X^2=1.64$, $p=.20$, Cramer's $V<.001$).

Significant association between condition and conversion rate ($X^2=8.36$, $p=.004$, Cramer's $V=.05$).

Meta

For Meta (Facebook and Instagram), each condition had almost one million impressions. About 0.40% of the impressions led to a click of the link to the ElectroRecycle website, so the click through rate was roughly the same for the two conditions and there was no significant association between condition and click through rate. There was, however, a significant *reduction* in conversions for the BI message, meaning fewer clicks on a subsequent link. This may be because the address as well as hours of operation in the BI message for Meta so further clicks were not needed.

There was a significant association between condition and post reactions (e.g., like, love, laugh, emotions people expressed at the ad). This means that the BI message increased the post reaction rate more than the control message. There was also a marginally significant association between condition and post shares (i.e., sharing the ad). This means that the BI message increased the post share rate than the control message.

Meta Campaigns Results

Condition	Impressions (number of times ad was displayed)	Click through rate (clicking the ElectroRecycle link)	Conversions (clicked on two links)	Post reactions	Post shares	Costs
Control	974,282	4,150 (0.43% CTR)	707 (0.07% CTR)	130 (0.01%)	22 (0.002%)	\$2,750
Intervention	937,533	3,889 (0.41% CTR)	274 (0.03% CTR)	178 (0.02%)	36 (0.004%)	\$2,750

No significant association between condition and link clicks ($X^2=1.40$, $p=.24$, Cramer's $V<.001$).

Significant association between condition and conversions ($X^2=174.81$, $p<.00001$, Cramer's $V=.01$).

Significant association between condition and post reactions ($X^2=9.44$, $p=.002$, Cramer's $V=.002$).

Significant association between condition and post shares ($X^2=3.94$, $p=.047$, Cramer's $V=.001$).

Cost-Benefit Analysis

The costs for running the Google Display and Meta campaigns were \$13,983. Other costs include agency design services and the salaries of those involved of the project partners, students and faculty. The KG of recycled small appliances did not increase in either the control or intervention sites during the treatment period. While the decrease in the weight was *less* in the intervention sites, it was marginal. While there were some significant results with some digital media metrics, the effect size was small. Thus, the costs of the BI intervention may exceed the benefits.

Part F. Recommendations

- **No further implementation or scaling of paid BI solution in its current form at this time** - Based on the null results for the KG of recycled small appliances collected, further implementing the solution is not recommended. The cost of trialing the messaging did not produce the intended results during the short trial. Having said that, making relevant information salient did result in improved digital media metrics around engagement. It may be worth further testing more specific versus general messaging.
- **Engage with the depots** - The depots are important stakeholders in the recycling process. Finding a way to formally involve them is critical as they can have substantial influence in the process, particularly around choice architecture (e.g., depot layout and messaging). We understand it is difficult to engage with all 220+ depots across B.C. as they are independent businesses. However, soliciting participation from a selection of depots and collaborating with them could bring forward more robust research, possibilities for complementary data collection, and BI solutions.
- **Another BI RIDE** - If participation from select collection sites is solicited, an example of another BI project could use messaging, signage, and other BI tools to make recycling bins more visible. It was identified during the scoping phase that a lot of manufacturers and retailers don't make this a priority as part of EPR (extended producer responsibility). Also, there are other behaviours that could be revisited, including repairing broken appliances.
- **Consider collecting additional data** - Another learning from the scoping phase was a lack of data points which made most trials to target repair and other behaviours infeasible. For further BI projects we recommend additional data tracking measures other than the weight of appliances. Additional tracking, will help target infrequently recycled appliances, and also help explore the secondary market of repair and donations to keep appliances in circularity. Additional tracking could include:
 - i. Classification of items while collecting at depots can help target appliances that aren't recycled as much, for example electric toothbrushes.
 - ii. Items repaired at all repair cafe locations, currently only three locations track these.
 - iii. Items donated at thrift stores.
- **Embed BI practices into the ElectroRecycle Program** - The learnings students gain through the nine-month *Advanced Professional Certificate in Behavioural Insights* program could be instrumental for the ElectroRecycle Program because, at its core, the program is about influencing human behaviour. Having a staff member or a team from one of the partner organizations complete the program could support the development of a behaviourally-informed organization and lead to future BI initiatives. This could include longer-term trials which could be better suited for the infrequent behaviour. Furthermore, this could complement future capstone projects with UBC Continuing Studies if the project partners decide to pursue this.

Part G. Discussion of BI & Research Ethics

Our study adhered to current ethical guidelines, with no significant ethical concerns regarding our research, BI solution, or research design. The goal of encouraging recycling posed no conflicts of interest and ensured fair, respectful, and professional treatment of participants.

The BI solution aimed to positively influence environmental improvement and enhance health and happiness, thus qualifying as a "nudge" for good. Although recycling small appliances requires more effort than alternatives like disposing of them in the garbage, the BI solution maintained freedom of choice. Individuals could disregard the nudge without facing negative consequences, even if the nudge demanded increased effort for the target behaviour.

Transparency was upheld, as the intervention provided clear and simplified information to facilitate recycling. We aspire for our BI solution to be featured in the next CESA Annual Report, adhering to the publicity principle. Importantly, the BI solution did not unfairly impact vulnerable populations, as the behaviour was avoidable without adverse effects.

The benefits of reducing landfill waste and recovering materials outweighed the recycling efforts. However, the solution has not been thoroughly tested due to time constraints. Had the solution been effective, the solution could have been scaled up by our partners using the results and existing resources.

Throughout the research and trial, measures were in place to ensure participant anonymity. One ethical consideration worth noting is that the audience viewing our BI message on digital media channels was unaware of their participation in a trial. However, given the commonality of digital ads and adherence to ethical principles of freedom of choice, transparency, and publicity, our research and trial complied with expected ethical standards.

Part H. Project Reflections

- **Timing gap too far apart between message delivery and behaviour** - given that the process of recycling small appliances has multiple steps and takes time, trialing a message through online channels was probably too little and temporally distant to be an effective nudge.
- **Touchpoints** - While we used digital media channels and could possibly reach a larger audience, it still is limited to people who are actively using these channels. Given constraints around timing and budget, we could not reach all people within a two-mile radius of the depots.
- **Barriers** - The barriers to recycling behaviour are large. While i-frame interventions are essential to influence individual behaviour by addressing personal barriers, this problem requires more s-frame interventions to address systemic barriers and complement i-frame interventions. For example, an incentive such as a nominal return amount could be worth trialing.
- **Limited scope of intervention** - While channel factors are proven to have big impacts, and light touch interventions lower the impact of confounding factors that can be at play, we recognize that small changes for a behaviour that faces many systemic barriers, may be ineffective. It may be more practical to trial significant changes to determine an effect.
- **Threat to validity** - Online platforms use complex algorithms to deliver ads depending on the optimization strategies chosen in the campaign set-up process. For instance, optimizing the number of impressions served delivers to a different audience than optimizing for clicks and to a different frequency. Cornil et al. (2023) suggest these algorithms might unintentionally influence the randomness by targeting users who are more likely to engage with the content than who are not.

While these are threats to internal validity, this also speaks to user interaction and behaviour outside of a lab study that is more replicable.

- **Scepticism** - We also wonder if this is more of an attitude versus a behaviour issue? In recent years, Canada's recycling industry has faced significant challenges, leading to more recycled items being sent to landfills. The problem intensified after China, which previously imported much of Canada's recyclable material, implemented a ban on importing certain types of waste in 2018. This left Canadian cities and recycling facilities struggling to find alternative markets and a substantial portion of collected recyclables ended up in landfills due to high cost of processing ([Global News](#), 2019). This can lead to scepticism about recycling in general and was also identified as one of the barriers during our primary research.

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Appendices

Appendix I. Recycling Discussion Guide

This research will seek to understand the current landscape among a small group of B.C. residents when it comes to recycling small appliances.

This is based on a ~15-20 minute interview guide. There will be a mix of close and open-ended questions.

Section 1: Introduction: (2-minutes)

- *Introduce yourself and your role as an independent moderator.*
- *Confirm that you are interested in their opinions and their experiences and that there are no right or wrong answers.*
- *Explain that they are not required to answer all of the questions and are able to skip a question if they want at any point. Also, say that they are allowed to end the interview at any point.*
- *Confirm that no personal information is required and state the purpose of this research and how it will be used.*
- *Ask if they have any questions before beginning.*

Section 2: Warm-Up: (3-minutes)

Purpose: Make the interviewee feel comfortable and introduce them to the topic.

Today we want to learn more about disposal of small appliances in your household.

First, we'd like to understand a little bit more about your most recent experience with replacing a small appliance. For the sake of this interview, please think only about small appliances, not electronics like laptops, cell phones or tablets. This includes items like blenders, coffee makers, hair blowers, electric toothbrushes, drills, saws etc.

Tell me more about the last time you replaced a small appliance in your household. What was it? For what reasons did you replace it?

What did you end up doing with that small appliance? Tell me more about that. **LISTEN FOR:** *Repair, Resell, Donate, Give away, Still in house, Garage, Recycling etc.*

IF STILL IN HOUSE: What are you most likely to do with this item? For what reasons, have you not done that yet?

Section 3: Disposal in-depth: (7-minutes)

Have you ever put a small appliance in the garbage before? This includes items like electric toothbrushes, toasters, coffee makers and plug-in air fresheners. If yes, tell me about the most recent item. What was it? For what reason did you put it in the garbage?

Thinking about all of the small appliances in your household, would you say that: **READ LIST:**

- All of them can be recycled
- Most of them can be recycled
- Some of them can be recycled
- A few of them can be recycled
- None of them can be recycled
- I don't know much about small appliance recycling

To the best of your knowledge, where can small appliances be recycled in your community? If you know of more than one place, please tell me all about them. If you don't know, that's ok too - in this case where would you search to find out.

ADJUST ACCORDINGLY IF RECYCLED AT SECTION 1: And have you ever recycled a small appliance before? If yes, tell me more about your most recent experience? What was the item(s)? Where did you recycle it? How did you learn about where to recycle it? How did you know that the item was recyclable?

IF HAVE NEVER RECYCLED: We want to know more about the reasons that broken small appliances do not get recycled. We are interested in your honest opinions. For what reason(s) have you never recycled a small appliance? **LISTEN FOR:** *No need, didn't know, repairs, etc.*

ASK ALL: Based on your personal experiences, what challenges or barriers, if any, are there to recycling small appliances in your community?

Section 4: One wish or three things you would tell others... (2-minutes)

Imagine that you could reach all of the people in your community, but you could only tell them 3 things about recycling small appliances. What would you tell them to encourage small appliance recycling? This can be anything - it can be functional, emotional, factual etc. ANYTHING GOES!

Section 5: Generate ideas for potential BI solutions (4-minutes)

- What do you think are the main benefits of recycling small appliances?
- What do you think is preventing people from recycling ANY small appliances?
- What do you think is preventing people from recycling ALL of their small appliances?

Thank you for your time today and for sharing your honest thoughts and opinions.

Appendix II. Interview Data Capture

We interviewed 10 people for up to 20 minutes between December 2023 and January 2024.

Answers to key questions from these interviews are captured below.

Reasons for having NEVER recycled small appliances:

- The city flyers on recycling barely has information on small appliance recycling, all it talks about are bottles, cans and the items they can't accept.
- Lack of awareness on small appliance recycling.
- Easier to sell or throw.
- Not aware of options and don't want to harm the environment so it is sitting at home.

Challenges or barriers to small appliance recycling:

- Inconvenience. Small community, not the same level of services.
- Knowing what they will and will not accept. Hours of operation (usually only during working hours).
- Convenience (15-minute drive each way).
- Lack of time to find information on items and locations for small appliance recycling.
- Lack of time, small kids, procrastination.
- Lack of awareness. (3X)

One wish or three things you would tell others:

- Repair or reuse. Don't buy it if you don't need it. Resist advertising and the pressure to purchase new.
- That it's easy and available at the local depot.
- It's important and it's pretty easy.
- They take items with cords, including TVs. The drop off locations are everywhere. It is easy - you just drop it off and leave it. No lines. No paperwork.
- More information on the places that take items. More information on the benefits - what are they doing with it?
- Easy access to information, curbside pick up of small appliances.
- Make it easy, curbside pick up, frequent spring clean events by city/strata council, more accessible drop off points.
- Not everything goes in garbage, refer to websites, do the right thing.
- What percentage of appliances end up in landfill, why is it difficult, how is it different from other garbage and potential hazards of trashing appliances.

Main benefits of recycling small appliances:

- Reduce the need to mine new minerals. Keep toxic chemicals out of water
- Less plastic. Reuse materials.
- Don't end up in a landfill and materials don't have to be mined from scratch. Recycling does take up a lot of energy but not as much as mining or making new ones.

- Not going to a landfill; anything that has value is stripped and reused. Peace of mind; makes you feel good; small accomplishment to try to help the environment; ownership.
- She said "hopefully" in front of all of these. Highlighting recent skepticism for recycling. 1. Reuse some of the pieces 2. Not taking up space in landfill 3. Removing any harmful pieces from seeping into ground.
- Reduces items in landfill and reduces the amount that goes in garbage that could otherwise be used.
- Not aware of the benefits.
- Good for the environment. (2X)
- Reduces landfill waste.

What's preventing people from recycling small appliances:

- People don't know where. Extra step (beyond curbside collection) Disenchanted with recycling (turns out it's not that effective and may cause more harm i.e. plastic island in the Pacific Ocean).
- Ease of access (home pick-up would help).
- Laziness.
- Lack of education on recycling and the benefits. Single use mentality; everything is disposal; nothing is built to be repaired.
- Lack of knowledge about what can/can't be recycled. Inconvenient both in terms of time and/or transport (i.e. those without a car).
- Time, lack of ease, accessibility, and lack of awareness. The only time we attempt repair is if the item is too large or expensive like we recently repaired our lawn mower.
- Lack of awareness of recycling options and the benefits of recycling.
- Time, lack of awareness, lack of incentives to recycle small appliances.
- Ignorance, no time for the extra effort it will take.
- Assumption that repair is expensive, time.
- Scepticism - not sure if recycled items are actually recycled or sent to landfills.

Summary

All participants were asked 10 core questions and up to 5 supplementary questions based on answers provided and time constraints. While the majority of the people felt strongly about the harm to the environment caused by appliances ending up in landfills, only a few actually recycled appliances. Most people were aware of curbside recycling as well as cans and bottles recycling, however, they suggested recycling of appliances was a complex process that included sourcing information from various places. Some were not aware of the range of appliances that can be recycled. They also described the process as tedious and their noble intentions to recycle were almost always overcome by the ease of concealing items in garbage, especially the smaller items like diffusers, blow dryers and blenders.

The log of interview data capture was used to list the top barriers using keywords and repeat phrases as heard in the interviews. The barriers identified are a mix of behavioural, lack of awareness more to do with steps involved in sourcing information, as well as attitudinal in nature as listed next.

Barriers to recycling small appliances identified during interview:

- Inconvenience
- Not as easy as regular recycling
- Laziness
- Single use mentality
- Lack of knowledge - What items are recyclable/where to recycle
- Easy to hide things in garbage bin (smaller items)
- Skepticism that items are actually recycled
- Life events - irregular events - e.g. a move, a bin - prompt garbage over recycling