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## **Not Always an Easy Win:**

### **The Effectiveness of a Ballot Bin Experiment to Prevent Cigarette Butt Littering**

*Neľahká úloha: Účinnosť experimentu s hlasovacou nádobou ako prevencia voči cigaretovým ohorkom*

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*Abstract: This paper presents the results of two behavioural interventions aimed at reducing cigarette butt littering which is a significant environmental pollutant. The interventions were priming – spraying shoeprints on the pavement leading to the nearest bin – and gamification – replacing two litter bins with two ballot bins. This experiment used a before-and-after uncontrolled experimental design and was conducted at a Bratislava transportation hub. Our results show that two interventions did not prove to be effective. The possible reasons are highly heterogeneous intervention group at the transportation hub, the effects of the pandemic and lockdown during which the experiment took place.*

**Key words:** *Cigarette butt littering. Nudge. Ballot bin. Gamification. Shoeprints.*

**JEL Classification:** D91. Q50.

## **Introduction**

One of the challenges faced by local governments is cigarette butt littering that pollutes the environment. Researchers and public policy makers try to address this issue by testing behavioural interventions focused on changing the smokers' behaviour. They build on the body of knowledge of social psychology and cognitive sciences indicating that smoking and cigarette butt littering is a habitual, automatic behaviour. Existing litter is also a strong predictor of future littering behaviour (Huang et al., 2019; Kolodko & Read, 2018).

Various local governments in Slovakia (Bernatová et al., 2019; City of Senec, 2020; Mareková, 2020) have decided to use gamification to decrease butt littering, but did not measure the results.

Our goal was to test whether this type of intervention can be effective in decreasing cigarette butt littering.

We tested two behavioural interventions at the transportation hub of Račianske múto, working together with the local government in Bratislava. The first was priming - sprayed shoeprints on the pavement leading to a standard litter bin. The second was a gamification tool – a special ballot bin. The experiment took place between September and November 2020.

## **1. Behavioural insights and cigarette butt littering**

Cigarette butt littering has been investigated from several perspectives. Researchers look at the social effects of this behaviour and how it is perceived by the various stakeholders, including smokers themselves. In order to change their habits, behavioural scientists develop models explaining this behaviour as well as the factors influencing its scale.

The research suggests several problematic societal effects of cigarette butt littering such as environmental pollution (e.g., air, water, soil) (Srbínoska et al., 2018) meaning that littering has a negative effect on public health (Kolodko & Read, 2018). At a minimum, cigarettes contain 150 highly toxic compounds, which have the potential to cause cancer or other changes in genes of human's organism (Araújo & Costa, 2019). After smoking the cigarette, the toxicity increases and cancerogenic and mutagenic compounds are concentrated in the remaining cigarette butt (Slaughter et al., 2011). About 80% of people are angry or frustrated by visible litter and individuals do not want to spend time in littered areas (ibid.). One research on a sample of 1,000 respondents demonstrated that 8% of smokers in the US do not consider cigarette butt litter and 75.8% of smokers agree with the statement that cigarette butt litter is toxic (Rath et al., 2012). Nevertheless, different studies at different times proved that three quarters of smokers still threw cigarette butts on the ground at least once in the US (ibid.) and similarly (75.5%) in the UK (Attitudes Towards Cigarette Disposal Outdoors, 1996). These findings have been the basis of several attempts to change the smokers' behavioural patterns.

Behavioural interventions related to cigarette butt littering are based on defining smoking as a strong habit and an automated process – people often light up a cigarette unintentionally, they do not remember their decision-making process (Jager, 2003) and do not consider it to be inappropriate behaviour (Kolodko & Read, 2018). Automatic system of thinking is known for its laziness and effortlessness (Kahneman, 2013), smokers do not want to make an effort to find the bin, therefore they drop the cigarette butt on the ground (Dehdari, 2020). They do not consider this behaviour as littering (Srbínoska et al., 2018). On the other hand, in a qualitative study based on interviews with smokers related to cigarette butt littering, respondents perceived

cigarette butts as dangerous trash (Kolodko & Read, 2018). The research shows that during the interview, the smokers used a reflective thinking system. They analysed the positives and the negatives, evaluated and concluded that cigarette butts were dangerous pollutants (ibid.). Using an automatic system of thinking, smokers intuitively do not see the danger in a single butt because of its small size (Torkashvand et al., 2020).

Another explanation of this behaviour is provided by Kolodko and Read (2018). The authors present smokers' behaviour as a cost-benefit analysis. According to the smoker's logic, the cost of finding the bin does not justify the benefit of a clean site. One cigarette butt is insignificant, the smoker does not consider the possible accumulation of litter over time (ibid.). This means policy-makers have to decrease the cost by making bins more visible, available, attractive, etc.

Researchers also examine the variables that affect the probability of littering with cigarettes. Smokers encounter difficulties such as access to the bin and the distance and effort to find the bin (Huang et al., 2019). In addition, the area's level of cleanness is directly correlated with littering: the more butts are in the area, the higher the likelihood of additional litter. The same applies if the situation is reversed, the fewer butts in an area, the lower the chance of littering (Tehan et al., 2017). The presence of cigarette butts is a marker of a social acceptability level in relation to littering at certain locations (ibid.). Tehan et al. (2017) also suggest that size, brightness, and branding affect the level of attractiveness of a litter. The authors define the larger, brighter and branded pieces as 'beacons of litter'. There are also other variables that affect cigarette butt littering, for example, age – young people litter more frequently than older people (Kolodko & Read, 2018; Krauss et al., 1978), or gender – men litter more frequently than women (Huang et al., 2019; Krauss et al., 1978).

### **1.1. Behavioural interventions to reduce cigarette butt littering**

In addition to the above-mentioned variables that increase butt littering behaviour, behavioural sciences provide insights on how to achieve behavioural change. Jones et al. (2013) discuss three approaches – nudge, think, and steer. A hard paternalism approach has been tested as well.

As for the libertarian paternalism – nudging – it relates to the automatic system of thinking. Nudging refers to a choice architecture which predictably affects people's behaviour (Thaler & Sunstein, 2008) by a minimal degree of coercion (Pavlovský, 2020). Based on the definition of smoking as an automatic activity, many researchers tested nudging as a possible tool for changing the smokers' behaviour. Policy makers expect to subconsciously affect the behaviour

of smokers (Thaler & Sunstein, 2008). Nudging has been tested in various forms, including gamification and priming. Gamification is an intervention with elements of game design in a non-gaming context (AlMarshedi et al., 2017; Deterding et al., 2011). This approach uses involvement as a social factor, however, an intervention with elements of game design has only a low level of interaction complexity (Huang et al., 2019). Ballot bins (see Appendix A) aimed at reducing cigarette butt littering have been tested mostly in the condition of homogenous intervention group (students). A ballot bin near student halls of residents in Sibiu, Romania reduced cigarette butt littering on site by 60% (Selagea et al., 2016). On one campus in Milano, Italy, an interactive ashtray design inspired by the darts game reduced cigarette butts by 41% in one location and by 14% in another. The difference between two locations was most likely caused by the cleanness level of the sites (Huang et al., 2019). Taking into account that both aforementioned experiments were conducted on campus, both results could be affected by the smokers' age (Kolodko & Read, 2018; Krauss et al., 1978).

In addition to gamification, priming is also used to nudge smokers to socially responsible behaviour and represents a certain type of stimulation for people to better visualise common goals (Molden, 2014). It is usually conducted by drawing shoeprints that lead to the bins on the pavement. Priming through shoeprints is also an example of a low level interaction (Huang et al., 2019). Priming in the form of posters and floor stickers has been applied in an experiment conducted in Bristol and Cardiff where the researchers achieved a 41.8% reduction of cigarette butt litter. However, the results varied on different sites due to other variables such as pedestrian traffic, unplanned cleaning (changing the level of cleanliness), heavy rains, construction works, etc. (Hall & Campbell, 2020). Shoeprint priming has been used in an intervention to deal with littering at the Bratislava Railway Station. The green shoe prints led to two smoking areas which were also highlighted by green tape. This priming contributed to reducing the number of smokers in non-smoking areas from 16.80 % to 4.44% (Bobčíková, 2016).

However, certain researchers criticise changing people's behaviour by nudging (Gellard et al., 2019; Jones et al., 2013; Leggett, 2014). They consider nudging as a short-term decision where long-term effects are in question (Gellard et al., 2019). Gellard et al. (2019) suggest that the problem of littering is the result of socioeconomic status. Therefore, policy-makers should focus on changing the socioeconomic status of individuals, which is a marker of ecological attitude and behaviour (ibid.).

The researchers from Milano analysed numerous behavioural interventions to reduce littering and classified them according to two criteria: social factor and interaction complexity. Social factors were divided into two categories – the pressure and involvement. The former

means that smokers' behaviour could be noticed and judged by other people. The latter represents the use of interactive elements and certain incentives for smokers who behave in the desired way. The Authors defined the levels of interaction complexity as low, medium and high (Huang et al., 2019). Ballot bins use involvement as a social factor with low interaction complexity. Shoe prints leading to the bin are also an example of a low-level interaction, but authors do not classify it by neither the pressure, nor the involvement social factor (ibid.).

In contrast to nudge, think focuses on the reflective system, changing not only the context but also attitudes of people toward littering. The main idea of 'think' is that deliberation – discussion of possible solutions of behavioural failure with citizens - counters the irrationality of people (Jones et al., 2013). Some experiments have used this approach. For example, in 2013 Keep Britain Tidy organized The Big Litter Inquiry, when they took a representative sample of the British society and organised discussions and workshops about littering with policy-makers. They collectively proposed solutions on how to reduce littering (The Big Litter Inquiry. The Public's Voice on Litter, 2013).

The third approach is steering. It focuses on both systems of thinking (Grist, 2010) and it proposes deliberation and discussion as an effective behavioural intervention. It includes a greater understanding of how our brain works and what are the physiological and biological reasons for irrationality (Jones et al., 2013).

The hard paternalism approach to reduce littering has also been tested. Lee, Ranney and Goldstein (2011) compared the effectiveness of low, medium and high strength policies towards reducing cigarette butt littering on campuses in the US. The high strength policy meant creating a 100% tobacco free zone indoor and outdoor. The low and medium strength policies meant prohibition of indoor smoking and 15-foot perimeters outdoor with smoking restriction, respectively. All three implemented policies reduced the number of cigarette butt littering near the building entrances. The high strength policy was more effective than the others and recommended by authors to be used on student campuses (ibid.).

## **2. Research questions and experiment design**

This section deals with the experimental design. It presents the objective of the experiment, the research question, the description of the interventions, experimental site (Račianske mýto in Bratislava, Slovakia), and procedures in data collection and analysis.

The main objective of this experiment was to reduce cigarette butt littering in the area of Račianske mýto in Bratislava. The research question is as follows: What is the effectiveness of

two different nudges - shoe prints, ballot bin – in reducing cigarette butt littering at Račianske mýto?

Bratislava travel hubs are places where cigarette butt littering occurs frequently. One of them, Račianské mýto, is where we conducted our experiment (see Figure 1). Račianske mýto is an important connection point between the eastern and western part of Bratislava. There are four public transportation stops, a public park and residential blocks in its immediate vicinity. According to the municipal public transport company, Račianske mýto serves 16 intra-city lines and 8 suburban lines. That means almost 2,300 connections per day, 200 connections per hour at peak times, which adds up to 35,000 passengers at Račianske mýto per day (Municipality of Bratislava, 2021).

Smokers passing through the experimental were not specifically notified of ongoing experiment before, during or after the study.





Figure 1 Experimental site: Račianské myto in Bratislava

Source: authors' overlay of photo from Google Maps

Note: Račianske myto is an important transportation hub in Bratislava. There are four public transportation stops, a public park (Park Račianské myto) and residential blocks in this area. Highlighted yellow area - part of the sidewalk in the park - is the area in which experiment took place.

Since we were not able to identify areas that would be comparable to Račianske myto elsewhere in the city, we decided to use a before-and-after uncontrolled design. The effectiveness of selected interventions was determined by comparing measurements before (baseline) and after interventions. Table 1 summarises how we measured the effect of the selected interventions on the total volume of discarded cigarette butts at the experimental site.

Table 1 Variables overview

Type of variable	Name of variable	Unit of measurement
Dependent variable	amount of cigarette butts	number of cigarette butts per day (Discrete)
Independent variable 1	presence of intervention 1	present / not present (Binary)
Independent variable 2	presence of intervention 2	present / not present (Binary)
Control variable 1	weather conditions – temperature	mean temperature during the measurement period (FRI-SUN, MON-THU)
Control variable 2	weather conditions – rainfall	mean rainfall during the measurement period (FRI-SUN, MON-THU)

Source: authors

Table 2 illustrates the three phases of the experiment (baseline, post intervention #1, post intervention #2). A total of 20 measurements have been completed by the local government's technical services during their routine cleaning of the experimental site, i.e., every Monday and Friday. The technical services personnel were instructed to separate cigarette butts from other types of trash during routine bin emptying. The cigarette butts were marked according to their date of collection and stored in separate plastic bags. We collected the bags every Friday and manually counted how many cigarette butts were inside. The three experimental phases ran one after another without any interruptions.

**Table 2 Timeline and experiment phases**

<b>Measurement timeline</b>	
Phase 1: Baseline measurement	14.9.2020 – 2.10.2020 (3 weeks)
Phase 2: Measurement after the installation of intervention #1 (shoeprints on pavement)	3.10.2020 – 23.10.2020 (3 weeks)
Phase 3: Measurement after the installation of intervention #2 (gamified litter bins – ballot bin)	24.10.2020 – 20.11.2020 (4 weeks)

Source: authors

Prior to the experiment, the area contained 7 litter bins (see Figure 1). During the third phase of the experiment, two of the bins were replaced by gamified bins. The experiment was very budget-friendly. The total costs of both interventions did not exceed 800 EUR. The installation of shoeprints costs 20 EUR, two ballot bins cost 500 EUR. The cost of cigarette butt collection was approximately 280 EUR (2 workers paid 7 EUR/hour, 2 hours a week during a 10-week period).

### **Interventions**

Prior research in the field suggests that:

- cigarette butts are small objects and as such people often do not consider them trash, which is why they are more likely to throw them on the ground;
- part of the society perceives throwing cigarette butts on the ground as an acceptable form of pollution;
- smokers do not realise the serious environmental impact of not properly removing cigarette butts;
- Račianske mýto might not contain sufficient number of bins or the present bins are inefficiently placed.



Based on these findings, we have decided to develop two interventions. The first intervention contains shoe prints – navigation to the nearest bin. The second intervention includes gamification – ballot bins.

The resulting efficiency of individual interventions was derived from the comparison of mean volume of discarded cigarette butts observed during the baseline measurement with the mean observed volume of the butts after implementing interventions. Given the relatively small number of observations and the non-RCT design, we furthermore computed Pearson's correlation coefficient (table 4) between mean cigarette butts (per day) and temperature and mean cigarette butts (per day) and rainfall in order to determine significance of possible correlative relationship between these variables.

### **Intervention 1: Shoe prints sprayed on the pavement, leading to the nearest bin**

Our first intervention was spraying shoeprints on the pavement. Every third shoeprint also contained a fuming cigarette icon within it. We used a bright orange exterior spray paint to prolong durability. The size of the shoeprints was lifelike. The shoeprints led to the nearest bin, starting approximately 2 meters from the bin. If there was a path crossing near the bin (in an approximately 2 meters radius), we also sprayed the shoeprints leading to the nearest bin at the crossing.

### **Intervention 2: Ballot bins**

The second intervention we applied was to replace two standard municipal litter bins with two gamified ballot bins for cigarette butts. The ballot bins display a question and two answers. Smokers are able to vote by inserting the cigarette butt through a slot that represents the answer they want to select. The bins have a transparent front which means people can see which answer is more popular. The question we asked the smokers was 'Do you plan to quit smoking in the New Year?' Our reasons for choosing this question were as follows.

- the experiment was taking place from late October to November, towards the end of the year;
- the question was specifically addressed to smokers.

Passing smokers could answer the question by inserting/dropping their cigarette butt into a slot representing the answer with which they identified with. The slots were clearly labelled as 'yes' and 'no'. The bright yellow colour of the bin was also designed to draw the attention of smokers.

### 3. Results

This paper tests the effectiveness of two interventions aimed to mitigate cigarette butt littering. We investigated how the interventions affected the behaviour of smokers discarding cigarette butts at the experimental area. The first intervention was priming in the form of sprayed shoeprints which led pedestrians to litter bins (Hall & Campbell, 2020). The second intervention – changing the behaviour with gamified ballot bins – was tested by several authors (Huang et al., 2019; Kolodko & Read, 2018; Krauss et al., 1978). However, these experiments were conducted in a very specific environment of student dormitories and on campuses. This experiment was conducted at Račianske mýto, an area that serves as a local transportation hub (public transport) and a place where people from the neighbourhood gather in the local park.

Table 3 Cigarette butt volume by treatment

	Mean cigarette butts (per day)	Mean cigarette butts (per measurement)
<b>Baseline (3 weeks)</b>	33.35 (SD=14.41)	115.83 (SD=48.41)
<b>Steps (3 weeks)</b>	40.44 (SD=30.64)	148 (SD=130.05)
<b>Gamification (4 weeks)</b>	69.76 (SD=41.78)	260.12 (SD=177.72)

Source: authors

Note: Mean cigarette butts per day was calculated as the amount of cigarette butts from the measurement divided by the number of days – Measurement 1 on Monday (measured FRI – SUN, 3 days), Measurement 2 on Friday, early morning (MON – THU, 4 days). Calculations made in R program.

During the three phases of the experiment (baseline, intervention 1 – shoe prints, intervention 2 - gamification) the Bratislava – Nové mesto technical services also collected cigarette butts from the ground in the selected area twice a week (Monday, Friday). Table 3 shows the mean cigarette butts per day for each phase of the intervention. The mean amount of cigarette butts is the lowest in the baseline, suggesting that the interventions - shoe prints and gamification - did not improve the smokers' littering behaviour. At first glance, the situation seems to have gotten even worse, the mean cigarette butts per day increased after both interventions. This increase is from 33.4 cigarette butts in baseline to 44.4 cigarette butts in intervention 1 – shoe prints, 69.8 cigarette butts in intervention 2 – gamification (ballot bin), respectively.

The standard deviation measures how concentrated the data points are around the mean. A small standard deviation means that the values in a statistical data set are close to the mean, and a large standard deviation means that the values in the data set are farther away from the mean. The mean values for both interventions have large standard deviations. The standard deviation of the mean cigarette butts (per day) in intervention 1 is twice as large as in the baseline. This

difference is even more severe when comparing the standard deviation of the mean cigarette butts (per day) in intervention 2 (41.8) and the standard deviation of the mean cigarette butts in the baseline (14.4). Larger values of standard deviations in both interventions indicate a large amount of variation in the amount of cigarette butts (per day as well as per measurement). In other words, we observe a larger variance (extreme values) in both intervention phases than in the baseline phase. This difference in variance could be one of the reasons why interventions did not reduce cigarette butts in the area. We discuss more about the possible reasons for this in the next section.

We have collected data on rainfall and temperature from the Slovak Hydrometeorological Institute to control the weather conditions. The data indicate that cigarette butt littering is not significantly associated with temperature or rainfall. The correlation of mean cigarette butts and temperature is -0.31, which indicates a weak negative correlation of cigarette butt littering behaviour and temperature – the lower the temperature, the more cigarette butts. It is important to note, that we would expect the opposite (positive) direction of the relationship – warmer weather can lead to more people (and also smokers) in the park and therefore more cigarette butts. The correlation between mean cigarette butts and rainfall is -0.23, the higher the rainfall, the less cigarette butts. However, neither of the two correlations are statistically significant ( $p$ -value  $> 0.1$ ).

Table 4 Correlation matrix – mean cigarette butts and temperature/rainfall

	<b>Mean cigarette butts (per day)</b>	<b>Temperature</b>	<b>Rainfall</b>
<b>Mean cigarette butts (per day)</b>	-	- 0.31	- 0.23
<b>Temperature</b>	- 0.31	-	0.01
<b>Rainfall</b>	- 0.23	0.01	-

Source: authors

Note: Correlations (Pearson) between mean cigarette butts (per day) and temperature and mean cigarette butts (per day) and rainfall are not statistically significant when  $p$ -value is larger than 0.1. Calculations made in R program.

### **Conclusion – lessons learned**

Although gamification and priming interventions have been conducted in several places to reduce butt littering, the testing of their effectiveness was usually limited. Our experiment consists of two interventions – shoe prints and gamification (ballot bin). The results indicate that both interventions have not been effective.

Field experiments in areas such as streets or public parks are difficult to measure due to the numerous variables that are difficult to control. Hall and Campbell (2020) state that the results can vary on different sites because of other variables such as pedestrian traffic, unplanned cleaning (changing the cleanness level), heavy rains, construction works, etc. In the following section we provide other possible reasons behind our results that should be considered before further experiments are conducted.

The first possible explanation is the heterogeneity of the people at the experimental site. In general, field experiments with a very limited possibility to control the characteristics of participants are difficult to measure. Our experimental site was a busy transportation hub (see Figure 1), used by thousands of commuters every day. This implies a very heterogeneous group of people, from students to workers and homeless people. Similar gamification interventions aimed at altering cigarette butt littering behaviour have been conducted among a more homogenous group of undergraduate students around halls of residence and on campuses (Huang et al., 2019; Kolodko & Read, 2018; Krauss et al., 1978). The heterogeneity of the intervention group suggests limited effectiveness for such an intervention design. Additionally, 2020 and 2021 were the years of the COVID-19 pandemic. The situation in Bratislava began to deteriorate in late October. Bratislava entered the lockdown on October 24, only a few days after the ballot bins (gamification bins) were installed. A soft lockdown lasted until the end of the experiment. The specific situation caused by the lockdown and the pandemic could also have an effect on the people in this transportation hub and therefore affect the results.

The second possible explanation for the results can be the skewed baseline data. Our baseline measurement may have been too short to allow us to identify the true magnitude of the cigarette butt pollution problem as well as the variation in butt littering at the site. The baseline measurements may also have been skewed by changes in the target group's behaviour due to the ongoing pandemic.

The experiment was conducted approximately 6 months after the first officially confirmed COVID-19 case and at a time of government imposed anti-epidemic measures. Restrictions related to this disease had been in place since the beginning of the pandemic. At the time of this experiment, the pandemic was publicly discussed and that might have been related to pandemic fatigue (WHO, 2020) among Slovak inhabitants and changed mobility patterns.

The third potential factor could be the limited ability of our research team to control the data collection. Although we have drafted the protocol and agreed on the time schedule with the local government, the cigarette butts could only be collected and measured by the local

government's technical services employees. Therefore, our control over the accuracy of the measurement was restricted.

Last but not least, increasing the number of interventions could boost their effectiveness in future experiments. The two interventions we used may have been insufficient to overcome the convenience of dropping the cigarette butt on the ground. Our interventions tried to nudge smokers travelling across a 130-meter-long stretch of sidewalk. As the map of the experimental site explains (Figure 1), the gamified bins were placed at the periphery of the selected area. The experiment participants entered or exited the area by walking past these bins.

Although, according to our baseline measurements they were installed at the places with the most cigarette litter and although their colour made them relatively easy to spot, the convenience of using them may have been diminished by the increasing distance between the bin and the smoker or by the closer proximity of other trash bins. Nevertheless, dropping a cigarette butt on the ground may have been more convenient than the priming effect of the shoeprints, even though they were sprayed not only in the direct vicinity of the bins but also in the surrounding area. Moreover, in both ballot bins we asked the question about the intention to quit smoking from the New Year. Even though this question was targeted at smokers, it could be perceived as irritating for the target group.

Therefore, further experiments are recommended to (1) focus on more homogeneous group of people (e.g., undergraduate students, drivers etc.), (2) ensure long period of baseline measurement, (3) directly control the measurement of the intervention results and (4) combine different behavioural interventions to increase its effectiveness (e.g., installation of ballot bin within convenient reach).

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**Appendix A**



Figure 2 Gamified ballot bin  
Source: authors

## Appendix B



Figure 3: Sprayed footsteps  
Source: authors