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Nudging people to pay their parking fines on time. Evidence from a cluster-randomized field experiment

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ABSTRACT

The timely payment of municipal parking fines signifies people's acceptance of parking regulations, reduces administrative enforcement costs, and prevents additional late-payment fees for individuals. However, public administrations face challenges in enforcing the timely payment of parking fines. A large group of people fail to pay their fines on time, which requires additional enforcement actions that can result in extra late-payment costs and payment-related stress. In this study we collaborate with the Belgian city of Mechelen and the Behavioral Insights Team of the Flemish regional government to test the compounded effects of three communicative nudges. i.e., simplification, explicit penalty, and social norm, on the timely payment of parking fines. In a cluster-randomized field experiment, parking offenders received either the original notification letter, a simplified notification letter, a simplified notification letter accompanied by an explicit reference to the potential penalties, or a simplified notification letter accompanied by an explicit penalty and a social norm message. The results indicate that people can be nudged to pay their fines on time, but only when multiple nudges are combined and used simultaneously.

1. Introduction

Managing people's parking behavior is a challenge for local public administrations. People's compliance with municipal parking regulations helps reduce road accidents, emissions and traffic congestion, and stimulates a better, more inclusive urban environment (Marsden, 2006). Well-designed parking policies increase the overall safety, health, viability, and attractiveness of inner-city residential and commercial areas (Bantjes et al., 2021; Du Plessis et al., 2020; Makowsky & Stratmann, 2011), and are an important source of revenue for the local administration (Lofstrom & Raphael, 2016; Marsden, 2006; Piehl & Williams, 2010; Su, 2020). For these policies to work effectively, people have to accept them and pay their fines correctly (Manville & Pinski, 2021; Tyler, 2006a, 2006b).

However, the timely payment rate of parking fines is relatively low and increasing this rate is an important issue for many local, regional, and national governments (Du Plessis et al., 2020; GASAM, 2020; Haynes et al., 2013). Because unpaid parking fines comprise a large number of payments of relatively small amounts, enforcement is costly. The timely payment rate of traffic and parking fines in cities such as Berlin (75%), Chicago (67%) and New York (60%) shows that there is room for improvement (Dušek et al., 2022; Heffetz et al., 2022). Increasing the timely payment rate has clear benefits for both public administrations and individual citizens. Timely payment reduces administrative enforcement costs (i.e., payment reminders, collection by a bailiff and legal proceedings) and related costs for the offender (i.e., late-payment fees and interest, legal fees, financial distress). Moreover, studies indicate that these additional costs disproportionally impact low-income households, who, on average, are less likely to pay their fines in a timely manner (Dušek et al., 2022; Harris et al., 2010; Heffetz et al., 2022; Mello, 2018).

One way to increase timely payment rates is by applying nudging techniques and behavioral interventions. Nudges are low-cost and effective policy instruments designed to subtly alter people's behavior without forbidding any options or significantly changing their economic incentives (Migchelbrink & Raymaekers, 2022; Thaler & Sunstein, 2008; Tummers, 2019). When applied to government communications such as brochures, application forms, and notification letters, nudges can sometimes lead to sizable effects at modest cost (Benartzi et al., 2017; Hummel & Maedche, 2019; John, 2018; Mertens et al., 2022). Furthermore, recent studies also show that the literature on nudging in general is often characterized by publication bias, low statistical power

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and unexplained heterogeneity, raising questions as to whether nudges really are the effective behavioral change tools they are often made out to be (DellaVigna & Linos, 2022; Maier et al., 2022; Szaszi et al., 2018, 2022).

In the field of tax compliance, numerous studies demonstrate that communicative nudges, such as simplification, explicit penalty, and social norms, can have a positive impact on timely payment (Antinyan & Asatryan, 2019; Bott et al., 2019; Brockmeyer et al., 2019; De Neve et al., 2021; Hallsworth et al., 2017; John & Blume, 2018; OECD, 2021; Vainre et al., 2020). Nevertheless, some behavioral tax studies show null (Kettle et al., 2017) or even negative (John & Blume, 2018) effects. Behavioral interventions in other enforcement domains such as compliance with municipal housing codes (Linos et al., 2020), payment for public utilities (Szabó & Ujhelyi, 2015), and the timely payment of delinquency fines (Haynes et al., 2013), speeding fines (Dušek et al., 2022), and parking fines (Heffetz et al., 2022) indicate that nudges can stimulate timely payment behavior in different law enforcement settings.

Based on this research, we test whether communicative nudges can also be used to increase timely payment of municipal parking fines. We formulate the following research question:

> What is the effect of communicative nudges (simplification, explicit penalty, social norm) on people's timely payment of parking fines?

More specifically, we use a cluster-randomized field experiment to test whether the compounded use of (1) simplification, (2) simplification and explicit penalty, and (3) simplification, explicit penalty and social norms in parking-violation notification letters increases timely payment of parking fines. For this experiment, we cooperated with field and policy experts from the city of Mechelen (GASAM, 2014b) and the Behavioral Insights Team of the Flemish regional government (De Smedt et al., 2018). Between 2015 and 2019, almost 40 percent of parking fines incurred by individuals in the city of Mechelen were paid late or not at all (Raymaekers, Fobé, Migchelbrink, Lerusse, & Brans, 2021). Therefore, Mechelen is an interesting case to test whether nudges can be used to increase timely payment.

We make three contributions to the literature. First, we test whether behavioral interventions used to increase people's timely payment of taxes are also applicable to the timely payment of parking fines. Although these interventions have proven their effectiveness in the field of tax compliance, there is little evidence that they translate into other enforcement domains and types of payment behaviors. We build on the findings of two recent studies that tested and revealed the potential effect of nudges on the timely payment of parking tickets and speeding tickets. Using administrative data covering a two-year period Heffetz et al. (2022) investigated the responsiveness to notification letters serving as reminders among New York City parking ticket recipients. By analyzing exogenous variation in the timing of the notification letters they found that such reminders have a significant positive effect on aggregate response behavior. Dušek et al. (2022) tested the effect of simplification and salience nudges on the timely payment of another type of traffic fines, i.e. speeding tickets by automated camera systems. Using a randomized controlled field experiment in the suburbs of Prague, Czech Republic, as well as a complementary survey experiment, they found that emphasizing the payment deadline and the late-payment penalties significantly increased payment rates.

Second, we contribute to the diversification of the methodological toolbox of public administration research by applying a cluster-randomized field experiment approach (CRT: cluster-randomized trial) where randomization at the individual level is not possible or not desirable (Gerber & Green, 2012; Moerbeek, 2006). Randomized-controlled trials (RCTs) are considered the gold standard in applied experimental research (Cartwright, 2007; Podsakoff & Podsakoff, 2019). However, not all empirical puzzles or administrative systems allow for such designs and it would not seem appropriate to limit our study to only those policy issues that allow for individual-level randomization (Moynihan, 2018; Van de Walle, 2017).

Third, this study addresses an actual real-world administrative challenge. Behavioral public administration research has been criticized for focusing on universalistic theory development at the expense of contextual dependencies and incremental developments in local policy making and management (Hallsworth, 2023; John, 2017; Van Ryzin, 2021). Instead, this study demonstrates that several insights and methods from behavioral public administration can also help to improve actual administrative procedures and processes in the field.

In the first section, we discuss previous research on the use of behavioral insights in stimulating the timely payment of taxes and apply this research to three hypotheses on people's timely payment of parking fines. In the second section, we discuss the design and implementation of our cluster-randomized field experiment. In section three we present the results. We use the final section to discuss the experiment's results, policy implications, and to draw our final conclusions.

2. Theory

The use of behavioral insights in government communications is a particularly interesting and cost-effective way to increase citizens' timely payment behavior (Benartzi et al., 2017; De Neve et al., 2021; Esmark, 2019; Raymaekers et al., 2023). Governments use brochures, forms, and letters to communicate and interact with citizens. According to Esmark (2019), changing the choice architecture and information content of such communications can help to alter, guide and encourage people's choices and behaviors.

In the aftermath of the financial crisis of 2008, policy and academic attention toward tax administration and enforcement increased drastically and led to a new wave of theoretical and empirical research into the determinants of tax evasion and compliance (Hallsworth, 2014; Slemrod & Weber, 2012). The basic deterence model of criminal behavior states that individual citizens and businesses rationally weigh the costs and benefits of undesirable behavior (Allingham & Sandmo, 1972; Becker, 1968). According to this perspective, the threat of a tax audit or legal sanctions such as tax penalties and incarceration increase people's willingness to comply with tax regulations (Doran, 2009; Slemrod, 2019). More recently, behavioral considerations challenged this utility maximization model and instead emphasized psychological determinants such as perceived moral costs, social norms, payment habits and attitudes of individuals toward the general concept of taxes (Botzem, 2019; Kirchler, 2007). As part of this behavioral agenda, the effect of government communication on people's compliance behavior has also been studied in more detail (Antinyan & Asatryan, 2019; Chirico et al., 2019; Slemrod et al., 2001).

Most studies that test the effects of behavioral insights and nudges in government communications only target a single intervention at a time. While this approach allows for the identification of the causal effects of individual interventions, it often does not result in statistically significant or durable behavioral change. According to Vainre et al. (2020) the use of single interventions in the field of compliance "may not be optimal for maximizing intervention effectiveness" (p. 1). Instead, they

propose a tailored compound intervention (TCI) approach and argue for the use of combinations of multiple nudges based on an analysis of relevant behavioral information. Moreover, behavioral studies in different policy domains such as agriculture (Howley & Ocean, 2021), electricity consumption (Brandon et al., 2019) and tax compliance (Antinyan & Asatryan, 2019; De Neve et al., 2021; Vainre et al., 2020) suggest that there is a scope for combining nudges to increase the effect size of an intervention. This allows for a more practice-oriented application of behavioral insights, optimizing the use of nudging where it matters most.

The first nudge we test to stimulate people's timely payment is simplification. People often have difficulty in understanding government communication and in distilling action relevant information, resulting in miscommunications and delay (Bhargava & Manoli, 2015; Zarcadoolas, 2011). Simplification facilitates people's understanding of government communications by reducing the cognitive load of reading and comprehending official texts, and by highlighting action relevant payment information (Antinyan & Asatryan, 2019; De Neve et al., 2021; John & Blume, 2018). Limiting the use of jargon and non-relevant administrative information, as well as highlighting action relevant information, can make it easier for people to understand what is expected of them. De Neve et al. (2021) demonstrate that simplifying tax correspondence can increase tax compliance by up to 10 percentage points. Similarly, John and Blume (2017, 2018) show that simplification can increase the timely payment of municipal taxes by 3.8 percentage points, as well as other preferred behaviors such as online renewals for disability parking permits. However, Holzmeister et al. (2022), find no effect of the mere simplification of letters on consumer debt repayments and response rates. In line with most studies, we expect simplification to increase the timely payment of fines and thus formulate the following hypothesis:

H_1: A simplified notification letter increases citizens' timely payment of parking fines as compared to the control notification letter.

However, simplification alone may not be sufficient. People's timely payment of parking fines could be further increased using an explicit penalty message (Ariel, 2012; De Neve et al., 2021; Vainre et al., 2020). Whereas simplification is based on the assumption that people's compliance can be facilitated by reducing cognitive load, the explicit reference to a potential penalty is based on the rationalist assumption that people choose whether to comply by subtracting the perceived risks and consequences of noncompliance from the perceived costs of compliance (Allingham & Sandmo, 1972; Ehrlich, 1973; Jensen et al., 2018; Nussim & Tabbach, 2009). By making an explicit reference to the risks and consequences of noncompliance, explicit penalty messages can increase people's tendency toward compliance and desirable behaviors (Alm et al., 2009; Chirico et al., 2019; Dušek et al., 2022; Hallsworth, 2014; Jensen et al., 2018).

Vainre et al. (2020) demonstrate that an explicit penalty message, combined with several constituent nudges, could increase employers' payroll tax compliance by 5.1 to 6.1 percent. Similarly, De Neve et al. (2021) show that the use of an explicit penalty message, in combination with simplified tax correspondence, additionally increased citizens' timely tax filings and payment by up to 1.2 percentage points. Moreover, Dušek et al. (2022) show that the use of an explicit penalty nudge can increase the payment of speeding tickets by about 1.2 percent. Based on these results, we hypothesize that adding a deterrence message to a simplified letter can further increase the probability of the timely payment for parking fines:

H_2: Adding an explicit penalty nudge to a simplified notification letter increases citizens' timely payment of parking fines as compared to the control notification letter.

Finally, we expect that citizens' timely payment of parking fines can be further improved by adding a descriptive social norm to a simplified letter in the form of a deterrence message (Cialdini, 2003; Cialdini & Goldstein, 2004; Hallsworth et al., 2017; John et al., 2019; Larkin et al., 2019). Although the use of social norms in government communications is a popular nudge, their effectiveness remains disputed (John et al., 2019; Silva & John, 2017), because of null results (Bird et al., 2021; Dimant et al., 2020; Fellner et al., 2013; Kettle et al., 2017; Martuza et al., 2022) and even backfiring effects (Beshears et al., 2015; Bicchieri & Dimant, 2022; Holzmeister et al., 2022). Descriptive social norms are based on social conformity theory (Bernheim, 1994) and the assumption that people adapt their behavior to the stated norm out of fear of non-conformity and due to the risk of social isolation (Cialdini & Goldstein, 2004; John & Blume, 2018). Evidence on the effectiveness of descriptive social norms in stimulating desirable behaviors is found across a wide range of policy domains, including waste recycling (Cialdini & Jacobson, 2021), sustainable consumption (Loschelder et al., 2019), energy conservation (Allcott, 2011), charitable donations (Agerström et al., 2016), the use of antibiotics (Hallsworth et al., 2016), and vaccination (Belle & Cantarelli, 2021). Based on these studies, we expect that the use of descriptive norms in combination with simplification and an explicit penalty message can positively impact the timely payment of parking fines:

H_3: Adding a social norm message to a simplified notification letter with an explicit penalty message increases citizens' timely payment of parking fines as compared to the control notification letter.

3. Data and method

We test the effects of simplification, an explicit penalty message, and a social norm nudge on people's timely payment of parking violations in the Flemish municipality of Mechelen using a cluster-randomized trial (CRT) (Hayes & Moulton, Lawrence, 2017; Moerbeek, 2006). The municipality of Mechelen, a medium-sized city of about 90,000 inhabitants, is responsible for sanctioning public nuisance violations, including minor parking violations, using municipal administrative sanctions (Schram & Lievens, 2015). In the case of Mechelen, administrative sanctions are administered by a local intermunicipal organization called the Municipal Administrative Sanctions District of Mechelen (GASAM: *Gemeentelijke Administratieve Sancties Arrondissement Mechelen*). These sanctions include category 1 (parking on the wrong side of the road, ignoring the car-free zone) and category 2 (unauthorised use of parking spaces reserved for people with a disability) parking violations. Category 1 violations are sanctioned with a €58 fine and category 2 violations are sanctioned with a €116 fine (GASAM, 2014a, 2014b). We use the notification letters for category 1 and 2 parking violations to test our hypotheses.

3.1. Treatment

Treatments were administered as alterations of the existing notification letter, whether it be changes (simplification) or additions (an explicit penalty message and social norm nudge). The control and treatment versions of the notification letter were randomized across clusters of notification letters and implemented repeatedly until the end

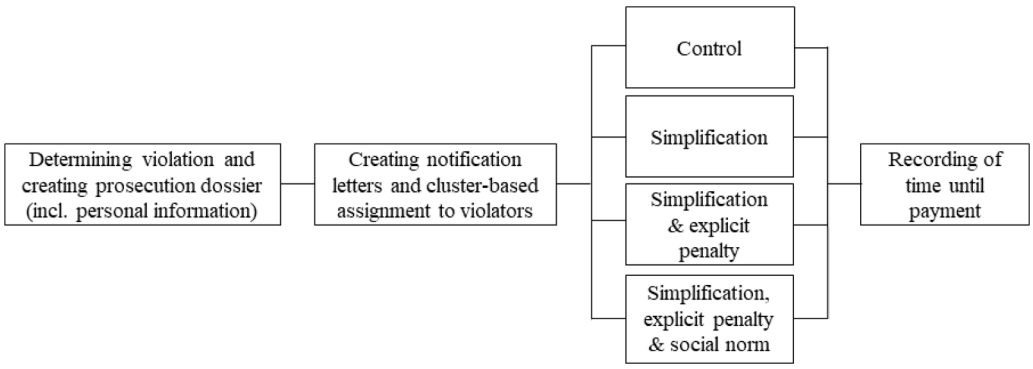

Fig. 1. Implementation flow of the experiment.

of the experiment. This way, each time a different version of the notification letter was sent out to a new group of parking offenders.[1]

The treatment consisted of four versions of the original notification letter. The original notification letter (letter A) served as the control condition to which the effect of the treatment of the other letters was compared. The first treatment letter (letter B) was used to test the first hypothesis and consisted of a simplified version of the original notification letter. The simplification consisted of a reduction of administrative and legal jargon, the visual restructuring of sentences and paragraphs, and the increase of salience of action-relevant payment information. The second treatment letter (letter C) was used to test the second hypothesis and consisted of the simplified letter (B) and the inclusion of an explicit penalty message related to the late-payment penalty: "*Watch out:* ***avoid additional costs*** *by paying your fine within 30 days. These additional costs can amount to 197 euros*", placed directly below the action-relevant payment information. The third treatment letter (letter D) was used to test hypothesis 3 and consisted of the simplified letter with an explicit penalty message (C) and the inclusion of an additional social norm message "***Two out of three*** *people pay their administrative fine on time. Will you follow this example?*", placed directly above the action-relevant payment information. The treatment materials are included in appendix A.

Timely payment was operationalized as payment within 33 days after the postage date of the notification letter. Individuals are requested to pay their fine within 30 days after receiving their notification letter, and GASAM maintains an additional grace period of 3 days for administrative delays. Timely payment is recorded dichotomously, in which no timely payment, i.e., late or no payment, is coded as 0 and payment within 33 days as 1. This way, we take right censoring, which is defined as no payment at the end of the experiment, into account. Timely payment was recorded by GASAM. Participants' gender (male vs. female) and age (in years) were obtained from the Belgian population register. The experiment received administrative and political approval from the city of Mechelen and was approved by the ethics board of our institutions (SMEC: G-2020-1435). The study was not preregistered. See Fig. 1 for the implementation flow of the experiment.

[1] The choice for a cluster-based randomization design followed the administrative procedures and ICT practicalities of the local administration we collaborated with to field the experiment. Every few days the local police sends the local administration a so-called batch containing an average of approximately 75 police reports related to parking violations. The local administration uses this these police reports to determine the parking fine and send out the notification letters, together with the police report. Because the organization was not technically equipped to randomize treatments at an individual level, we randomly assigned a different treatment letter to each new batch of letters. The clustering of letters in batches was controlled for using fixed effects for the clusters in the estimation of the effects of treatment.

3.2. Estimation procedure

We estimated the effects of treatment using a generalized linear mixed effects regression analysis (glmer; Bates et al., 2020), using the statistical software 'R' (R Core Team, 2020), version 4.0.2. The data and code for replication are available at: osf.io/7qab2 (Migchelbrink & Raymaekers, 2023). We accounted for the dependency in outcomes due to the clustered application of treatments by modeling the clusters as fixed effects (Hayes & Moulton, Lawrence, 2017; Moerbeek, 2006; Raudenbush, 1997). To assess the effects of treatment in relation to the control letter (letter A), we included the treatment letters (letters B, C, & D) as dummy-coded explanatory variables into the analysis.

4. Results

The experiment was fielded between June 2020 and February 2021. During that time, $n = 2664$ individuals incurred a fine for a category 1 or 2 parking violation in the city of Mechelen. All were included in the experiment. This sample consisted of $n = 1723$ men (64.7%) and $n = 941$ women (35.3%), with an average age of 42.7 years. $n = 2152$ of these participants received a sanction for a category 1 parking violation and $n = 512$ for a category 2 violation. In total, the participants incurred €184,208 in parking fines, of which $n = 939$ were overdue. Letters were sent out in 34 clusters, totaling 8 or 9 clusters per letter. Each cluster comprised between 70 and 89 subjects (see Table 1).

We assessed the success of cluster-randomized assignment based on participants' age, gender, and the category of the violation. The results (Appendix B) indicate a certain degree of variation in participants' age, gender, and category of violation depending on the type of notification letter, but no significant differences. The cluster-randomized assignment of notification letters resulted in equivalent groups based on these covariates.

The results of the generalized linear mixed effects regression analysis are presented as average marginal effects in Table 2 and are displayed in Fig. 2. Model 1 contains dummy variables for the experimental treatments and displays the average marginal effects of treatment on participants' timely payment depending on the communicative nudges compared to the original control notification letter. Model 2 takes additional information into account, such as participants' age, gender, and the category of the parking violation.

According to these results, about 1.6 percent of the variance in the logits of timely payment was attributable to differences between the clusters in which the treatments were administered. The design effects show that the clustering resulted in a loss of statistical efficiency of between 2.08 and 2.37, indicating that the variance of the proportions more than doubled due to clustering as compared to individual-level

Table 1
Number of participants and clusters.

Letter	Intervention	n. participants per treatment	n. clusters per treatment	$\bar{x}$ participants per cluster
A	Control	629	9	70
B	Simplification	680	9	76
C	Simplification & explicit penalty	645	8	81
D	Simplification, explicit penalty & social norm	710	8	89
	Total	2664	34	

Table 2
Effects of treatment, results in average marginal effects.

	Model 1 AME (se)	95% CI	Model 2 AME (se)	95% CI
Control letter	–	–	–	–
Simplified letter	−.011 (0.038)	[−.084, 0.063]	−.009 (0.037)	[−.082, 0.064]
Simplified letter + deterrence message	.051 (0.036)	[−.009, 0.130]	.063 (0.035)	[−.006, 0.132]
Simplified letter + deterrence and social norm message	.079* (0.035)	[.012, 0.147]	.084* (0.034)	[.016, 0.151]
Gender (male)			−.018 (0.019)	[−.056, 0.020]
Age (years)			.002** (0.001)	[.001, 0.003]
Violation (Cat. 1)			.032 (0.024)	[−.014, 0.078]
Intraclass correlation coefficient (ICC)	.016	.015		
Number of participants ($n_{1)}$	2664	2664		
Number of clusters ($n_{2)}$	34	34		

Notes: * $p < .05$, ** $p < .01$, *** $p < .001$ (two-tailed test).

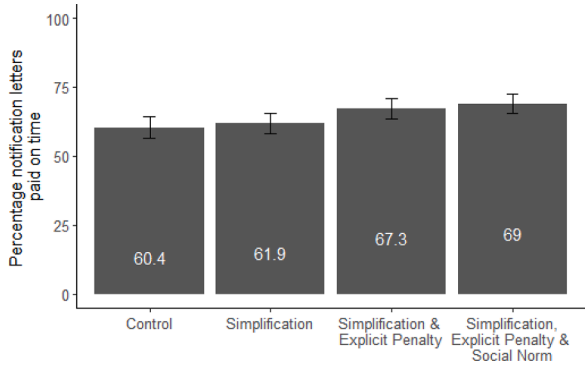

Fig. 2. Percentage rates of timely payment for the control and treatment condition.

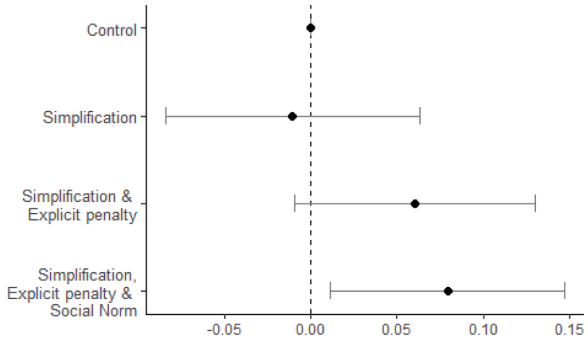

Fig. 3. Effects of treatment in average marginal effects.

assignment.[2]

The results indicate that one treatment significantly affected the likelihood of timely versus non-timely payment of parking fines (Figs. 2 & 3).[3] Participants who received the existing control letter were about 56 percent more likely to pay their sanction on time than they were to pay late (OR=1.56, 95% CI [1.25, 1.95]). Participants who received the simplified letter were about 4.6 percent less likely to pay their sanction on time than those who received the control letter (OR=0.95, 95% CI [.69, 1.32]), an estimated 1.1 percentage points difference. However, this difference was not statistically significant. Participants who received the simplified letter with an explicit penalty message were about 32 percent more likely to pay their sanction on time than participants who received the control letter (OR=1.32, 95% CI [.95, 1.82]), an estimated 5.1 percentage points difference. However, this difference was also not statistically significant. Finally, participants who received the simplified letter with both a deterrence message and a social norm message were about 43.5 percent more likely to pay their sanction on time (OR=1.44, 95% CI [1.04, 1.98]), an estimated 7.9 percentage points difference. This difference was significant, at a 95% confidence level.

The difference in the estimated likelihoods of timely payments between the simplified letter with a deterrence and social norm messages and the control letter equals a standard deviation difference of approximately 0.2 (Cohen's $d = 0.197$). Consequently, this 43% increase represents a relatively small increase in the likelihood of timely payment of parking fines due to the simplification, deterrence, and social norm

[2] Cluster sizes per treatment condition were moderately imbalanced. Following the approach used by Guittet, Ravaud, and Giraudeau (2006), we calculated design effects based on the average cluster size per treatment condition. The design effects ranged from 2.068 for the control letter and 2.160 for the simplified letter, to 2.238 for the simplified letter with a deterrence message and 2.362 for the simplified letter with a deterrence and social norm message.

[3] We examined whether our results were robust against multiple comparisons by calculating and the adjusted p-values using the Benjamini and Yekutieli (2001) correction (p.adjust) in R. The result of this analysis shows that the effects of treatment are not completely robust against multiple comparisons. Adjusting for multiple comparison pushes our results beyond statistical significance at the 95% level. This is likely a consequence of the relatively low level of statistical power we obtained in our experiment. For more details, see Appendix C.

messages combined. In addition to the main effects of treatment, we analyzed the influence of the control variables in Model 2. The results indicate that participants' age significantly impacted the estimated odds ratio for timely payment (OR=1.01, 95% CI [1.00, 1.02]). At the same time, participants' gender and the category of violation did not appear to significantly affect the timely payment of administrative sanctions.

5. Discussion and conclusion

Can people be nudged to pay their parking fines on time? This study indicated that they can, especially when multiple nudges are used simultaneously. Letter simplification did not result in a significant increase in people's timely payment of parking fines. As such, the data offer no support for the first hypothesis (H_1: not supported). Adding an explicit penalty message to the simplified notification letter did increase respondents' timely payment of parking fines, both compared to the original notification letter and to the simplified notification letter, but these increases were not statistically significant at the 95 percent confidence level (H_2: not supported). Finally, the compounded use of a social norm message, an explicit penalty message and a simplified notification letter did result in a statistically significant increase in respondents' timely payment of parking fines as compared to the original control letter (H_3: supported). When they received this letter, respondents were about 44 percent more likely to pay their fine on time than when they received the original control letter. This means that they were about 124 percent more likely to pay their fines on time than to pay late or not at all.

Contrary to De Neve et al. (2021) and John and Blume (2018), we find no evidence that simplification as a single intervention increases people's timely payment behavior. We also do not find support for the effectiveness of explicit penalty messages, for example as discussed by Vainre et al. (2020) and by Dušek et al. (2022). Instead, we only observe a statistically significant increase in the timely payment of fines when we use multiple nudges simultaneously. Consequently, with these results, we add evidence to the growing body of nudge literature suggesting that the relationship between nudge outputs and behavioral outcomes is complex. Nudge interventions and nudge combinations may work under certain conditions, but their effectiveness is characterized by heterogeneity across policy domains, nudge types, populations segments, baseline attitudes, geographical locations and targeted behaviors (Dewies et al., 2021; Holzmeister et al., 2022; Osman et al., 2020; Szaszi et al., 2018, 2022). The mixed, contradictory and uncertain results of individual nudges and the struggle to confirm theoretical predictions about deterrence and non-deterrence nudges support our view that behavioral-based policy interventions can be compounded (Vainre et al., 2020) and should be grounded in a practice-oriented design which takes the specific local context into consideration (Van Ryzin, 2021).

As a practice-oriented design science, public administration is uniquely equipped to collaborate with local governments and public organizations in designing and implementing policy-interventions to address social and administrative challenges (James et al., 2017; Van Ryzin, 2021). However, practice-based collaborations are not without their design and implementation challenges (John, 2017). In the case of this study, specific constraints result in at least three limitations. First, due to the administrative procedure for sending out notification letters to parking offenders, we were unable to randomize treatments at the individual level. Instead, we opted to assign the treatments based on the clusters in which these letters were distributed (Raudenbush, 1997). The resulting design effects indicated that this approach reduces the statistical power of our analysis by half (Crespi, 2019; Moerbeek, 2006). At the same time, the proportion of variance attributable to clustering was very low (1.7 percent), which we controlled for using cluster-based fixed effects (Bates et al., 2015).

Second, the field experiment was conducted within a single local administration, i.e., the municipality of Mechelen. Although this approach allowed us to assess the effects of treatment in great detail (Baekgaard et al., 2015; John, 2017, 2020) and with high ecological validity (Hansen & Tummers, 2020) while keeping contextual factors constant, we cannot rule out that people in different localities react differently to our treatments. Replicating the current study in different localities could serve to further strengthen the external validity and reliability of the results (Walker et al., 2019). Third, due to the cluster-randomized design of the experiment, the statistical power of the analysis is relatively low (Appendix C).[4] Future studies can replicate this study using an individual level randomized design or test the effects of compounding nudges in a full-factorial design.

Our results indicate that people can be nudged to pay their parking fines on time, but only when multiple nudges are combined and used simultaneously. While the use of nudges in government communications are becoming more and more popular, our relatively modest and null findings serve as a cautionary reminder that the effectiveness of nudges is not guaranteed. Obtaining a better understanding of the settings and conditions in which nudges operate, both in isolation and in combination, has the potential to improve their reliability and scalability.

Data availability

The data is available following the in-text reference.

Acknowledgement

We are grateful to the City of Mechelen, the intermunicipal Municipal Administrative Sanctions of the District of Mechelen (GASAM), the Behavioral Insights Team of the Flemish regional government and the Policy Research center of Governance Innovation (Steunpunt Bestuurlijke Vernieuwing) of the Flemish government for their collaboration and input. Without their help and support, this project would not have been possible. Finally, we would like to thank the anonymous reviewers for their valuable comments and suggestions.

Appendix A. Experimental materials (Notification letters)

Letter A - Control

[4] We conducted a power analysis on the three treatment conditions in our model using the simr package (Green & MacLeod, 2016) for generalized linear mixed models (Bates et al., 2015) in R. Simr uses Monte Carlo simulations to calculate the power of an analysis. In this setup, the tested effect is known and so every positive test is a true positive and every negative test is a Type II error. This way, the probability that the test rejects the null hypothesis assuming the null hypothesis is falls can be straightforwardly calculated. Unsurprisingly, this rate is low for the two treatment conditions that did not result in a statistically significant change of the rate of timely payment. Both estimates of the treatment effect were surrounded by a lot of statistical uncertainty. The one effect of treatment that did result in a statistically significant change in the rate of timely payment has a power of .63, which is generally understood to be underpowered. More details in Appendix C.

GASAM/Mechelen
Grote Markt 21 - 2800 Mechelen
E [redacted]
T [redacted]
Telefonisch bereikbaar
Ma: 9u tot 12u en 13u30 tot 16u30
Di, Woe: 13u30 tot 16u30
Do, Vrij: 9u tot 12u

Ons kenmerk:	Bijlagen:	Datum:
«dossiernr»	PV «Nummer_PV» Antwoordformulier	«stukdatum»

Geachte

Op **«Datum_inbreuk»** werd om **«Uur_inbreuk» uur** vastgesteld dat het voertuig met nummerplaat **«Nummerplaat_voertuig»** fout geparkeerd of stil stond ter hoogte van: **«Straat_inbreuk»**. Als bijlage vindt u het proces-verbaal met de informatie van de inbreuk[1]. De overtreding in het proces-verbaal is een inbreuk op **«Artikelnummer»** van de bijzondere politieverordening van de stad Mechelen. Deze politieverordening vindt u op de website van de stad: www.mechelen.be/gas-politieverordening-parkeren-en-stilstaan.

Op deze overtreding staat een administratieve geldboete van **«Bedrag_boete» euro**. U moet het bedrag overschrijven binnen de 30 dagen met onderstaande gegevens:

Bedrag:	**«Bedrag_boete» euro**
IBAN rekening stad Mechelen:	[redacted]
BIC stad Mechelen:	[redacted]
Begunstigde:	Stadsbestuur Mechelen Grote Markt 21 - 2800 Mechelen
Mededeling:	***«Refnr»***

Niet akkoord met de administratieve geldboete?

U kan **binnen de termijn van 30 dagen** na ontvangst van deze brief **éénmalig schriftelijk verweer** indienen.

Er wordt van een bestuurder verwacht dat hij/zij het verkeersreglement en de verkeersborden kent en respecteert. De bestuurder moet steeds controleren of er een verkeersbord staat opgesteld dat het parkeren of stilstaan reglementeert op de plaats waar hij/zij het voertuig plaatst.

Dien verweer in met het bijgevoegde antwoordformulier. Dit verweer moet alle argumenten en bewijsmiddelen bevatten. Elke administratieve geldboete heeft een uniek kenmerknummer (2020N...) dat u in het verweer moet vermelden. Bij meerdere geldboetes moet u alle kenmerknummers vermelden om misverstanden te vermijden.

Verzend het antwoordformulier bij voorkeur via e-mail. U kan dit formulier ook per post opsturen.

Ligt de boete hoger dan 70 euro dan kan u worden gehoord. Maak hiervoor telefonisch een afspraak.

Hoogachtend

[redacted]
Sanctionerend ambtenaar

[1] Uw gegevens zullen, in navolging van artikel 44 van de wet van 24 juni 2013 betreffende de gemeentelijke administratieve sancties en milsnaleving van de voorwaarden bepaald in het Koninklijk Besluit, worden opgenomen in het register van de gemeentelijke administratieve sancties. Uw gegevens worden verwerkt conform de bepalingen van de Wet van 8 december 1992 tot de bescherming van de persoonlijke levenssfeer ten opzichte van de verwerking van persoonsgegevens. U heeft op ieder moment recht tot inzage en verbetering van de gegevens die op u betrekking hebben.

Letter B - Simplification

MECHELEN

GASAM/Mechelen
Grote Markt 21 - 2800 Mechelen
E [redacted]
T [redacted]
Telefonisch bereikbaar
(behalve dinsdagnamiddag)

Ons kenmerk:	Bijlagen:	Datum:
«dossiernr»	PV «Nummer_PV» Antwoordformulier	«stukdatum»

Geldboete voor foutparkeren of fout stilstaan

Geachte (voornaam) (achternaam),

Op «Datum_inbreuk» werd om «Uur_overtreding» uur vastgesteld dat uw voertuig met nummerplaat «Nummerplaat_voertuig» **foutgeparkeerd stond of fout stilstond** ter hoogte van «Straat_overtreding». Als bijlage vindt u het proces-verbaal met de informatie van de overtreding.[1]

Het gaat om een overtreding op «Artikelnummer» van de bijzondere politieverordening van Stad Mechelen. Die vindt u terug op www.mechelen.be/parkeren-en-stilstaan. Op deze overtreding staat een administratieve geldboete van **«Bedrag_boete» euro**. Schrijf het bedrag over met de onderstaande gegevens, **binnen 30 dagen** nadat u deze brief hebt ontvangen.

Bedrag:	**«Bedrag_boete» euro**
Begunstigde:	Stadsbestuur Mechelen Grote Markt 21 - 2800 Mechelen
IBAN:	[redacted]
BIC:	[redacted]
Mededeling:	***«Refnr»***

Gaat u niet akkoord met uw geldboete?

U kunt **eenmalig schriftelijk verweer** indienen via het bijgevoegde antwoordformulier. Doe dit **binnen 30 dagen** nadat u deze brief hebt ontvangen. Vermeld het uniek kenmerknummer (2020N…) dat u links bovenaan deze brief vindt. Bij meerdere boetes dient u alle kenmerknummers te vermelden. Voeg eventuele bewijsstukken toe en bezorg de ondertekende versie van het formulier bij voorkeur via e-mail. U kunt het ook met de post opsturen.

Enkel bij een boete van 116 euro kunt u uw argumenten mondeling komen toelichten. Maak daarvoor telefonisch een afspraak.

Hoogachtend,

[redacted]
Sanctionerend ambtenaar

[1] Uw gegevens worden opgenomen in het register van de gemeentelijke administratieve sancties, met toepassing van artikel 44 van de wet van 24 juni 2013 betreffende de gemeentelijke administratieve sancties. De voorwaarden uit het koninklijk besluit worden daarbij nageleefd. Uw gegevens worden verwerkt met toepassing van de wet van 8 december 1992 tot bescherming van de persoonlijke levenssfeer ten opzichte van de verwerking van persoonsgegevens. U hebt op ieder moment het recht om uw gegevens in te kijken en te verbeteren.

Letter C – Simplification & deterrence

GASAM/Mechelen
Grote Markt 21 - 2800 Mechelen
E [redacted]
T [redacted]
Telefonisch bereikbaar
(behalve dinsdagnamiddag)

Ons kenmerk:	Bijlagen:	Datum:
«dossiernr»	PV «Nummer_PV» Antwoordformulier	«stukdatum»

Geldboete voor foutparkeren of fout stilstaan

Geachte (voornaam) (achternaam),

Op «Datum_inbreuk» werd om «Uur_overtreding» uur vastgesteld dat uw voertuig met nummerplaat «Nummerplaat_voertuig» **foutgeparkeerd stond of fout stilstond** ter hoogte van «Straat_overtreding». Als bijlage vindt u het proces-verbaal met de informatie van de overtreding.[1]

Het gaat om een overtreding op «Artikelnummer» van de bijzondere politieverordening van Stad Mechelen. Die vindt u terug op www.mechelen.be/parkeren-en-stilstaan. Op deze overtreding staat een administratieve geldboete van **«Bedrag_boete» euro**. Schrijf het bedrag over met de onderstaande gegevens, **binnen 30 dagen** nadat u deze brief hebt ontvangen.

Opgelet: **vermijd extra kosten** door binnen 30 dagen te betalen. Deze extra kosten kunnen oplopen tot 197 euro.

Bedrag:	**«Bedrag_boete» euro**
Begunstigde:	Stadsbestuur Mechelen Grote Markt 21 - 2800 Mechelen
IBAN:	[redacted]
BIC:	[redacted]
Mededeling:	***«Refnr»***

Gaat u niet akkoord met uw geldboete?

U kunt **eenmalig schriftelijk verweer** indienen via het bijgevoegde antwoordformulier. Doe dit **binnen 30 dagen** nadat u deze brief hebt ontvangen. Vermeld het uniek kenmerknummer (2020N...) dat u links bovenaan deze brief vindt. Bij meerdere boetes dient u alle kenmerknummers te vermelden. Voeg eventuele bewijsstukken toe en bezorg de ondertekende versie van het formulier bij voorkeur via e-mail. U kunt het ook met de post opsturen.

Enkel bij een boete van 116 euro kunt u uw argumenten mondeling komen toelichten. Maak daarvoor telefonisch een afspraak.

Hoogachtend,

[redacted]
Sanctionerend ambtenaar

[1] Uw gegevens worden opgenomen in het register van de gemeentelijke administratieve sancties, met toepassing van artikel 44 van de wet van 24 juni 2013 betreffende de gemeentelijke administratieve sancties. De voorwaarden uit het koninklijk besluit worden daarbij nageleefd. Uw gegevens worden verwerkt met toepassing van de wet van 8 december 1992 tot bescherming van de persoonlijke levenssfeer ten opzichte van de verwerking van persoonsgegevens. U hebt op ieder moment het recht om uw gegevens in te kijken en te verbeteren.

Letter D – Simplification, deterrence & social norm

GASAM/Mechelen
Grote Markt 21 - 2800 Mechelen
E [redacted]
T [redacted]
Telefonisch bereikbaar
(behalve dinsdagnamiddag)

Ons kenmerk:	Bijlagen:	Datum:
«dossiernr»	PV «Nummer_PV» Antwoordformulier	«stukdatum»

Geldboete voor foutparkeren of fout stilstaan

Geachte (voornaam) (achternaam),

Op «Datum_inbreuk» werd om «Uur_overtreding» uur vastgesteld dat uw voertuig met nummerplaat «Nummerplaat_voertuig» **foutgeparkeerd stond of fout stilstond** ter hoogte van «Straat_overtreding». Als bijlage vindt u het proces-verbaal met de informatie van de overtreding.[1]

Het gaat om een overtreding op «Artikelnummer» van de bijzondere politieverordening van Stad Mechelen. Die vindt u terug op www.mechelen.be/parkeren-en-stilstaan. Op deze overtreding staat een administratieve geldboete van **«Bedrag_boete» euro**.

Schrijf het bedrag over met de onderstaande gegevens, **binnen 30 dagen** nadat u deze brief hebt ontvangen. Opgelet: **vermijd extra kosten** door binnen 30 dagen te betalen. Deze extra kosten kunnen oplopen tot 197 euro.

Twee op drie mensen betalen hun administratieve geldboete op tijd. Volgt u dit voorbeeld?

Bedrag:	**«Bedrag_boete» euro**
Begunstigde:	Stadsbestuur Mechelen Grote Markt 21 - 2800 Mechelen
IBAN:	[redacted]
BIC:	[redacted]
Mededeling:	***«Refnr»***

Gaat u niet akkoord met uw geldboete?

U kunt **eenmalig schriftelijk verweer** indienen via het bijgevoegde antwoordformulier. Doe dit **binnen 30 dagen** nadat u deze brief hebt ontvangen. Vermeld het uniek kenmerknummer (2020N…) dat u links bovenaan deze brief vindt. Bij meerdere boetes dient u alle kenmerknummers te vermelden. Voeg eventuele bewijsstukken toe en bezorg de ondertekende versie van het formulier bij voorkeur via e-mail. U kunt het ook met de post opsturen.

Enkel bij een boete van 116 euro kunt u uw argumenten mondeling komen toelichten. Maak daarvoor telefonisch een afspraak.

Hoogachtend,

[redacted]
Sanctionerend ambtenaar

[1] Uw gegevens worden opgenomen in het register van de gemeentelijke administratieve sancties, met toepassing van artikel 44 van de wet van 24 juni 2013 betreffende de gemeentelijke administratieve sancties. De voorwaarden uit het koninklijk besluit worden daarbij nageleefd. Uw gegevens worden verwerkt met toepassing van de wet van 8 december 1992 tot bescherming van de persoonlijke levenssfeer ten opzichte van de verwerking van persoonsgegevens. U hebt op ieder moment het recht om uw gegevens in te kijken en te verbeteren.

Appendix B. Balance checks

	Age Estimate (se)	Gender (Male) Logit (se)	Type (Cat. 2) Logit (se)
Intercept	43.582*** (0.636)	−.677*** (0.084)	1.450*** (0.216)
Control letter	–	–	–
Simplified letter	−.090 (0.895)	.191 (0.116)	.377 (0.313)
Simplified letter, deterrence message	−1.264 (0.906)	.012 (0.118)	.023 (0.313)
Simplified letter, deterrence & social norm message	−1.389 (0.884)	.073 (0.115)	−.123 (0.310)
ICC	0.003	0	0.086
n1	2664	2664	2664
n2	34	34	34

Notes: * $p < .05$, ** $p < .01$, *** $p < .001$ (two-tailed test). Standard Deviations appear in the parentheses below the means.

Appendix C. Corrections for multiple comparisons

	Logit (se)	Adjusted p-value
Intercept	.444	<. 001
Simplified letter	−0.047 (0.165)	.776
Simplified letter + deterrence message	.274 (0.166)	.131
Simplified letter + deterrence and social norm message	.361 (0.163)	.054

Power analysis on treatment conditions

Treatment condition	N simulations	Alpha	Power	95% CI
Simplified letter	250	.05	.12	[.636, 0.20]
Simplified letter + deterrence message	250	.05	.456	[.331, 0.533
Simplified letter + deterrence and social norm message	250	.05	.632	[.528, 724]

References

Agerström, J., Carlsson, R., Nicklasson, L., & Guntell, L. (2016). Using descriptive social norms to increase charitable giving: The power of local norms. *Journal of Economic Psychology, 52*, 147–153. https://doi.org/10.1016/j.joep.2015.12.007

Allcott, H. (2011). Social norms and energy conservation. *Journal of Public Economics, 95*(9–10), 1082–1095. https://doi.org/10.1016/j.jpubeco.2011.03.003

Allingham, M. G., & Sandmo, A. (1972). Income tax evasion: A theoretical analysis. *Journal of Public Economics, 1*, 323–338.

Alm, J., Jackson, B. R., & McKee, M. (2009). Getting the word out: Enforcement information dissemination and compliance behavior. *Journal of Public Economics, 93*(3–4), 392–402. https://doi.org/10.1016/j.jpubeco.2008.10.007

Antinyan, A., & Asatryan, Z. (2019). Nudging for tax compliance: A meta-analysis. *SSRN Electronic Journal, November*. https://doi.org/10.2139/ssrn.3500744

Ariel, B. (2012). Deterrence and moral persuasion effects on corporate tax compliance: Findings from a randomized controlled trial. *Criminology; an interdisciplinary journal, 50*(1), 27–69. https://doi.org/10.1111/j.1745-9125.2011.00256.x

Baekgaard, M., Baethge, C., Blom-Hansen, J., Dunlop, C. A., Esteve, M., Jakobsen, M., et al. (2015). Conducting experiments in public management research: A practical guide. *International Public Management Journal, 18*(2), 323–342. https://doi.org/10.1080/10967494.2015.1024905

Bantjes, J., du Plessis, S., Jansen, A., & Siebrits, K. (2021). Better enforcement is essential, but may be inadequate: Findings of a survey on the factors affecting payment of speeding fines in Cape Town, South Africa. *Sustainability, 13*(9), 5028. https://doi.org/10.3390/su13095028

Bates, D. M., Mächler, M., Bolker, B., & Walker, S. (2015). Fitting Linear Mixed-Effects Models Using lme4. *Journal of Statistical Software, 67*(1), 1–48. https://doi.org/10.18637/jss.v067.i01

Bates, D.M., Maechler, M., Bolker, B., Walker, S., Christensen, R.H.B., Singmann, H. et al. (2020). *Package lme4*. https://cran.r-project.org/web/packages/lme4/lme4.pdf.

Becker, G. S. (1968). Crime and punishment: An economic approach. *Journal of Political Economy, 76*(2), 169–217. https://www.jstor.org/stable/1830482.

Belle, N., & Cantarelli, P. (2021). Nudging public employees through descriptive social norms in healthcare organizations. *Public Administration Review, 81*(4), 589–598. https://doi.org/10.1111/puar.13353

Benartzi, S., Beshears, J., Milkman, K. L., Sunstein, C. R., Thaler, R. H., Shankar, M., et al. (2017). Should governments invest more in nudging? *Psychological Science, 28*(8), 1041–1055. https://doi.org/10.1177/0956797617702501

Benjamini, Y., & Yekutieli, D. (2001). The control of the false discovery rate in multiple testing under dependency. *The Annals of Statistics, 29*(4). https://doi.org/10.1214/aos/1013699998

Bernheim, B. D. (1994). A theory of conformity. *Journal of Political Economy, 102*(5), 841–877. https://doi.org/10.1086/261957

Beshears, J., Choi, J. J., Laibson, D., Madrian, B. C., & Milkman, K. L. (2015). The effect of providing peer information on retirement savings decisions. *Journal of Finance, 70*(3), 1161–1201. https://doi.org/10.1111/jofi.12258

Bhargava, S., & Manoli, D. (2015). Psychological Frictions and the Incomplete Take-Up of Social Benefits: Evidence from an IRS Field Experiment. *American Economic Review, 105*(11), 3489–3529. https://doi.org/10.1257/aer.20121493

Bicchieri, C., & Dimant, E. (2022). Nudging with care: The risks and benefits of social information. *Public choice, 191*(3–4), 443–464. https://doi.org/10.1007/s11127-019-00684-6

Bird, K. A., Castleman, B. L., Denning, J. T., Goodman, J., Lamberton, C., & Rosinger, K. O. (2021). Nudging at scale: Experimental evidence from FAFSA completion campaigns. *Journal of Economic Behavior and Organization, 183*, 105–128. https://doi.org/10.1016/j.jebo.2020.12.022

Bott, K. M., Cappelen, A. W., Sørensen, E. O., & Tungodden, B. (2019). You ve got mail: A randomized field experiment on tax evasion. *Management Science, 66*(7), 2801–2819. https://doi.org/10.1287/mnsc.2019.3390

Botzem, S. (2019). The governance of behavioural taxation: Moralization and the new models of tax collection. In H. Strassheim, & S. Beck (Eds.), *Handbook of behavioural change and public policy* (pp. 272–283). Edward Elgar Publishing Limited.

Brandon, A., List, J. A., Metcalfe, R. D., Price, M. K., & Rundhammer, F. (2019). Testing for crowd out in social nudges: Evidence from a natural field experiment in the market for electricity. *Proceedings of the National Academy of Sciences of the United States of America, 116*(12), 5293–5298. https://doi.org/10.1073/pnas.1802874115

Brockmeyer, A., Smith, S., Hernandez, M., & Kettle, S. (2019). Casting a wider tax net: Experimental evidence from Costa Rica. *American Economic Journal: Economic Policy, 11*(3), 55–87. https://doi.org/10.1257/pol.20160589

Cartwright, N. (2007). Are RCTs the gold standard? *BioSocieties, 2*(1), 11–20. https://doi.org/10.1017/S1745855207005029

Chirico, M., Inman, R., Loeffler, C., MacDonald, J., & Sieg, H. (2019). Deterring Property Tax Delinquency in Philadelphia. *National Tax Journal, 72*(3), 479–506. https://doi.org/10.17310/ntj.2019.3.01

Cialdini, R. B. (2003). Crafting normative messages to protect the environment. *Current Directions in Psychological Science, 12*(4), 105–109. https://doi.org/10.1111/1467-8721.01242

Cialdini, R. B., & Goldstein, N. J. (2004). Social influence: Compliance and conformity. *Annual Review of Psychology, 55*(1), 591–621. https://doi.org/10.1146/annurev.psych.55.090902.142015

Cialdini, R. B., & Jacobson, R. P. (2021). Influences of social norms on climate change-related behaviors. *Current Opinion in Behavioral Sciences, 42*, 1–8. https://doi.org/10.1016/j.cobeha.2021.01.005

Crespi, C. (2019). *Design and Analysis of Cluster Randomized Trials*. https://www.researchgate.net/publication/332913023_Design_and_Analysis_of_Cluster_Randomized_Trials/related.

De Neve, J.-. E., Imbert, C., Spinnewijn, J., Tsankova, T., & Luts, M (2021). How to improve tax compliance? Evidence from population-wide experiments in Belgium. *Journal of Political Economy, 129*(5), 1425–1463. https://doi.org/10.1086/713096

De Smedt, P., Beyst, V., Vandenberghe, P., & Nuyts, S. (2018). Beter beleid maken met gedrags- inzichten, een nieuw team binnen de Vlaamse overheid. *Vlaams Tijdschrift Voor Overheidsmanagement, 23*(4), 7–20.

DellaVigna, S., & Linos, E. (2022). RCTs to Scale: Comprehensive evidence from two nudge units. *Econometrica : journal of the Econometric Society, 90*(1), 81–116. https://doi.org/10.3982/ecta18709

Dewies, M., Schop-Etman, A., Rohde, K. I. M., & Denktaş, S. (2021). Nudging is Ineffective When Attitudes Are Unsupportive: An Example from a Natural Field Experiment. *Basic and Applied Social Psychology, 43*(4), 213–225. https://doi.org/10.1080/01973533.2021.1917412

Dimant, E., van Kleef, G. A., & Shalvi, S. (2020). Requiem for a nudge: Framing effects in nudging honesty. *Journal of Economic Behavior and Organization, 172*, 247–266. https://doi.org/10.1016/j.jebo.2020.02.015

Doran, M. (2009). Tax penalties and tax compliance. *Harvard Journal on Legislation, 46*(1), 111–161.

Du Plessis, S., Hartig, B., Jansen, A., & Siebrits, K. (2020). Improving payment of traffic fines with financial incentives: Discounts vs. penalties. *Transportation Research Part F: Traffic Psychology and Behaviour, 74*, 298–306. https://doi.org/10.1016/j.trf.2020.08.019

Dušek, L., Pardo, N., & Traxler, C. (2022). Salience and timely compliance: Evidence from speeding tickets. *Journal of Policy Analysis and Management, 41*(2), 426–449. https://doi.org/10.1002/pam.22387

Ehrlich, I. (1973). Participation in illegitimate activities: A theoretical and empirical investigation. *Journal of Political Economy2, 81*(3), 521–565.

Esmark, A. (2019). Communicative governance at work: How choice architects nudge citizens towards health, wealth and happiness in the information age. *Public Management Review, 21*(1), 138–158. https://doi.org/10.1080/14719037.2018.1473476

Fellner, G., Sausgruber, R., & Traxler, C. (2013). Testing enforcement strategies in the field: Threat, moral appeal and social information. *Journal of the European Economic Association, 11*(3), 634–660. https://doi.org/10.1111/jeea.12013

GASAM. (2014a). *Bijzondere politieverordening betreffende de gemeentelijke administratieve sancties voor de overtredingen betreffende het stilstaan en het parkeren en voor de overtredingen betreffende de verkeersborden C3 en F103, vastgesteld met automatische werkende to* (p. 11). City of Mechelen. https://www.mechelen.be/gas/procedure-parkeren-stilstaan-en-autoluw.

GASAM. (2014b). *Memorandum GAS-Traffic parking and care-free zones city of mechelen* (p. 2). City of Mechelen. https://www.mechelen.be/gas/procedure-parkeren-stilstaan-en-autoluw.

GASAM. (2020). *GASAM Jaarverslag 2019*. https://docplayer.nl/111914787-Interlokale-vereniging-gemeentelijke-administratieve-sancties-arrondissement-mechelen-gasam-jaarverslag.html.

Gerber, A. S., & Green, D. P. (2012). *Field experiments. design, analysis, and interpretation*. W.W. Norton & Company, Inc.

Green, P., & MacLeod, C. J. (2016). SIMR: An R package for power analysis of generalized linear mixed models by simulation. *Methods in Ecology and Evolution, 7*(4), 493–498. https://doi.org/10.1111/2041-210X.12504

Guittet, L., Ravaud, P., & Giraudeau, B. (2006). Planning a cluster randomized trial with unequal cluster sizes: Practical issues involving continuous outcomes. *BMC Medical Research Methodology, 6*(1), 17. https://doi.org/10.1186/1471-2288-6-17

Hallsworth, M. (2014). The use of field experiments to increase tax compliance. *Oxford Review of Economic Policy, 30*(4), 658–679. https://doi.org/10.1093/oxrep/gru034

Hallsworth, M. (2023). A manifesto for applying behavioural science. *Nature Human Behaviour*. https://doi.org/10.1038/s41562-023-01555-3

Hallsworth, M., Chadborn, T., Sallis, A., Sanders, M., Berry, D., Greaves, F., et al. (2016). Provision of social norm feedback to high prescribers of antibiotics in general practice: A pragmatic national randomised controlled trial. *The Lancet, 387*(10029), 1743–1752. https://doi.org/10.1016/S0140-6736(16)00215-4

Hallsworth, M., List, J. A., Metcalfe, R. D., & Vlaev, I. (2017). The behavioralist as tax collector: Using natural field experiments to enhance tax compliance. *Journal of Public Economics, 148*, 14–31. https://doi.org/10.1016/j.jpubeco.2017.02.003

Hansen, J. A., & Tummers, L. (2020). A systematic review of field experiments in public administration. *Public Administration Review, 9999*, 1–11. https://doi.org/10.1111/puar.13181

Harris, A., Evans, H., & Beckett, K. (2010). Drawing blood from stones: Legal debt and social inequality in the contemporary United States. *American Journal of Sociology, 115*(6), 1753–1799. https://doi.org/10.1086/651940

Hayes, R. J., & Moulton, Lawrence, H. (2017). *Cluster randomised trials* (2nd ed.). Chapman and Hall/CRC. https://doi.org/10.4324/9781315370286

Haynes, L., Green, D., Gallagher, R., John, P., & Torgerson, D. (2013). Collection of delinquent fines: An adaptive randomized trial to assess the effectiveness of alternative text messages. *Journal of Policy Analysis and Management, 32*(4), 718–730. https://doi.org/10.1002/pam

Heffetz, O., O'Donoghue, T., & Schneider, H. S. (2022). Reminders work, but for whom? Evidence from New York City parking ticket recipients. *American Economic Journal: Economic Policy, 14*(4), 343–370. https://doi.org/10.1257/pol.20200400

Holzmeister, F., Huber, J., Kirchler, M., & Schwaiger, R. (2022). Nudging debtors to pay their debt: Two randomized controlled trials. *Journal of Economic Behavior and Organization, 198*(Study 1), 535–551. https://doi.org/10.1016/j.jebo.2022.04.006

Howley, P., & Ocean, N. (2021). Can nudging only get you so far? Testing for crowd out effects. *SSRN Electronic Journal, 49*(October 2021), 1086–1112. https://doi.org/10.2139/ssrn.3841593

Hummel, D., & Maedche, A. (2019). How effective is nudging? A quantitative review on the effect sizes and limits of empirical nudging studies. *Journal of Behavioral and Experimental Economics, 80*(February), 47–58. https://doi.org/10.1016/j.socec.2019.03.005

James, O., Jilke, S. R., & Van Ryzin, G. G. (Eds.). (2017). *Experiments in public management research. challenges and contributions*. Cambridge University Press. https://doi.org/10.1017/9781316676912.

Jensen, N. H., Reuss, L. F., & Rasmussen, S. (2018). Increasing public debt collection with nudging: Results of two natural fields experiments. *Scandinavian Journal of Public Administration, 22*(4), 45–64.

John, P. (2017). *Field experiments in political science and public policy*. Routledge. https://doi.org/10.4324/9781315773025

John, P. (2018). How far to nudge?: Assessing behavioural public policy. *How far to nudge?: Assessing behavioural public policy*. Edward Elgar Publishing Limited. https://doi.org/10.4337/9781786430557

John, P. (2020). Improving causal claims in public policy through randomized designs in the field. *Journal of Comparative Policy Analysis: Research and Practice, 00*(00), 1–17. https://doi.org/10.1080/13876988.2020.1782751

John, P., & Blume, T. (2017). *Nudges That Promote Channel Shift: A Randomized Evaluation of Messages to Encourage Citizens to Renew Benefits Online, 9*(2), 168–183. https://doi.org/10.1002/poi3.148

John, P., & Blume, T. (2018). How best to nudge taxpayers? The impact of message simplification and descriptive social norms on payment rates in a central London local authority. *Journal of Behavioral Public Administration, 1*(1). https://doi.org/10.30636/jbpa.11.10

John, P., Sanders, M., & Wang, J. (2019). A panacea for improving citizen behaviors? Introduction to the symposium on the use of social norms in public administration. *Journal of Behavioral Public Administration, 2*(2), 1–8. https://doi.org/10.30636/jbpa.22.119

Kettle, S., Hernandez, M., Sanders, M., Hauser, O., & Ruda, S. (2017). Failure to CAPTCHA attention: Null results from an honesty priming experiment in Guatemala. *Behavioral Sciences, 7*(4), 28. https://doi.org/10.3390/bs7020028

Kirchler, E. (2007). *The economic psychology of tax behaviour*. Cambridge University Press.

Larkin, C., Sanders, M., Andresen, I., & Algate, F. (2019). Testing local descriptive norms and salience of enforcement action: A field experiment to increase tax collection. *Journal of Behavioral Public Administration, 2*(1), 1–11. https://doi.org/10.30636/jbpa.21.54

Linos, E., Quan, L. T., & Kirkman, E. (2020). Nudging early reduces administrative burden: Three field experiments to improve code enforcement. *Journal of Policy Analysis and Management, 39*(1), 243–265. https://doi.org/10.1002/pam.22178

Lofstrom, M., & Raphael, S. (2016). Crime, the criminal justice system, and socioeconomic inequality. *Journal of Economic Perspectives, 30*(2), 103–126. https://doi.org/10.1257/jep.30.2.103

Loschelder, D. D., Siepelmeyer, H., Fischer, D., & Rubel, J. A. (2019). Dynamic norms drive sustainable consumption: Norm-based nudging helps café customers to avoid disposable to-go-cups. *Journal of Economic Psychology, 75*, Article 102146. https://doi.org/10.1016/j.joep.2019.02.002

Maier, M., Bartoš, F., Stanley, T. D., Shanks, D. R., Harris, A. J. L., & Wagenmakers, E. J. (2022). No evidence for nudging after adjusting for publication bias. *Proceedings of the National Academy of Sciences of the United States of America, 119*(31), 10–11. https://doi.org/10.1073/pnas.2200300119

Makowsky, M. D., & Stratmann, T. (2011). More tickets, fewer accidents: How cash-strapped towns make for safer roads. *Journal of Law and Economics, 54*(4), 863–888. https://doi.org/10.1086/659260

Manville, M., & Pinski, M. (2021). The causes and consequences of curb parking management. *Transportation Research Part A: Policy and Practice, 152*(August), 295–307. https://doi.org/10.1016/j.tra.2021.07.007

Marsden, G. (2006). The evidence base for parking policies—A review. *Transport Policy, 13*(6), 447–457. https://doi.org/10.1016/j.tranpol.2006.05.009

Martuza, J. Bin, Skard, S. R., Løvlie, L., & Thorbjørnsen, H (2022). Do honesty-nudges really work? A large-scale field experiment in an insurance context. *Journal of Consumer Behaviour, 21*(4), 927–951. https://doi.org/10.1002/cb.2049

Mello, S. (2018). *Speed Trap or Poverty Trap? Fines, Fees, and Financial Wellbeing*. https://mello.github.io/files/jmp.pdf.

Mertens, S., Herberz, M., Hahnel, U. J. J., & Brosch, T. (2022). The effectiveness of nudging: A meta-analysis of choice architecture interventions across behavioral domains. *Proceedings of the National Academy of Sciences, 119*(1), 1–10. https://doi.org/10.1073/pnas.2107346118

Migchelbrink, K., & Raymaekers, P. (2022). Public managers' trust in citizens and their preferences for behavioral policy instruments: Evidence from a mixed-methods study. *Behavioural Public Policy*, 1–24. https://doi.org/10.1017/bpp.2022.21

Migchelbrink, K., & Raymaekers, P. (2023). *Nudging people to pay their parking fines on time. Retrieved fromosf.io/7qab2*. Open Science Foundation. osf.io/7qab2.

Moerbeek, M. (2006). Cluster Randomized Trials: Design and Analysis. In H. Pham (Ed.), *Springer handbook of engineering statistics* (pp. 705–718). London: Springer. https://doi.org/10.1007/978-1-84628-288-1_39.

Moynihan, D. (2018). A great schism approaching? Towards a micro and macro public administration. *Journal of Behavioral Public Administration, 1*(1). https://doi.org/10.30636/jbpa.11.15

Nussim, J., & Tabbach, A. D. (2009). Deterrence and avoidance. *International Review of Law and Economics, 29*(4), 314–323. https://doi.org/10.1016/j.irle.2009.05.001

OECD. (2021). *Behavioural Insights for Better Tax Administration: A Brief Guide.https://doi.org/10.1787/a6f731d0-en*.

Osman, M., McLachlan, S., Fenton, N., Neil, M., Löfstedt, R., & Meder, B. (2020). Learning from behavioural changes that fail. *Trends in Cognitive Sciences, 24*(12), 969–980. https://doi.org/10.1016/j.tics.2020.09.009

Piehl, A. M., & Williams, G. (2010). Institutional requirements for effective imposition of fines. In P. J. Cook, J. Ludwig, & J. McCrary (Eds.), *Controlling crime: Strategies and tradeoffs* (pp. 95–121). University of Chicago Press.

Podsakoff, P. M., & Podsakoff, N. P. (2019). Experimental designs in management and leadership research: Strengths, limitations, and recommendations for improving publishability. *Leadership Quarterly, 30*(1), 11–33. https://doi.org/10.1016/j.leaqua.2018.11.002

R Core Team. (2020). *R: A language and environment for statistical computing (4.0.2)*. R Foundation for Statistical Computing. https://www.r-project.org/.

Raudenbush, S. W. (1997). Statistical analysis and optimal design for cluster randomized trials. *Psychological Methods, 2*(2), 173–185. https://doi.org/10.1037/1082-989X.2.2.173

Raymaekers, P., Fobé, E., Lerusse, A., Dhondt, S., & Brans, M. (2023). Driven by head or heart? Testing the effect of rational and emotional anti-speeding messages on self-reported speeding intentions. *Transportation Research Interdisciplinary Perspectives, 17*. https://doi.org/10.1016/j.trip.2022.100726

Schram, F., & Lievens, J. (2015). *Gemeentelijke administratieve sancties: Een antwoord op overlast?* Vanden Broele.

Silva, A., & John, P. (2017). Social norms don't always work: An experiment to encourage more efficient fees collection for students. *PloS one, 12*(5), Article e0177354. https://doi.org/10.1371/journal.pone.0177354

Slemrod, J. (2019). Tax compliance and enforcement. *Journal of Economic Literature, 57*(4), 904–954.

Slemrod, J., Blumenthal, M., & Christian, C. (2001). Taxpayer response to an increased probability of audit: Evidence from a controlled experiment in Minnesota. *Journal of Public Economics, 79*(3), 455–483. https://doi.org/10.1016/S0047-2727(99)00107-3

Slemrod, J., & Weber, C. (2012). Evidence of the invisible: Toward a credibility revolution in the empirical analysis of tax evasion and the informal economy. *International Tax and Public Finance, 19*(1), 25–53. https://doi.org/10.1007/s10797-011-9181-0

Su, M. (2020). Taxation by citation? Exploring local governments' revenue motive for traffic fines. *Public Administration Review, 80*(1), 36–45. https://doi.org/10.1111/puar.13125

Szabó, A., & Ujhelyi, G. (2015). Reducing nonpayment for public utilities: Experimental evidence from South Africa. *Journal of Development Economics, 117*, 20–31. https://doi.org/10.1016/j.jdeveco.2015.06.002

Szaszi, B., Higney, A., Charlton, A., Gelman, A., Ziano, I., Aczel, B., et al. (2022). No reason to expect large and consistent effects of nudge interventions. *PsyArXiv, 119*(31), 2022. https://psyarxiv.com/mwhf3/.

Szaszi, B., Palinkas, A., Palfi, B., Szollosi, A., & Aczel, B. (2018). A systematic scoping review of the choice architecture movement: Toward understanding when and why nudges work. *Journal of Behavioral Decision Making, 31*(3), 355–366. https://doi.org/10.1002/bdm.2035

Thaler, R. H., & Sunstein, C. R. (2008). *Nudge: Improving decisions about health, wealth, and happiness*. Yale University Press.

Tummers, L. (2019). Public policy and behavior change. *Public Administration Review, 79*(6), 925–930. https://doi.org/10.1111/puar.13109

Tyler, T. R. (2006a). Psychological perspectives on legitimacy and legitimation. *Annual Review of Psychology, 57*(1), 375–400. https://doi.org/10.1146/annurev.psych.57.102904.190038

Tyler, T. R. (2006b). *Why people obey the law*. Princeton University Press.

Vainre, M., Aaben, L., Paulus, A., Koppel, H., Tammsaar, H., Telve, K., et al. (2020). Nudging towards tax compliance: A fieldwork-informed randomised controlled trial. *Journal of Behavioral Public Administration, 3*(1), 1–10. https://doi.org/10.30636/jbpa.31.84

Van de Walle, S. (2017). The experimental turn in public management: How methodological preferences drive substantive choices. In O. James, S. R. Jilke, & G. G. Van Ryzin (Eds.), *Experiments in public management research* (pp. 461–475). Cambridge University Press. https://doi.org/10.1017/9781316676912.023.

Van Ryzin, G. G. (2021). Nudging and muddling through. *Perspectives on Public Management and Governance*, 1–7. https://doi.org/10.1093/ppmgov/gvab021

Walker, R. M., Brewer, G. A., Lee, M. J., Petrovsky, N., & van Witteloostuijn, A. (2019). Best practice recommendations for replicating experiments in public administration. *Journal of Public Administration Research and Theory, 29*(4), 609–626. https://doi.org/10.1093/jopart/muy047

Zarcadoolas, C. (2011). The simplicity complex: Exploring simplified health messages in a complex world. *Health Promotion International, 26*(3), 338–350. https://doi.org/10.1093/heapro/daq075

Raymaekers, P., Fobé, E., Migchelbrink, K., Lerusse, A., & Brans, M. (2021). Nudging in actie. Beleidsexperimenten ontwerpen op basis van gedragsinzichten. https://5d674347-9091-4aa6-9911-2b5c73cc9448.filesusr.com/ugd/b8884e_6a28b9a01d984f0d96e36572bc921f48.pdf.