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APPLICATION OF BEHAVIORAL SCIENCE AND NUDGING IN PUBLIC AREAS: A FIELD STUDY ON THE REDUCTION OF VANDALISM IN ELEVATORS

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Abstract

The purpose of this study was to find out whether a reduction of vandalism in elevators can be achieved by applying visual stimuli as part of a nudging approach. In the course of an experimental field study, three different nudging concepts as well as a control group were observed in 120 social housing elevators in Lisbon. The study then assessed whether and to what degree the occurrence of vandalism in these elevators had changed at two different temporal measurement points. The results do not indicate a significant reduction of vandalism as a result of the nudges. However, it can be concluded that visual stimuli nudges should be developed according to the situation and the target group as well as validated in the course of a long-term field study. Nevertheless, the findings of this study once again demonstrate that nudges indeed represent a promising and cost-effective alternative to hard regulations in combating vandalism in public areas.

Keywords *Consumer Behavior, Behavioral Science, Nudging, Decision-Making, Public Policy, Vandalism, Visual Stimuli*

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1 Introduction

The concept of nudging has become more publicly relevant, especially in recent years and after the publication of Thaler and Sunstein's bestseller Nudge (2009). Ever since, it has been a much-discussed issue in both economics, the private and public sector, academia, and politics. This is illustrated not least by the award of the Nobel Prizes in Economics for Thaler in 2017 (Appelbaum, 2017) or for Banerjee and Duflo in 2019 (Patel, 2020). Unlike regulatory instruments, nudging distinguishes itself by aiming at a steering effect without limiting or eliminating the choices of consumers or citizens from the outset. Nudging as an approach rejects the concept of "homo oeconomicus" and instead holds the premise of people not always acting in a rationally utility-maximizing way and experiencing cognitive biases (Ghisellini & Chang, 2018; Sunstein & Reisch, 2014, p. 334).

In recent years, nudging has slowly evolved from a marketing concept to an approach also used in public policy (Codagnone, Bogliacino, Veltri, Lupiáñez-Villanueva, & Gaskell, 2014). Within this, it can potentially replace expensive and hard governmental or institutional regulations. However, especially in regard to the application of nudging in the public sphere, research is still in its beginning. In this context, one very present and recurring issue in public areas is vandalism. From damage to public restrooms or elevators, graffiti on walls, litter, and theft - the restoration as well as the prevention of vandalism, for example with video surveillance, tends to be complex and expensive (Chalfant, 1992). In particular, vandalism in elevators is a troublesome issue for many social housing operators. For this reason, the emerging question arises whether nudging can be used to achieve a more cost-effective and efficient reduction in vandalism behavior as this represents the primary cause of most elevator breakdowns in low-cost housing (Au-Yong, Azmi, & Mahassan, 2018; Ibn Brahim, 2021). A behavioral approach to this matter is also reflected by

numerous studies indicating that vandalism is strongly conditioned by emotional and especially environmental factors (Goldstein, 1996; Liu, Wu, & Che, 2019). Seeing the relevance of this topic as well as the lack of academic studies in its regard so far, the research question of this paper is: *Can a behavioral intervention in form of visual stimuli result in a reduction of vandalism in elevators?* The nudges in form of three different visual stimuli are based on concepts of individuals' subconsciousness, morals and values, and biological need to take care of the weakest. In an experimental field study setting, the nudges have been installed in 120 social housing elevators in Lisbon. As part of a long-term study over several months, this paper analyzes and interprets the initial data after two months of installing the nudges and the implications on vandalism behavior, thereby contributing to the existing literature. The present document begins with a literature review in which existing knowledge will be presented, followed by a methodology section, results, and a discussion. This research will conclude with a section in which theoretical and practical implications will be addressed, as well as limitations and suggestions for future research.

2 Literature Review

2.1 Introduction to Behavior-Based Regulation and the Nudging Approach

Following the publications of Daniel Kahneman (2011), Richard Thaler (2015) and Cass Sunstein (2011), research on behavioral economics and behavior-based regulation has been gaining increasing global popularity. As a result, many international organizations and national governments have now established dedicated nudge units to tackle this topic in the course of policymaking and consumer affairs (Dolan, Hallsworth, Halpern, King, & Vlaev, 2010; Yeung, 2012). Two popular nudges are, for example, the reduction of the plate size in hotel restaurants to reduce food waste (Kallbekken & Sælen, 2013) or the default choice for organ donation as opt-out policy (Johnson & Goldstein, 2003). The key point and attraction of behavior-based regulation stems particularly from the fact that it neither restricts the freedom of the individual nor imposes

any prohibitions or regulations on behavior (Thaler & Sunstein, 2009). Instead, gentle "pokes" - so-called nudges - are built into the physical, social, and psychological decision-making context to encourage certain behaviors (Thaler & Sunstein, 2009). In this context, nudging builds on the empirically documented fact that human behavior is not always rational based (Stanovich, 2011) but instead, subject to heuristics and biases. In this way, "supposedly irrelevant factors" (SIFs) (Thaler R. H., 2015) systematically influence cognitive decision-making processes. The premise respectively indispensable condition of nudging is that other behavioral options than the one advocated by the nudge must still be available. This means that no social, financial, or other costs ("opt-out"-costs) may be incurred (Thaler & Sunstein, 2009). Thereby, the most common definition of nudging that is based on the research of Thaler and Sunstein (2009) states:

> A nudge, as we will use the term, is any aspect of the choice architecture [i.e., the context in which people make decisions] that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives. To count as a mere nudge, the intervention must be easy and cheap to avoid. (p. 6)

This also implies that nudging as an approach is highly context-specific and varies accordingly by objective, target group and situational framework (Purnhagen & Reisch, 2015). Consequently, so far there are no valid universal models and methods that are applicable to all situations. Nevertheless, designing, testing, and implementing nudging systematically is both possible and useful.

Table 1: Quality criteria of good architecture of choice

Method	Assessment of effectiveness
- Thorough methodical analysis as the foundation	- Effectiveness ex ante and ex post

- Systematically empirical and case-specific - Cost-benefit analysis; controlled experiments; long-term studies etc. - "Adoptive" monitoring (test - learn - adapt)	- Comparison (if necessary, in combination) with other regulatory instruments - Side effects on other stakeholders
Objectives	**Procedure**
- Target group specific - Welfare enhancement (external and internal effects)	- Transparent and accessible to public evaluation - Taking into account institutional, cultural, and social norms and values - Complementary on a selective basis, not substitutional per se

Source: Adapted from Purnhagen & Reisch (2015)

2.2 Types and Concepts of Nudging

2.2.1 Core Tendencies of Human Behavior and Ten Important Nudges

In the essay "Empirically Informed Regulation", Cass Sunstein (2011) characterizes four core tendencies of human behavior. In general, those can be classified as biases as well as heuristics and (social) influences that strongly affect human decision-making. Cass Sunstein (2011) describes them as (1) inertia and procrastination, (2) framing and presentation, (3) social influences and (4) difficulties in assessing probability.

(1) Inertia and Procrastination: Although long-term benefits may be large and the costs of changing may be small, people tend to maintain the status quo of their behavior or decision. This effect resonates especially with default nudges (Dolan et al., 2010). Moreover, people have a tendency of not weighing short term net costs of decisions rationally against long term net benefits. Consequently, decisions are prone to be delayed (procrastination), future is discounted hyperbolically (present bias), leading to systematically myopic decisions.

(2) Framing and Presentation: Framing stands for the psychological phenomenon whereby differing phrasings of information influence the recipient's behavior - despite the actual content being the same (Tversky & Kahneman, 2000). In this way and according to the prospect theory (Kahneman & Tversky, 1979), a decision is influenced, for example, if communication indicates profits (profit frame) or the avoidance of losses (loss aversion). Furthermore, information that contrasts with other stimuli is more likely to be recognized (salience). Addressing this bias, simplicity and comprehensibility of information are more likely to induce certain behaviors (Dolan et al., 2010).

(3) Social Influences: The perceived behavior of other people can have a profound influence on individual decisions and behaviors (Kahneman, 2011). The areas of individual lifestyle, health and risk behavior are particularly affected here. Behavior and attitudes of others can even trigger informational cascades (Surowiecki, 2004). Additionally, the concern for one's own reputation is intricately linked to social norms here. However, social influences can also affect the willingness to cooperate. In addition to the phenomenon of reciprocity, this can lead to cooperation and collective problem-solving behavior. Besides that, cooperation can also result from assumptions about other people’s cooperation and the potential punishment of people who fail to cooperate (Kelley & Stahelski, 1970).

(4) Difficulties in Assessing Probabilities: Often based on emotions and the availability and recency of certain information (availability bias) (Tversky & Kahneman, 1982), people tend to have difficulties with assessing probabilities which may lead to inaccurate judgments (Dolan et al., 2010). Moreover, there is a bias to weigh good news bigger than bad news as well as giving special weight to information that confirms their antecedent beliefs (confirmation bias) (Karlsson, Loewenstein, & Seppi, 2009).

Based on the before mentioned core empirically proven tendencies of human behavior, an overview of ten important nudges can be drawn (Appendix 1).

2.2.2 Type 1 and Type 2 Nudges

In accordance with the theory of Nobel Prize winner Daniel Kahneman (2011), human thinking and decision-making can be grouped into two mental "systems". In this context, System 1 decisions represent the intuitive, habitual, and affectively controlled ones. By deduction, System 1 decisions are more or less automatized and occur at high speed, therefore deliberation and reflection are not inherent in these decisions. In contrast, System 2 decisions involve reflection and conscious cognitive control (Bruns, Kantorowicz-Reznichenko, Klement, Jonsson, & Rahali, 2018). Consequently, information processing and decision making require more effort compared to System 1. The activation of one of the systems predominantly depends on the respective individual, the task and the situation (Kahneman, 2011).

Grounded by these findings of Kahneman (2011) and those of Thaler and Sunstein (2003), a link has been established by Hansen and Jespersen (2013), distinguishing between two types of nudges. "Type 1 Nudges" address the automated behavior of the individual without intending to elicit conscious reflection on thinking and behavior. In contrast, "Type 2 Nudges" are more focused on conscious and reflected decision making and require increased attention. In addition to this, Hansen and Jespersen (2013) distinguish the degree of transparency of nudges (Appendix 2). While transparent nudges are visually or cognitively clear, non-transparent nudges are not immediately recognizable, for example, in the case of different framing of information.

2.3 Nudging and Vandalism

Alongside the typical approach of using nudges in, for example, commercial marketing, the above-mentioned concepts can also be relevant to the public sector and environmental psychology. Be it the reduction of car accidents, Covid-19 measures, organ donation or tackling vandalism and

crime (Enghofer, 2021). Especially the last topic – tackling vandalism and crime – has been intensively discussed in behavioral science and in regard to the use of nudging.

The phenomenon respectively the act of vandalism has various definitions, depending on which aspects are included and from which perspective and field of expertise it is defined (Cohen S. , 1984; Herrmann, 2014; Yavuz & Kuloğlu, 2010). The criminologist John E. Conklin proposed the following definition of vandalism: Vandalism defines as “the destruction, damage, degradation of shape or appearance of a property without the permission of its owner” (Conklin, 1989, p. 110). A common online language dictionary defines vandalism as follows "willful or malicious destruction or defacement of public or private property" (Merriam-Webster, 2021). Historically, vandalism as such has existed for thousands of years (Merrills, 2009). In itself, it is therefore not a new phenomenon that has only been occurring in recent decades. The ways and means of vandalism have changed over time, but some distinct patterns can be identified. As studies show, vandalism does not occur everywhere, and when it does, it is usually an individual or group based temporary pointed act of destruction (van Vliet, 1992). This indicates the linkage of vandalism to external and internal factors that motivate those actions. Willem van Vliet (1992, p. 32) proposes that vandalism is an "[...] intermittent behavioral and environmental outcome that can be seen as a function of some set of independent and interacting variables". As mentioned before, the individual motivation for damaging, defacing, or destroying third party objects can be rooted in different causes (Coxon & Napper, 2021). For instance, it has been argued that young individuals may see vandalism and criminal behavior as a way of impressing and appealing to their peers (Omogho Esiri, 2016). This observation is partly supported by the fact that vandalistic behavior often occurs when two or more people are together (Omogho Esiri, 2016). While social factors such as peer pressure can be a motivating factor, so can emotional ones. Drawing on several academic studies, it was found that vandalism can often be caused by negative emotions such as anger, boredom, frustration, or

revenge (Lévy-Leboyer, 1984). Yet, playfulness or creativity - specifically in the case of graffiti - are also considered as motivators (Cohen S. , 1984; Gürth, 2014). The prevention of vandalism thus requires the analysis of contextual factors so that interventions, such as nudging, can be applied to mitigate or deflect those triggers. This procedure to reduce vandalism finds support in a number of studies, according to which even minor changes in the environment and decision-making architecture can have significant effects. For instance, it only takes one visibly broken window in a neighborhood to increase the likelihood of further windows being broken by people (Liu, Wu, & Che, 2019). Following an experiment by the well-known psychologist Zimbardo (1969), Wilson and Kelling (1982) developed the Broken Windows approach and applied the results of the previous findings to the issue of decay in urban environments. According to them, urban decay and neglect are triggers respectively promoters of vandalism and criminal activity. However, there are also some critical voices (Laue, 1999; Sampson & Raudenbush, 1999) that query the representativeness and causality of Zimbardo's results and derivations by Wilson and Kelling (1982). Nevertheless, other studies indeed show that the frequency of robberies in the subway decreases significantly if the graffiti on trains and walls is removed (Kelling & Coles, 1996; Moser, 2015).

In order to counter vandalism without binding regulations and at the same time in a cost-effective way, nudging concepts have repeatedly demonstrated their effectiveness in recent years. For example, the Watching Eye effect is a visual nudge that addresses people's subconscious by stimulating rapid and unconscious cognitive processing and cueing increased prosocial behavior (Dear, Dutton, & Fox, 2019). The Watching Eyes effect and its psychological rationale have been investigated in numerous studies scenarios in the past. According to Conty, George & Hietanen (2016), the effect stems from a subconscious behavioral reaction in which the individual's self-awareness is stimulated and a prosocial or reputation-conforming behavioral adjustment is induced.

Based on research and results from experimental settings, the Watching Eye effect respectively eye cues are often used in public policy and public places in the United Kingdom and Scandinavia to reduce crime and vandalism (Dear et al., 2019).

The topic of vandalism, especially in social housing elevators, is yet another relevant issue. For this reason, the research question arose whether visual nudges, such as the Watching Eye effect, could be used to reduce incidents of vandalism. In addition to the Watching Eye effect, two other nudges were designed - one with a hero image addressing morals and values of the recipient, and a gazing puppy image based on the childhood respectively baby schema - and installed in a total of 120 social housing elevators in Lisbon. Based upon this, hypothesis 1 of this research paper is the following:

H1: Watching Eyes visual stimuli are effective in reducing vandalism in elevators.

To address concepts of values and morals, the visual nudge of the hero is based, notably, on the findings of Kinsella, Ritchie and Igou (2015). It was found in studies that the confrontation with heroes stimulates positive emotions such as gratitude, admiration and awe while promoting motivation towards becoming a better person by raising awareness of the ideal self (Ibn Brahim, 2021). In this way, heroes can promote motivation to behave prosocially and morally right (Van Tongeren et al., 2018). Above all, as explained before, an individual's negative emotions serve as motivators for destructive behavior. Hence, supporting or triggering positive attitudes might influence the behavior in the elevator and reduce acts of vandalism. Therefore, hypothesis 2 is developed as:

H2: Hero visual stimuli are effective in reducing vandalism in elevators.

The third nudging concept of the gazing puppy builds on the psychological effect of the childhood schema or "cute response effect" (Ibn Brahim, 2021). According to this, facial characteristics such as large eyes and a large head activate both caretaking behavior, aggression

reduction, and affirmative emotional control of behavior (Borgi, Cogliati-Dezza, Brelsford, Meints, & Cirulli, 2014). In this regard, researchers report that the prosocial hormone oxytocin is emitted as part of the cute response mechanism (Luo et al., 2015; Nagasawa, Kikusui, Onaka, & Ohta, 2009). According to further studies, the cute response mechanism does not only occur at the encounter with human babies, but also with animals, as the encoding process of the cuteness mechanism is the same for human and non-human faces (Borgi et al., 2014; Ibn Brahim, 2021). In this context, stimulating positive emotions and thereby reducing those of anger or revenge plays a role within this nudge as well. Following these findings, the visual stimuli of the gazing puppy which aims to trigger the individual's biological need to take care of the weakest was developed. Hypothesis 3 therefore reads as follows:

H3: Gazing Puppy visual stimuli are effective in reducing vandalism in elevators.

Additionally, the graphical concepts of the nudges developed also base on the previously illustrated nudging mechanisms mentioned in the chapters before and in Appendix 1. Apart from the use of social norms and influence and framing (Tversky & Kahneman, 2000), there are also aspects of warnings, graphics and reminders as well as informing people of the nature and consequences of their own past choices. Addressing sociopsychological aspects respectively social norms through especially the Watching Eye and Hero stimuli are of high relevance, as vandalistic behavior often occurs in groups of two or more people, as described before.

In addition, all three nudges are of course classifiable in terms of types and transparency. As such, they all fall along the lines of transparent nudges as they can be visually and cognitively conceived. Thereby, concerns regarding a manipulation of the recipients as well as a general controversy about moral legitimacy can be dispelled. However, whether these nudging concepts respectively visual stimuli explicitly address System 1 or 2 tend to depend on the recipient. For instance, they appeal to heuristics such as the childhood schema or subconscious social

observation, and therefore involve System 1 (Bruns et al., 2018; Hansen & Jespersen, 2013). On the other hand, the hero image can also be used to encourage active reflection on one's own behavior and, for example, littering on the floor.

3 Method

This study aims to experimentally investigate the effects of three different visual nudges on the prevalence of vandalism in social housing elevators. Each of the three different nudges - Watching Eyes (Appendix 3), Hero (Appendix 4) and Gazing Puppy (Appendix 5) - was developed in the form of pictures with accompanying short text. Thus, three experimental groups and one control group were set up. For each nudge respectively experimental group, in cooperation with the municipality company "Gebalis", the visuals were installed in 30 elevators in social housing complexes in the Lisbon metropolitan area. In an additional 30 elevators, no nudge was applied - these constitute the control group. Consequently, a total of 120 elevators in social housing complexes in the greater Lisbon area were included in the study.

The overall mission of Gebalis is to "rehabilitate and maintain the existing public housing units, mitigate segregation and community development" (Gebalis, 2021). There are currently around 61,400 residents in the 3,261 buildings in the municipality of Lisbon (Gebalis, 2021). Due to this high number of buildings and consequently elevators, as well as the aforementioned mission statement, the issue of reducing elevator vandalism is relevant to "Gebalis" from both a social and infrastructural perspective, constituting the ground of this cooperation.

The first data collection as a pretest was carried out before the application of the nudges. After eight weeks of applying the nudges, it was examined and documented whether and which vandalism incidents occurred in those 120 elevators. On the basis of this dataset, different methods have been applied in the form of quantitative data analysis. The main focus, according to the research question, was certainly on the analysis of the dependent variable of the degree of

vandalism and the independent variable of the nudge groups. However, an explorative approach concerning covariates and other dependencies of variables was kept throughout the study.

3.1 Sample, Procedure und Measurement

A total of 120 elevators in social housing complexes located in the Lisbon area have been selected for the study. In a total of 90 of these elevators, one of the three visual nudges was installed in a clearly visible position. In another thirty, no visual nudge was installed so that they served as a control group. The experimental data collection was conducted twice – the pretest (n = 120) and the actual experiment (n = 120). The first data collection represented the pretest. This is considered a quality procedure for the research instrument and the entire research design (Weichbold, 2014). It was conducted before the main data collection in order to also test the reliability of the experiment. Seeing this, a total of n = 240 observations was obtained. The observations are evenly distributed across the four groups, a control condition (no visual cue) and three treatments (treatment 1: Watching Eyes, treatment 2: Hero, treatment 3: Gazing Puppy).

Consequently, for each group, 60 observations have been collected (n per condition = 60) overall. Given the hypothesis to examine the effect of nudge interventions on the level of vandalism, the method of between subject design proved to be the most appropriate.

3.2 Verification of quality criteria

In order to ensure that the conclusions derived from the study are valid, empirical studies are subject to quality and validity criteria (Breakwell, 2006). In consideration of developing the architecture of choice (Purnhagen & Reisch, 2015) and the nudge approach as soundly and profoundly as possible, the present study complies with the criteria explained in Illustration No. 1. As such, methodological and case specific preliminary work and prior elicitation has been undertaken. Moreover, this research will also be executed as a prospective long-term study. Thus, an adaptive study design may be ensured in the long term. The assessment of effectiveness resides

both in the course of the literature review as well as the discussion of (mainly regulatory) instruments to prevent vandalism within Ibn Brahim's (2021) paper. Effectiveness ex ante and ex post is particularly ensured by the pre and posttest analysis. Furthermore, by restricting the analysis to social housing complexes in the Lisbon metropolitan area, target group specificity and welfare enhancement, also seeing the municipality company Gebalis as cooperating stakeholder, is given. In the section of the discussion of results as well as the limitations, procedural criterion is thoroughly addressed and discussed, which is why the quality is given here as well.

Since the evaluation of the intervention measure (nudges) takes place under field conditions and is based on already operating elevators, a comprehensive randomization may not be given. This is due to the fact that possible confounding variables, such as those resulting from the geographic location of the elevators, cannot be distributed equally or randomly. Based on this, this study is in the methodological field of the quasi-experiment (Morling, 2021). As these conditions may affect the internal validity (Cook & Campbell, 1986) - i.e., how unambiguous the causal interpretation of the results is in terms of content - replications, for example, are all the more important to secure the resulting causal interrelations. As a result of the above-mentioned context, it can be stated that the concept of local molar causal validity, which was specified by Campbell (1986), prevails here. According to Shadish, Cook and Campbell (2002), this concept includes the following understanding of internal validity:

> Understood as local molar causal validity, internal validity is about whether a complex and inevitably multivariate treatment package caused a difference in some variable-as-it-was-measured within the particular setting, time frames, and kinds of units that were sampled in a study. (p. 54)

Nevertheless, a high level of external validity can be assumed due to the implementation under real-life conditions, in the form of a field experiment, and not under laboratory conditions. Thus,

the overall applicability of the results of the study (Breakwell, 2006) is highly probable, certainly in social housing complexes in the Lisbon metropolitan area.

4 Results

Subsequent to the data collection in the field phase, multiple quantitative analysis methods using IBM SPSS have been applied in order to validate the hypotheses. Firstly, the dependent variable of the degree of vandalism and the independent variable of the nudges (Watching Eyes, Hero, Gazing Puppy) have been tested in the course of a univariate analysis. The subsequent sections examined which further dependencies exist between and among the ascertained variables. This was investigated particularly through AN(C)OVAs, chi-square analyses and multiple linear regression. Furthermore, the relationship between the pretest data and the posttest data was examined.

4.1 Differences in Vandalism between the Visual Stimuli Nudge Concepts

A one-way between groups ANOVA was conducted in order to assess the effects of the different nudging groups (+ the control group) on the degree of vandalism. Nudging was divided into one of three categories plus the control group: Control group (M = 1.07, SD = 2.45), Watching Eyes (M = 1.87, SD = 2.96), Gazing Puppy (M = 2.13, SD = 3.54), to Hero (M = 2.00, SD = 4.07). According to the inspection of the boxplot there were outliers and data was not normally distributed (Shapiro-Wilk test with α = .05). Homogeneity of variances was asserted using Levene's test based upon the median which showed that equal variances could be assumed (p = .598). Even though two assumptions for a one-way ANOVA were violated, the analysis is still feasible. This is because the one-factor ANOVA is relatively robust especially to violations of the normal distribution assumption (Schmider, Ziegler, Danay, Beyer, & Bühner, 2010; Blanca, Alarcón, Arnau, Bono, & Bendayan, 2017). Seeing the results, the degree of vandalism does not differ statistically for the different groups of nudges (+ the control group) (F(3, 116) = .629, p = .598 > .05, n^2 = .016).

Additionally, Turkey post-hoc analysis revealed no significant difference ($p < .001$) between the groups.

Analyzing whether the application of any nudge in comparison to the control group (independent variable with two categories) has an impact on the degree of vandalism (dependent variable), a one-way ANOVA showed that there is no significant difference ($F(1, 118) = 1.818$, $p = .180 > .05$).

4.2 Differences in Vandalism Pre- and Posttest Analysis

In the following, a pretest/posttest design analysis was carried out. In this way, the variation in the degree of vandalism from pre to post was analyzed between the different groups (nudges). For this purpose, a mixed ANOVA was calculated. As such, the metric parameter (degree of vandalism) on two measurement time points (pre- and post-measurement) was used as a repeated-measures factor (within-subject factor) while the nudge group was used as the between-subjects factor. There was no statistically significant interaction between pre- and post-measurement and nudge group ($F(3, 116) = 1.749$, $p = .161$). However, there was a significant main effect for pre- and post-measurement ($F(1, 116) = 44.115$, $p < .001$). There was no significant main effect for nudge group, meaning that nudge groups did not differ significantly with $F(3, 116) = 1.215$, $p = .307$).

Another mixed ANOVA was run, having the metric parameter (degree of vandalism) again on two measurement time points (pre- and post-measurement as a repeated-measures factor (within-subject factor)). Contrary to the first mentioned mixed ANOVA, this time, a transformed variable with two categories (nudge application and control group) was used as the between-subjects factor. However, no statistically significant interaction between pre- and post-measurement and the application of any nudge in comparison to the control group (Greenhouse-Geisser $F(1, 118) = 2.882$, $p = .092$) was found here as well.

4.3 Differences in Vandalism between Neighborhoods

To determine if the neighborhood has an impact on the occurrence and the degree of vandalism a one-way ANCOVA was performed. Means adjusted for nudge group showed the highest degree of vandalism in the neighborhoods of Bela Vista (M = 12.63, SD = 2.41) and Alfinetes (M = 8.92, SD = 1.48). The degree of vandalism was lowest in the neighborhoods of Vale de Alcantara (M = -.87, SD = 1.88) and Oriente (M = 2.60, SD = 2.77).

Table 3: Descriptive statistics of a one-way ANCOVA on differences in the degree of vandalism between neighborhoods with nudge groups as covariate

		Unadjusted		Adjusted	
	N	*M*	*SD*	*M*	*SD*
Alfinetes	21	8.86	6.48	8.92	1.48
Alta de Lisboa	29	6.59	5.77	6.44	1.29
Bela Vista	8	12.75	10.00	12.63	2.41
Boavista	10	1.60	5.68	7.60	2.14
Horta Nova	21	8.71	6.34	8.78	1.48
Olaias	7	7.86	9.75	8.00	2.58
Oriente	6	8.00	7.51	2.60	2.77
Padre Cruz	5	13.40	9.29	7.52	3.04
Vale de Alcantara	13	2.85	4.96	-.87	1.88

After adjusting for nudge group as covariate, the one-way ANCOVA indicated that the degree of vandalism differed statistically significant for the different neighborhoods with $F(8,110) = 2.085$, $p = .043$, $n^2 = .132$. However, the analysis by Bonferroni-corrected post-hoc tests yielded,

that there was no statistically significant difference between the neighborhoods analyzed with nudge group as covariate (all *p-values* > .05).

4.4 Determinants for the Degree of Vandalism

A multiple linear regression was performed with degree of vandalism as the dependent variable and nudge versus control group, elevator lobby, neighborhood, and operation as predictor variables. The R^2 for the overall model was .018, indicative for a low goodness-of-fit according to Cohen (1988). Nudge versus control group, elevator lobby, neighborhood and operation were not able to statistically significant predict degree of vandalism with $F(4, 217) = 1.009$, $p = .404$.

Table 4: Multiple Linear Regression with Degree of Vandalism as Dependent Variable and Nudge/Control Group, Elevator Lobby, Neighborhood and Operation as Predictors

					Collinearity	
	B	*SE*	*T*	*p*	*Tolerance*	*VIF*
Nudge/Control	.438	.365	1.200	.231	.950	1.053
Lobby	.114	.098	1.164	.246	.951	1.052
Neighborhood	-.054	.066	-.817	.415	.929	1.076
Operation	-.031	.287	-.110	.913	.965	1.036

There were some reported cases in which the attached nudge itself got vandalized. It was thus examined whether a relationship can be found between the vandalized nudges and the nudging concept . There was not a significant association, and the Cohen (1988) effect size appeared to be small ($\chi^2(3) = 3.243$, $p = .356$, $\varphi = 0.164$). A small but not significant tendency towards the Gazing Puppy nudges being more often vandalized in comparison to the other nudging concepts can nevertheless be detected.

4.5 Associations in regard to the Localization of the Vandalism Incident

The following section provides two sets of statistical tests of independence by applying Fisher's Chi-Square Test respectively Fisher's Exact Chi-Square Test (Fisher-Yates Test). It was examined as to what extent the localization of the vandalism incident, as in what type of vandalism incident in the elevator, is independent upon firstly the neighborhood and secondly the vandalism degree.

The chi-square test for association between the vandalism localization and the neighborhood, while having 31 cell frequencies smaller than 5, showed no statistically significant association between the localization of the vandalism incident and the neighborhood with $\chi^2(32) = 34.44$, $p = .352$, $\varphi = 0.206$. The null hypothesis reads that the two variables are independent. Since we do not reach the level of significance ($\alpha = .05$), we do not reject the null hypothesis. Thus, we do not have enough evidence to say that there is a significant relationship between the two variables. Even though the compliance with the cell frequency of more than 5, as one of the conditions of chi-square, is not fulfilled in this case, further analysis is still feasible. However, it should be noted that there may be distortion in the interpretation of the results.

Furthermore, a chi-square test was performed between the vandalism degree and the localization of the vandalism incident. It was found that 19 expected cell frequencies were smaller than 5. There was a statistically significant medium level of association (Cohen J. , 1988) between the degree of vandalism and the localization of the vandalism incident with $\chi^2(24) = 78.76$, $p < .001$, $\varphi = 0.31$, indicating that the degree of vandalism was not equally distributed between the localization of the incident.

5 Discussion

The starting point of this research paper was the growing interest and relevance of the topic of nudging as a use case in the public sphere. The perceived advantages of the nudging approach

are based on the assumption that behavior-based results can be achieved in a cost-effective, efficient, and effective way without a rigid set of rules or restrictions. However, a distinction must be made as to which types and kinds of nudges should be applied, which in turn is largely based on situation and setting. In this context, the question of whether transparent visual nudges can be used to achieve behavioral changes in elevators with regard to vandalism shapes the issue.

The results of this study indicate that based on the given data set, no conclusions about the efficiency of the applied nudges on the incidents of vandalism in elevators can be drawn at this point. As such, this study reveals that none of the applied nudges led to a reduction in the level of vandalism after installation. Not only does this apply when considering the different nudges individually, but it is also the case when comparing the nudges as a whole with the control group. Here, too, no significant conclusions can be drawn about a change in vandalism behavior. These insights coincide with the findings of other studies, which argue against a universal effectiveness of the nudges in use and advocate a rather situation- and target group-specific approach.

Findings show, for instance, that the Baby Scheme, which was used in the course of the Gazing Puppy nudge, causes differences in helping and caretaking behavior between men and women (Golle, Lisibach, Mast, & Lobmaier, 2013). This finding is also accompanied by the findings of other studies indicating that vandalism is more often committed by men than by women (Liu & Lin, 2007; Nordmarker, Hjärthag, Perrin-Wallqvist, & Archer, 2016). Consequently, the low effectiveness - in general and in comparison to the other applied nudge concepts - of the Gazing Puppy nudge can be partially interpreted in the context of these findings.

Moreover, no significant effects on vandalism behavior were found with respect to the Hero nudge, which was supposed to address values and morals. These results can be considered surprising, since this nudge aimed at addressing morals and values of the individual in order to reduce antisocial behavior. This is because previous studies showed that antisocial behavior

strongly correlates with impulsivity, alongside aggressiveness, temperament, extroversion, arousal, and negative affectivity (Luengo, Carrillo-de-la-Peña, Otero, & Romero, 1994; Nordmarker et al., 2016; Widom & Toch, 1999). And that, conversely, vandalism represents one form of antisocial behavior that correlates strongly with impulsivity (Luengo et al., 1994). It is therefore unexpected that this nudge does not seem to have any influence on vandalism behavior either.

Similar findings go along with the Watching Eyes effect. In comparison to the other nudge stimuli, the Watching Eyes stimulus appears to be the most promising in reducing vandalism in elevators, however no significant correlations can be found either. The effectiveness of the Watching Eyes effect and the reasons for it differ between previous studies, leading to the conclusion that the effectiveness of the Watching Eyes effect is highly situational. For example, some studies assume that the feeling of being watched induces people to behave more altruistically, caused by the motivation to gain and maintain a positive social reputation (Bateson, Nettle, & Roberts, 2006; Haley & Fessler, 2005). However, and this is in alignment with the present study, there is evidence that the Watching Eyes effect has no impact on individual impulsivity, which, as mentioned before, is significantly related to antisocial behavior and vandalism (Luengo et al., 1994; Shinohara & Yamamoto, 2018;). Additionally, a study by Baillon, Selim and van Dolder (2013) suggested that the Watching Eyes effect occurs solely when people engage in social interaction rather than personal decision-making tasks.

As the pre- and posttest analysis shows, the degree of vandalism differs significantly between the two temporal measurements. However, the nudge group has not been a decisive factor within this analysis. Additionally, this study indicates that among those neighborhoods in which the nudges were installed, some are more prone to vandalism than others. It may be concluded that in this context, differences might be due to external factors and measurement biases that could not be eliminated to some extent. Aspects such as reduced mobility due to the Covid-19 pandemic,

timing, and measurement-related biases as well as especially demographic and building-specific factors might be relevant here. Considering this, previous studies suggest an architectural and design-oriented way to combat vandalism by, for example, utilizing attention seeking mechanisms on other objects or the imitation and thereby simulation of already destroyed or cracked surfaces as design objects (Allen & Greenberger, 1978; Sokolov, Kukhta, Kornienko, Kondratyeva, & Kukhta, 2016).

Furthermore, this paper concludes that the development and application of nudges should not only consider psychological constructs and effects, which in this case have been the Watching Eyes effect, the Gazing Puppy based on the “baby scheme” and the Hero as enhancement of morals and values. Instead, aspects that are situation and target group specific, such as gender structures or socioeconomics, should also be considered to meet the quality criteria as outlined in Table 1.

5.1 Theoretical and Practical Implications

This study provides insights regarding the implementation of nudges to reduce vandalism in social housing elevators. As such, this study contributes to the advancement of the existing academic literature in the area of nudging in public areas and policy. As a result, it is of interest to social housing corporations, elevator companies, policymakers, and other areas where vandalism represents an issue. This study's applied nudging concepts "Watching Eyes," "Gazing Puppy," and "Hero" have not resulted in sufficient evidence of vandalism reduction. In addition to the aforementioned constraints of these nudging concepts, this may also be due to the limited period of the research. Correspondingly, seeing future research and real-life application it can be concluded that a long-term approach as well as the evaluation of other visual stimuli based on the nudging concepts mentioned in the chapters before and displayed in Appendix 1 should be considered. As a consequence, other visual stimuli could be examined that are based on social norm nudges such as the bandwagon effect. However, it remains possible that certain beforementioned

concepts will indeed be found to significantly reduce vandalism in elevators and thus represent a cost-effective and easy-to-implement method - especially in comparison to expensive surveillance systems. In line with other studies, it is noted accordingly that the application and design of nudges does not follow a universal principle nor is there a "one-size-fits-all" technique. Thus, as described in Table 1, all conditions of testing and the eventual implementation of a nudge need to be validated in order to ensure that the quality criteria for lasting effectiveness and efficiency are met (Purnhagen & Reisch, 2015). However, especially for policymakers and public institutions it is important to keep in mind both the quality criteria according to Table 1 but also the transparency dimensions according to Appendix 2. Otherwise not only the effectiveness but also the (moral) legitimacy within the population might be at stake (Hansen & Jespersen, 2013; Thorun, et al., 2016).

5.2 Limitations and further research

This research paper provides valuable insights into the use of behavioral science concepts in public settings - namely, the use of nudges to reduce vandalism in elevators. Nevertheless, there are some limitations to this paper that need to be considered for further studies.

Firstly, one limitation is that the applied visual nudging concepts shall be validated and explored in a larger sample. In this way, other nudging concepts than the ones used in this study can be considered as well. As such, nudges based on the psychological construct of social proof might also serve to be exploited. Additionally, gamification approaches (Mohammed & Hirai, 2021) based on behavioral science could be examined when it comes to littering in elevators. Summing this limitational aspect up, a more detailed review and validation of the visual nudges in regard to a larger sample and a longer timeframe should definitely be addressed in further studies.

Another limitation lies in the methodology applied. The method itself consists of a quasi-experimental study, in which some confounding factors cannot be fully ruled out. For example, it

is not possible to fully standardize all general conditions or covariates in the elevators, such as the type of social housing complex or the interior design of the elevator. Expanding the sample and collecting data over a longer period of time offers opportunities for future research in this area. The analysis of more in-depth data sources regarding the different social housing complexes can also be the basis of a more robust analysis here. For example, age, income, and gender structures as well as information on the households living there could expand the analysis.

5.3 Conclusion

This study was built around the following research question: *Can a behavioral intervention in the form of visual stimuli result in a reduction of vandalism in elevators?*. Despite the expectations, the results with their analyses did not indicate a significant reduction of vandalism as a result of the applied three visual stimuli respectively nudges. As a result, none of the formulated hypotheses was able to be confirmed in the course of this study. However, an important insight and learning for future nudging applications and studies emerged indicating that there is no one-size-fits-all nudging approach to reduce vandalism. Instead, visual stimuli nudges should be developed and explored in accordance with the underlying situation as well as the target group. Secondly, a comprehensive validation of all applied nudging concepts in the course of a long-term field study is recommended. Despite those rather critical aspects, nudging still represents a promising and cost-effective alternative to hard regulations in combating vandalism in elevators and within public areas in general.

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7 Appendix

Appendix 1: Table displaying ten important nudges

Default Rules	One of the most effective nudges. As long as there is not the urge to choose actively, people tend to stay with the default option and not opt. This is because actively choosing is cognitively burdensome and time-consuming.
Simplification	Complexity can lead to confusion, an increase in costs and thereby discouraging certain behaviors. Information and e.g., programs in public policy should be easy and intuitive to process.
Use of Social Norms	An extremely effective nudge is to underline that other (relevant) people are already engaging in certain behavior. This applies especially if the information is based on a local and specific level for the recipient.
Increase in Ease and Convenience	People have the tendency to make the easy choice. Reducing the barriers (complexity, time etc.) encourages certain behavior.

	Especially if the choice is not just easy but also fun, people are more likely to make it.
Disclosure	Disclosure policies can be highly effective especially in terms of informed choices (system 2 Kahneman). However, this strongly requires comprehensibility and accessibility.
Warnings, Graphic or Otherwise	Human perception is limited, leading to the fact that the graphical design (large fonts, bold letters etc.) can be effective to trigger people's attention.
Precommitment Strategies	The individual precommitment to certain behaviors and actions increases the probability of actually sticking to them and acting according to resulting goals.
Reminders	Retaining certain behavior is often based on inertia, procrastination or time constrains. Small and timely well-placed reminders can have a significant impact in encouraging certain actions and behaviors.
Eliciting Implementation Intentions	The likeliness of engaging in a certain way can be increased by eliciting implementation intentions. A popular example is "Do you plan to vote?".
Informing people of the nature and consequences of their own past choices	Actively informing people about the consequences and nature of their past choices

	and behaviors. Thereby encouraging an individual reflection process and learning from past decisions.

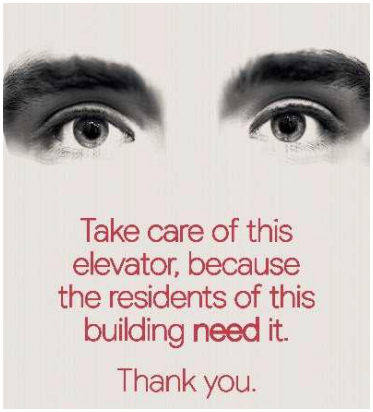
Source: Adapted from Cass Sunstein (2011)

Appendix 2: Nudging by transparency and addressing of cognitive systems

	Transparent	**Non-transparent**
System 2 (Automatic System)	- Transparent simplification of a consistent set of choices - Examples: - Modification of standard settings (e.g., printer, savings plan, pension)	- The manipulation of the set of choices - Examples: - Size of the plate - Default of organ donation - (contradiction solution)
System 1 (Reflective System)	- Visible and apparent attempts to influence behavior - Examples: - Graphical or auditive Warnings - Reminders	- Non-transparent manipulation of behavior - Examples: - Framing - Anchoring

Source: Adapted from Hansen and Jespersen (2013, p.23)

Appendix 3: Eyes Image – Watching Eyes Effect



Appendix 4: Hero Image – Appealing to Morals and Values

Appendix 5: Gazing Puppy Image – Baby Schema („Cute Response Effect“)