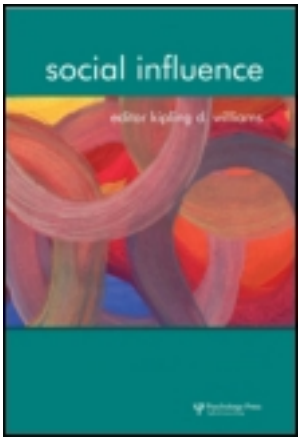

Social Influence
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/psif20

Making less of a mess: Scent exposure as a tool for behavioral change

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Version of record first published: 13 Feb 2012.

To cite this article: Dr. M. A. de Lange , L. W. Debets , K. Ruitenburg & R. W. Holland (2012): Making less of a mess: Scent exposure as a tool for behavioral change, Social Influence, 7:2, 90-97

To link to this article: http://dx.doi.org/10.1080/15534510.2012.659509

SOCIAL INFLUENCE
2012, 7 (2), 90–97

Psychology Press
Taylor & Francis Group

Making less of a mess: Scent exposure as a tool for behavioral change

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Following a cognitive route from olfactory perception to goal-directed behavior, we aimed to influence littering behavior on Dutch trains. In order to achieve this, the scent of a cleaning product was subtly dispersed in train compartments. Compared to passengers in unscented compartments, passengers littered less as measured by the weight and number of items left behind in compartments containing cleaner scent. Apart from extending research on the influence of scent on behavior in a natural environment, the findings suggest that the cognitive route from scents to behavior provides a tool for behavior change in everyday life.

Keywords: Scent; Olfactory perception; Influence; Littering; Applied research.

Scents are powerful triggers of human thought and action. The manner in which scents or olfactory cues influence cognition and behavior can be categorized into at least two types of processes. On the one hand, scents may alter an individual's general mood and subsequent behavior and approach–avoidance tendencies (e.g., Baron, 1997; Bone & Ellen, 1999; Hirsch, 1995; Spangenberg, Crowley, & Henderson, 1996). On the other hand, scents may influence behavior by means of the cognitive activation of associations and goal representations. Recently, Holland and colleagues (Holland, Hendriks & Aarts, 2005) explored such a cognitive route by which scents may

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http://www.psypress.com/socinf http://dx.doi.org/10.1080/15534510.2012.659509

influence our goal-directed actions, based on the empirical evidence within social cognition on priming effects.

From the literature on priming effects we know that we get smarter when we think about professors (Dijksterhuis & van Knippenberg, 1998), we start to help more when primed with the concept of helping (Macrae & Johnson, 1998), and we work harder when an achievement goal is non-consciously activated (Bargh, Gollwitzer, Lee-Chai, Barndollar, & Troetschel, 2001). Due to priming, associations are activated and subsequently activate related motor-representations and goals (see Bargh, Gollwitzer, & Oettingen, 2010; Custers & Aarts, 2010; for an embodied cognition account for these findings see Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005).

Consistent with these previous priming studies, Holland and colleagues (2005) showed that scents influence behavior by means of activating related associations and goals. Their research revealed that participants subtly exposed to the scent of all-purpose cleaner were faster to identify words related to cleaning, listed more cleaning-related activities when making plans for the rest of the day (e.g., doing the dishes; tidying up the room) and showed more cleaning-related behavior (while eating a crumbly biscuit) than control participants. One of the studies showed that exposure to the cleaner scent affected behavior even when the behavior was conducted a couple of minutes later in another non-scented room, suggesting that the goal to clean was activated by the scent and remained activated over time. These findings illustrate that being exposed to cleaner scent is enough to trigger the goal to clean and enhance cleaning-related behaviors, even when participants are not aware of the scent.

Although demonstrating important first evidence for a cognitive route from scents to behavior, these studies remain silent with regard to the applied value of a cognitive process triggered by scents. The studies were conducted in a laboratory setting, which is ideal for understanding basic social cognitive processes as many potentially interfering processes can be controlled for. Furthermore, the potential influence of individual differences in habits and the external influence of norms can easily be reduced in a lab setting. For example, the nature of the behavioral measure was non-habitual (how often do we eat a crumbly biscuit while seated at a spotless white table?) and observed in a relatively anonymous manner (private cubicles). Thus, the setting of these studies was optimized to test the theoretical assumptions, but not to test the implications for everyday behavior.

Questioning the applied value of scents as triggers of behavior and specific goals is by no means trivial. In contrast to many lab settings, everyday behavior is often regulated by a complex interplay of many internal (e.g., habits) and external (e.g., descriptive norms) processes. Therefore it is as yet unclear whether scent cues are strong enough to trigger goals and

goal-directed action in an everyday life setting. In other words, do the insights in scent priming effects on behavior provide tools for behavioral change in applied settings? We aim to answer these questions by conducting a field experiment on the influence of scent on behavior.

THE PRESENT RESEARCH

The current research aimed to demonstrate that exposure to scents can be used as a tool to achieve behavior change. Specifically, we aimed to test whether cleaner scent can trigger cleaning-related behavior in trains of Dutch Railways (NS).

Dutch Railways has the goal of providing customers the opportunity to travel in clean railway cars. Mildly stated, this is not always achieved. Commuters make a mess of the compartments by leaving garbage (e.g., used cups, plastic bags, etc.) on the seats and on the floor. Both passengers and conductors report that this is annoying and occurs regularly (Debets & Ruitenburg, 2010). Apparently many passengers do not travel with the goal in mind of keeping the train compartments clean. Is it possible to subtly cue the cleaning goals in the traveler's mind with the ultimate result that he or she makes less of a mess?

We aimed to test this possibility by measuring the garbage left behind in railway compartments (on seats and on the floor) as a function of scent exposure. A field experiment was designed wherein trash was collected and weighed at the final stops of a train route of 1 hour and 44 minutes, from four train compartments (two control compartments, two scented compartments). Because of the possible effects of external events on the amount of littering, pre-measurements took place in all four compartments 1 week prior to the implementation of the intervention. We expected an interaction effect between time of measurement and type of compartments, such that no differences were expected on the amount of littering during the pre-measure, whereas we predicted less littering during the post-measure in the scented compartments compared to the non-scented control compartments.

METHOD

The train

Dutch Railways allocated a specific train for this research project, which traveled between Amersfoort-Schothorst and Enkhuizen, The Netherlands. Although trains are usually rotated along different railway lines during the day and week, our "experimental" train was allowed to run on the same line for the duration of this research, thereby controlling for any unexpected differences in littering between railway lines and between specific trains.

Design and measurements

The field experiment employed a 2 (Measurement: Pre-measure vs Intervention) × 2 (Scent condition: No scent vs Cleaner scent) design. All trash outside of the garbage bins was collected and weighed at the final stops of the train route between Amersfoort-Schothorst and Enkhuizen, The Netherlands. There were 32 pre-measurements (split evenly between the two types of compartments) and 36 measurements during the intervention period (split evenly between no-scent and cleaner-scent compartments). All measurements were done between 7.00 am and 7.00 pm.

Procedure

In the scented compartments seven small containers containing citrus-scented all-purpose cleaner were hidden from sight in the overhead luggage racks. To enhance the scent intensity 50 milliliters of perfume oil "Capitaine" was added to every liter of cleaner. The intensity of the cleaner scent was checked at the final stops. When necessary, more all-purpose cleaning liquid was added to the containers.

At the two final stops of the train route, two confederates collected all the trash outside of the garbage bins out of the scented and non-scented compartments. The number of trash items was counted and the total amount weighed (in grams) before cleaners employed by the Dutch Railroads emptied the garbage bins of all compartments. The train departed again after the garbage collection.

RESULTS

Before testing the hypothesized effect of cleaner scent on littering, the data were inspected for extreme values. In total four measurements (5.9%) that deviated over three times the interquartile range from the mean weight of collected trash were removed from the dataset. All four outliers were encountered in the non-scented compartments, two during the pre-measure and two during the intervention measure.

The remaining data were subjected to an ANOVA with Measurement (pre-measure vs intervention) and Scent condition (no scent vs cleaner scent) as between-participants factors and weight of collected trash as a dependent variable. There was no general effect of scent condition, $F(1, 60) < 1$, *ns*. However, we did find the predicted interaction between scent condition and time of measurement, $F(1, 60) = 5.59$, $p = .02$, $\eta_p^2 = .09$, see Table 1 for means. More importantly, whereas the compartments did not differ during the pre-measure, $F(1, 60) < 1$, *ns*, there was a significant difference in the

TABLE 1
Littered trash by scent condition and measurement time

	Pre-measure		*Intervention measure*	
	Weight	*Item count*	*Weight*	*Item count*
No-scent compartment	20.3 (15.8)	3.5 (1.9)	35.6 (31.0)	5.1 (2.8)
Cleaner-scent compartment	21.4 (19.5)	3.9 (4.0)	11.7 (14.4)	2.7 (3.0)

Average weight in grams of littered trash and collected number of items during pre-measurements and intervention measurements in scented and unscented train compartments (standard deviations in parentheses).

weight of the collected trash during the intervention measure. In the scented compartment, less trash was left behind than in the no-scent compartment, $F(1, 60) = 10.86$, $p < .01$, $\eta_p^2 = .15$.

As expected, the correlation between the weight of littered trash and the number of trash items was positive, $r = .51$, $p < .01$. The results of analyses on the number of trash items collected in the different conditions thus supported the findings above. Again, no general effect of scent condition was found, $F(1, 60) < 1$, *ns.*, but the interaction between scent condition and time of measurement was significant, $F(1, 60) = 4.42$, $p = .04$, $\eta_p^2 = .07$. Simple effects in these analyses supported our predictions. Whereas no difference in number of trash items was found during the pre-measure, $F(1, 60) < 1$, *ns.*, fewer items were littered in the scented compartment, compared to the no-scent compartment during the intervention measure, $F(1, 60) = 6.79$, $p < .02$, $\eta_p^2 = .10$.

Interestingly, in comparison to the pre-measure, the weight of littered trash increased marginally in the no-scent compartment, $F(1, 60) = 3.92$, $p = .05$, while this was not the case for the scented compartment. Although on average the weight seems to decrease in the scented compartment, this decrease did not reach the conventional level of significance, $F(1, 60) = 1.81$, $p = .18$. The same pattern is apparent in the number of trash items, although these simple effects also do not reach significance, $F(1, 60) = 1.82$, $p = .18$ and $F(1, 60) = 2.62$, $p = .11$ for the no-scent and cleaner-scent conditions respectively.

To summarize, the amount of littering seems to (unexpectedly) increase in the no-scent compartment whereas it remains constant in the scented compartment. More importantly, however, is the interaction between scent condition and time of measurement. There is a significant difference in the predicted direction between the scented and non-scented compartment during the intervention measurement, whereas there was no difference between the compartments during the pre-measure.

DISCUSSION

Our results reveal that, during the intervention period, the amount of littering was significantly reduced in train compartments where cleaner scent was dispersed compared to control compartments. These effects were obtained for the number of littered items as well as for the average weight of the littered garbage. The number of garbage items found in control compartments was almost twice as much as in the scented compartments. The average weight of the littered garbage was even more than three times higher in the control compartments compared to the scented compartments. It thus seems to be possible to change the littering behavior of people in a train environment using a simple and relatively cheap intervention.

As noted above, an unexpected effect of measurement time was encountered in the collected results. The amount of trash littered in the no-scent or control compartments tended to be higher during the intervention measure, compared to the control measure taken 2 weeks earlier. The reason for this increase in littering in the control condition is not fully clear, but we observed two factors that could have contributed to littering in the train compartments. First, between the control and intervention measurement the school holidays began for the region in which the measurements were taking place. Second, the world championship soccer matches were taking place during the intervention measure.

However, since the train compartments did not differ with regards to littering during the pre-measure and were kept constant during all measurement times, we see no reason to suspect any general differences in littering behavior between the types of train compartments used in the current research. Only when scents were diffused in some of the compartments, significantly less littering in these scented compartments compared to the control compartments was observed. Since the only factor that was different for the two types of compartments was the dispersal of scent, the most parsimonious explanation for the interaction between measurement time and compartment seems to be that cleaner scent counteracted the increased littering behavior found in the control compartments.

These findings have many important implications. First, they provide support for the ecological validity of a cognitive, associative route from scents to behavior. Although previous studies suggested that scents powerfully trigger goals and specific behaviors (Holland et al., 2005) as a result of the associations that come to mind when people are confronted with a scent, these studies were conducted in controlled laboratory settings. In contrast, we tested this route from scents on behavior in a natural setting and found similar kinds of effects on behavior. Perhaps even more important, the positive results of our scent manipulation in a field setting

provide support for the idea that the cognitive route of scents to behavior can be used as a tool for behavioral change. Merely dispersing a scent seems to trigger related goals and influence subsequent behavior.

Note that we do not claim that we are the first to test the influence of scents on behavioral change per se. Several studies have reported the effects of dispersing pleasant scents as a tool to enhance people's mood states and subsequent behavior (see, e.g., Baron, 1997; Hirsch, 1995). We cannot fully exclude such an affective explanation for the effect of cleaner scent. However, some tentative support for the cognitive route within the current research comes from a survey study concerning "travel experience" that was performed outside of the measurement period of the research in this paper, but in the same train in both scented and control compartments. This study ($N = 309$) included a measure for the hedonic experience of the smell of the train compartments. No differences were found on this measure between scented and non-scented compartments ($F < 1$). In our view these findings, together with prior evidence on the role of associations in the scent to behavior route (Holland et al., 2005; see also Liljenquist, Zhong & Galinsky, 2010), make a cognitive explanation the most parsimonious explanation of the littering behavior in the scented train compartments.

Our observation that cleaner scent reduces littering in train compartments may have important implications that go beyond its direct effects. For example, the presence or absence of littering may have further consequences on norm violation. If people are confronted with littered train compartments they may feel that norms already have been violated, which may spread to disorder in other behavioral domains. Indeed Keizer, Lindenberg, and Steg (2008) showed that the perception of norm violation (e.g., littering) may subsequently enhance non-social behavior (e.g., stealing). Simple manipulations that reduce littering might thus have more positive implications. We introduced the scent of cleaner as a tool for behavior change in applied settings, but perhaps it might cause people, in more than the literal way, to make less of a mess.

Manuscript received 1 July 2011
Manuscript accepted 9 January 2012
First published online 13 February 2012

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