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Sniffing the mood for cooperation: Personality and odor induced affective states effects

Abstract*: The paper explores situational and dispositional underpinnings of cooperative behavior. According to psychological research, cooperation is strongly related to affective states (Forgas, 1998) and personality dimensions (Volk, Thöni, & Ruigrok, 2011). In an experimental study we examined the conditions under which people cooperate with each other. The dispositional traits of co-workers (personality), the contribution to a collaborative effort, and a situational factor – ambient odor condition were taken into consideration. A one-way ANOVA revealed that compared to a malodorous condition, both the pleasant odor condition and the natural odor condition showed higher rates of cooperation. Further analysis indicated that only malodors influenced affective states which in turn determined social decisions. Although we found effects for the participants' agreeableness and the coworker's contribution to a joint work, they appeared to play a less critical role than affective states induced by the experimental odor conditions tested here.*

Key words*: cooperation, odorants, affective state, personality*

Introduction

If Stuart Mill's (1844) theoretical model treating human as *Homo Oecomonicus* was correct, the word *cooperation* would have had an entirely different meaning than it has today. People would strive only to maximize their own personal benefit at minimum cost, while ignoring the interests of other members of society. However, since it was concluded that this is not true (Ingram, 1888), scientists began to explore this issue, asking questions about the origins of Homo Sapiens' *irrational* cooperative actions. Cooperation was defined as a form of pro-social behavior (Hinde & Groebel, 1991), occurring when a joint action between two or more persons is performed in order to achieve common benefits (Messick & McClintock, 1968). An inherent part of this process is a desire to give support and to share both failures and successes between partners (Engemann, Bzdok, Eickhoff, Vogeley, & Schilbach, 2012). Therefore, the tendency to share goods with others, often verified via economic games, also came to be associated with effective cooperation (Von Neumann & Morgenstern, 1944).

Current research on cooperative behavior focuses mainly on two aspects: the first one analyses situational factors related to pro-social behaviors, and the second verifies its relationship with dispositional traits of coworkers. In our study, we decided to combine both research approaches by exploring the linkages between the tendency to cooperate in dyads and: 1) personality traits of coworkers and 2) the partners' affective state and its relationship with ambient odor condition.

Cooperation and dispositional traits of coworkers (personality)

Examining the relationships between dispositional traits of coworkers and cooperative behavior is often based on the Big-Five model (Costa & McCrae, 1992), which specifies five fundamental personality dimensions: agreeableness, conscientiousness, neuroticism, extraversion, and openness to experience.

In research on cooperation the primary focus is on agreeableness, connected with a high level of altruism,

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trusting others, and focusing on cooperative actions (Zawadzki, Strelau, Szczepaniak, and Śliwińska, 1998). For example, Volk, Thöni, and Ruigrok (2011) demonstrated that high levels of this trait predict cooperative behavior. According to Graziano and Eisenberg (1997) agreeable individuals tend to reject their own benefits in favor of group interests. Indeed, John and Srivastava (1999, p. 121) have defined agreeableness as "a prosocial and communal orientation toward others." This has been confirmed empirically in other studies on cooperation (Pothos, Pery, Corr, Matthew, and Busemeyer, 2011). Thus, it seems crucial to take agreeableness into consideration when analyzing dispositional determinants of cooperative behavior.

Cooperation and affective state of coworkers (mood)

Experiments examining connections between mood and cognition (Forgas, 1998) show that situational, short-term, positive or negative feelings may influence people's expectations, plans, and behaviors. For example, positive mood can provoke helping behavior toward strangers (Isen & Levin, 1972; North, Tarrant, & Hargreaves, 2004). Examining the direct link between affect and cooperation, Forgas (1998) conducted a series of studies in which positive affect significantly increased pro-social behavior and promoted greater openness during the process of negotiations. This pattern was observed in both formal and informal interpersonal interactions. According to Rubin, Kim, and Peretz's (1990) theory, good mood should be associated with an increased availability of optimistic thoughts. By this logic, persons in a negative affective state and with pessimistic thoughts, may tend to underestimate the likelihood of successful cooperation, which in turn can lead to the adoption of competing negotiation strategies (Forgas, 1998). Hence, we address the practical question of whether cooperative behavior might be related to the rate of affective states, produced in our experiment as a result of working in specific ambient odor conditions.

Situational factors related to pro-social behaviors (odors and mood)

There is no doubt that the power of scent stimuli has much in common with affective states and behavioral tendencies (Lehrner, Eckersberger, Walla, Pötsch, & Deecke, 2000; Lehrner, Marwinski, Lehr, Johren, & Deecke, 2005; see also Burnett, Solterbeck, & Strapp, 2004, and Sela & Sobel, 2010, for reviews). Relevant here are the studies using positron emission tomography (Herz, Eliassen, Beland & Souza, 2004), which have shown that the same structures of the limbic system are involved in the processes of odor perception and regulation of emotional reactions.

Psychological experiments have demonstrated that such scents as lavender, cinnamon, basil, and citrus help people relax. Thyme, rosemary, and mint have refreshing properties, and the aroma of rose can overcome a depressed mood. Finally, chocolate, licorice, and ginger evoke a romantic atmosphere (Czerniawska & Czerniawska-Far, 2007, 2009). Effects of pleasant scent on affect have also been shown in studies on infants, who smiled in response to a chocolate aroma (Maurer and Maurer, 1994). Lehrner and colleagues (2000, 2005) found that orange flavor may provoke positive emotions during a dental visit. Knasko (1992) showed that an unpleasant odor (dimethyl sulfide) negatively affects mood. It seems that the odors personal appreciation is directly linked with the affective state valence (i.e., positive or negative). Villemure, Slotnick, and Bushnell (2003) observed that only odors designated by the subjects themselves as pleasant have beneficial effects on their affective state. Smells like or dislike: they carry an emotional dimension, hedonic, which is not a property of the odor itself, but a property of the interaction between an odor and a subject. The way we learn and experience an odor determines the dimension of pleasure or displeasure that we associate to it, and could sometimes lead to observe important inter-individual differences.

Baron (1997) conducted a series of studies on the sense of smell and social reactions, and showed that pleasant odors were associated with helping behavior. Specifically, passersby surrounded by a pleasant odor condition were significantly more likely to retrieve a dropped pen or provide a change for a dollar, than those in a neutral odor condition. It was also shown that participants were aware of the olfactory stimulus and reported significantly higher levels of positive mood in the pleasant odor condition. Similarly, pleasant smell increased helping behavior, even without a direct request for help, in a study by Guéguen (2001).

Rotton, Frey, Barry, Milligan, and Fitzpatrick (1979) performed an experiment in which subjects could punish their partners for making mistakes in a group task. Participants in a neutral odor condition desired to punish their partners to a lesser extent than those surrounded by an unpleasant scent. However, we should not be surprised by such results. As noted by Hirsch (1998) unpleasant aromas may be extremely harmful to human physiology often causing headaches, asthma attacks, or respiratory problems. They can also trigger a tendency to behave in an aggressive manner. Hirsch (1998) described his own research on athletes who were more aggressive and in turn more likely to do hard exercise in an unpleasant odor condition.

Since Baron's experiments from 1990, we also know that odors can have an effect on groups communication strategies used to solve a problem. The literature bring into light that when a group is asked to solve collectively a task in a pleasant scented place, the group sets higher goals, is inclined to adopt more effective strategies and made more concessions during the phases of negotiations. In other words, more collaborative behaviors are observed. Similar results were observed with pleasant body odors (Chen, 2001; Pierce, Cohen & Ulrich, 2004). In the same way, Zemke and Shoemaker (2007) showed that a pleasant odor spread in a workplace (geranium essential oil) have a positive influence on the number of social interactions produced by the workers.

These facts speak for themselves. Apparently odors, belonging to the so-called *atmospherics* that determine consumer behavior (Yalch & Spangenberg, 2000) might

also affect other decisions made by humans. And there are indeed many indications that this relationship is mediated by hedonistic experiences. As Saint-Bauzel and Fointiat (2013) underlined, the effect of mood as a mediation variable has been considered in a few studies (Baron, 1997; Guéguen and Petr, 2006), even if evidence of that mediation has not been provided in any of them. In this way, the present research represents an innovative challenge.

Overview of the Study

The aim of the present study was to examine dispositional and situational determinants of cooperative behavior, and to learn more about the importance of odors in humans' social relations. Based on the research discussed above, we assumed that there would be differences in cooperative behavior (Hypothesis 1) and differences in affective state (Hypothesis 2) between participants working in pleasant versus unpleasant versus control odor conditions. More specifically, we proposed that the effect of odor on cooperative behavior is mediated by affect (Hypothesis 3). Thus we suggested that compared to a control group, participants working in pleasant odor condition should declare more positive affect and as a consequence be more cooperative. Moreover, subjects working in a malodor condition should experience negative affect, leading to less cooperation than those working in control odor condition. With regards to personality, we assumed that agreeableness (Hypothesis 4) is positively related to cooperative behavior. In our final model we also controlled for coworkers' perceived contribution to a joint work. We sought to verify whether the effects of the crucial variables would be observed event if we account for subjective assessment of partner's contribution to achieved results – another variable typically associated with cooperative behavior.

Materials and Methods

Participants

Participants were University of Warsaw students (N = 77; 54 female and 23 male; mean age 21.29 years, *SD* = 1.71), beginning university courses in linguistic and educational sciences. All participants were of Polish nationality and white race (Caucasian). The study followed a between-groups design and was conducted in lecture halls. We intended to examine 30 respondents per group[1]. After rejecting faulty questionnaires there were: 27 respondents in the pleasant odor condition, 26 in the unpleasant odor condition, and 24 in the control group; of these 77, 68 participants completed the personality inventory. Participation was voluntary and anonymous, with no remuneration offered to participants. Participants were told that they had an opportunity to take part in a study on decision making. At the end they were informed about the true nature of the experiment.

Environmental Conditions and Stimuli

Our experiment was performed in lecture halls which varied in size from about 30–60 m^2. All of them were properly ventilated before spraying the scent. The fragrance diffuser and vials of odors were not visible to the participants. Selection of specific odors was based on previous knowledge (Czerniawska & Czerniawska-Far, 2007, 2009), but we also asked six independent raters to give their opinions about the scents. The judges' task was to smell each of thirteen specific odors and rate their pleasantness using a 7-point Likert scale ranging from 1 (definitely unpleasant) to 7 (definitely pleasant). Judges performing olfactory judgments chose the smell of chocolate (M = 6.17, SD = 1.17) as the most pleasant scent and the smell of vinegar (M = 1.83, SD = 0.98) as the least pleasant one. As a result, we used the smell of chocolate in the pleasant odor condition and the smell of vinegar in the unpleasant one. No odor was applied in the control condition.

Procedure

Participants were randomly assigned either to a pleasant odor group, or to an unpleasant odor group, or to a control group with no odor applied. At the beginning of the session, participants were assigned to two person groups (dyads) on the basis of two criteria: (1) the dyad did not contain students who were sitting next to one another at the beginning of the session and (2) the dyad members did not know each another. Next, each dyad was given a set of cards on each of which was a verbal puzzle requiring the dyad to come up with a number of words beginning with a certain letter of the alphabet (e.g., *four city names starting with the letter A*). After we read aloud the directions and briefly described the task, each dyad had 5 minutes to come up with as many words as it could. The participants were also asked to consult and cooperate in order to accomplish the task. We observed that participants appeared to follow our instructions, immediately exchanging view and together determining the words to be written. After 5 minutes, dyads were asked to return the completed tasks and start the next part of the study. But before that, once again they were asked to change their seats. We asked them to sit as far away as possible from their partner. Also, for the sake of privacy, we made efforts to ensure considerable spatial intervals between participants. Next, respondents received two questionnaires. The first one let us check if the manipulation was effective[2] and contained questions related to their affective state, and their perceptions of cooperation within the dyad. The second was the Polish adaptation (Zawadzki et al., 1998) of the NEO-Five Factor Inventory (Costa & McCrae, 1992). We asked also participants to provide their gender and age. The whole procedure took around 20 minutes. As soon as they finished, we collected the questionnaires, thanked respondents for

[1] Sample size was predetermined prior to data collection. We based on sample sizes used in similar types of research – 30 respondents per condition (e.g., Guéguen & Petr, 2006).

[2] We also measured perceived sound and light intensity in order to divert attention from the purpose of the study. None of the variables was significantly related to our dependent variables.

their participation in the experiment and gave them some information about the study. Most of the respondents showed curiosity and asked many questions about olfaction and psychology. Finally, they were given an email address in case they had additional questions or were interested in cumulative feedback.

Measures

Perception of the odor was measured with two items. We checked whether participants were aware of the presence of the odor (*yes/no*), and those who did, were asked to rate how pleasant it was in their opinion. Their answers could range from 1 (*definitely unpleasant*) to 7 (*definitely pleasant*).

Perceived cooperative behavior was measured with three items capturing the participant's attitude towards cooperation and their tendency to share goods (prize) with the partner. Participants were asked 1) *to what extent they perceive cooperation as positive* from 1 (*definitely negative cooperation*) to 7 (*definitely positive cooperation*), 2) their *subjective desire to share a prize with their partner*; from 1 (*low desire to share a prize*) to 7 (*high desire to share a prize*), and 3) to *take into consideration partner's commitment to the cooperation and decide to what extent they were willing to share a prize with a partner* from 1 (*definitely unwilling to share a prize a partner*) to 7 (*definitely willing to share a prize with a partner*). We averaged the items for each participant to create a measure of perceived cooperative behavior. According to Loewenthal's norms (1996) the scale was highly reliable, (M = 5.74, SD = 1.22, α = .80)[3].

Affective state was measured with two items. Specifically, we asked about the feeling of comfort and positive mood. Answers could range from 1 (very low) to 7 (very high). The two items were positively correlated, $r(75) = .49$, $p < .001$, so their averaged scores were used to create a measure of affective state (M = 4.89, SD = 1.39)[4]. We decided to use only two items for the sake of brevity and time obligation.

Agreeableness was measured by the Polish adaptation (Zawadzki, Strelau, Szczepaniak, & Śliwińska, 1998) of the NEO-Five Factor Inventory (Costa & McCrae, 1992). The instrument has good psychometric properties. Reliability coefficient for agreeableness (α = .68) was sufficient for research purposes (George & Mallery, 2003).

Contribution to joint work was measured with two items as a controlled variable. The first was the perception of own contribution to the joint work (M = 5.69, SD = 1.17) and the second checked the perception of partner's contribution to a joint work (M = 5.82, SD = 1.43); both scales from 1 (*low contribution*) to 7 (*high contribution*).

Results

Experimental design verification

In the first step of data analysis, we checked the effectiveness of the experimental manipulation. A Chi-square test was conducted to check whether the awareness of the odor differed between groups with experimental manipulation versus the control group. There was a significant association between the study condition (odor/no odor) and awareness of the odor. Participants in the experimental groups (81%) admitted to feel some kind of odor more often than did participants in the control group (17%), $\chi^2(1) = 27.61$, $p < .001$, Cramer's V = .60. One person did not answer the question.

We used the independent-samples Student's t test to verify if the scents' pleasantness evaluation differed across the two experimental conditions (the smell of chocolate vs. the smell of vinegar). We took into consideration only those respondents who admitted to detect an odor. Results revealed a statistically significant difference in the evaluation of the scent's pleasantness between experimental groups. Respondents working in the chocolate condition perceived the scent as more pleasant (M = 3.96, SD = 1.85) than did respondents in the vinegar one (M = 2.74, SD = 1.28), $t(41) = -2.44$; $p = .02$, $r = .36$.

Experimental effects

The impact of odor on perceived cooperative behavior

Our first hypothesis assumed differences in the rate of cooperative behavior between pleasant versus unpleasant versus control odor condition. A one-way ANOVA revealed a significant main effect of the smell condition $F(2,74) = 3.77$; $p = .03$, $\eta^2_p = .09$. *Post hoc* comparisons between group means performed by Tukey's method, indicated statistically significant differences between the group working in a pleasant smell condition (M = 6.06, SD = 0.90) and the group working in an unpleasant smell condition (M = 5.23, SD = 1.37), ($p = .03$). Moreover, the differences between the unpleasant odor condition and the control group were marginally significant (M = 5.94, SD = 1.20), ($p = .08$). There were no significant differences between the pleasant odor condition and the control group ($p = .94$).

The impact of odor on affective state

Our second hypothesis assumed differences in positive affective state between pleasant versus unpleasant versus control odor condition. A one-way ANOVA revealed a significant main effect of the smell condition $F(2,74) = 5.44$; $p = .01$, $\eta^2_p = .13$. *Post hoc* comparisons between group means, performed by Tukey's method, indicated statistically significant differences between the group working in a pleasant smell condition (M = 5.13, SD = 1.14) and the group working in an unpleasant smell condition (M = 4.21, SD = 1.53), ($p = .03$). Also, there were

[3] Data were analyzed with IBM SPSS 21.0 (2012).

[4] The pattern of results remained similar when we analyzed feelings of comfort and positive mood separately.

statistically significant differences between the unpleasant odor condition and the control group (M = 5.35, SD = 1.23), (p = .01). However, there were no significant differences between the pleasant odor condition and the control group (p = .82).

Odor, affective state and perceived cooperative behavior

Taking into consideration previous analyses, we decided to check for an indirect effect of the smell condition on cooperative behavior via affective state. Variable coding the smell condition (pleasant smell vs. control condition, and unpleasant smell vs. control condition) was recoded into two dummy variables. The first dummy variable encoded the difference between pleasant smell and control condition; the second dummy variable encoded the difference between unpleasant smell and control condition. We followed the bootstrapping procedure proposed by Preacher, Rucker, and Hayes (2007) and Hayes (2009), using the PROCESS procedure proposed by Hayes (2013). We employed model 4 (Figure 1) in which affective state mediated the path between odor condition and cooperative behavior, and drew 10,000 bootstrapped samples. The indirect effect of pleasant smell condition on cooperative behavior via affective state had a bootstrap 95% bias-corrected confidence interval of -0.46 to 0.20. The indirect effect of unpleasant smell condition on cooperative behavior via affective state had a bootstrap 95% bias-corrected confidence interval of -1.06 to -0.16 (Figure 1).

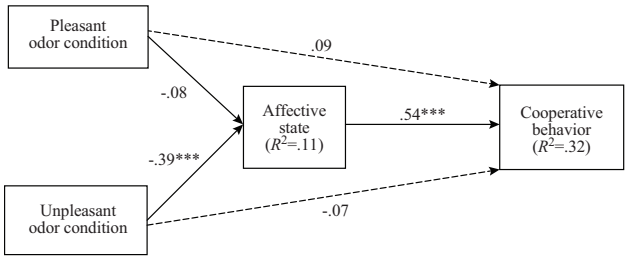

Figure 1. Indirect effect of pleasant odor condition and unpleasant odor condition on cooperative behavior via affective state. Entries are standardized coefficients. Dotted lines indicate direct effects

* p < .05; *** p < .001.

The findings provide support for our third hypothesis that affective state mediates the relationship between the odor condition and cooperative behavior. Negative effect of malodor on cooperation was accounted for by negative affective state associated with working in an unpleasant odor condition.

Correlation analyses

Agreeableness and perceived cooperative behavior

Agreeableness was significantly related to cooperative behavior. This relation, as we supposed, was positive (r = .29; p = .02). We conducted the same analysis for other dimensions of personality (conscientiousness, neuroticism, extraversion, and openness to experience). None of them was significantly related to cooperative behavior (all ps > .10).

Final Model

A hierarchical multiple regression analysis was conducted to examine the relations between our predictor variables and perceived cooperative behavior. Prior to this hierarchical multiple regression we performed first-order correlation analyses of the associations between our four predictors. A summary of results is shown in Table 1.

Table 1. Correlations between Agreeableness, Perception of own and partner's contribution to joint work, Affective state, and Cooperative behavior

Variables	1	2	3	4
1. Agreeableness	–			
2. Perception of own contribution to a joint work	.12	–		
3. Perception of partner's contribution to a joint work	.47***	.25*	–	
4. Affective state	.23+	.18	.36**	–
5. Cooperative behavior	.29*	.24*	.53***	.58***

+ p < .10; * p < .05; ** p < .01; *** p < .001.

Previous analyses indicated that agreeableness was the only personality aspect related to perceived cooperative behavior. Therefore, agreeableness was the first input variable in the regression. In the second step, the following variables were introduced: perception of own contribution to a joint work and perception of partner's contribution to a joint work. In the third step the situational affective state variable was taken into account.

Collinearity diagnostics showed no problems with too high correlated variables (indicators of tolerance for each variable > 0.2), or the autocorrelation of the errors (Durbin-Watson statistic = 2.04). In the first step, analyses indicated a significant main effect of agreeableness (b = 0.06), $F(1,66) = 6.25$; p = .02. The second step showed a significant main effect of partner's contribution to a joint work, b = 0.44; p <.001, on perceived cooperative behavior, $_{\Delta}R^2$ = .22; p < .001. The complex model made up of four predictors was significantly more effective in predicting perceived cooperative behavior than previous models, as evidenced by a sizeable and significant change in R^2 (Cohen, 1988), $_{\Delta}R^2$ = .18; p < .001. It proved to be well-fitted to data $F(4,63) = 14.83$ and accounted for 45% of variance of perceived cooperative behavior. The strongest predictor of cooperation was affective state, b = 0.42; p < .001. Thus, the more positive affective state, the higher rates of perceived cooperative behavior. Another statistically significant predictor of cooperation was the perception of partner's contribution to a joint work,

Table 2. Final model

Variables	Step 1		Step 2		Step 3	
	b	***SE***	***b***	***SE***	***b***	***SE***
Agreeableness	0.06*	0.02	0.01	0.02	0.03	0.02
Perception of own contribution to a joint work	–	–	0.09	0.12	0.07	0.11
Perception of partner's contribution to a joint work	–	–	0.44***	0.11	0.31**	0.10
Affective state	–	–	–	–	0.42***	0.09
R^2	0.07		0.27		0.45	

* $p < .05$; ** $p < .01$; *** $p < .001$.

$b = 0.31$; $p = .002$. After taking into account situational factors directly related to the cooperation, the dispositional aspect of agreeableness does not seem to play a crucial role, $b = 0.03$; $p = .87$. There was also no significant effect of own contribution to joint wok, $b = 0.07$; $p = .63$ (Table 2).

Discussion

In this paper we examined factors that influence or are related to perceived cooperative behavior. The results of our study partly confirmed the hypothesis that ambient is an important factor underlying the tendency to cooperate. According to our study, this refers mainly to malodor evoking negative affective state which in turn reduces human willingness to cooperate. As dispositional aspects of cooperation are concerned, we found a significant positive relationship between agreeableness and our dependent variable. Thus, our results confirmed conclusions reached by previous researchers (Volk et al., 2011) and the authors of the Polish adaptation (Zawadzki et al., 1998) of the personality NEO-Five Factor Inventory (Costa & McCrae, 1992). Finally, the last analyses showed that positive affective state and high evaluation of partner's contribution to joint work (our controlled variable) are the most strongly related to cooperation.

Manipulation checks revealed that as in experiments carried out by Baron (1997), respondents adequately assessed the presence and the hedonic properties of an odor. As a result, the described study cannot be interpreted as subliminal stimuli effects on humans' emotions or behavior (Sela & Sobel, 2010). People aware of an unpleasant odor environment declared lower scores on both affective state and cooperation scales, as compared to persons solving the task in a pleasant scent condition or a control odor group. Also, it is worth mentioning that there were no significant differences among respondents cooperating in control versus pleasant odor group. However, the chocolate odor condition – that the participants of the pretest evaluated as strongly pleasant ($M = 6.17$, $SD = 1.17$ in a 7-points scale), was evaluated by the experimental sample very differently ($M = 3.96$, $SD = 0.98$ in a 7-points scale). Although odor pleasantness was still significantly higher in the chocolate odor condition than in the vinegar odor condition, we cannot declare that participants perceived the chocolate odor as a typically pleasant. Thus, this result should be interpreted with caution. In fact, some research suggest that pleasant odors indeed may improve performances in a cognitive task (Baron & Bronfen, 1994; Ho & Spence, 2005), provoke helping behavior (Baron, 1997) or even increase compliance (Saint-Bauzel & Fointiat, 2012). Also, Jacquemier (2001) has shown that releasing flowers scents in underground stations enhances positively the users' stations perceptions, and the intentions to take the underground. In the applied field of health, a study by Martin (1996) shows that pleasant odors improve the own perception of patients as for their health and well-being. Conversely, malodors may disrupt prosocial initiatives and apparently they do so quite effectively. For instance, as in our study, unpleasant smell can make people feel uncomfortable, leading to interpersonal hostility and unwillingness to share goods or cooperate in any other way. In the above mentioned experiments (Hirsch, 1998), negative odors were prone to provoke aggression and malaise. So, the consequences of prevailing aromas ought to be considered not only in business companies, but also in public institutions. Importantly, taking care about pleasant or at least neutral smell conditions in hospitals, trains or subway stations and other places of public use should be profitable to all members of society.

Conclusions and Future Directions

The most problematic issue of our study and of its implications is that we did not use a typical way of verifying cooperative behavior. Our aim was to initiate more natural interactions in dyads without depending on long-time requiring economic games. Because of such methodological approach, it might be difficult to compare our results to other research in this area. However, our motivation was to create natural conditions of cooperation, reflecting everyday life experiences. Furthermore, by taking into account the willingness to share goods (reward) within the team, we referred to the key aspect of previously research methods.

Another drawback of the study was to test mainly female students of the same university, who were also similar in age. Thus, future investigation should provide greater diversity in this regard, and also ensure larger sample size.

Further research is also needed to understand the influence of subliminal odor stimuli on pro-social behavior. Namely, the manipulation ought to be applied in such a way that respondents would not be aware of the scent. This would require using a very small amount of odor, which is not an easy task in variable spatial conditions. It is also hard to determine what extent of an undetectable smell could affect humans' behavior. Perhaps it would not be equal for all kind of odors, and depend both on odor concentration and respondents' individual differences. Moreover, taking into account all of the listed variables would probably require using structural equation modeling. This could help understand the complex nature of cooperative behaviors.

To sum up, it seems that scents and cooperation which have accompanied humanity for a long time, have much in common. Experimenting with odors and cooperation is full of pitfalls and methodological complexities. In the case of odors, they are associated with formal issues of ensuring appropriate research conditions or selecting the best specifics for our needs. As cooperation is concerned, it is hard to choose the right measurement of cooperative behavior, which would be the best to reflect reality. Maybe a good solution would be to use more direct methods, instead of self-reported strategies. It is also interesting what the results would be if the respondents had to face not just imaginary, but real goods sharing. What is more, it is not clear to what extent cooperation in dyads can be compared to working in a larger team. Anyway, quoted dilemmas should not discourage researchers, but on contrary inspire them and promote further search for better experimental methods. Any conclusions reached in that domain can be extremely useful, just as cooperation was and will always be useful in everyday life of human beings.

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