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Odor and Affect: Individual Differences in the Impact of Odor on Liking for Places, Things and People

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Abstract

This paper provides evidence of substantial individual differences in the affective importance of odors, and offers initial validation for an eight-item scale of the impact of odor (AIO) on liking for people, places, foods and cosmetic/health products. In study 1, 116 American college students and 336 Flemish Belgian college students completed the AIO along with other measures of reactions to odors and to commercial products designed to mask body odors. There were substantial individual differences in AIO scores, but means were similar for males and females, and for US and Belgian respondents. Higher AIO scores were associated with more odor-mediated memory, more attention to odors and more liking or disliking for odors as a function of their association with liked and disliked persons. AIO scores were not related to preference for toiletries with artificial scents, to use of products to mask natural body odors, or to disgust sensitivity. In study 2, AIO scores were strongly related to a measure of evaluative conditioning (a form of Pavlovian associative learning) in the laboratory, using liked and disliked odors as unconditioned stimuli and pictures of faces as conditioned stimuli.

Introduction

How important is smell in determining what we do and do not like? While researchers have focused on sensory acuity (Cain, 1982), or individual differences in liking for various odors (Engen, 1974, 1991), we have chosen to focus on the degree to which good and bad smells affect how much we like the places, things and people we encounter. In the present paper we report the results of our initial efforts to develop a scale to measure individual differences in the affective impact of odor, including some initial evidence of convergent and discriminant validity.

People do not ordinarily doubt the enormous importance of hearing and vision in their lives, but it is not uncommon for people to differ in talking about the importance of their sense of smell. In the present study, we asked 452 subjects to rank the relative desirability of permanent loss of their sense of smell, their hearing in one ear, or their left small toe. About 50% of subjects ranked loss of the sense of smell as most unacceptable. This finding supports the idea of high variability in the perceived importance of the sense of smell in life. In addition to high variability in judgements of general importance, the sense of smell differs from most other senses in its heavy affective loading. For humans, it seems that the sense of smell (along with taste) stands out as having more immediate and direct emotional impact.

The predominately emotional response to smells makes sense biologically. For most mammals, the olfactory system is critically involved in recognition of food and mates. Biologically speaking, the olfactory system is very primitive in structure, although it has evolved to be capable of fine differentiation between smells. Unlike most other sensory receptors, smell receptors are actually neurons. The olfactory nerve is the only sensory nerve that goes directly to the base of each cerebral hemisphere without synapsing in the thalamus, reminding us that the human forebrain evolved from tissue devoted to processing olfactory information. The olfactory system has direct anatomical and phylogenetic linkages to the limbic system, making it the sensory system most closely related to the parts of the brain that seem to mediate emotion. Thus, compared to the responses made to input from visual and auditory systems, responses to odors are relatively emotional (Engen, 1982, 1991). Indeed psychologists have been able to use odors in experimental manipulations of affect (Zillman *et al*., 1981; Baron, 1983, 1986), and have shown that odors aid the recall of emotional memories (Herz and Cupchik, 1995). Our interest here is in the possibility that the impact of odor may be much greater for some individuals than for others.

Based on results from a pilot questionnaire developed in collaboration with Todrank (Todrank *et al*., 1995), we conducted a series of surveys aimed at developing a questionnaire measure of individual differences in the affective impact of odor. Initial items were revised several times, and

Table 1 Items, means and standard deviations for AIO and other measures

Item	US		Belgian	
	Mean	SD	Mean	SD
AIO				
When you like a new food, is it partly because you like the smell?[a]	2.1	0.69	2.2	0.67
When you don't like a new food, is it partly because you don't like the smell?[a]	2.1	0.64	2.1	0.72
When you like a new place, is it partly because you like the odors there?[a]	1.8	0.81	2.2	0.69
When you don't like a new place, is it partly because you don't like the odors there?[a]	1.8	0.77	2.1	0.72
When you like a new cosmetic or health product, is it partly because you like the smell?[a]	2.1	0.77	2.5	0.72
When you don't like a new cosmetic or health product, is it partly because you don't like the smell?[a]	1.9	0.79	2.2	0.81
When you like a new person you've met, is it partly because you like their smell?[a]	1.3	0.87	1.6	0.86
When you don't like a new person you've met, is it partly because you don't like their smell?[a]	1.3	0.82	1.5	0.75
Odor-mediated memory				
Have pleasant odors ever brought back memories of places you haven't been for some time?[a]	2.3	0.86	2.2	0.75
Have bad odors ever brought back memories of places you haven't been for some time?[a]	1.7	0.94	1.7	0.78
Have pleasant odors ever brought back memories of people you haven't seen for some time?[a]	2.2	0.86	2.6	0.86
Have bad odors ever brought back memories of people you haven't seen for some time?[a]	1.4	0.88	1.5	0.75
Attention to odor				
How would you rate the amount of attention you pay to odors relative to other people your age?[b]	2.4	0.93	2.2	0.74
Do you find yourself in situations where you smell something but most other people do not?[a]	1.5	0.80	1.9	0.62
Do you tend to notice 'off' odors in the refrigerator before others do?[a]	1.6	0.87	1.6	0.79
Odor affect via association				
Did you ever come to like an odor because it was associated with someone you liked?[c]	0.89	0.32	0.81	0.40
Did you ever come to dislike an odor because it was associated with someone you didn't like?[c]	0.60	0.49	0.44	0.50

For AIO and odor-mediated memory items, choices are: never, rarely, sometimes, often (range 0–3). Because of missing data, table entries represent n = 110–116 US and n = 330–336 Belgian students.

[a]Choices are: never, rarely, sometimes, often (range 0–3).

[b]Choices are: a lot less, a little less, about the same, a little more, a lot more (range 0–4).

[c]Choices are: no, yes (range 0–1).

items that failed to show a relation to the rest of the scale were dropped. The eight items composing our final scale of the affective impact of odor (AIO) are presented in Table 1. These items ask about the impact of good or bad smells in determining liking for new foods, new places, new cosmetic/health products and new persons. We intended for the AIO scale to measure individual differences in the extent to which good and bad smells affect liking and memory for places, things and persons, and were interested in evaluating the relationships between AIO and the strength of association of smells with persons.

In order to begin providing some evidence of convergent and discriminant validity for our new scale, Study 1 included several measures of individual differences that we felt were possibly related to the affective impact of odor. Thus we included items to assess the extent to which odors evoke memories of people and places, the amount of attention paid to odor, whether an odor is liked or disliked because of its association with a liked or disliked person, use of odor-masking products, and preference for scented versus unscented products. A measure of sensitivity to disgust (Haidt *et al.*, 1994) was included in Study 1 for the US but not for the Belgian respondents.

In Study 2, we examined the usefulness of the AIO in predicting learned responses to faces paired with pleasant, neutral or unpleasant odors in an evaluative conditioning paradigm. Evaluative conditioning is a type of Pavlovian associative learning in which the hedonic value of one entity (e.g. object, picture, odor) is changed as a result of its pairing with a positively or negatively valenced entity. Evaluative conditioning can take place without the awareness of the subject, and is thought to be critical in the formation of preferences (Levy and Martin, 1990)

Study 1

The goal of Study 1 was to examine the structure of our eight-item scale of the AIO in two samples of respondents,

and to examine as well the relation of the AIO to the potential correlates introduced above.

Method

Respondents

The scale was completed by 116 students (70 females, 42 males and four of unreported gender) enrolled in a mid-level psychology course at the University of Pennsylvania in order to fulfill a research participation requirement. The sample was 74% white, 16% Asian and 10% of other racial origin. The scale was also completed by 336 Flemish Belgian college students (255 female, 80 male, one of unreported gender), in a mid-level psychology course at the University of Leuven. For this sample, the scale was translated into Dutch and then back-translated to English to check for accuracy of translation.

Measures

Affective impact of odor. The eight AIO items asked about the impact of liked and disliked smells on reactions to new foods, new places, new cosmetic/health products and new persons. The items were conceptually paired such that in each of the four domains, one item asked about the impact of a pleasant odor and the other item asked about the impact of an unpleasant odor. For example, the positively phrased item in the food domain asked, 'When you like a new food, is it partly because you like the smell?' The negative complement asked, 'When you don't like a new food, is it partly because you don't like the smell?' The response format for these eight items was a four-point scale (scored 0–3) with the choices: 'never, rarely, sometimes, often.' The items are presented in Table 1, with paired positive/negative items listed together, although the questionnaire presented first all the positive items and then their negative complements. The AIO scale was calculated as the mean of the eight items, with higher scores indicating more impact of odors on liking for people, places, foods, and cosmetic and health products.

Odor-mediated memory. Four items (Table 1) assessed the frequency with which good and bad smells elicit memories of place and person. The 'Memory' scale was calculated as the mean of these four items, with higher scores indicating more odor-mediated memory.

Attention to odor. Three items (Table 1) assessed subjective attention to odors. The 'Attention' scale was calculated as the mean of these three items, with higher scores indicating more attention to odor.

Odor affect via association. Two items (Table 1) assessed whether an odor ever came to be liked or disliked because of association with a liked or disliked person. The 'Association' scale was calculated as the mean of these two items, with higher scores indicating more impact of affective responses to a person on affective responses to odors associated with the person.

Use of odor-masking products. Four items asked 'How often do you use (breathmints/mouthsprays, mouthwash, chewing gum, perfume/cologne)?' on a scale of 'never', 'once a week or less', '2–3 times a week', 'every day', 'more than once a day' (coded 0–4). A fifth item asked 'How often do you brush your teeth?' on a scale of 'less than once a day', 'once a day', 'twice a day', 'more than twice a day' (coded 0–3). The 'Masking' scale was calculated as the mean of these five items, with higher scores indicating more use of odor-masking products.

Preference for scented products. Four items asked 'What kind of (bath/shower soap, toilet paper, laundry detergent, deodorant) do you prefer?' on a scale of 'unscented', 'no preference', 'scented' (coded 0–2). The 'scented' scale was calculated as the mean of these four items, with higher scores indicating preference for scented products.

Disgust. Disgust sensitivity may also be related to the affective importance of odors; many elicitors of disgust (body products, spoiled foods) have strong and generally disliked odors. US but not Belgian respondents completed a short (16 item) version of the Disgust Scale (Haidt *et al.*, 1994).

Questionnaire

The items just described appeared in the questionnaire in the following order: attention to odor; affective impact of odor; disgust; unscented versus scented products; and odor-masking behaviors. A variety of other items about food and flavor, other reactions to odor, and standard demographic variables were also included.

Results

General indicators of variation in importance of odors

The responses of both US and Belgian respondents confirm the wide range of importance of odors. We can identify in both samples people whose likes and dislikes are intensely influenced by odors and also people who show general indifference to odors, as illustrated by ranges in the AIO score from near zero (two subjects: never influenced by odor) to three (four subjects often influenced by odor in evaluating new persons, places, foods and cosmetics/health products). Figure 1 presents the range of AIO scores for the US and Belgian respondents. In the combined samples, 1.7% of subjects scored <1 (odors influence liking less than rarely) and 46% scored >2 (odors influence liking more than sometimes).

Gender and culture differences

Table 2 presents the mean scale scores for males and females, separately for US and Belgian respondents. Statistical comparisons among the four means for each scale are

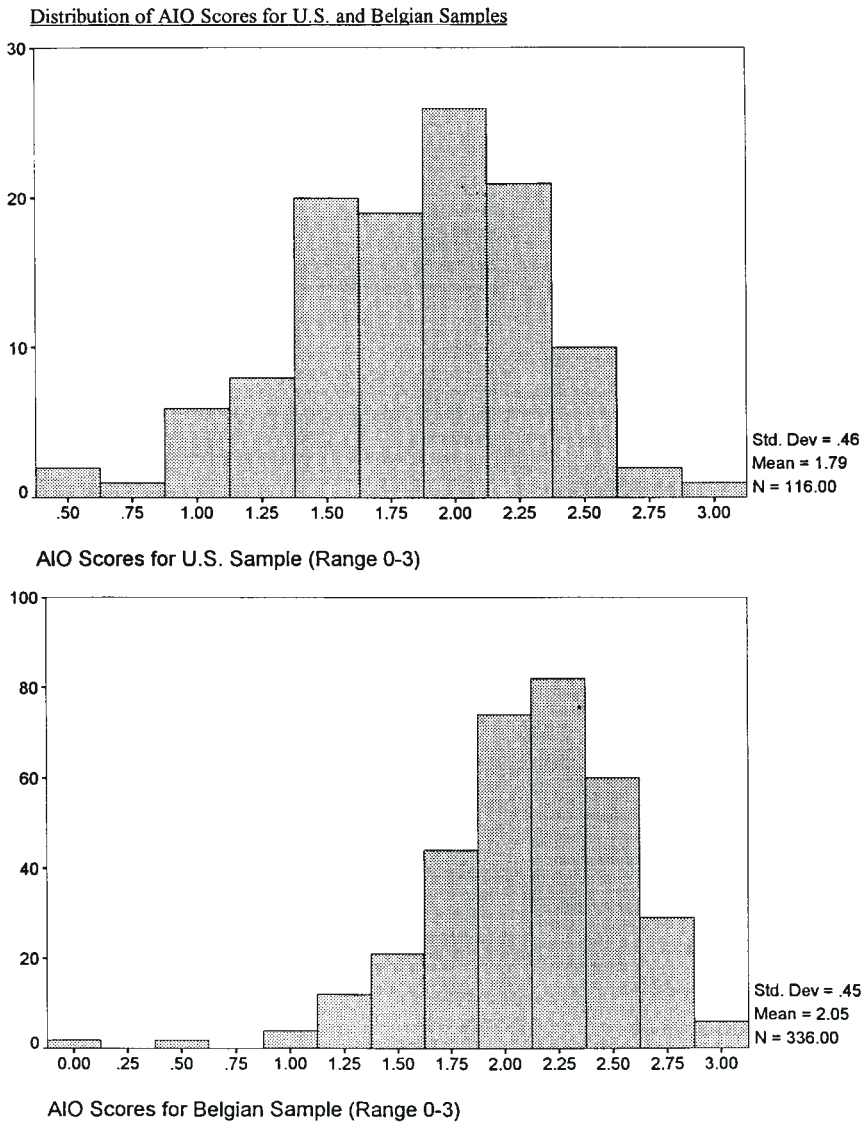

Figure 1 Distribution of AIO scores for US and Belgian samples.

difficult to interpret because of the wide variation in number of respondents contributing to the different means. Thus we take a conservative approach in noting only substantive differences, where a mean differs by more than half of its standard deviation from other means for the same scale.

Overall, gender and national differences on our scales are surprisingly small, especially in light of a documented higher odor sensitivity in females (Doty *et al.*, 1984) (Table 2). Belgian females scored higher on AIO than American females [2.07 versus 1.77, $t(323) = -4.97$, $P < 0.001$]. There were no other significant gender or culture differences on the AIO scale, or on the Memory or Scented scales. Belgian males stood out for their low score on Association, which was significantly lower than all other groups [0.48 versus 0.68, 0.74, 0.74, t range 3.65 to 4.42, Ps < 0.001]. The scale that showed the most substantial differences was Masking: this was higher in females for both nationalities [1.40 versus 1.14 for Belgians, $t(333) = 3.24$, $P < 0.001$; 2.03 versus 1.63 for US respondents, $t(110) = 3.12$, $P < 0.05$] and higher in Americans than Belgians [2.03 versus 1.40 for females, $t(323) = 7.34$, $P < 0.001$; 1.63 versus 1.14 for males, $t(120) = 3.98$, $P < 0.001$].

In our subsequent analyses, we will merge male and female data, but we will maintain parallel analyses for the Belgian and US respondents.

Composition and scoring of the scales

Our first analyses examine inter-item correlations of the AIO scale and of the various other scales to be correlated with the AIO. We also report the mean and SD of each scale for the US and Belgian respondents (Table 3).

Affective impact of odor. The mean AIO scores for both US and Belgian respondents fall near the middle of the 0–3 range, at 1.79 and 2.05 (see Table 3).

The inter-item correlations were subjected to principal components analysis and showed one dominant factor accounting for 29% of the total variance for US respondents and 36% of the total variance for Belgian respondents (eigenvalues >1.0 were 2.83 and 1.36 for US and 2.92, 1.11 and 1.08 for Belgian respondents). All eight items loaded above 0.52 on the first factor, and factor rotation showed no hint of a distinction between liked and disliked odors. Thus the factor analysis supported representing the affective impact of odor in a single AIO score. Cronbach's alpha for the AIO measure was 0.73 for US respondents and 0.75 for Belgian respondents.

Table 2 Means and SDs of odor-related scales by nationality and gender

Scale (range)	Gender	US		Belgian	
		Mean	SD	Mean	SD
AIO (0–3)	female	1.77	0.46	2.07	0.44
	male	1.82	0.48	1.99	0.46
Memory (0–3)	female	1.95	0.63	1.88	0.60
	male	1.88	0.84	1.68	0.61
Attention (0–3.3)	female	1.84	0.64	1.94	0.52
	male	1.72	0.74	1.74	0.59
Association (0–1)	female	0.74	0.32	0.68	0.34
	male	0.74	0.36	0.48	0.40
Masking (0–4)	female	2.03	0.67	1.40	0.62
	male	1.63	0.61	1.14	0.67
Scented (0–2)	female	0.70	0.50	0.70	0.42
	male	0.89	0.54	0.77	0.46

For US respondents, means are based on 42 males and 70 females; for Belgian respondents, they are based on 80 males and 255 females. Range for each scale is the range of observed scores.

Other scales. Means, standard deviations and reliability estimates are similarly presented in Table 3 for the five scales that represent potential correlates of the AIO. As for the AIO, reliability estimates for these scales were calculated from mean inter-item correlations. These scales depend on fewer items than the AIO and show generally lower reliability estimates. One notable exception is the scale of odor-mediated memory (Memory), for which reliability estimates are surprisingly high—0.80 for US respondents and 0.77 for Belgian respondents—even though the scale depends on only four items.

Correlations of AIO with other scales

The correlations of AIO with other scales are shown for both samples in Table 4. The US and Belgian correlations

Table 3 Means, SDs, mean inter-item correlations and reliability estimates for each scale for Belgian and US respondents

Scale (no. of items)	US				Belgian			
	Mean	SD	r_{11}	Alpha	Mean	SD	r_{11}	Alpha
AIO (8)	1.79	0.46	0.26	0.73	2.05	0.45	0.27	0.75
Memory (4)	1.92	0.71	0.52	0.80	1.83	0.61	0.45	0.77
Attention (3)	1.79	0.67	0.43	0.71	1.89	0.55	0.36	0.61
Association (2)	0.74	0.33	0.25	0.37	0.63	0.36	0.31	0.47
Masking (5)	1.88	0.67	0.19	0.55	1.34	0.64	0.27	0.53
Scented (4)	0.75	0.52	0.22	0.52	0.72	0.43	0.14	0.38
Disgust (16)	0.61	0.17	0.16	0.69				

US means are based on n = l14–116, Belgian means on n = 333–336; r_{11} is mean of inter-item correlations; 'Alpha' refers to Cronbach's alpha.

Table 4 Intercorrelations of AIO scale and other scales

	1	2	3	4	5	6
AIO	–	0.38[a]	0.39[a]	0.31[a]	0.17[a]	0.08
Memory	0.56[a]	–	0.35[a]	0.31[a]	0.40[a]	0.06
Attention	0.30[a]	0.31[a]	–	0.18[a]	0.14	0.05
Association	0.40[a]	0.51[a]	0.17	–	0.14	0.07
Masking	0.04	0.20	0.17	0.19	–	–0.34[a]
Scented	0.06	–0.06	–0.04	0.02	–0.28[a]	–
Disgust	–0.11	0.00	0.13	0.01	0.24[a]	0.22[a]

US correlations (lower left) are based on n = 114–116; Belgian correlations (upper right) are based on n = 333–336.

[a]Correlations significant at $P < 0.01$, one-tailed.

are very similar. In both cases, AIO is significantly and substantially correlated with odor-mediated memory (Memory), attention to odor (Attention) and odor affect via association (Association). Memory, Attention and Association are themselves intercorrelated in a way that suggests that individual differences in the importance of odor may not be limited to the impact of odor on liking. This point will be taken up in the Discussion.

Use of odor-masking products (Masking) and preference for unscented products (Scented) are negatively related in a reasonable way (users of odor-masking products tend to prefer scented products), but Masking and Scented are not correlated with AIO. Nor is sensitivity to disgust (Disgust) related to AIO.

Discussion

Our eight-item scale of the affective impact of odor had mean inter-item correlations of 0.26 and 0.27 with Cronbach's alpha estimates of 0.73 and 0.75 for the US and Belgian samples respectively. This level of reliability is adequate for a research scale.

The results of Study 1 offered some surprises. Individual differences in the affective impact of odor were significantly related to differences in the frequency of odor-related memory, differences in attention to odor and differences in the impact of personal associations on liking for odor. It seems that the affective impact of odor—the degree to which odors affect liking for new people, places and things—may be part of a larger individual difference construct. Perhaps odor is affectively more important for some individuals than for others, not just in determining liking for what is associated with an odor, but in determining liking of odors for what they are associated with, in greater attention to odor, and in greater power of odor to evoke memory.

Study 2

To provide additional evidence of convergent validity, we returned to the experimental research on evaluative conditioning that had originally suggested the importance of individual differences in the affective importance of odor (Todrank *et al.*, 1995). We predicted that high scorers on AIO should show stronger evaluative conditioning than low scorers in a cross-modal evaluative conditioning experiment using liked and disliked odors as unconditioned stimuli and photographs of faces as conditioned stimuli. In the original study (Todrank *et al.*, 1995), photographs of faces rated as neutral in valence were paired with odors rated as positive or negative in valence and given to subjects to look at and smell repeatedly in an attempt to show that the pairings could cause the ratings of the photographs to match that of the odors in a post-test. The logic behind our prediction that those with high AIO scores should show stronger evaluative conditioning is that individuals who are more likely to evaluate people, places and things on the basis of their odors should be more easily conditioned to evaluate faces on the basis of the odors associated with these faces.

As part of the pretest required for selection of positive and negative odors, Study 2 had subjects rate ten odors (selected to produce a range of affective responses) on a hedonic scale. We predicted that individuals high on AIO, Memory, Attention or Association would assign a wider range of hedonic ratings to the odor set and would be less inclined to rate odors as neutral. This prediction was based on the evidence in Study 1 that linked AIO to Memory, Attention and Association: if AIO is part of a larger tendency to link evaluation and odor, then individuals high on AIO or its correlates should show more variation of evaluation in relation to odors and should be less likely to react to odors without evaluation.

Method

Respondents

The scale was completed by 23 students (16 females, seven males) from the University of Pennsylvania who were participating in a cross-modal evaluative conditioning experiment.

Procedure

The procedure is described in detail elsewhere (Todrank *et al.*, 1995). The results reported in this study were from the random replication (Experiment 5) in Todrank *et al.* (Todrank *et al.*, 1995). Respondents first rated a set of photographs of people's faces according to how much they thought they would like the person in the photograph if they actually met them. Respondents then rated a set of ten odors (selected to represent a wide range of affective responses) according to how much they liked the odors (scale of –10 to +10). For each respondent, three neutrally rated photographs were chosen by the experimenter and randomly paired with one negative, one neutral and one positive odor according to the respondent's own ratings of the odors. Respondents were then exposed to each odor–photograph pair eight times over a period of 15–30 min. Finally, respondents again separately rated the odors and photographs. An elaborate cover story was used to avoid demand characteristics. The story involved the experimenter testing for a possible relationship between preferences for sensory stimuli and skin conductance responses to those stimuli. Thus, subjects were attached to sensors that were said to measure skin conductance, and the experimenter appeared to be watching the data appear on a computer as the experiment progressed. Subjects were told that they were given the unpaired photographs and odors to rate in order to obtain measures of their responses, and then these would be randomly paired in an attempt to determine what would happen if stimuli that had elicited different responses were paired. Finally, subjects were told that the final rating of unpaired photographs and odors was necessary to

Table 5 Correlations of AIO and other scales with performance in odor rating and evaluative conditioning

	AIO	Memory	Attention	Association	Mask	Scented
Dislike conditioning[a]	–0.63	–0.33	0.04	–0.39	–0.08	0.22
Like conditioning[a]	0.11	–0.15	0.21	0.12	0.03	–0.37
Range of odor ratings[b]	0.06	–0.17	0.27	0.04	0.00	–0.23
No. odors rated 0[b]	–0.38	–0.33	0.02	–0.40	–0.09	0.33

Tabled correlations based on $n = 23$ experimental subjects. Correlations >0.35 are significantly different from zero, P 0.05, one tailed.

[a]Change in rating of face paired with disliked odor or liked odor.

[b]Range between maximum and minimum hedonic ratings for ten probe odors, rated on scale of –10 to +10, and number of the ten odors rated as 0.

determine if the skin conductance responses had remained stable relative to the initial rating.

Subjects completed the AIO and related measures following their participation in the experiment.

Results

We developed four measures from the evaluative conditioning experiment to relate to the AIO and to the other odor-related scales. One was the range of ratings assigned to the ten pretest odors, a second was the number of odors assigned a neutral (0) value. The third and fourth were measures of the success of evaluative conditioning: decrease in the rating of the face paired with the unpleasant odor, and increase in the rating of the face paired with the pleasant odor. The evaluative conditioning experiment produced a significant negative conditioning effect, but not a significant positive conditioning effect. In light of this result, we would expect any link between AIO and conditioning to appear most clearly in the negative conditioning correlation.

The correlations between evaluative conditioning measures, the AIO and the other five odor-related scales are presented in Table 5. Note the substantial and significant correlation in the predicted direction ($r = 0.63$, $P < 0.001$), between negative changes in the CS paired with the unpleasant odor and AIO score. The Association scale was similarly associated with more conditioning of dislike for the photograph paired with the negative odor ($r = –0.39$, $P < 0.05$). The lack of any significant correlations with positive conditioning is not surprising, given the absence of a significant positive conditioning effect.

Our predictions about odor range were not substantiated. There was not a significant positive correlation between AIO score and the range of ratings given to the odors presented. As predicted, however, there was a significant correlation ($r = –0.38$, $P < 0.05$) such that high AIO was associated with assignment of fewer neutral values to odors. Similarly, high scores on Memory and Association were associated with assignment of fewer neutral values to odors (rs = –0.33 and –0.40). The Attention scale did not relate significantly to any of the measures of responsiveness to odors or conditioning success.

General discussion

We began our research with the idea that there are large individual differences in the extent to which good and bad smells affect liking and disliking for a variety of things. Open-ended questions and pilot studies led to eight questionnaire items assessing the impact of odor on feelings toward places, things and persons. Study 1 showed that these eight items formed a scale of adequate reliability for assessing the affective importance of odor. AIO scale means, SDs and reliabilities were generally quite similar for US and Belgian respondents.

Our exploration of relations between AIO and other measures led to some surprises. AIO was substantially correlated with Memory, Attention and Association, and these other scales were themselves intercorrelated. The affective impact of odor on liking for people, places and things appears to be at the center of a larger circle of covariation, such that individuals who are high on the AIO tend also to be more likely to report odor-evoked memories, to be more sensitive to odors and to like or dislike odors because of their association with liked or disliked persons. This widening circle of covariation needs to be tested further with scales that are better developed and more reliable than our initial versions; the AIO had some preliminary piloting and refinement before the two studies reported here, but the Memory, Attention and Association scales were included in the reported research as initial explorations.

The results were surprising also in that the AIO was not related to use of odor-masking products (Masking) or to preference for scented toiletries (Scented). We had surmised that individuals who were more affected by odor in evaluating other people would be more concerned with masking their own bad breath or body odor, and would prefer more scented toiletries that could help to mask body odors. Similarly we expected that individuals high on AIO might be high in sensitivity to disgust. None of these expectations was supported, although Masking and Scented were correlated with sensitivity to disgust as expected (rs = 0.24 and 0.34;

more use of odor-masking products associated with more preference for scented toiletries). These results must again be taken as tentative to the extent that the Masking and Scented scales were initial and exploratory measures with weak reliabilities.

The second study directly linked AIO to reactions to odors in an experiment on evaluative conditioning. This convergence of independent measures is worthy of note because the correlation cannot be inflated by common method variance: the AIO is a self-report measure whereas evaluative conditioning was assessed as change in evaluation of photographs from beginning to end of an experiment. The convergence of measures is further remarkable because the experimental measure was obtained from respondents working under a cover story that obscured the actual purpose of the experiment in such a way that respondents were unlikely to know whether or how much their photo evaluations had changed as a function of the associated odors.

The absence of a correlation between AIO and the size of the range used to rate odors in the evaluative conditioning experiment suggests that AIO is not related to a wider range of evaluation of odors as positive or negative. It appears that those with high AIO scores are not more sensitive to positive and negative odors—if that were so, stronger positive and negative ratings would have been used by this group in rating the odors. In light of this finding, we can see in retrospect why AIO scores were not related to use of odor-masking products or preference for scented versus unscented products. Avoiding or seeking out odors is presumably a function of the evaluation of the odors: the worse the smell, the greater the effort to avoid it; the better the smell, the greater the effort to experience it. Therefore, we expected that high AIO scores would be related to more frequent use of odor-masking products and to a stronger preference for scented products. But if, as we found, high and low scorers on AIO do not differ systematically in the direction or extremity of their evaluation of a smell, then they will not differ in their preferences for scented products nor in their motivation to mask body odors.

Similarly, the lack of relationship between AIO scores and sensitivity to disgust is understandable if individual differences in disgust have to do more with how bad a disgusting smell smells than with the evaluation of the person, place, or thing associated with the smell. Future research might test this interpretation by determining whether spoiled food, for instance, smells worse for individuals high on sensitivity to disgust than for individuals low on the disgust scale, but smells no different to individuals high and low on AIO. It is consistent with this interpretation that disgust scores were significantly, but weakly, correlated with use of odor-masking products ($r = 0.24$).

Thus our understanding of the construct assessed by the AIO scale has been sharpened by evidence of both convergent and discriminant validity. The AIO scale assesses individual differences in the extent to which good and bad smells affect liking and memory for places, things and persons; the evaluative conditioning results confirm this interpretation of the scale for bad smells. AIO is related to attention to odors, memory evoked by odors, and the extent to which smells are liked or disliked because of associations with liked or disliked persons. The AIO is not related to use of odor-masking products or preference for scented products. Taken together, this pattern suggests that the AIO is measuring individual differences in the strength of the linkage between affect for odor and affect for things associated with odor, rather than simply the degree of affective reaction to odor.

It would be of interest to further the validation of the AIO by measuring odor thresholds and odor psychophysical functions for people with different AIO and Attention scores. Since AIO and Attention are positively correlated, it may be that part of AIO is mediated by attention to odors, and part of Attention is mediated by olfactory acuity or other sensory/perceptual variables.

It is worth noting that individual differences in affective importance of odors may have commercial implications. Even if most people agree that a particular scent—perfume or cologne—is pleasant and attractive, our results suggest that not all of those who like it will be equally impressed by it in evaluating the wearer (Baron, 1983). The power of odor to affect feelings for people is evidently quite variable. It may be possible to learn something about the origins or correlates of this variation, although neither gender nor nationality was consistently associated with AIO scores for our respondents. It might be of interest to determine AIO and attention to odors from subjects in studies involving olfaction, as in mood induction studies. AIO scores might help to identify subjects who are likely to show odor-manipulation effects.

Another area of particular interest, explored in a parallel paper derived from the same data base, has to do with the relation of AIO to interest in foods (P. Rozin *et al.*, unpublished data). There are grounds to believe that the responsiveness to external odors gauged in the scales described in this study may be independent of responses to the retronasally experienced odors involved in the experience of flavor (Rozin, 1982), and we have collected evidence that supports this hypothesis (P. Rozin *et al.*, unpublished data).

In conclusion, this research documents, for the first time, a wide range in affective response to and attention to odors, and demonstrates that the differences in affective response extend across sensory domains. The results add another dimension to our understanding of the role of odor in life. We have introduced a new eight-item instrument—the AIO—which may be of use as a moderating variable in studies of human olfaction, or as a means of market segmentation for commercial uses of odors and fragrances.

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