

Proustian Products are Preferred: The Relationship Between Odor-Evoked Memory and Product Evaluation

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Abstract

Introduction The Proustian memory effect—that fragrances elicit more emotional and evocative memories than other memory cues—is well established. Fragrances also potentiate a variety of psychological states from moods to motivated behavior. Consumer research has shown that pleasant, product-congruent scents enhance product appeal, that products with greater emotional and cognitive involvement are perceived more positively, and that scent can increase recall for product information. However, the effect of Proustian memories on product perception has never been examined. The aim of the present study was to address this issue.

Methods An extensive pilot test in which the methods for the main experiment were established was first conducted. The main experiment then tested how a product (body lotion) that varied in fragrance pleasantness and Proustian memory potency was perceived.

Results Data analyses from a nationwide study showed that if the lotion fragrance was perceived as very pleasant, and it evoked potent personal emotional memories, that lotion was liked better and judged to be superior on a variety of functional and emotional attributes than the same lotion whose scent was perceived as equally pleasant but was not experienced as evocative.

Conclusions Our findings demonstrate that it is the personal potency of Proustian memories evoked by a product's fragrance, more than the hedonic qualities of the scent per se, that drives product perception and has important implications for the development of scented products.

Keywords Proustian memory · Odor · Pleasantness · Consumer preferences · Scented products

Most household and personal care products are scented. Anecdotally, scent appears to enhance product appeal, but there has been little empirical research on the topic. To date, it has been demonstrated that a pleasant ambient scent can favorably increase the perception of a shopping environment and consequently product quality (Chebat and Michon 2003), and that a scent which is perceived as thematically or conceptually congruent with a product can enhance perceived product value and desirability, approach behavior, and spending (Doucé et al. 2013; Fiore et al. 2000; Spangenberg et al. 2006). Importantly, it was also recently found that a product's scent can enhance recall for product information and create long-lasting scent-product associations in memory (Krishna et al. 2010).

Consumer research has demonstrated that products that elicit greater cognitive and emotional involvement lead to higher product evaluation and affiliation (e.g., Alba et al. 1991; Cobb-Walgren et al. 1995; Keller 1993; Stuart et al. 1987; Till 1998), and that when autobiographical memories are triggered by viewing an advertisement for a product, people show more favorable evaluation of the product than if no autobiographical memories are evoked (Baumgartner et al. 1992). However, it is not known how memories that are triggered by a product's scent will affect product evaluations.

Olfactory cognition and perception have a number of unique features (for reviews see Herz and Engen 1996;

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Wilson and Stevenson 2006; Zucco 2007). Perhaps most notable are the special qualities of odor-evoked memories. Memories evoked by odors have been shown to be from earlier in life and thought of less frequently than memories elicited by visual or verbal cues (Chu and Downes 2000; Willander and Larsson 2006; Rubin et al. 1984). Most strikingly, odor-evoked memories are distinctively more emotional and evocative—capable of bringing one back to the feeling of being at the original event—than memories elicited by cues from any other sensory modality (Herz 1998; 2004; Larsson and Willander 2009; Zucco et al. 2012). Odor-evoked memories are often referred to as “Proustian memories” after the literary anecdote described by Marcel Proust where the aroma of linden tea and a madeleine biscuit suddenly triggered an intensely emotional and evocative recollection of a long-forgotten event (Chu and Downes 2000; Proust 1928).

The unparalleled emotional and evocative qualities of odor-evoked memory are explained by the uniquely direct connection between the neural substrates of olfaction, emotion, and memory. Only two synapses separate the olfactory nerve from the amygdala, the limbic structure critical for the expression and experience of emotion and human emotional memory, and only three synapses separate the olfactory nerve from the hippocampus, directly involved in odor associative learning and various declarative memory functions (Cahill et al. 1995; Eichenbaum 2001; Yeshurun et al. 2009). Neuroimaging studies have further shown a significant neurobiological correlation specifically between recall of emotional odor-evoked memories and activity in the amygdala (Arshamian et al. 2013; Herz et al. 2004b).

The valence of the emotion linked to an odor has been shown to be the primary determinant of subsequent liking and perceived pleasantness (see Engen 1988; Herz 2012; Zucco 2012 for reviews). For example, Herz et al. (2004a) demonstrated that if a novel odor were first experienced while undergoing an emotionally positive experience it was liked better than the same odor experienced in a neutral context, and similarly when a novel odor was first experienced while undergoing a negative emotional experience, it was perceived as more unpleasant than if presented in a neutral context. This type of associative learning corresponds to the well-established phenomenon of “evaluative conditioning”, in which the valence of a stimulus is altered as a function of pairing that stimulus with another, either positive or negative, stimulus (De Houwer et al. 2001; see Hofmann et al. 2010 for review). However, published research has not yet been conducted on how perception of consumer goods is affected by the valence (i.e., pleasantness) of the odor that emanates from it.

Emotional associations elicited by an odor can also produce corresponding changes in motivation and behavior. For example, in laboratory studies, novel scents which were linked to frustrating experiences reduced motivation and

performance when participants were later exposed to them (Epple and Herz 1999; Herz et al. 2004c), and fragrances that have acquired connotations of being energizing or calming lead to heightened physical and mental performance or anxiety reduction, respectively (Lehrner et al. 2005; Raudenbush et al. 2001, 2009; see Herz 2009 for a general review of aromatherapy research). Thus, odors which elicit certain emotions and/or associations can motivate responses in the presence of those odors accordingly. However, whether emotional responses elicited by an odor can alter consumer responding is presently unknown.

The present research was conducted to explore how odor hedonics and memory evocativeness influence responses towards scented products. Specifically, we investigated whether body lotion would be liked more and perceived to be superior on a variety of performance attributes as a function of the pleasantness and memory evocativeness of its fragrance. In order to carry out this research, an extensive pilot study was first conducted to establish the methodology for the main experiment.

Pilot Study

The purpose of the pilot study was to select a set of “target” fragrances and a “control” fragrance that would then be added to body lotion in the main experiment, and to determine what the best age range for participants in the main experiment should be.

The criteria for target fragrances were that they easily evoke pleasant autobiographical memories, positive emotions, and be perceived as smelling pleasant. The criteria for the control fragrance were that it evoke few memories and emotions, and be rated near neutral for pleasantness.

Women outperform men at every level of odor responding at every age, and tend to have more emotional and personal involvement with odors than men (Doty and Cameron 2009; Chen and Dalton 2005). Moreover, women are the prime consumers of scented body lotion. As such, women only were tested in the present research. Olfactory acuity (detection, identification) has been shown to peak in the mid-teenage years and hold steady until the early fifties when it begins to decline (Doty et al. 1984). Thus, women within this broad age range would be appropriate participants for the main experiment. However, younger and middle age women are likely to have different family responsibilities and lifestyles as well as potential differences in prior olfactory experiences (e.g., due to the products they were exposed to while they were growing up). Therefore, to determine the best age range for participants in the main experiment, responses from young adults and early middle aged women were compared.

Methods

Participants

Participants were 122 women living in the Cincinnati metro area. They were recruited from two age groups: young adult (age range 22–31, $N=54$) and early middle age (age range 42–51, $N=68$). Participants were representative of the local population for socio-economic status and ethnicity, and all self-reported to have a normal sense of smell, no allergies, were non-smokers, free from any major medical conditions, and not pregnant. Informed consent was obtained from all participants before the study began. Participants were compensated \$55.00 upon completion.

Stimuli

Four trained commercial perfumers prepared 16 fragrances (coded with random numerals between 1 and 100) for this research. Fragrance qualities are described in Table 1. None of the fragrances were currently used within any personal care products. The fragrance of “*Jergens Original Scent*” was included as a benchmark comparison fragrance (17 fragrances were tested in total). *Jergens Original Scent* was chosen as the benchmark because this study evaluated lotions, and we wanted the comparison fragrance to be a lotion scent that was pleasant and memory evocative. The cherry-almond fragrance of *Jergens Original Scent* has been in the US

marketplace since 1926. This fragrance is generally rated as very pleasant, and because of its long history, many people have childhood memories associated to it—thus we expected this fragrance to be memory evocative. To be chosen as a lotion fragrance for the Main Experiment, potential fragrances in the pilot study had to meet the qualitative criteria of the benchmark.

Fragrances were added to otherwise scent-free commercial grade white body-lotion at a 0.1 % fragrance concentration, which is the industry standard, and presented in opaque white jars with black lids (hereafter called “odor jars”). The order of odor jar presentation was randomized in a Latin square and counterbalanced across participants.

Procedure

The pilot study was conducted at a market research facility in the metro Cincinnati area. When the participant arrived, they were taken to a standard testing room. Participants were tested in groups of five. Each participant was seated at their own desk which had been pre-arranged with odor jars and paper-and-pencil questionnaires. To minimize possible effects of uncontrolled odors interfering with the perception of the fragrance samples, participants were asked not to chew gum and both participants and experimenters had been previously instructed not to wear any perfumed products on the day of testing; the room itself was clean and not deodorized with fragrance.

Table 1 Pilot study fragrance qualities, hedonic ratings, memory evocativeness, and overall pleasantness

Fragrance	Main note	Sub note	Pleasant	Familiar	Intense	Evocative rate	Overall P-score
Benchmark	Floral	Powdery	6.41 (2.40)	7.32 (2.26)	6.02 (1.49)	0.75	6.83
S09	Gourmand	Vanilla	6.61 (2.18)	6.25 (2.42)	5.08 (1.68)	0.62	7.10
S79	Fruity	Fruity	6.92 (1.70)	6.44 (2.09)	5.52 (1.34)	0.62	7.24
S24	Citrus	Floral	6.60 (2.15)	6.26 (2.34)	5.62 (1.41)	0.59	6.94
S71	Fruity	Floral	6.52 (1.97)	6.20 (2.21)	5.66 (1.47)	0.58	6.77
S87	Floral	Aldehyde	5.48 (2.52)	5.68 (2.57)	6.23 (1.84)	0.57	6.04
S98	Green	Fruity	6.25 (2.20)	5.96 (2.30)	5.34 (1.69)	0.57	6.90
S15	Herbal	Lavender	4.14 (2.57)	5.14 (2.72)	6.29 (2.11)	0.55	4.85
S63	Oriental	–	5.75 (2.43)	5.48 (2.40)	5.67 (1.76)	0.53	5.95
S42	Floral	Balsamic	6.02 (2.19)	5.38 (2.58)	5.27 (1.79)	0.48	6.76
S46	Chypre	Floral	6.08 (2.11)	5.30 (2.56)	4.43 (1.78)	0.44	6.61
S12	Floral	Aldehyde	5.86 (2.24)	5.07 (2.47)	4.85 (2.02)	0.43	6.51
S20	Floral	Green	5.86 (2.24)	5.07 (2.47)	4.85 (2.02)	0.41	6.49
S33	Fruity	Green	6.27 (1.92)	4.98 (2.48)	4.85 (1.56)	0.38	6.76
S58	Floral	Aldehyde	6.14 (2.14)	4.89 (2.78)	5.20 (2.54)	0.38	6.63
S37	Woody	Hinoki	2.81 (2.16)	3.33 (2.65)	5.78 (3.14)	0.35	3.24
S61	Green	Fruity	4.83 (2.41)	3.97 (2.53)	5.20 (2.54)	0.30	5.52

Notes=perfumery fragrances properties. Evocative rate=percentage of participants who recalled an autobiographical memory to the fragrance. Overall P-score=overall pleasantness score, derived from the mean of emotion positivity, fragrance pleasantness, and memory pleasantness. Fragrances are listed in order of memory evocativeness rate

Participants were told that they would be smelling a series of fragrances prepared in body lotion and answering questions concerning their emotions and memories to the fragrances. They were instructed to go at their own pace, that they should not try to name the odors, that we were interested in their personal thoughts and feelings, and that there were no right or wrong answers. Participants completed all evaluations for one odor jar before proceeding to the next one. To mitigate cross-adaptation and fatigue, participants took a 5-min break after every fifth odor jar evaluation. At least one experimenter was in the room with the participants at all times to direct the study and answer any questions.

To evaluate a fragrance, participants first opened an odor jar, sniffed inside, and indicated whether the scent elicited any emotions. If no emotions were elicited, they were instructed to skip to the next section. If the scent did elicit emotions, they were asked to write down the emotions that they were feeling and to rate how pleasant (1=extremely bad to 9=extremely good) and intense (1=extremely weak to 9=extremely strong) each emotion was.

Next, participants sniffed inside the odor jar and assessed whether the fragrance evoked a memory. If the participant experienced a memory they were asked to write a detailed description and rate it for pleasantness (“How pleasant is your recollection?” 1=extremely unpleasant to 9=extremely pleasant), emotional intensity (“How emotionally intense is your recollection?” 1=extremely weak to 9=extremely strong), evocativeness (“To what degree does this fragrance take you back to the original time and place of this memory?” 1=I am not at all “brought back” to 9=I am completely “brought back”), and clarity (“How specific or vague is your recollection?” 1=a totally vague association to 9=a very specific event). Although we did not explicitly ask for “autobiographical” memory recollections, participants had been told not to try to name the odors and simple odor source descriptions (e.g., “reminds me of rose”) did not occur. We therefore assumed that the memories recounted (e.g., “makes me think about summers at the beach”) were autobiographical.

Lastly, participants sniffed inside the odor jar and rated how pleasant (1=extremely unpleasant to 9=extremely pleasant), familiar (1=extremely unfamiliar to 9=extremely familiar), and strong (1=too weak to 9=too strong) they perceived the fragrance to be. After completing these evaluations for all 17 odor jars, participants were thanked, debriefed, and paid. Depending upon the participant’s speed and experiences, the study took between 1.5 and 2 h to complete.

Results

Selection of Target and Control Fragrances

To be selected as a target fragrance for the main experiment, the fragrance had to easily evoke memories. Memory

evocation rate was determined by calculating the percentage of participants who reported a memory for each fragrance. The benchmark (*Jergens Original Scent*) was found to evoke the most memories, followed by S09, S79, and S24 (see Table 1).

In addition to evoking autobiographical memories, target fragrances were required to be perceived as pleasant smelling, to evoke pleasant memories, and elicit positive emotions. These ratings were highly inter-correlated; fragrance pleasantness and pleasantness of memory ($r=0.97$), fragrance pleasantness and positivity of emotion ($r=0.96$), and pleasantness of memory and positivity of emotion ($r=0.98$). Therefore, an “overall pleasantness score” was calculated for each fragrance based on the average of these three ratings. As Table 1 shows, the following fragrances received the highest “overall pleasantness” scores, respectively: S09, S79, and S24. By contrast, S61 elicited the fewest autobiographical memories and was rated 5.52 for overall pleasantness (5=neutral) and was thus deemed the most suitable control fragrance for the main experiment. One-way analysis of variance (ANOVA) and Newman Keuls post hoc comparisons examining the benchmark, targets: S09, S24, S79, and control: S61, for “overall pleasantness” confirmed that the control fragrance scored lower than the benchmark and three target fragrances, $F(4, 348)=4.90, p<0.01$. There were no differences between the benchmark and target fragrances. A significant main effect for fragrance familiarity, $F(4, 348)=10.55, p<0.01$, and subsequent post hoc comparisons verified that the benchmark was the most familiar fragrance, the control fragrance the least familiar, and importantly that familiarity did not differ between the three target fragrances. There were no statistical effects found for fragrance intensity. Thus, the target fragrances S09, S24, and S79 were selected for further testing.

To validate fragrance selection for Proustian memory effects, one-way ANOVAs comparing the benchmark, targets: S09, S24, S79, and control: S61, revealed significant main effects on all autobiographical memory dependent measures; pleasantness $F(4, 348)=4.62, p<0.01$, emotional intensity, $F(4, 348)=4.12, p<0.01$, evocativeness, $F(4, 348)=7.70, p<0.01$, and clarity, $F(4, 348)=4.22, p<0.01$. Post hoc comparisons showed that the benchmark and three target fragrance evoked more pleasant, evocative, and clearer autobiographical memories than the control fragrance. Memory emotional intensity was lower for the control fragrance than the benchmark and S24. The three target fragrances did not differ statistically from each other on any of these measures. See Table 2.

Differences Between Age Groups

Autobiographical memory responses were compared between the two age groups for the five selected fragrances with a 2×5 between-subjects ANOVA. A significant age by fragrance interaction for memory pleasantness, $F(4, 343)=4.10, p<0.01$, was obtained. The younger group recalled more pleasant

Table 2 Pilot study: mean (SD) autobiographical memory qualities for the benchmark and selected fragrances

	Pleasantness	Emotional intensity	Evocativeness	Clarity
Fragrance				
Benchmark (Jergens Original)	7.17 (2.04)	7.34 (1.51)	7.49 (1.51)	6.93 (2.23)
S09 (target)	7.38 (1.70)	6.72 (1.76)	6.95 (1.54)	6.50 (1.92)
S24 (target)	7.19 (1.89)	7.01 (1.60)	7.08 (1.61)	6.87 (1.85)
S79 (target)	7.37 (1.68)	6.57 (1.77)	6.62 (1.79)	6.25 (1.95)
S61 (control)	5.84 (2.81)	6.14 (2.33)	5.70 (2.60)	5.41 (2.97)

Scalar data were responses to the following: Pleasantness: “How pleasant is your recollection?” 1=extremely unpleasant to 9=extremely pleasant. Emotional Intensity: “How emotionally intense is your recollection?” 1=extremely weak to 9=extremely strong. Evocativeness: “To what degree does this fragrance take you back to the original time and place of this memory?” 1=I am not at all “brought back” to 9=I am completely “brought back”. Clarity: “How specific or vague is your recollection?” 1=a totally vague association to 9=a very specific event

memories to the benchmark and target fragrances than to the control. The means and standard deviations (in parentheses) for pleasantness were as follows: *M* benchmark=7.20 (2.07), *M* S09=7.82 (1.62), *M* S24=7.26 (2.09), *M* S79=7.67 (1.13), versus *M* control=4.79 (2.93). For the older age group, there were no statistical differences in memory ratings as a function of fragrance: *M* benchmark=7.16 (2.02), *M* S09=7.02 (1.70), *M* S24=7.15 (1.74), *M* S79=7.05 (2.08), and *M* control=6.94 (2.26). It was therefore determined that the younger group had more differentiated responses to the fragrances and would be the best age group to test in the main experiment.

Main Experiment

The purpose of this experiment was to investigate body lotion liking and perceived performance as a function of the pleasantness and memory evocativeness of the fragrance added to it. The three target fragrances and control fragrance selected from the pilot study were used to create the comparison products. Fragrance pleasantness and Proustian memory evocativeness were evaluated upon initial exposure to the lotion, and then lotion liking and perceived performance were assessed after 1 week of home usage.

Based on the unique emotional intensity of odor-evoked memory, evidence that emotional associations triggered by odors can alter perception and behavior (Herz et al. 2004a, b; Lehrner et al. 2005; Raudenbush et al. 2009), and research showing more positive judgments for products that are cognitively and emotionally involving (Alba et al. 1991; Cobb-Walgren et al. 1995; Keller 1993; Stuart et al. 1987; Till 1998), it was hypothesized that body lotions scented with a pleasant and memory evocative scent (target fragrances) would be liked more and evaluated more positively than the same body lotion scented with the control fragrance.

Methods

Participants

Two hundred seventy-one women within the age range of 22–31 years, from locations spanning the United States (18 % Northeast, 22 % Midwest, 37 % South, 23 % West) participated. No one had taken part in the pilot study. Prospective participants were recruited from a database of previously registered consumer volunteers who received an email asking if they would like to partake in the present experiment. They were then screened in a telephone interview to select those who met the same demographic, health, and olfactory characteristics as individuals in the pilot study. Informed consent was obtained from all individual participants included in the study. Participants received \$5.00 and complimentary body lotion upon completion.

Stimuli

The same commercial-grade, white, scent-free body lotion as in the Pilot Study was used as the substrate. Four lotion versions were then prepared with the three target fragrances (S09, S24, S79) and control fragrance (S61) added at 0.1 % concentration. All lotions were identically packaged in white plastic eight ounce squeeze bottles and labeled “Hand and Body Lotion”. They were shipped to participants by the United States Postal Service. Participants randomly received lotion scented with one of the four fragrances as follows: targets—S09, *N*=71; S24, *N*=67; S79, *N*=68; control—S61, *N*=65.

Procedure

Participants were told that the purpose of the study was to create new personal care products and that their involvement would require 1 week of body lotion usage and completing two short online surveys. The order of activities was (1) pre-usage survey, (2) 1-week usage period, and (3) post-usage survey. All activities

were conducted at the participants' home. Prior to the start of the experiment, participants were contacted by telephone and given information about when they would be receiving their lotion and when the emails to access the online surveys would be sent.

Pre-Usage Survey Participants received an email on the designated day with a link to the survey website. The pre-usage survey first asked participants to smell the lotion they had just received and to rate its fragrance for pleasantness, intensity, familiarity, and uniqueness each on nine-point scales (1=extremely unpleasant, too weak, not at all familiar, not at all unique; 9=extremely pleasant, too strong, extremely familiar, extremely unique). Then they were asked to smell the lotion again and assess whether the fragrance evoked any recollective feelings, associations, or specific autobiographical memories, and if so to describe and evaluate their experience on four rating scales: pleasantness (1=extremely unpleasant to 9=extremely pleasant), emotional intensity (1=extremely weak to 9=extremely strong), evocativeness (1=I am not at all "brought back" to 9=I am completely "brought back"), clarity (1=a totally vague association to 9=a very specific event). The instructions for recall of memory-emotional associations were slightly broader than in the pilot study because we did not want participants to variously assume any restrictions as to what constituted a memory, and we could later filter memories as a function of their Proustian Memory Potency Score for more detailed analyses (see Results section for full explanation). After completing the pre-usage survey, participants were told to start using the lotion for 1 week as they normally would in place of their usual hand and body lotion.

Post-Usage Survey Following the week of lotion usage, participants received an email with a link to the post-usage survey which asked them to rate how much they liked the lotion (1=dislike very much, 2=like somewhat, 3=neither like nor dislike, 4=like somewhat, 5=like very much) and to assess the lotion on 20 performance attributes each on nine-point scales (1=disagree strongly to 9=agree strongly). The performance attributes were drawn from a standard personal care product assessment battery and included 16 functional and four emotional qualities (see Table 3).

Results

Pre-Usage Survey

Rating scale responses to the lotion fragrances when participants first smelled them are shown in Table 3. One-way between-subjects ANOVAs and Newman Keuls post hoc comparisons were performed on these data. Results revealed that lotions scented with the target fragrances were rated as significantly more pleasant, $F(3, 267)=19.18, p<0.01$, and familiar, $F(3, 267)=10.42, p<0.01$, than lotion scented with the control fragrance. Ratings given to the three target fragrances did not differ statistically from each other. Judgments for fragrance intensity $F(3, 267)=2.05, p>0.05$, and uniqueness, $F(3, 267)=2.20, p>0.05$, did not differ statistically across lotions.

The percentage of participants who experienced an emotional memory association as a function of their lotion fragrance were S09=96 %, S24=89 %, S79=91 %, and S61=73 %. A composite score of participants' emotional memory experience was calculated from the mean of participant's recollection ratings on emotional intensity, evocativeness, and clarity (Cronbach's alpha=0.925) and is subsequently referred to as their "Proustian Memory Potency Score" (PMPS). PMPS obtained for each lotion fragrance is shown in Table 3. Post hoc tests demonstrated that the target fragrances S09 and S79 yielded significantly higher PMPS than the control fragrance. Ratings given to S24 did not differ significantly from the control or S09 and S79. Because PMPS was our main variable of interest, S24 was dropped from further analyses and the target fragrances S09 and S79 were examined in comparison to the control fragrance for the post-usage survey results.

Post-Usage Survey

After 1 week of lotion usage, judgments of lotion liking corresponded to pre-usage PMPS. Figure 1a shows that lotions scented with the two target fragrances with the highest

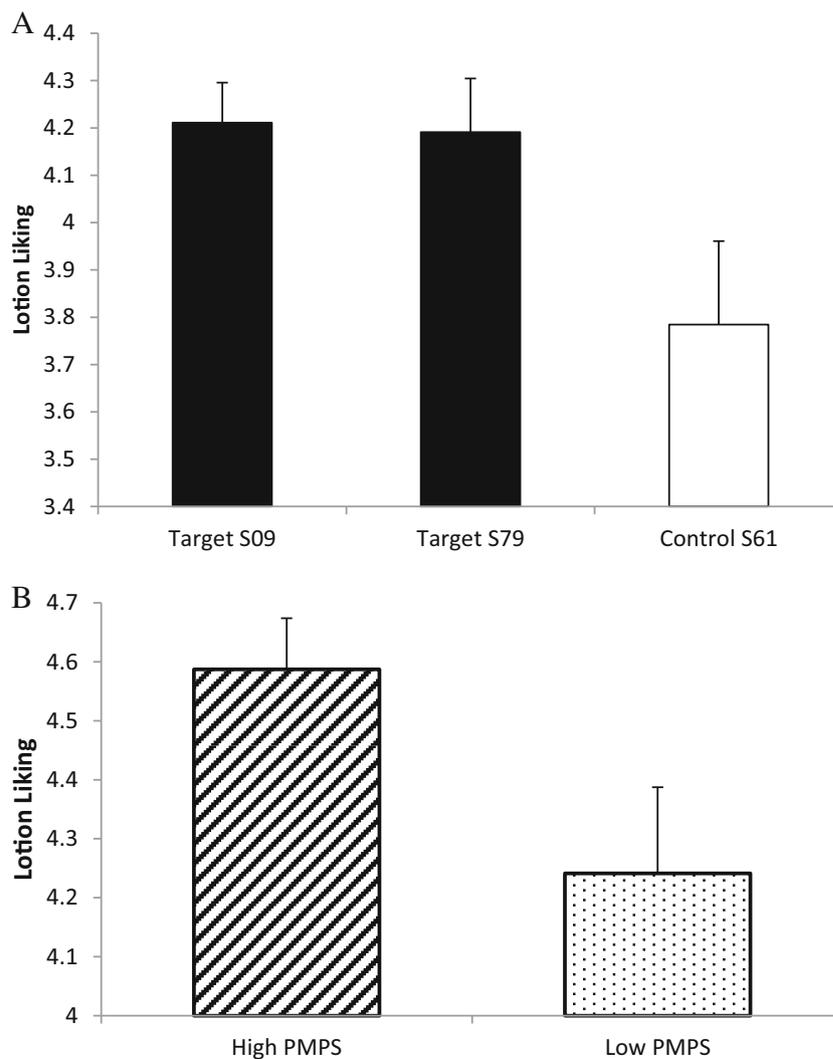
Table 3 Main experiment pre-usage survey: means and standard deviations for lotion fragrance ratings

Fragrance	Pleasantness	Familiarity	Intensity	Uniqueness	PMPS
S09 (target)	7.51 (1.21)	6.11 (1.95)	4.69 (1.13)	5.58 (1.95)	5.80 (2.26)
S24 (target)	7.07 (1.52)	5.79 (1.89)	5.04 (1.10)	5.82 (1.85)	4.87 (2.19)
S79 (target)	7.66 (1.47)	5.90 (2.02)	5.06 (1.06)	6.40 (1.88)	5.32 (2.58)
S61 (control)	5.80 (2.01)	4.32 (2.30)	4.69 (1.45)	5.80 (2.08)	4.17 (2.58)

Responses to fragrances were made using 1–9 category scales: 1=extremely unpleasant, too weak, not at all familiar, not at all unique; 9=extremely pleasant, too strong, extremely familiar, extremely unique

PMPS Proustian Memory Potency Score (M memory emotional intensity, evocativeness, clarity)

Fig. 1 a Mean (\pm SEM) lotion liking after 1 week of usage as a function of lotion fragrance. Lotions scented with the target fragrances (S09, S79) were liked significantly more than lotion scented with the control fragrance. “Liking” in the post-usage survey was measured on a 1–5 scale (1=dislike very much, 3=neither like or dislike, 5=like very much). **b** Mean (\pm SEM) lotion liking after 1 week of usage as a function of the Proustian memory potency (PMPS) of the fragrance. Participants who experienced high PMPS from their lotion fragrance liked their lotion significantly more, regardless of what the fragrance was, than participants who experienced low PMPS from their lotion fragrance



PMPS received higher liking ratings than lotion scented with the control fragrance, $F(2, 203)=3.81$, $p<0.05$. Post hoc comparisons also indicated that liking for lotions scented with the two target fragrances did not differ statistically from each other. Despite greater liking for lotions scented with the target fragrances, our first analysis of the performance attribute ratings did not reveal any statistical differences in the responses given to lotions that were scented with the target fragrances versus the control fragrance.

The selection of target fragrances was based on the criteria of (1) high fragrance pleasantness and (2) high PMPS. Unsurprisingly, fragrance pleasantness ratings correlated with subsequent lotion liking ratings, $r=0.49$, $p<0.01$. However, this presents a confound if any participants did not particularly like their lotion scent. Therefore, to unconfound possible effects of fragrance disliking, and to disentangle the effects of fragrance pleasantness and PMPS, only participants who rated their lotion fragrance as very high in pleasantness (ratings of

7–9, $N=181$) were selected for further analysis. These participants were then sorted into a high-PMPS group (PMPS from 7 to 9, $N=63$) and a low-PMPS group (PMPS from 1 to 3, $N=29$). Participants with a PMPS in the moderate range (4–6, $N=89$) were excluded.

Two-sided t tests for independent samples conducted between the high- and low-PMPS groups demonstrated Proustian memory effects. First, as Fig. 1b shows, high-PMPS participants liked their lotion significantly more than low-PMPS participants, $t(90)=2.14$, $p<0.05$. Second, PMPS potency yielded strong corresponding effects on ratings of the lotion attributes. Table 4 shows that nine out of 16 functional attributes were rated significantly more positively by the high PMPS group than the low PMPS group, and three out of four emotion attributes were rated statistically higher by the high-PMPS group than the low-PMPS group. Where statistically reliable differences were not obtained, the trend was consistently for higher ratings by the high-PMPS group.

Table 4 Main experiment post-usage survey: lotion performance ratings as a function of fragrance Proustian memory potency

Lotion attribute	High PMPS	Low PMPS	<i>t</i> value
Functional			
Provides long-lasting moisturization	7.70 (1.81)	6.83 (2.17)	2.01*
Absorbs completely	7.90 (1.81)	6.93 (1.96)	2.33*
Absorbs quickly	7.76 (1.88)	6.72 (2.30)	2.29*
Spreads easily	8.43 (0.95)	7.76 (1.33)	2.45**
Is an everyday body moisturizer	8.08 (1.72)	7.97 (1.74)	0.29
Makes my skin feel resilient	7.68 (1.80)	6.62 (2.01)	2.53*
Leaves my skin feeling silky	7.75 (1.74)	6.97 (1.74)	2.00*
Provides my skin with superior moisture	7.71 (1.85)	7.00 (2.31)	1.59
Does not leave my skin greasy or sticky	7.22 (2.65)	6.10 (2.62)	1.89
Prevents my skin from being rough	8.06 (1.51)	7.38 (1.93)	1.84
Prevents my skin from being dry	8.05 (1.64)	7.41 (1.84)	1.66
Leave skin feeling smooth	8.03 (1.71)	7.55 (1.48)	1.30
Leave skin feeling soft	8.03 (1.72)	7.76 (1.30)	1.06
Leaves my skin looking healthy	8.05 (1.54)	6.97 (1.27)	3.30**
Makes my skin more youthful	7.54 (1.72)	6.10 (1.84)	3.64**
Makes my skin more radiant	7.76 (1.67)	6.24 (1.77)	3.98**
Emotional			
Makes my skin look more beautiful	7.84 (1.61)	6.38 (1.86)	3.85**
Makes me feel good when I use it	7.89 (1.65)	7.07 (1.51)	2.28*
Is a product for me	7.75 (2.01)	7.24 (1.75)	1.17
Helps me take better care of my skin	8.06 (1.50)	7.03 (1.88)	2.82**

Means are displayed with their standard deviation in parentheses. For all *t* tests, *df*=90. Performance attributes were all rated on 1–9 scales

***p*<0.01, **p*<0.05

Discussion

Our results showed that target fragrances were rated as more pleasant and familiar than the control fragrance, and that lotions scented with target fragrances that evoked strong Proustian memories were liked better than lotions scented with the control fragrance after 1 week of lotion usage. More importantly, it was found that individual Proustian memory potency predicted lotion liking and perceived body lotion performance after the week of lotion usage. When evaluations from participants who rated the fragrance as very pleasant were specifically examined, those who experienced a highly potent Proustian memory liked their lotion more and evaluated the lotion more positively on a wide range of functional and emotional performance attributes compared to participants who experienced a weak Proustian memory, regardless of what the specific fragrance was. That is, it was the degree to which the fragrance evoked a Proustian memory for a given individual that determined liking and performance perception of the lotion more so than the specific fragrance per se, and this effect went beyond merely perceiving the scent to be highly pleasant. The present findings confirm our hypothesis that lotions scented with a pleasant and memory-evoking

fragrance will be preferred, and demonstrate for the first time that lotion liking and perceived performance is determined by the degree to which an individual experiences potent Proustian memories elicited by the lotion's scent.

Our results extend prior research showing that a product's scent can produce long-lasting product associations and enhance memory for product information (Krishna et al. 2010), and newly show that the personal experience of emotional memory evocativeness from a product's scent can enhance its appeal and perceived qualities. Following from research on evaluative conditioning with odors and general olfactory associative and behavioral effects (e.g., Hofmann et al. 2010; Zucco 2012), our findings demonstrate that Proustian memory potency confers added product value and has implications for product development.

The present study reveals that the hedonic and evocative nature of a product's fragrance can drive product liking and performance perception. Notably, our findings indicated that the elicitation of personal memories by a scent is more important than mere positive hedonics. The target fragrances selected from the pilot study all received high pleasantness ratings; however, they did not influence product liking equivalently. What was needed in order for a product to be best received and

perceived was an individual's experience of an intense Proustian memory. An interesting question for future research is whether a Proustian fragrance can amplify basic product deliverables. That is, if the unscented substrate of one lotion were judged to have superior product performance than the substrate of a different lotion, could adding a Proustian fragrance make the worse product be believed to perform as well or better than the superior product?

Our findings highlight the individualized nature of Proustian fragrance "effectiveness". This reflects the fact that olfactory perception is predominantly determined by prior learning and personal history, and idiosyncrasies abound (see Engen 1988; Herz 2012; Zucco 2012). That being said, knowledge of a given culture can facilitate predicting certain scent associations. For example, in North America and Europe, orangey-citrus scents are often perceived as happy and calming (Lehrner et al. 2005), whereas in Japan, jasmine is frequently associated with a positive and relaxed mood (Kuroda et al. 2005). Early fragrance experiences are also important. The preponderance of odor associations are formed in childhood because this is the first time most odors are encountered (Chu and Downes 2000; Willander and Larsson 2006). This also has ramifications for cross-cultural odor research and development. If it is known when people in a given region first experienced various scents, it may aid in the design of products whose scents are most likely to elicit Proustian memories. In future research, it would also be important to determine whether regional differences (local and international) exist in what odors are most preferred and considered acceptable in various types of personal care products. The perceived congruence between a product and its scent is another important factor to consider.

In the domain of scent marketing, it has been shown that when a product's scent is perceived to be conceptually congruent with the product, higher value is ascribed to the product and sales are increased (Spangenberg et al. 2006). However, if a pleasant scent does not match expectations based on product theme, lower responses towards merchandise are obtained, even compared to when no scent is used at all (Doucé et al. 2013; Fiore et al. 2000; Mattila and Wirtz 2001). In the present research, we were fortunate to test target fragrances that seem to have been perceived as thematically compatible with body lotion. In future research, examining Proustian memory effects scent-product congruence should be explicitly examined.

The present research has several limitations. First, only one type of scented product was tested (body lotion); therefore, it is not known to what degree the Proustian memory effect generalizes to other scented goods. For example, it may be that personal care products (i.e., products that are worn on the skin and are thus intimate) are more affected by Proustian memory effects than less intimate items such as household products. A related issue is that odor hedonic evaluations (e.g., pleasantness, familiarity) and memory evocativeness

are often highly correlated (Herz and Cupchik 1992; Distel et al. 1999), and it would be important to know how each variable individually contributed to the lotion ratings. Future research should also attempt to examine fragrance evocativeness in isolation with hedonic factors held constant. Another limitation is that gender was not considered in the present study. Thus, it is not known whether men are as affected or responsive to Proustian fragrances as women, and this may also be mediated by the product in question. For example, men and women may be equally influenced by the Proustian quality of personal care products but differ in other domains of scented merchandise. In the future, both men and women and different categories of scented products should be examined. Finally, we did not compare different sensory features (e.g., odor, color, tactile qualities) of body lotion to determine which was most responsible for augmenting perceived product value and liking. However, in light of past research demonstrating that odors are more emotional and evocative than other sensory cues (e.g., Herz 2004; Arshamian et al. 2013), we believe that focusing only on various olfactory features was warranted here.

Prior consumer research has shown that products with greater emotional and cognitive involvement are liked better (Alba et al. 1991; Cobb-Walgren et al. 1995; Keller 1993; Stuart et al. 1987; Till 1998), that ambient scent can increase product value (Chebat and Michon 2003; Fiore et al. 2000; Spangenberg et al. 2006), and that a product's scent enhances recall for product information and creates long-lasting associations in memory (Krishna et al. 2010). It has now been revealed that a product whose scent evokes potent personal memories is liked better and evaluated more positively on a wide array of functional and emotional attributes than the same product with an equivalently pleasant scent but which does not elicit Proustian memories. In sum, Proustian products are preferred.

Compliance with Ethics Requirements

Conflict of Interest Rachel Herz has received research grants from Kao Corporation. All other authors declare that they have no conflict of interest.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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