Effects of Fragrances on Vigilance Performance and Stress

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The present project originated in an interest in testing the hypothesis that certain fragrances have an inherent ability to affect peoples' level of physiological arousal independently of their hedonic properties. Empirical data supporting that hypothesis were quite limited, however, and came from two kinds of sources: subjective reports (Schwartz, Whitehorn, Heron, & Jones, 1986) and electroencephalographic (EEG) records (Lorig & Schwartz, 1988; Lorig, Schwartz, Herman, & Lane, 1988). We proposed to study the *behavioral* effects of such fragrances, using a laboratory analogue of a class of important real-world tasks known as vigilance or sustained attention tasks.

In vigilance tasks, people monitor a display over extended periods of time, looking for infrequently occurring "signals," the kind of tasks that might occupy radar operators, quality control inspectors, nuclear power plant operators, long distance drivers, and so on. The most ubiquitous finding in research on vigilance performance is that subjects' efficiency, though initially high, declines over time on task (Dember & Warm, 1979). Substantial differences are also noted in overall level of performance as a function of task and subject characteristics.

While theories of vigilance performance, and especially of the typical decline in performance that occurs over time (the "vigilance decrement"), point to a variety of causal factors, in many of those theories (see Parasuraman, 1984) poor performance is attributable to a low level of arousal. Thus, if there are fragrances which affect arousal level, then their administration during the course of a vigilance task should be expected to affect performance efficiency. Our research to date has been designed to test that notion.

An initial pilot study enabled us to select two fragrances—Peppermint and Muguet—for further investigation. That study confirmed prior information provided by International Flavors and Fragrances that both fragrances were given high hedonic (pleasantness) ratings, but that Peppermint was reported to be stimulating/alerting while Muguet was reported to be relaxing. Following the pilot study, we have completed three experiments.

In the first, 36 college-age subjects were randomly assigned to one of three conditions, Peppermint, Muguet, or plain air. In all three conditions, a 30-second puff of scented or plain air was administered to the subjects through a modified oxygen mask once every five minutes over the course of a 40-minute vigil.

Subjects monitored a video screen for the occasional occurrence of a visual pattern defined as the signal to be detected. These signals were interspersed among a larger number of rapidly occurring non-signal patterns, which matched the signals in every respect but one: the non-signals were two parallel lines flanking a dot centered on the screen, each 10 mm from the dot; signals were those same lines, each 12 mm from the center dot.

Our data consisted both of measures of performance accuracy (the percentage of correct signal detections, or "hits" and the percentage of commission errors, or "false alarms") and of subjective reports of such feelings as strain, drowsiness and irritability, as well as of task demandingness (workload). We had thought that even if the fragrances did not affect performance accuracy, they might, and especially Muguet (because of its relaxing quality), reduce the perceived stress of the vigilance task.

The data showed that both Peppermint and Muguet were associated with superior overall performance accuracy, relative to the plain air control condition; analysis of the data revealed that this effect was one of improved sensitivity, not one of subjects'

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greater willingness to respond, a finding repeated in our subsequent studies. Though overall performance efficiency was affected, neither fragrance eliminated the vigilance decrement. And there was little, if any, evidence that either fragrance made the task seem less demanding or reduced the feelings of stress that subjects usually report after serving in a demanding vigilance task.

The above study was conducted in the vigilance laboratory at the University of Cincinnati. A partial replication has been completed at the Catholic University in Washington, DC. In that experiment, a Peppermint condition was compared with two control conditions, one in which subjects received puffs of plain air (as in the above study) and a second in which no mask was worn nor air delivered.

Sixteen college-age subjects, eight men and eight women, were randomly assigned to each of the three conditions. Again, the results showed significantly greater performance accuracy in the Peppermint condition than in either control condition. Currently under way at Catholic University is a follow-up study using elderly subjects.

In a third experiment, delivery of scented or plain air was under the subject's control, as it is likely to be in many real-world applications. That is, subjects could administer a brief (nine-second) burst of air or fragrance, depending on the condition to which they had been assigned, whenever they wished over the course of the vigil. They were told that some people find those puffs of fragrance, or air, to be helpful. A no-mask, no-air condition was also used to control for possible placebo effects of the instructions.

Twelve college-age subjects, six men and six women, were randomly assigned to each of the four condition, Peppermint, Muguet, Air, No-air. Again, stress and workload measures were taken in addition to performance measures. As before, stress and workload did not vary with condition.

In this experiment, unlike the first two, performance accuracy proved to be dependent on the interaction between subject gender and condition. Thus, for men, performance was best, unexpectedly and inexplicably, in the Air condition, with the other three about equal; however, for the women, performance was best under the two fragrance conditions, with Air and No- air conditions about the same. In effect, when Peppermint and Muguet are self-administered on an ad lib schedule, women subjects' performance shows the same beneficial effect as in the earlier experiments in which fragrance delivery was under the experimenter's control. The results for men are anomalous, and at this point we are unable to offer a satisfactory explanation.

The Fragrance Research Fund

This article is an informal description of one of the research projects supported by The Fragrance Research Fund. This fund has as its main objective the financing of research related to the impact of fragrances in humans.

It studies the sense of smell and human reaction to olfactory stimulation. The research is of an interdisciplinary nature, including anatomatical and ultrastructural observations, physiological and biochemical studies as well as psychological and behavioral reactions to fragrance.

This research is expected to clarify how fragrances operate and how they impact, via the central nervous system and hormonal mediators, on moods, mental attitudes and general physical health.

The President of The Fragrance Research Fund is Dr. Jack Mausner, Senior Vice President Research and Development, Chanel, Inc. For further information on the research and educational activities of the Fragrance Research Fund and of the Fragrance Foundation contact: Annette Green, The Fragrance Foundation, 142 East 30th Street, New York, NY 10016, USA.

One incidental observation has to do with the total amount of fragrance delivered under the self-administration conditions of this experiment in comparison with the amount delivered in the previous experiments: on average, subjects received the same total amount of scented or unscented air regardless of whether the delivery was experimenter-or subject-controlled.

The first experiment indicates that both Peppermint and Muguet have beneficial effects on vigilance performance: subjects detected more signals overall under fragrance conditions than in the Air condition. The second experiment replicated those results with Peppermint. In both experiments the improved performance is attributable to increased sensitivity to signals rather than to response bias. In neither experiment was stress or perceived workload affected by fragrance.

The fact that Peppermint and Muguet had comparable effects in the first experiment is somewhat surprising since one was assessed as alerting (Peppermint) while the other (Muguet) was assessed as relaxing. Both, as noted earlier, were judged as very pleasant fragrances. It may be that the hedonic property of these fragrances is carrying the effect on vigilance performance rather than their inherent alerting/relaxing property. We are about to start additional experiments to check that possibility as well as to examine fragrance effects on other behavioral tasks.

The third experiment, in which scented or unscented air was self-delivered ad lib, provides confirmation of the earlier results, but only for female subjects, another intriguing finding that needs to be followed up.

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