

Cognitive Aspects of Perfumery*

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Individuals who exhibit superior athletic, art or academic abilities have always been the subject of intense interest. Not surprisingly, considerable attention has been focused on understanding the conditions that lead to the development of exceptional expertise among a select few. For the past several decades, cognitive psychologists have made significant advances in understanding the nature and development of expertise, and the insights gained from the study of experts in a variety of fields can be applied to understanding the creativity and artistry exhibited by perfumers. In that spirit, it seems appropriate to share some thoughts about perfumers and the art and science of perfumery from the perspective of cognitive psychology. Specifically, I would like to talk about perfumers as examples of individuals with expertise, and illustrate the differences between novices (nonperfumers) and experts (perfumers) in the context of odor perceptions.

Expertise in Odor Perception

Much has been written about the prerequisites for becoming a perfumer.¹ Chief among these requirements are those involving olfactory ability; namely, sensitivity, discrimination and memory for odors. However, the disparity between novice and expert abilities in these domains is often remarkably small and easily overcome. For example, it is commonly assumed that a perfumer must possess an exceptional degree of olfactory sensitivity to be successful. This intuition has not proven valid. Although some perfumers are capable of exquisite sensitivity, so are many nonperfumers. What seems to be necessary for the development of increased sensitivity is experience, often in the form of simple, repeated exposure to a particular odorant. In many studies that repeatedly test the odor

sensitivity of the same individuals, increases in sensitivity to those odorants are quite commonly observed. This improvement is illustrated quite dramatically in a study in which I examined the changes in sensitivity, across six weekly tests, among nonperfumers (novices) to the odorants isobornyl acetate or geraniol. The odor detection thresholds for these odorants increased an average of 256-fold from the first to the sixth assessment.² Striking increases in olfactory sensitivity following repeated testing has also been observed by other researchers.^{3,4}

Novices also differ from experts (i.e., perfumers) in their ability to discriminate between similar odorants or to analyze the constituent components in a complex fragrance. This distinction has long been acknowledged; as, for example, when Piesse (1891) noted that "To the unlearned nose, all odours are alike; but when tutored, either for pleasure or profit, no member of the body is more sensitive."⁵ This ability is obviously critical to the perfumer. However, there is evidence that discrimination ability can be learned.

The role that experience plays in honing olfactory discrimination has been explored in several recent studies of olfactory mixture perception. In a recent study,⁶ untrained novices were asked to identify the components of various odorant mixtures. The odorants ranged in complexity from two to six components, and untrained subjects performed quite poorly on the task. Even with the benefit of some exposure to the possible components, subjects were able to identify the components of a binary mixture only 12% of the time. They were virtually unable to identify all the components of mixtures that contained three or more ingredients. However, perfumers tested in this same experiment were able to identify the ingredients of two- and three-component mixtures quite successfully.

Furthermore, there is suggestive evidence that an individual's discriminatory prowess can be amplified by

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mere exposure to an odorant. In studies of long-term odor adaptation, adult subjects who were exposed to either benzyl acetate or isobornyl acetate in their home for two weeks were asked to describe the odor using standard odor profile descriptors.² At the first assessment, which took place after only 24 hours of exposure, the majority of subjects described the odor in very general terms, using only one or two descriptors such as “flowery” or “disinfectant.” By the end of two weeks of exposure, however, the frequency of descriptor use had risen, particularly among semantic descriptors that identified specific odor qualities such as “warm,” “citrusy,” “green” or “spicy.” Although no direct test was made of any subject’s ability to discriminate among similar smelling odorants, repeated exposure to an odorant appeared to enhance the subjects’ ability to describe the sensory qualities of the odorant and thus conceivably could produce better discriminability as well.

What Distinguishes Experts from Novices?

The foregoing examples are not intended to suggest that perfumers are not distinguishable from nonperfumers on the basis of sensory ability. However, it seems prudent to regard any enhanced sensory ability among perfumers as a by-product of the development of their expertise, rather than as the source or the nature of the expertise itself. My view, based on considerable research in olfactory processes

among nonperfumers, or novices, is that most fundamental differences separating novices from experts are cognitive differences, such as odor memory. Put simply, expertise seems to consist of differences in the way task-relevant information (odor memory) is stored and organized, and differences in the way that information is evaluated and subsequently used. For perfumers, it is the training of the cognitive processes that provide the association between the perception of an odor and the ability to recognize it, name it and compose with it. These cognitive processes and their subsequent associations are often differently manifested in novices than in experts.

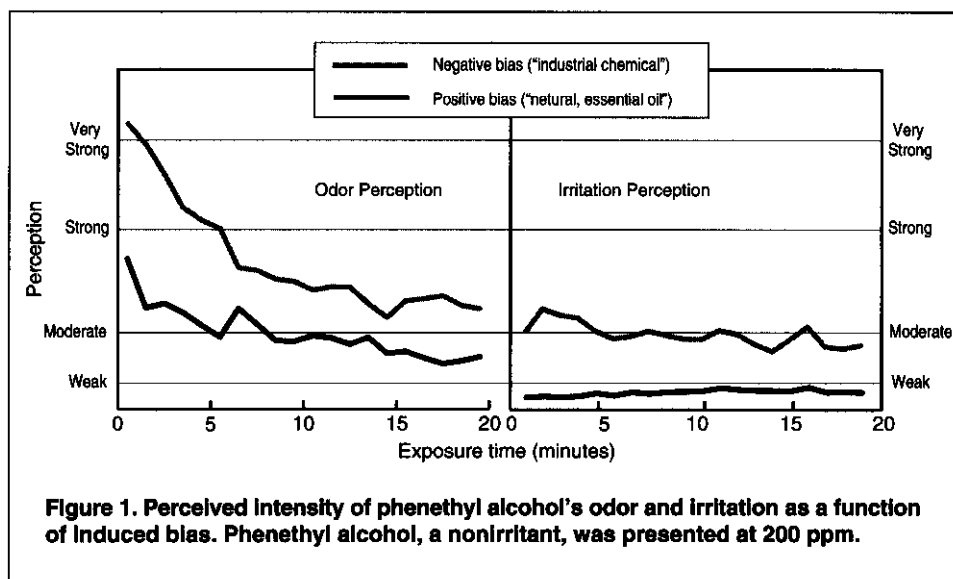
For example, novices are usually quite good at recognizing previously encountered odors, but they are notoriously poor at identifying them—a task that is central to many of the perfumer’s daily activities. When novices *do* recognize odors, they typically retrieve associative information about the odor, such as where they have encountered it, but not the odor’s identity or name. So, whereas the perfumer can smell a blotter imbued with vanillin and retrieve both its identity and classification, a novice is more likely to retrieve information such as “it smells like my mother’s kitchen when she’s baking.”

Sensory and Cognitive Aspects of Odor Perception

It should come as no surprise that novice/expert differences in both the sensory and cognitive aspects of odor perception can produce differences in how novices and experts respond to an odor or a fragrance. Consider, for example, the situation where an individual becomes an expert from repeated exposure to the same odor, as in the workplace. As a general observation, the odor perceptions of novices are more likely to be determined, or biased, by the context in which the odorant is perceived, while experts, such as exposed workers, are more likely to process the odorant independent of the context in which it occurs or what biasing information is given about it.

This distinction can be illustrated with data from a study in which I examined how the perception of both the strength and the irritancy of a fragrance component can be biased by what subjects are led to believe about the nature of the odorant source.⁷ Two groups of people were told very different things about the nature of an odorant on which they were to be tested. Participants assigned to the positive group were told that the fragrance was a natural, essential oil. Those assigned to the negative group were told that the fragrance was an industrial chemical. Of course, both groups were exposed to the same odor, at exactly the same concentration. However, as shown in Figure 1, the group with the negative information rated odor intensity as much higher than the positive group. They also rated irritation higher than the other group.

This result demonstrates the power of cognitive processes, such as expectations, on the perception of odors. This feature of odor perception has been long utilized by marketing and advertising departments who strive to set



an ambience or context for a fragrance product. Given the current concerns over the health effects stemming from the use of fragrance in public places, it is not surprising that much current fragrance advertising incorporates images that suggest the advertised perfume

creative domains.

Historically, there has been a great deal of interest in identifying what determines expertise in creative or intellectual domains. In 1869, Sir Francis Galton⁸ wrote that three factors were necessary for attaining expert performance levels: innate talent, motivation and perseverance, and deliberate practice. For a long time, the first factor was considered a prerequisite. There exists a relatively widespread conception that if individuals are innately talented they can easily and rapidly achieve an exceptional level of performance once they have acquired basic skills and knowledge. Extensive recent analyses of skill learning and expertise in a number of domains,⁹ and the individual study of acknowledged "geniuses" or "experts" has largely disproved this notion. Those analyses have clearly shown that musicians, athletes or chess players can acquire virtually all of the distinguishing characteristics of expert performers through deliberate practice of relevant activities. The differences between expert performers and normal adults in these domains reflect a life-long period of deliberate effort to improve performance.

Cognitive Aspects of Creativity in Perfumery

All cognitive activities are ways of handling or processing information. Odor perception is no exception. Any person who perceives, remembers or thinks about odors has to acquire, retrieve or transform information about them.

Given this definition, it is customary to classify the novice as one having limited cognitive processing abilities. Research shows us that experts, on the other hand, have found ways to organize, store and access relevant information so it is incredibly efficient to use.¹⁰ Experts do not necessarily have superior memories per se; they simply have better memory for the task-relevant material. Through deliberate practice with the elements of their craft, they have learned to overcome some of the normal limitations of memory in regard to their domain-specific fields.

was distilled from natural substances rather than synthesized.

The Nature of Expertise in Perfumery

Having identified some obvious differences in the abilities and responses of novices and experts when they process odors and fragrances, we can apply these distinctions to the understanding of the development of expertise in perfumery. Unfortunately, little systematic investigation into the cognitive nature of the development of expertise in perfumery exists. Hence, we must seek understanding from studies of the development of expertise in other artistic and

As an example of this, consider what happens when you are told to glance at the following list of letters for two seconds so as to remember them for a subsequent memory test.

DDTIBMRSVPUSSR

If you now cover the page and try to recall the letters you may find it difficult to remember more than six or eight. Now, glance at the following list for two seconds and try to remember it for a subsequent memory test.

DDT IBM RSVP USSR

Compared to the first configuration, the organization of the letters in the second configuration should make it much easier for you to recall more of them. The difficulty with the first list occurs because of processing limits in human memory. The maximum amount of information we can keep in working memory at one time is about seven items. So, when we try to rehearse more than seven or eight letters that are unrelated, we fill our incoming memory buffer and displace items that are already there. When you become familiar with items, such as letters, so that they can be meaningfully organized, you can arrange them into groups so that you have less total items to remember. This strategy is called "chunking." Chunking allows you to remember more individual components because you organize them into chunks, or larger groups. Experts make considerable use of this cognitive organizational principle. Information that they use repeatedly is often organized into larger, more meaningful groups so the limits of human information processing can be superseded.

An example of how an expert perfumer can "chunk" information is shown below.

eugenol
iso-eugenol
phenylethyl alcohol
geraniol
ionone beta
methyl ionone gamma
sandalore
vetiver oil

The list contains eight different fragrance materials or chemicals that are used in perfumery. A nonperfumer studying this list would process it as eight separate ingredients, whereas a perfumer would study this list and see two distinct accords. The first four ingredients form a carnation accord, or blend, and the second four form a woody accord. Through extensive experience, recognizing these chunks or patterns of odorants makes remembering the individual components far easier for the expert than for the novice.

In addition, nonperfumers have different mental representations of these elements. Imagine how a nonperfumer would carry out the task if asked to imagine the final perceptual outcome of the eight blended ingredients. To do this task, a nonperfumer would probably attempt to evoke the sensory memory of each single odor and then blend the resulting elements. Given our knowledge of the

limits of working memory, this would be an impossible task. For the perfumer, however, these elements are already organized into two distinct accords which, through extensive cognitive and physical experience, can be mentally combined.

Jean Carles, a noted perfumer, recognized the tremendous reliance that perfumery placed on cognitive skills when he stated that the most important feature for a perfumer to possess is a good olfactory memory.¹ Why is memory so important? When perfumers create a perfume, they do so from memory. The resulting composition is based not on sensations, but primarily on the memory of sensations. This is a cognitive process, not a sensory one.

The same process is critical for the expression of creativity in other domains. Painters need to know how a face will look from a multitude of angles, and how colors will harmonize or clash. These attempts are all performed on the canvas of the mind, long before the painter picks up a brush. Similarly, composers of music must know the timbres of the various instruments and the sound, look and feel of chords, and key structures.

Such expertise, gained at considerable cost, yields an interesting benefit. When the elements of one's craft and their potential combinations come to be so well represented mentally, it appears that one can continue to create

without additional sensory input. Consider, for example, Beethoven. His later deafness precluded his receiving any auditory feedback from his musical compositions, yet he could utilize his memory of the notes, the various instruments and their myriad combinations to create new musical compositions.

An obvious corollary of this logic is that a perfumer whose olfactory abilities had been lost might still be able to create perfumes on the blotter of the mind, based on the memory of all those once-experienced and now stored odors and their combinations. In the domain of perfumery, as in music and painting, true creative ability results primarily from years of deliberate practice which produce a vast interassociated network of mental representations of the elements (i.e., odorants) of composition.

Creativity and Preparation: The Ten Year Rule

The development of creative expertise in perfumery obviously requires a great deal of preparation, as does becoming expert in other domains. But can we predict the amount of time necessary to develop creative expertise in perfumery? From the extensive analysis of expertise in other domains, researchers have concluded that the amount of preparation necessary to achieve expert status in any creative field is rarely less than ten years. In the cognitive analysis of expertise, this has come to be known as "the ten year rule."

For example, master chess players use an enormous amount of chess-pattern knowledge in order to play a match. To acquire this knowledge, the chess player must spend thousands of hours in preparation—playing chess, reading chess magazines or analyzing the games of other players. It is extremely rare for anyone to reach the grand-master skill level with less than ten years of intensive study.¹¹ Even writers have their "ten year rule." An analysis of 123 of the most famous poets in the 19th century revealed that although they began to publish, on average, at age 25, those same individuals didn't produce their greatest work until age 35.¹²

In the field of musical composition, a bare minimum of ten years' experience is also necessary for excellence. A recent review estimated that an average of 20 years elapsed from the time an individual started to study music until that person first composed an outstanding piece of music.⁹ Even the child prodigy Mozart saw his productivity increase steadily for the first 10-12 years of his career. Although Mozart did produce works in the very early part of his career, those works were not masterpieces according to Hayes' retrospective analysis of the quality of those works.¹³ Hayes showed that Mozart did not produce any masterpieces until he had spent ten years in intensive training. Hayes extended this finding by analyzing the average masterpiece productivity during each year of the careers of 76 major composers. Again the ten year rule applied. Hayes showed that, on average, the 76 composers were at least 12 years into their careers before they began to produce

masterpieces at the rate of one or more per decade.

Although no formal study of the productivity curve of perfumers has been undertaken from this cognitive perspective, informal polling of a few senior perfumers revealed that the ten year rule may be highly applicable to success in perfumery as well. A relatively long period of apprenticeship and training appears necessary for a perfumer to create a masterpiece perfume. Throughout these long years of preparation before the muse speaks, the novice perfumer can take inspiration from the example that musical composers provide. For composers, the long period of preparation that is necessary to attain creative excellence in composition is balanced by an even longer period of creative productivity. Creative expertise that rests on a solid foundation of knowledge of the elements of the specific domain appears to flourish for many years. From the perspective of cognitive science, all artists, whether they are musicians, painters or perfumers, require a lengthy period of preparation to establish the necessary cognitive requisites for creative excellence. Once established, those cognitive skills can be utilized to create works of art, such as innovative fragrances, indefinitely.

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