LUNDS UNIVERSITET

INSTITUTIONEN FÖR PSYKOLOGI

Olfactory Memory and Verbal Overshadowing: Experts, Novices and the Effect of Objective Descriptions

Kristin Nordin

Kandidatuppsats ht 2009

Handledare: Mikael Johansson

Abstract

Examining the relation between olfactory memory and verbal processing, this study aimed at exploring the phenomenon of verbal overshadowing and its effect on novices' and experts' memory performance. Two main questions were asked; would olfactory memory be susceptible to overshadowing and would subjects, not only generating their own verbalizations but also being given objectively correct ones, show signs of recognition impairment? The results were predicted to show impaired performance for the novices in the verbalization conditions but not for the experts. The over all performance on the recognition test was too weak for allowing any generalizations, but in line with the hypothesis the weakest performance for novices was observed to be the self-generated verbalization condition. Surprisingly and contrary to the hypothesis, not only experts but also novices seemed to benefit from the objective descriptions.

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Olfactory Memory and Verbal Overshadowing: Experts, Novices and the Effect of Objective Descriptions

There are several theories surrounding the question of how language and verbalization processing can effect memory and recognition. Recognition performance is by some researchers suggested to be improved by verbalization tasks (Jones-Gotman & Zatorre, 1993; Lyman & McDaniel, 1990), but some studies show that recognition of certain stimuli might, on the contrary, be negatively affected by the stimuli being verbalized (Schooler & Engstler-Schooler, 1990; Melcher & Schooler, 1996). The phenomenon of recognition impairment caused by verbalization is referred to as verbal overshadowing and manifests it self when a mismatch between subjects' verbal and perceptual expertise is present. The inadequate description being generated through verbalization by someone lacking in verbal expertise in a particular field will instead of complementing the memory for the stimuli overshadow it and thus impair memory recognition performance (Schooler & Engstler-Schooler, 1990).

The idea that language and verbalization can interfere with the memories of perceptual stimuli, such as visual memories of faces or the memories of colors, provides an interesting aspect to the study of the perceptual memory processes. The present study investigated the olfactory memory and the recognition of odors' susceptibility to overshadowing by different types of verbalization tasks. Of certain interest was the idea that not only generating your own descriptions could affect the recognition performance, but that even being given objectively correct descriptions of the items could have an impact on recognition of the stimuli. Comparing novices to experts, novices were expected to suffer the negative consequences of verbalization, whilst experts were thought to avoid overshadowing and contrary to the novices, perhaps even benefit from the objective descriptions – this maybe being explained by the idea that their level of verbal expertise could enable them to connect those descriptions with appropriate prior knowledge in their semantic memory (see Gobet, 1998 for a review).

This essay starts with a look at the episodic and olfactory memory systems and also with a look at the theories surrounding verbalization in relation to recognition performance. Different studies have reached different results and examples of these will be examined in this introduction. The concept of verbal overshadowing will be elaborated in more detail and presented alongside the final inquiry and hypothesis of the study.

The episodic and semantic memory systems

Memories have been shown to differ in many aspects – the nature of their characteristics and the conditions by which they are both encoded and retrieved have made it possible to distinguish between different types of memory processes. One distinction that is commonly adopted and written about is the one between semantic and episodic memory. This distinction allows the existence of two different memory systems, each occupied with their own type of memories. The distinction entails that memories of personal experiences and the pure knowledge of facts fall into separate systems (Tulving, 1972). The semantic memory contains the foundation for our understanding of language, our knowledge of learned facts and relations between different concepts and their meanings. The episodic memory on the other hand, deals with the memories of our subjective experiences. Tulving (1972) argues that the spatiotemporal aspects of encoding plays an important role for episodic memory, where temporal relationships are represented as properties of items, while in semantic memory the temporal aspects hardly play a role at all – the encoding situation is central to the episodic memory and becomes a part of the memory it self; we remember learning the alphabet, but for the semantic memory it is not significant to remember learning something or under which circumstances we did so – we just know the alphabet.

Another difference between the two systems is that the conditions of retrieval differ greatly from one to the other. While it is, according to Tulving, possible to make inferences and generate knowledge about things you haven't originally encoded from facts stored in your semantic memory, it is not possible to do so from the memories stored in the episodic memory – the episodic memory process of remembering, can only be concerned with memories of actually encoded experiences (Tulving, 1972). So, since semantic memory involves the things we know, while episodic memory involves the things we remember – experiments aimed at studying remembrance of items deals with the episodic memory. However, the interaction between the two memory systems is an important aspect to take into consideration. Episodic memory can be affected by semantic memory; one possibility is the fact that semantic memory can influence attention which in turn influences experience and episodic memory (Goldstein, 2005). Semantically coherent material has also been suggested to enhance episodic memory performance by enhancing familiarity, indicating that the contents of semantic memory is important for episodic memory recognition (Greve, van Rossum & Donaldson, 2006).

Episodic memory rests upon the systems of the medial temporal lobe and among them the hippocampal area of the brain. These regions are central to many memory processes and studies have shown the negative impact that damages on these areas have on the ability to create new memories and access old ones (see Milner, Squire & Kandel, 1998 for a review). Apart from the regions shared with the semantic memory, the episodic memory system also depends on the frontal lobes; source amnesia, when patients have trouble remembering the context of the encoding – the experience of having encoded something – is an impairment of the declarative memory that has been discovered to correlate with damages on the frontal lobes, suggesting that this area also plays a part in episodic memory (Squire & Shimamura, 1987).

The fact that episodic memory seems to use parts of the brain that the semantic memory doesn't – parts that are relatively new in the development of the brain – is interesting and affects Tulvings' (2002) discussion of the possibility that the episodic memory developed out of the semantic memory. Additionally, the discovery of the frontal lobes' significance to the episodic memory brings an interesting aspect to his idea that the episodic memory is unique to humans. The temporal properties that are so important to our episodic memory, and the "sense of self in subjective time", are according to Tulving things that are missing in non human animals.

Olfactory memory characteristics and multi modal processing

Like the episodic memory, the olfactory memory is located in the frontal and medial temporal lobes. But it is also suggested that it is more dependent on the right hemisphere than it is on the left. The importance of the right temporal lobe and orbitofrontal regions of the brain for olfactory memory was investigated in a study that examined patients with damages to those areas on either the left or the right side of the brain. Patients with damages on their left hemisphere performed similar to the control group while patients with right hemisphere-damages had a significantly impaired performance. This indicates that the temporal and orbitofrontal areas of the right hemisphere of the brain have more involvement in olfactory memory than the same areas of the left hemisphere (Jones-Gotman & Zatorre, 1993).

One characteristic of the olfactory memory is the slow forgetting-curve that is manifested in

the results of recognition and identification tests. Olfactory stimuli seem to be hard to forget. In studies concerning long-term memory for odors subjects show little sign of forgetting the items presented to them, even after several months (Engen & Ross, 1973; Lawless & Cain, 1975). One explanation that has been suggested is that odors are encoded as relatively featureless items. An encoded item with few features are thought to be easier to match correctly in the test phase of a recognition experiment, than one with many features. There is less to be confused by and interfered with (Schab, 1991).

A commonly accepted idea is that processing stimuli in multiple ways can have positive effects on recognition. One account that revolves around this thought and offers an explanation is the theory of dual coding (Paivio, 1990). It suggests that two independent memory subsystems – one verbal and one nonverbal/symbolic, that are structurally and functionally distinct, both contribute to the memory and recognition of different stimuli. Verbalizing perceptual items would mean creating two traces/codes to rely upon during retrieval that in turn would enhance the chances of accurate recognition.

The recognition capacity for odors and its relation to verbalization as a processing modality has been tested in a number of studies – if the idea of dual codes and the positive effects of verbally processing perceptual items also characterizes olfactory memory. While studying the hemispheric aspects of olfactory memory, Jones-Gotman and Zatorre (1993) also explored the effects of verbalization on recognition performance. They found that the verbalization tasks given to the subjects aided their memory for the presented items. Comparing the recognition for labelled items with the recognition for nonlabelled items showed a small, but significant difference – labelled items were better recognized than the nonlabelled items. This result held up across the different groups (right/left hemisphere patients and controls) in the study.

Not only verbal processing but also elaboration of other kinds, for example visual, has been found to enhance recognition performance. An experiment that tested subjects' recognition of odors in relation to the odor names, their picture or just the experience of the odor it self – reached results that indicated that subjects who processed the items in multiple ways performed better in the test phase. That is, smelling paired with verbalization and smelling paired with visual tasks led to better results than what just smelling or just processing an odor name did – results that align with the concept of dual coding theory (Lyman & McDaniel,

1990).

Despite these positive results of how verbalization can affect memory and recognition, there have also been studies getting results that show no enhancement of memory in relation to verbalization tasks. Testing the long-term memory for odors, Engen and Ross (1973) found that the subjects who completed verbalization tasks in connection to the items did not perform better than those who didn't process the items verbally. The odors were recognized very well even after a longer period of time, but not in correlation to the verbalization factor. After also getting results that indicated no positive effect of the verbalization tasks, another study came to the conclusion that even though the memory system for verbal stimuli and the memory system for odors differ greatly from each other, the two subsystems do not complement each other like they are sometimes described to (Lawless & Cain, 1975). What the researchers did find was that the familiarity and pleasantness of the odors correlated with each other, but that it did not significantly affect the recognition for the items. As Engen and Ross, Lawless and Cain observed a very slow deterioration of memory for the odors.

Verbal overshadowing

Challenging the notion of verbal processing having none or only positive effects on memory and recognition performance is the theory of verbal overshadowing (Schooler & Engstler-Schooler, 1990). It states that verbal processing risks interfering with perceptual memories and lessen their chances of being remembered, instead of increasing recognition accuracy. This overshadowing especially effects those memories that are difficult to communicate verbally – when non-verbal or non-verbalizable stimuli, such as colors and tastes, are the objects of verbalization, the original perceptual memory of the stimuli will risk getting overshadowed by the verbalization of it (Schooler & Engstler-Schooler, 1990; Melcher & Schooler, 1996). It is the stimuli that is hard to verbalize that suffers the most from the overshadowing, because it is this stimuli that is most often involved in cases of mismatch between subjects' verbal and perceptual expertise. When individuals are better at experiencing objects than they are at describing them, a mismatch between these two abilities occurs. It is this mismatch that can be held responsible for the, all of a sudden, negative effects of verbalization. For a person that is lacking in verbal expertise, the verbal code produced by verbalizing the stimuli will hinder more than it will help recognition since it is not sufficiently related to the actual perceptual memory. You could say that the mismatch creates an exception

for the dual coding's positive effects on memory. With target items that are verbally similar to the distractors, subjects recognition performance will risk severe impairment (Schooler & Engstler-Schooler, 1990).

There are several accounts tying to provide explanations for verbal overshadowing. One of the most commonly accepted ones perceives the overshadowing as a recoding interference phenomenon where a recoded representation, generated through verbalization after the encoding of the original stimuli, takes over and shuts out/overshadows the perceptual memory (Schooler & Engstler-Schooler, 1990). The recoding interference hypothesis is linked to the account that explains the overshadowing by referring to the content of verbalizations. Other explanations describe the overshadowing as a result of process shifting or a shift in response criterion from a liberal way of thinking to a more conservative way when deciding how to classify the item in the test phase (Chin & Schooler, 2008). One study that can give support to the content account for explaining the negative effects of verbalization on perceptual memory, is Melcher and Schoolers (1996) wine-tasting experiment. With the general idea that the overshadowing is created by a mismatch between perceptual and verbal expertise, the researchers compared three groups with different levels of knowledge about wines. Novices, intermediates and experts all completed verbalization tasks after encoding the target wines, and as predicted – the intermediate group (that had a higher perceptual expertise than they had verbal expertise) showed significantly impaired recognition performance compared to the other groups and the control group. Experts, with a smaller mismatch between their perceptual and verbal expertise, avoided the overshadowing – as did the novices. Surprisingly, this group even seemed to improve their recognition accuracy by verbalizing the items. Since both intermediates and experts verbalized the items, researchers came to the conclusion that the differences in performance must stem from the content of the verbalizations and not just the fact that the stimuli were verbalized.

If the overshadowing effect depends on the content of the verbalizations, it is not wrong to expect the quality of the content, the quality of the verbalizations, to correlate with recognition performance – but this has not been the case and therefore the content account for explaining verbal overshadowing leaves some aspects unexplained (Chin & Schooler, 2008). One interesting variable to look further for in this situation is the subjects' confidence in their verbalizations – maybe being aware of ones lack of mismatch between verbal an perceptual

expertise in an area is a significant part of what escapes the overshadowing.

Verbal overshadowing can be analyzed without referring to the content of the verbalizations, and instead explained by highlighting a possible process shift. When observing faces the process in use is holistic – we take every part of the face into account, and experience a "whole". But when asked to describe a face we verbalize the parts, not the whole, thus shifting the holistic/global process towards a more local one which will not aid, but rather impair in later recognition testing (Chin & Schooler, 2008). The observed fragile nature of verbal overshadowing is also something this process shift theory accounts for. In a series of experiments Schooler and Engstler-Schooler (1990) studied the phenomenon of verbal overshadowing for both stimuli such as faces and colors. They termed the phenomenon verbal *overshadowing* after observing how the impairment could disappear. When forcing subjects to discriminate quickly between target items and distractors (giving them a short recognition-period) the overshadowing did not seem to affect them very much. Process shifting could explain these temporary and reversible qualities of verbal overshadowing. Further, the recognition criterion shifting account suggests that subjects attitudes while choosing/deciding how to classify the items in the test phase is what shifts and thereby affects the recognition results. After verbalizing the target items subjects become more prone to choosing the "not present" option if there is one. If this is the case, it will have a negative impact on recognition scores. This account, as well as the process shift account, offers explanations that has nothing to to with the content of the verbalizations, but rather the mere fact that verbalization occurs and changes our way of thinking (Chin & Schooler, 2008; Clare & Lewandowsky, 2004).

Taking in to account the previously reviewed research on episodic and olfactory memory, and the act of verbalizations' possible consequences for recognition performance – both positive and negative – this study aimed at exploring the phenomenon of verbal overshadowing in connection to the field of olfactory memory. Although olfaction and recognition has been studied prior to this study, as well as verbal overshadowing has – the two combined constitutes an interesting contribution to the field of memory research. Of certain interest to this study was the difference in verbal and perceptual mismatch between novices and experts and what implications it would have; with the additional inquiry of how the two groups would be effected by studying objective verbalizations (i.e accurate descriptions) of the items in relation to just generating their own. Note that the novices in the present study are not novices

in the same sense as the novices in Melcher and Schoolers wine-study from 1996, but rather like their intermediate group. Experts were predicted to show no sign of verbal overshadowing for their own generated descriptions while novices on the other hand were expected to show recognition impairments after generating their own descriptions of the items. The objective descriptions were thought to be able to help experts' performance, but not the performance of the novices – who without the necessary vocabulary for odors would have a hard time benefiting from them.

Method

Participants

9 men and 12 women with the mean age of 23,3 participated in the experiment. The participants were categorized into two groups; *experts* with formal training or extensive experience of the wine industry, and *novices* who had had no such training or experience and were thought to have a considerably lower verbal expertise concerning odors. The experts were graduating students from the sommelier school Gustibus in Malmö Sweden, and all of the novices were volunteering students from different faculties of Lund University. In total the experiment included 3 experts and 18 novices. All participants were asked not to wear any perfume or other scent during the experiment in order to not interfere with the items in the study. Of the participants, 3 were smokers.

Material

The test material used in the study consisted of 60 different combinations of odors. Each combination was a mixture of three essential oils, balanced so that the intensity of each oil was similar to the others. No two oils occurred together more than once in order to make the combinations as distinctive as possible. In all, 33 essential oils were used to make up the 60 combinations. Examples of combinations are; a) lemon, lavender, rosemary and b) ginger, sage, clove. The reason for combining odors and not presenting them in their original form was to enable the participants to generate vivid and detailed descriptions of more complex stimuli. All of the odor combinations were mixed and kept in 10 ml brown colored glass bottles. The 60 combinations were divided into two groups, A and B, in order to function as both old and new items, and those two groups were in turn divided into three sets – one for each condition of encoding.

The test material also included the compendium containing the tasks given to the participants to complete after the presentation of each item. The compendium included three types of tasks connected to the encoding conditions, two of which were verbalization-oriented and one functioning as a distracter (cf. baseline task). The first verbalization task consisted in generating short descriptions of the combinations while the second verbalization task consisted in studying and reflecting upon the names of the ingredients in the combinations. The distraction task consisted in solving simple math problems.

Procedure

The experiment had two separate phases, following the procedure of an episodic recognition test where participants first study a part of the test material and in the test phase have to distinguish the studied items from items being presented to them for the first time. Any effect of the verbalization tasks in the study phase are manifested in the results on the recognition test in the test phase – evidence of verbal overshadowing should thereby be apparent from the participants' results on the recognition test.

For this experiment the participants were divided into two main groups who each studied 30 of the 60 different odor combinations, either those from group A or group B. Each main group of participants was divided into smaller test groups and participants were tested 3-6 at a time. The order of presentation was randomly decided and balanced across the smaller test groups.

The testing took place in a small classroom where the participants sat two at one table, as far from each other as possible. During the study phase, each item was briefly presented to the participants individually, just long enough for them to take one sniff. They were instructed to complete one of three tasks after every item; either they were supposed to a) generate their own description of the item, b) study the objective list of ingredients, or c) solve simple math problems to distract them from verbalizing their experience of the item. A participant completed the same type of task ten times before switching to the next type. These tasks were both counterbalanced across the participants and their level of prior knowledge. In between the presentation of every two items, participants were asked to briefly smell fresh, grounded coffee in order to prevent overloading the olfactory system.

When all participants in the test group had completed their task, the following item was presented and so on until all 30 odor combinations had been presented. At the end of the session every item had been followed by every type of task. The study phase took 45 minutes and was followed by a 15 minute retention period during which participants were given a newspaper article along with instructions to find different things in it – such as the 3 longest sentences, every occurrence of the combination "ng" or all of the punctuations and so on until the time period was over.

In the test phase, participants received all of the 60 items to smell in a randomized order, unique for each group. Their assignment was to decide whether or not the item presented to them was old or new – if they recognized it or not. They did this by circling the alternative of their choice on a test sheet they were given. At this stage, each item could for every participant be either old or new and had been followed by one of the three tasks from the study phase. Their answers could fall into four categories, depending on its match to the actual status of the item. If a participant answered "old" when the item was old, the answer would be a *hit*. The answer "old" when the item was new would fall under the category of *false alarm*, the answer "new" when the item was old would fall under the category *miss* and if participants answered "new" when the item really was new it would count as a *correct rejection*.

Table 1. *Model for classifying recognition test responses.*

Item Status Response	New	Old
"Old"	False alarm	Hit
"New"	Correct rejection	Miss

The order of presentation during the test phase was counterbalanced across the smaller test groups. The test phase lasted approximately 45 minutes – in all, the experiment took about 1h and 50 min to complete. Participants were informed of all the stages in the experiment beforehand and were asked to sign a consent form before the start of the first phase. After the completion of the experiment the participants were given more information about the phenomenon of verbal overshadowing and informed of the hypothesis of the study.

Results

Only the data from the novice group was analyzed using statistical methods – the collected data from the group of experts was considered too sparse to be analyzed using any statistical method. Below, the results are presented, but for the expert group only the means for each condition.

Novices

Recognition memory performance for the odors in the three conditions Generated verbalization, Objective verbalization and No verbalization was calculated after the model Pr= p(Hit) – p(FA) (Snodgrass & Corwin, 1988) and then entered in to a one-way repeated measures analysis of variance (ANOVA). While calculating the novices response it became obvious that the performance was over all very poor, effecting the analyzability of the data. The discrimination performance, Pr value, in the three conditions were tested against a value of 0 (indicating no above-chance discrimination performance) with a one-sample t-test and revealed above-chance performances in both the conditions of Objective verbalization ($t(17) = 2.53$, $p = .022$) and No verbalization ($t(17) = 2.16$, $p = .045$), but showed no such performance in the condition of Generated verbalization ($t(17) = 1.07$, $p = .300$). The ANOVA did not show any significant differences between any of the conditions, suggesting no effect of verbalization on recognition performance; $F(2,34) = .71$, $p = .50$, but the way too weak performance makes it hard to draw any such conclusion from those results. The means and standard errors are presented in Table 2. From looking at the means a small difference between the two verbalization conditions can be found. The mean performance in the condition Objective verbalization is slightly better than the performance in the condition of Generated verbalization, which also shows a lower mean performance than the distractive, control condition of No verbalization.

Table 2. *Descriptive Statistics for recognition performance for conditions Generated, Objective and No verbalization for novices.*

Condition	N	*M*	*SEM*
Generated verb.	18	0.06	0.05
Objective verb.	18	0.13	0.05
No verbalization	18	0.11	0.05

Experts

The group of experts response was not statistically analyzed, but as with the response of the novices, it was calculated according to the formula of Pr= p(Hit) – p(FA). Comparing the mean performance in the conditions it becomes clear that a difference between the two verbalization conditions and the control condition of no verbalization exists. According to the means presented in Table 3, experts' performance is best in the objective description condition and the worst in the control condition where no verbalization was made.

Table 3. *Descriptive Statistics for recognition performance for conditions Generated, Objective and No verbalization for experts.*

Condition	N	*M*
Generated verbalization	3	0,22
Objective verbalization	3	0,26
No verbalization	3	0,16

Discussion

The results from the novice group unfortunately do not tell us much about the main question of the study, or its hypothesis. The experiment was designed to examine individuals memory of odors in relation to verbalization, but nothing that either supports or refuses the hypothesis that verbalization would cause memory impairment through verbal overshadowing can be found in the results. None of the conditions was by the analysis found to have a significant effect on memory recognition – but this does not mean that none of the conditions is not capable of having such an effect anyway in a differently conducted experiment. Over all, the observed memory performance is too weak to function as a basis for any conclusions about verbalizations' consequences for odor memory. Further, not only is it impossible to state something about the effects of generating ones own descriptions of the items on memory performance, but the additional question of how receiving objectively correct descriptions of the items would effect recognition performance can not be answered either. It seems as though the experiment and testing was too demanding and too difficult to generate any useful results – subjects' performance just did not reach an adequate level of analyzability. However, it is worth noting the results of the t-tests analyzing discrimination performance each condition.

The condition of Generated verbalizations did not show a significant discrimination performance while the other two conditions did. The condition predicted to display the weakest performance thereby did. This nourishes the thought of seeing significant effects of verbal overshadowing and indicates that an experiment that would be less difficult for subjects (thereby with increased performance in the conditions), would hopefully show significant differences between the condition of Generated verbalizations and the other two, who actually show an above-chance discrimination performance. Results like these would contribute to the general knowledge of memory functioning and its relation to multi modal coding and specifically verbalization processing. It would also tell us about the difference between generating and being given descriptions and what importance this distinction has to memory performance.

Explaining the weak recognition performance

A number of variables can be referred to in the discussion of what it could have been that brought on these insufficient results. The first and one of the most obvious factors to discuss is the items used in the experiment, and first of all the number of items. Subjects were given 30 different odor combinations to study and encode, and were then supposed to distinguish these from 30 new ones in the test phase. This large number of complex stimuli might have been too much for the subjects to handle – giving them a task of this sort might have been expecting too much.

In combination with the number of items, an important thing to notice is the character of the items. In order to promote subjects to generate as vivid descriptions as possible, each item was made up by three different odors. Given the limited amount of essential oils available this made the 60 odor combinations quite similar to each other. One solution would maybe have been to make the groups A and B as distinctive as possible, hopefully making it a bit easier for the subjects to discriminate between old and new odor combinations in the test phase. At the same time, verbal overshadowing is thought to manifest it self when the target stimuli is verbally similar to the distracter stimuli (Schooler & Engstler-Schooler, 1990). This might still have been the case though, even if the groups A and B had been less alike – one can imagine that the items just by being combinations of essential oils would have been sufficiently alike to the novices, even if as distinct as possible.

Another aspect of the experiment that has to be considered is the different time intervals. First, the subjects completed each task in just a couple of minutes – maybe this led to the verbalizations not being elaborative enough. With a smaller number of items the encoding time and the verbalization time for each odor combination could have been longer without making the entire experiment too long and too tiring for the subjects. Enabling encoding by giving it more time would maybe have had a chance of making the recognition performance better. Second, the 60 items presented in the test phase might have made the test phase too long. An alternative could have been to have two separate test phases, or as mentioned before – decrease the number of items in the experiment so that subjects could have been presented with maybe just 30 odor combinations in the test phase. One negative side of having a long test phase with many items is that subjects risk getting confused. Is the items they smell in the end of the testing really "old" or from the beginning of the test phase? With very similar items and a long test phase it becomes hard to just discriminate between old and new items – the test phase becomes a third factor and risks interfering with it self. Testing subjects for one condition at a time would also have been an alternative – conducting the experiment in three blocks, each with one study and one test phase.

A third time aspect, connected to the test phase, has to do with the time given for recognition. A short time for deciding between classifying the item as either "old" or "new" has been shown to eliminate the overshadowing effect (Schooler & Engstler-Schooler, 1990). The present experiment did not supply subjects with very much time for a decision, but even if it had – it still seems as though the number of items and the similarity between them would have caused a poor performance quality, not giving the overshadowing a chance to manifest it self in the first place.

One aspect of this study that is as obviously in need of a discussion as the aspect of the items, is the number of subjects. In order to get a stronger result and more data to base any conclusions on, the sample should have been much larger. Unfortunately this study did not reach an ideal amount of subjects, but again – the observed lack of any satisfying performance indicates that even a bigger number of subjects would have found the testing difficult. Once more, it is the number and the nature of the items that seems to dominate the effects in the performance. Even though a larger sample would have increased the chances of seeing stronger tendencies and would maybe have resulted in bigger differences between the

conditions it would probably not have been able to, on its own, increase the chances of seeing any generalizable effect of verbal overshadowing. It remains a fact that performance was far too weak. As long as the problematic situation with the odor combinations remains, the much important aspect of the number of subjects unfortunately has little influence on the generalizability of the results in the present study.

Interpreting the memory recognition results

The results do not tell us much about the relationship between olfactory memory and verbal overshadowing. The novices' performance on the recognition test was far too poor for supplying any ground for conclusions about verbalizations effect on odor memory. But this experiment has qualities that could still be learned from. It provides us with a type of measurement of what is clearly too difficult for subjects and what exceeds their recognition capacity. Although conclusions can not be drawn when it comes to verbal overshadowing – conclusions about other factors effecting memory capacity for odors can. The amount of items in the present study, the similarity between the items and the time given for encoding and recognition are all marking important limits of capacity for odor memory.

As mentioned, in the novice group no statistically significant differences between the three conditions can be spotted, even though a small difference in mean performance between generated descriptions and objective descriptions is present. Novices performed the best with items followed by the objective descriptions, then with the items followed by the distracting math tasks and lastly with the items preceding the generating of verbalizations. Contrary to the hypothesis of the study, it seems like the objective descriptions/verbalizations actually had either slightly positive consequences for recognition, or not as negative consequences as the other conditions. Novices were thought not to be able to benefit from the objective descriptions in a noticeable way, since their level of verbal expertise perhaps would not have been able to connect their own experience of the odors to a description outside of their referential frames. Considering the possibility that the novices verbal expertise in the field of odors actually was higher than initially expected (that they were less of “verbal-novices” than assumed), maybe the objective descriptions did manage to eliminate a bit of the mismatch (in the same way this was expected to happen for the experts). The condition that was expected to show best performance was the distractive condition of No verbalization. It did not turn out that way, since the objective descriptions surprisingly came out on top. What did align with

the hypothesis though, is the fact that generating your own descriptions/verbalizations of the items gave the lowest performance on the recognition test. This is clearly an example of an observation that could potentially have more forcefully indicated something about the relationship between verbalization and olfactory memory – given a larger number of subjects and a smaller, more divers, set of items.

Looking at the experts' results and just by conducting a rather direct examination of the mean performance for each condition, a difference between the two verbalization conditions and the control condition can be found. The experts performed generally better than the novices and results clearly show a rather noticeable difference in means between the condition of Objective verbalization and No verbalization for the expert group. That the two verbalization conditions resulted in a higher performance is what the hypothesis predicted. The experts were never thought to be effected negatively by verbalization, and it seems now there is a chance that they were not – even though one should not aspire to make generalizations from these results when the performance level still is an issue and the size of the expert group leaves much to ask for. But speculating around the means may still be interesting. Experts seem to benefit from processing the odors verbally and they also show signs of benefiting extra from the objective descriptions. The interaction between semantic memory and episodic memory can be referred to in order to shed some light on the experts' superior memory performance. There are several accounts trying to explain expert memory (see Gobet, 1998 for a review), one of which is focused around how prior knowledge stored in the semantic memory; its encoding, organization and retrieval, enables experts' performance. Considered together with the idea that attention gets influenced by semantic memory and in turn influences experience and episodic memory (Goldstein, 2005), the difference in levels of verbal knowledge among novices and experts explains why experts perform better than novices – who does not have as much prior verbal knowledge stored to rely on. Since semantic memory is important for episodic memory, and since the contents of novices' semantic memory in this case is too weak – they, unlike the experts suffers the negative effects of verbalization on recognition memory. Further, one can discuss the possibility of explaining these results with one of the the accounts for verbal overshadowing (Chin & Schooler, 2008). For example the content account would take into consideration the level of prior semantic knowledge; both experts and novices completed the same tasks – but still, experts performed better – suggesting that the content of their verbalizations helped them

more than the content of the novices' verbalizations helped the novices. But the process shift account could also be interpreted and applied here; even though experts, like the novices, might have described the parts making up the stimuli and not the “whole” – they might be better at connecting these parts and still understand it as something whole, relatable to the item, assuming that their verbal knowledge allow them to make descriptions closely related to their experience.

Both novices and experts performed best in the Objective verbalization condition. But the groups differ from each other in the other conditions. For novices, the self-generated descriptions led to the weakest results, while for the experts both verbalization conditions out performed the No verbalization condition. This is a really interesting result because, although a very fragile one, it is pointing in the right direction according to the hypothesis. The most interesting task of this experiment is trying to understand why the objective descriptions seemed to work for the novice group as well as for the experts. One interesting possibility that might explain parts of this is the idea of confidence. Judgments of confidence have been proven to function as good predictors for memory accuracy – a positive correlation between confidence and memory accuracy was detected in an experiment that examined memory for deceptive and non-deceptive sentences, where confidence was defined as an inferential process based on the cues available to subjects and their beliefs in the relation between those cues and memory accuracy (Brewer, Sampaio & Barlow, 2005). If a correlation like this, which makes confidence a candidate for predicting memory recognition performance, also could be detected in odor memory – it might be able to be used in explaining the results observed in the Objective condition of the present study. In the case of the novice group the confidence explanation might sound a bit like this; assuming that the novices in the study might have had a higher level of verbal expertise in the field of odors than initially expected (although still sufficiently low to create a mismatch, since novices performed the worst after generating their own verbalizations), getting their experiences confirmed by the objective descriptions could have increased their confidence levels and had a positive effect on recognition. This would also explain why the self-generated, unconfirmed descriptions showed the lowest mean performance. For experts – their self-generated descriptions do not need the confirmation as bad as the novices' do but do instead already contain a certain amount of confidence, and thereby they manage better than the descriptions in the control condition. Additionally, the objective descriptions may just be thought to provide extra

confidence. This is an account that covers both groups. Further, the phenomenon of "feeling of knowing" (FOK), connected to confidence, can be referred to when examining the difference in results between novices and experts. Koriat (1993) aimed at understanding the underlying mechanism of what it is that makes us know that we know something. One part of his discussion dealt with the importance of the effectiveness of memory storage and retrieval. If experts are thought to outshine novices in these aspects, as some accounts suggest (see Gobet, 1998 for a review), it is not wrong to assume that they will also be able to make more accurate FOK judgments, and in turn increase confidence and recognition performance.

To summarize, this study that examined the relationship between olfactory recognition memory and verbalization reached results both insufficient for generalizations, but worth discussing and speculating around at the same time. The main question of the study was weather the olfactory recognition memory was at risk of getting effected by the phenomenon of verbal overshadowing or not, with the additional question of if and how objectively correct descriptions would have an effect on recognition performance for odors. Although performance was over all too weak to say anything about, comparing the initial discrimination performance and the means between the conditions still encouraged a discussion about some differences that could be discovered. Both novices and experts performed the best in the condition where they were given objective descriptions to study, but the groups differed from each other in the other conditions. As hypothesized, the novices' performance was weakest when they had to generate their own descriptions, but the experts did not show a comparable "impairment". The, in this study, unmeasured factor of confidence was offered as a possible explanation for these results, suggesting that something else than just a too low level of verbal expertise among the novices caused the self-generated descriptions to lead to the lowest performance. If it only came down to the assumed low verbal expertise – the fact that novices seemed to benefit from the objectively correct descriptions would be hard to explain.

For future record, some important parts of this study and the experiment should be taken into consideration. The relation between verbal overshadowing and olfactory memory recognition is an intriguing object to examine further, but with better-suited equipment. The items should not be too many or too alike. Nor should recognition be tested all together in one long test phase. Experiments would definitely benefit from having more subjects and also including more factors such as a measurement of confidence, in order to research a possible explanation

for the objectively correct descriptions' surprisingly positive effects. Other interesting factors such as motivation and emotion could also be incorporated in studies wanting to examine the reasons behind the performance level in the Objective condition. Maybe experts are more motivated and maybe they have stronger emotions connected to olfaction that might cause they superior performance. Future studies have great chances of developing the questions and hypothesis of this study, and not only get *signs* of tendencies, but most likely even be able to say something generalizable about the interesting phenomenon of verbal overshadowing and the nature of olfactory memory.

References

Brewer, W. F., Sampaio, C., & Barlow, M. R. (2005). Confidence and Accuracy in the Recall of Deceptive and Non-deceptive Sentences. *Journal of Memory and Language, 52,* 618-627.

Chin, J. M., & Schooler, J. W. (2008). Why Do Words Hurt? Content, Process, and Criterion Shift Accounts for Verbal Overshadowing. *European Journal of Cognitive Psychology, 20,* 396-413.

Clare, J., & Lewandowsky, S. (2004). Verbalizing Facial Memory: Criterion Effects in Verbal Overshadowing. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 30*, 739-755.

Engen, T., & Ross, B. M. (1973). Long-Term Memory of Odors With and Without Verbal Descriptions. *Journal of Experimental Psychology, 100,* 221-227.

Gobet, F. (1998). Expert Memory: A Comparison of Four Theories. *Cognition, 66,* 115-152.

Goldstein, B. E. (2005). *Cognitive Psychology: Connecting Mind, Research and Everyday Experience.* Thomson Wadsworth, Belmont CA.

Greve, A., van Rossum, M. C. W., & Donaldson, D. I. (2006). Investigating the Functional Interaction Between Semantic and Episodic Memory: Convergent Behavioral and Electrophysiological Evidence for the Role of Familiarity. *NeuroImage, 34,* 801-814.

Jones-Gotman, M., & Zatorre, R. J. (1993). Odor Recognition Memory in Humans: Role of Right Temporal and Orbitofrontal Regions. *Brain and Cognition, 22,* 182-198.

Koriat, A. (1993). How do we Know that we Know? The Accessibility Model of the feeling of Knowing. *Psychological Review, 100,* 609-639.

Lawless, H. T., & Cain, W. S. (1975). Recognition Memory for Odors. *Chemical Senses and Flavor, 1,* 331-337.

Lyman, B. J., & McDaniel, M. A. (1990). Memory for Odors and Odor Names: Modalities of Elaboration and Imagery. *Journal of Experimental Psychology: Learning, Memory and Cognition, 16,* 656-664.

Melcher, J. M., & Schooler, J. W. (1996). The Misremembrance of Wines Past: Verbal and Perceptual Expertise Differentially Mediate Verbal Overshadowing of Taste Memory. *Journal of Memory and Language, 35,* 231-245.

Milner, B., Squire, L. R., & Kandel, E. R. (1998). Cognitive Neuroscience and the Study of Memory. *Neuron, 20,* 445-468.

Paivio, A. (1990). *Mental Representations: A Dual Coding Approach* (chapter 4). Oxford University Press, New York.

Schab, F. R. (1991). Odor Memory: Taking Stock. *Psychological Bulletin, 109,* 242-251.

Schooler, J. W., & Engstler-Schooler, T. Y. (1990). Verbal Overshadowing of Visual Memories: Some Things are Better Left Unsaid. *Cognitive Psychology, 22,* 36-71.

Snodgrass, J. G., & Corwin, J. (1988). Pragmatics of Measuring Recognition Memory: Applications to Dementia and Amnesia. *Journal of Experimental Psychology: General, 117,* 34-50.

Squire, L. R. (2004). Memory Systems of the Brain: A brief history and current perspective. *Neurobiology of Learning and Memory, 82,* 171-177.

Squire, L. R., & Shimamura, A. P. (1987). A Neuropsychological Study of Fact Memory and Source Amnesia. *Journal of Experimental Psychology: Learning, Memory and Cognition, 13,* 464-473.

Tulving, E. (1972). Episodic and Semantic Memory. In E. Tulving & W. Donaldson (Eds.), *Organization of Memory* (pp. 381-403). Academic Press, New York and London.

Tulving, E. (2002). Episodic Memory: From Mind to Brain. *Annual Reviews Psychology, 53,* 1-25.