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The effect of the ageing of crime scene objects on the results of scent identification line-ups using trained dogs

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Abstract

In a scent identification line-up, a trained dog matches the scent trace left by a perpetrator at the crime scene to the odour of a suspect in a line-up of different odours. The procedures are strictly defined and the results are routinely used by the police and as evidence in court in a number of European countries. This paper describes the effect of ageing of the odour trace collected at the crime scene on the performance of the dogs in recognising the perpetrator in a line-up. The results show that whilst the dogs perform faultlessly in matching odours collected on the same day, the results drop to a lower level and become more variable in the period studied (2 weeks to 6 months). However, the results do not show a systematic decrease in performance. A possible explanation is the development of a steady state in the glass jars containing the perpetrator odour trace after initial differential evaporation of components of the residue or break down of unsaturated components into saturated ones. Prevention of this initial change may prevent the drop in performance observed in this study, thus increasing the reliability of these scent identifications.

Keywords: Scent; Identification; Canine; Ageing

1. Introduction

A scent identification line-up is a procedure where a trained dog works in a match to sample set-up. Usually, the dog is given scent collected in some way at a crime scene as a sample, and is asked to compare this odour with a number of odours in a row, one of which is the odour of the suspect. Scent identification line-ups are performed in a number of European countries, and accepted as part of the evidence presented in court [1].

Research conducted in this field is slow work and fraught with difficulties. It takes a long time to train a dog, and therefore the numbers of dogs available at any time is low. The police who train the dogs prefer to use them for operational cases instead of keeping them available for research. The performance of the dogs can be variable. Sometimes a dog is retired early when it does not perform well. Collecting odours for research purposes is time consuming and it is sometimes difficult to find sufficiently large groups of people willing to co-operate in giving their odours. Learning effects can influence results if the same group of people is used in successive experiments. This has led to a situation where the results are accepted in court, but there are still questions about the scientific base and the reliability of the results [2].

Continuing research efforts are being made especially in Poland and in Holland. Much research focuses on the effect of variables such as contamination or masking and the possible use of other odour cues than the unique individual odour of a person. However, one basic question of these line-ups has not yet been addressed. In the majority of cases, the sample odour collected at the scene of the crime is collected some time before the possibly matching odour of the suspect. Given its volatile nature, odour traces change with time, as is known from perfumes. The chemical composition of residue on objects after handling has also been shown to change with time [3]. The effect of these changes caused by time on the performance of the dogs has not been studied yet.

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This paper describes two experiments conducted in The Netherlands. The first experiment followed a set-up designed to obtain a lot of information in a minimal time, the second experiment was conducted following the usual scent identification line-up protocol used by the police in The Netherlands.

2. Material and methods

2.1. Experiment 1

2.1.1. Subject

Dog A: German Shepherd cross breed, male, age 8 years.

2.1.2. Material

Odours were collected on three different kinds of material: stainless steel metal tube, PVC electric tubing, or cotton cloth.

Eight different males contributed target odours on the three kinds of material on eight occasions during half a year. They did this by keeping an object with them for 10 min in a pocket, and rubbing it well between their hands for a short while. In this way, 187 target odours were collected (on five occasions, the target person forgot). For each target odour, four similar foil odours were collected from different people at the same time and on the same kind of material as the target odour.

2.1.3. Experimental set-up

Five jars containing odours were placed in a circle. During a test, the dog had to search for the odour of a specific target person during nine trials. The first of the nine trials was a ''priming'' trial, where the dog was given the target odour amidst unscented pieces of similar material. In the subsequent eight trials, the target odour was presented among four similar foil odours. The position of the target odour was random. The age of the odours was increased in steps: 0, 2, 4, 8, 12, 16, 20 and 24 weeks. The dog handler did not know the position of the target odour, and signalled when the dog made its response (lying down, or standing over the jar of its choice). A correct choice was rewarded with a retrieving game (the handler would pretend the toy came out of the chosen jar, the usual training reward). After a no-recognition (the dog had smelled all of the jars at least once but did not react to any of the odours) or an incorrect choice (a full response as interpreted by the handler for a non-target odour), the first priming trial was repeated to refresh the memory of the dog and to standardise that each trial was preceded by a ''successful'' trial that had led to a reward.

2.2. Experiment 2

2.2.1. Subjects

Dogs B–K: Malinois and German Shepherd cross breeds, three females, seven males, varying in age from 2–7-year-old. Two of these dogs were operational German dogs, the others were operational Dutch dogs.

2.2.2. Material

To simulate odour traces left at a crime scene, 10 different target people were asked to scent 8 pieces of cotton cloth at time 0 by holding them in their pocket for some minutes, and rubbing them well between their hands. The cloths were packaged separately in glass jars with a twist off top. The odours for the line-up were collected in the official way at time 0, and 2, 4, 8, 12, 16, 20 and 24 weeks later. For each line-up, the target person and six others (foils) were asked to scent stainless steel tubes by holding them in their hands for approximately 2 min. One foil was also asked to scent a piece of cloth for the control trial in the protocol. The tubes (and the control piece of cloth) were packaged separately in glass jars with twist-off tops. This material was used within a week for the line-ups. Each of the dogs worked with the odour of a single target person.

2.2.3. Experimental set-up

The tubes were clamped in holder on two platforms, each platform containing the odours of the target person and the six foils, but in a different sequence as determined by dice. The protocol followed five steps:

1. Match the odour of the control cloth to the matching control foil odour in row 1;
2. Match the odour of the control cloth to the matching control foil odour in row 2;
3. Evaluate the interest for the dog for the target odours in the line-up;
4. Match the odour of the simulated crime scene cloth to the target person in row 1;
5. Match the odour of the simulated crime scene cloth to the target person in row 2.

For steps 1, 2, 4 and 5 the handler would stand in front of the row with his dog, and give the dog the sample scent. After a command ''search'', the dog would search for a matching odour on the platform. The handler did not know the position of the matching odour, and observed his dog. When his dog indicated its choice, the handler would raise his hand, and would be given a signal (red/green light) to inform him if the correct choice had been made. If the dog made a correct choice, the tube would be released from its holder, and the dog was allowed to run around with it for a while and bring it to its handler as a reward. After an incorrect choice, or if the dog did not make a choice at all, the handler would recall the dog and it would not be rewarded.

No choice or choosing a foil in steps 1 and 2 led to a disqualification. Special interest for the target odour (step 3) also led to a disqualification. Matching the simulated crime scene cloth to the target odour in both steps 4 and 5 was called correct recognition. Not responding to any odour in step 4 or 5 was a no-recognition, responding to a foil in these steps was an incorrect choice. If a dog was disqualified in a

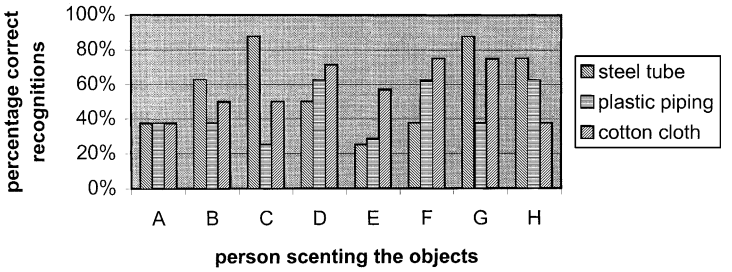

Fig. 1. Results of experiment 1: percentage correct recognitions of different material types of all ages scented by different people by dog A.

line-up, it was usually given a second chance later in that week, using a duplicate set of tubes.

3. Results

3.1. Experiment 1

The results were analysed in a number of different ways. First, the difference between the eight people and the material type were analysed. Here, all the different ages were taken together. These results are given in Fig. 1. Percentages correct are used since occasionally data was missing due to a person forgetting to scent the objects on time. On average the results varied from 37 to 67% correct choices between individuals, but no single individual was recognised systematically better (or worse) with all material types. In Table 1, the results are averaged per material type. None of the material types is recognised significantly better (or worse) than the others.

Table 1
Average percentage recognitions and standard deviations of different material types cumulated over persons and age by dog A

	Average (%)	S.D.
Steel tube	57.8	24.3
Plastic piping	44.2	15.2
Cotton cloth	56.7	15.5

Finally, in Fig. 2 the results are cumulated per material type in time. None of the material types is recognised systematically better or worse than the others. After the initial 100% recognition at time 0, recognition drops, and varies between 25 and 61% (average 45.8%, standard deviation 19.0).

3.2. Experiment 2

In total, 90 line-ups were conducted. In 14 line-ups, the dog was disqualified in either steps 1–3. In 10 of these cases, the line-up was repeated later on in the week, in the other 4 this was not possible due to lack of material. In one case, the second line-up also led to a disqualification. After a successful qualification, two dogs only chose correctly based on the time 0 target odour. The other dogs varied between five to seven correct choices out of eight. The combined results are given in Table 2. After the initial 100% recognition at time 0, recognition drops and varies between 33 and 75% (average 58.8%, standard deviation 13.6). If the results of the first two non-performers are disregarded, the average recognition rate after time 0 climbs to 73.7% (standard deviation 17.9).

3.3. Combined results experiment 1 and 2

The results of the cloth-trials of experiment 1 are combined with the results of experiment 2 (excluding the non-performers) in Fig. 3. After the initial 100% recognitions at time 0, recognition drops but the operational dogs perform better on average than dog A of the experiment 1.

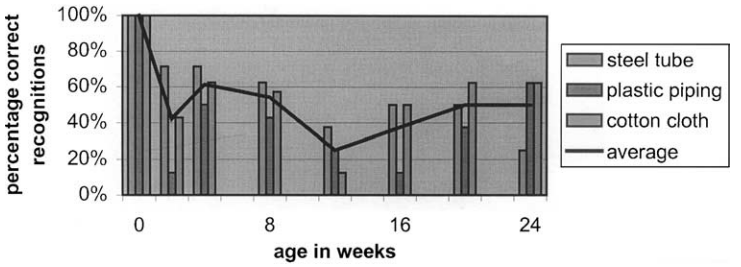

Fig. 2. Results of experiment 1: percentage correct recognitions of objects scented by all the people of different material type differing in age by dog A.

Table 2
Correct recognitions, no recognitions and incorrect choices based on pieces of cloth of increasing age by 10 dogs

	Age of cotton cloths (weeks)							
	0	2	4	8	12	16	20	24
Correct recognition	10	6	6	6	6	6	5	3
No recognition	0	2	3	3	1	2	4	6
Incorrect choice	0	2	0	1	1	1	1	0

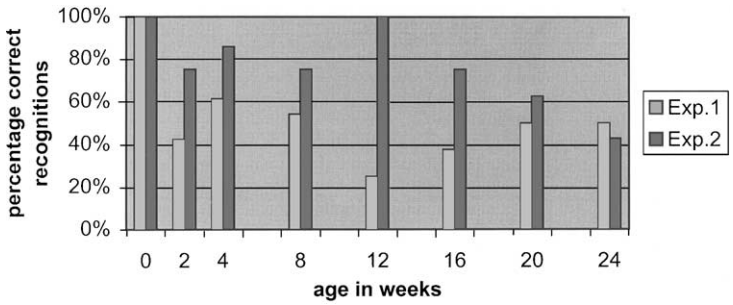

Fig. 3. Averaged results of experiment 1 (dog A) and experiment 2 (excluding the results of the two non-performers in experiment 2).

4. Discussion

The main objective of the experiments was to examine the effect of the ageing of odour evidence on the performance of the dogs in scent identification line-ups. Before evaluating the results of the experiments in this respect, a number of points that impact the performance of the dogs need to be discussed.

A first point is the effect of the set-up itself. The first experiment was designed as a ''quick and dirty'' set-up to collect a lot of information in a short period of time. A detailed examination of the protocol itself showed that it did not lead to systematic errors. The only ''weak'' point in the set-up was that the dog did not respond to the target odour if it was the first odour it came upon as readily as it did when it came to the target later in the circle. A major difference with the usual line-up protocol was the time it took to conduct. The circle-protocol took approximately 15 min, much longer than the usual protocol that only takes 4 min, or a training session, which usually does not last longer than 5 min. The performance dip at 12 weeks may well be an artefact of this prolonged working time. In terms of behaviour, a lack of interest was sometimes clear halfway through but with some additional playing the handler was able to revive the interest of his dog in the proceedings. The second set-up followed the current Dutch operational protocol. The difference here is that in operational cases, the handlers may decide which dogs they will use for a given case. In the experiment, participation was compulsory. The freedom to decide which dogs to deploy leads to a lower number of disqualifications in operational cases (less than 5%) than was found in these compulsory experimental line-ups (16.7%).

A second point that needs discussion is the effect of material type on the performance of the dogs. The results of the first experiment showed that there was no significant effect of material type. This is in line with earlier research [4], but seems to contradict the experience of training these dogs. Training experience shows that steel tubes are recognised most easily, followed by hard, smooth plastic, and cloth is recognised less easily. It may be that these subtle differences are overcome during the years of operational work. However, care should be taken when extrapolating from data presented here.

A third point is the possible effect of the scent source on the performance of a dog. It has been shown that occasionally a dog responds to or shows a marked interest in the odour of a particular person, and will do this in different contexts and at different times [5]. This observation is in line with training experience that dogs find the odour of one person much more difficult to recognise than another, and that on the other hand some odours are ''easy''. Experience with DNA profiles has also shown that some people are ''shedders'': they leave more body material behind than others, enabling forensic technicians to trace them more easily. Whether these ''shedders'' are also people whose scent is easily recognised by dogs is unknown. In the second experiment, two dogs did not perform well. This may have been caused by two poor scent-givers. However, both of these non-performers were retired early due to lack of consistent field performance. Three other dogs have since been retired for behavioural problems (not related to performance in scent identifications) or old age and five are still operational.

The general objective of the experiments was to determine the effect of ageing of articles collected at crime scenes

on the performance of dogs in scent identification line-ups. Both the experiments show a marked drop from 100% recognitions with fresh material, but results after are lower and vary. Some of the factors that may have caused this variation have been discussed above, but such variability in performance has been described earlier and is not uncommon. The difference in the results between the two experiments described in this paper show, once again, the effect of experimental set-up on the performance of dogs in scent identification line-ups and illustrate how careful one must be in extrapolating data [6]. A number of other observations are worth noting.

First: training experience has shown that when training on aged objects, one needs to train the dog up to 5–6 day-old material and then it can recognise much older material. Secondly, recently a small-scale experiment with five Dutch and four German dogs was conducted. Here, material that had been scented by two persons more than 7 years earlier was used in scent identification line-ups. In total 12 line-ups were conducted, and 8 of these led to a positive identification [7]. This is very much in line with the results of the experiments described in this paper. And lastly, analysing data from Dutch operational cases leads to the observation that there seems to be little difference in the performance of dogs using material up to half a year-old, or using material that is between half a-year and 1-year-old.

In general, the conclusion can be drawn that after the initial drop, ageing does not seem to diminish the recognition of the dogs significantly. However, important questions are why this initial drop occurs, and how it can be prevented.

One answer to the cause of the initial drop may lie in the volatile nature of scent. Not all molecules evaporate at the same rate. Residue left on objects consists of different components. Even if initially the same residue is left on two objects but at a different time, the headspace above the objects at a later time can be different if the components of the residue have different vapour pressures. Since the objects are stored in glass jars, one can expect some kind of steady state to evolve since the amount of evaporation is limited, explaining the levelling off in the performance. Another explanation can be found in work that has been done in the quest to develop latent fingerprints. Latent fingerprints consist predominantly of fatty acids, and different laboratories have studied the composition of these prints [3]. Left out in the open air, it seems that large, unsaturated fatty acids are broken down into smaller, saturated fatty acids. The majority of these changes occur within the first week. This could also have a significant effect on the headspace, and depending on which components the dog is using as a cue, this could also explain the drop in performance.

Freezing the material, or storing it at low temperatures, could perhaps prevent the drop in performance. Scent pads used for bloodhound trailing in the United States are usually frozen, but there is no experimental basis supporting this choice. Further work is necessary in this field, and should also incorporate scent sampling methods and materials, and packaging.

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