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Scent identification lineups by dogs (*Canis familiaris*): experimental design and forensic application

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Abstract

Scent identification lineups by dogs (*Canis familiaris*) are performed differently in different countries, but basically follow a match-to-sample-like protocol. Different experimental designs were tested using certified Dutch police tracker dog/handler combinations. The standard scent identification lineup design currently used in the Netherlands is compared with an older design and with two new designs that cater for varying motivation, individual preferences and physical limitations of the dogs. The designs are evaluated on performance and forensic prerequisites. Experimental design significantly affects the performance of the combinations: incorporating a control trial as an obligatory 'calibration' for the dog leads to the best results and meets the most forensic prerequisites.

Keywords: Scent; Identification; Dog; Learning

1. Introduction

The remarkable olfactory acuity of dogs is put to use in collecting forensic evidence. Dogs are trained to detect different kinds of scent and are used by the police in various contexts. In a number of countries dogs are also used to identify criminals on the basis of scent traces left at the scene of the crime. A positive identification can be used during the police investigation (confronting the suspect with a positive identification often leads to an admission of the crime) and/or as part of the evidence that is presented in court.

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There are no international standards for any of these aspects: not in the way the dogs are trained, certified, or used, nor in the experimental design of the identifications, nor in the way the police or the judiciary of the different countries involved use the outcome of such identifications. There is also little or no published information as to the reliability of the identifications: they are considered to be the greatest achievement for a dog and his handler, but they are the most controversial from a judiciary point of view (Taslitz, 1990). This study focuses on these scent identifications.

The assumption underlying scent identification tests is that people have unique odour profiles, constant over time, that a dog can recognise and that it can discriminate from the odour profiles of other people. There is good evidence that this is the case (Kalmus, 1955; Nicolaides, 1974; Green et al., 1984; Halpin, 1986; Hepper, 1988; Ferstl et al., 1992; Schoon and de Bruin, 1994; Settle et al., 1994). For forensic application the 'better than chance' statistical testing used in these studies is not good enough: the level of performance of the dog is crucial for identification tests to be of use.

A common element of the identification tests is that they all follow a 'match-to-sample'-like procedure. The dogs are trained to match the perpetrator's odour profile on an object that is related to a crime, the corpus delicti, with the suspect's odour profile by selecting it from a number of different odour profiles. In the Netherlands, the corpus delicti is the sample odour that has to be matched to hand-odours collected on stainless steel tubes according to a legally prescribed method: one tube with hand odour of the suspect and other tubes with hand odours of 'innocent' people, referred to here as extras. In Germany the same method is followed, but a check is performed to see that the dog is not specifically interested in the scent of the suspect. To this end the suspect's odour profile is used as an extra (innocent) scent in a training trial on the day before the test with the corpus delicti. In Hungary, the sample scent presented to the dog is the suspect's odour profile, collected on a locally available diaper, and the scent of the corpus delicti is in the array of scents the dog has to choose from. In this way one is sure that the dog bases its choice on a fresh, strong odour for one is never sure how much odour is present on the corpus delicti; indeed, no scent at all may be left on the corpus delicti, leading to a difficult situation for the dog. The forensic background of these experiments entails that the protocol is not strictly 'match to sample', since the dogs can be confronted with situations where no match is possible at all, for example when the suspect is in fact innocent. In these cases the dogs are not allowed to select any odour profile, and the dog is recalled by his handler when he does not make a quick or determined choice. Strictly speaking, therefore, the result of a scent identification test is the result of the dog/handler combination.

This study examines the effect of some variations in experimental design on the performance of trained Dutch human scent tracker police dogs/handler combinations. The legal police scent identification method ('negative check') is the standard with which the other designs will be compared. The three other experimental designs could not vary too much from the standard since the work was done with operational police dogs. 'Old' is a design formerly used by the Dutch police and therefore worth evaluating. The other two designs ('positive check' and 'reverse and check') were new for all of the dogs and handlers. They were designed to maximise the performance of the dog/handler combination within the limitations set by working with operational police dogs, and to refute the lawyer's ploy that the dog selected the suspect's odour profile because he was attracted to it for some unknown reason. Both of these designs incorporated a 'motivation check': a pre-trial check of the dog's willingness and ability to perform scent identifications at that particular time and place.

The designs are evaluated in the light of their forensic application: is the level of performance in any of the designs better than that of the standard, and do the designs meet all the prerequisites forensic science demands? Although the experiments were not designed to investigate the role of the handler, an attempt will be made to evaluate this role. This will lead to a discussion of some possible reasons for the differences in performance.

2. Animals, material and methods

2.1. Animals

The experiments were conducted with eight certified police 'human scent tracker dogs' from all over the Netherlands. These dogs have to pass an examination with their handler each year and an obligatory part of the exam is scent identification. The most common exam scent identification module chosen (there are two modules) follows the negative check design described below. The dogs were shepherd dogs (German, Malinois, Dutch and mixed parentage), six male and two female, and varied in age from 3 to 9 years. Owing to different obligations the participation of the dogs varied, but an effort was made to distribute each dog's participation equally over the four experimental designs (see Table 2). The experiments were conducted over a period of 8 months from September 1992 to April 1993. Each dog performed a maximum of two experiments on a test-day, and the test-days were at least 1 week apart.

2.2. Preparation of the experiment

Human odour profiles were collected on stainless steel oval tubes of 10 cm length that are currently used in police scent identification tests, following usual police protocol. Each person held tubes in his/her hands for 5 min; for each person, the tubes were then placed in a glass jar with a twist-off top. The tubes were also used as experimental corpus delicti. In these cases the tubes were held by hand for 5 or 30 s by the 62 'suspects', and were then stored in glass jars as above. The experiments were prepared at police training schools either on the day the experiments were done or the day before. The 372 student volunteers were unknown to the dogs. Tubes and jars were cleaned by boiling in semi-distilled water for 30 min and 10 min, respectively, and tubes are handled with tongs thereafter, following normal police protocol.

2.3. General experimental protocol

The experiments were conducted under normal working conditions for the dog and his handler. The sites were known to the dog: outdoor areas (parking lots), an unheated garage or hall with a paved or concrete floor. Each experiment consisted of a number of trials. Each trial consisted of an array of tubes laid out in a row on the floor in the absence of the dog handler and his dog, leaving 40–60 cm between the tubes and 5–10 m between the rows, following normal police protocol. The sample tube is placed near the first trial row at the indication of the handler (this too is normal police protocol). All tubes were handled with tongs only.

When the preparations were completed, the dog handler approached the first trial row with his dog and commanded it to 'sit'. The dog was made to 'take air' of the sample tube, to do this the handler picked up the sample tube with a pair of tongs and held it to the nose of the dog using his other hand to direct the nose of the dog to the sample tube. After this the dog was commanded to 'search' in the row for the matching tube. The dog selected a tube by retrieving it. After a correct choice the handler took the dog to the second trial row and repeated the 'taking air' and 'search' commands. An incorrect choice at any point terminated the experiment immediately: I told the handler that his dog had made a wrong choice and the handler would recall his dog. When a dog failed to select a tube but had smelled at all of the tubes twice, it was called back by the handler (again, normal police protocol). The handler did not know the position of the correct tube in the row. The actions of the handler and his dog were videotaped.

2.4. Experimental designs

Four different experimental designs were tested (Table 1). The background and underlying theory of each of these designs is described together with details concerning the actual protocol.

Table 1
The experimental designs

Design	Sample scent presented to dog	Trial row 1 (random sequence)	Trial row 2 (random sequence)	Comments
Negative check	Corpus delicti	X, 1, 2, 3, 4, 5	6, 7, 8, 9, 10,11	Rows 1 and 2 in random order
Old	Corpus delicti	X, 1, 2, 3, 4, 5	X, 1, 2, 3, 4, 5	
Positive check	1: Control	X, C, 1, 2, 3, 4, 5	X, 1, 2, 3, 4, 5	Row 2 only if 1 correct and all tubes smelled
	2: Corpus delicti			
Reverse and check	X	X, 1, 2, 3, 4, 5	Corp. del., 6, 7, 8, 12, 13	Row 2 only if 1 correct

Corpus delicti: object related to crime, in this study stainless steel tube held by hand for 5 or 30 s by suspect; X, suspect's tube, held by hand for 5 min; control: control object scented in different ways by control person; C, control tube, held by hand for 5 min; 1–11, extra tubes, held by hand by different people for 5 min; 12 and 13, sham corpus delicti tubes held by hand by different people for 5 or 30 s.

2.4.1. The 'negative check' design

This design (currently used by the Dutch police force) demonstrated the ability of a dog to not retrieve any tube when no match is possible (negative control) and had a large array of odour profiles that the dog could choose from (12 different odour profiles). The sample scent was the corpus delicti and the matching steel tube was present in one of two rows of six, the other row only containing extra odour profiles.

In this study, the sample object presented to the dog (corpus delicti) was a stainless steel tube held by hand for 5 or 30 s by the 'suspect', and the choice had to be made between 12 tubes that had been held for 5 min (Table 1). These 12 tubes were laid down in two rows of six, each row to be used in a single trial: a negative control trial row in which the dog had to refrain from retrieving a tube and a trial row in which the matching tube had to be retrieved. The same sample scent was used for both trial rows. The order in which these two trial rows were presented was random and unknown to the dog handler. A faulty retrieval in any row terminated the experiment. Not picking up a tube was the correct response in the negative control row and therefore did not terminate the experiment.

2.4.2. 'Old' design

This design had been in use (in slightly different versions) by the Dutch police for more than 20 years, up to 1991. All tracker dogs are initially trained in this experimental design, the older dogs participating in this study had also done forensic work according to this protocol for some years. The sample scent that was presented to the dog is the corpus delicti, and the dog had to choose between six steel tubes. One tube carried the odour profile of the suspect, the other five the odour profiles from five other individuals. After a correct retrieval (the tube containing the suspect's odour profile) this procedure was repeated, using the same sample scent, with a second row containing fresh tubes of the same six individuals in a different sequence.

For this study, the sample object presented to the dog (the corpus delicti) was a tube held by hand for 5 or 30 s by the 'suspect', and the choice had to be made from a row of six tubes that had been held for 5 min (Table 1). A faulty retrieval, or failing to make a choice, terminated the experiment.

2.4.3. 'Positive check' design

This design required that the dog demonstrated its ability to match the odour profile of a control person on an object (first sample scent) with that on a tube prior to the actual experiment (a positive control trial, Table 1). This control trial consisted of a match that was considered 'easy' for the dog by his handler: if the dog failed, it was no use trying a more difficult match. If the dog succeeded in this control trial it continued with the actual experiment in which the second sample scent was the real corpus delicti and the match was one of six tubes. An advantage of the design is that the dog demonstrated its lack of special interest in the suspect's scent (a favourite lawyer's ploy) as this scent is one of the extras in the first control trial.

In the first trial row the six tubes containing the odour profiles of the actual experiment (five extras and the future suspect) were used together with a seventh tube with the odour profile of the control person (Table 1). The control sample object had been scented in different ways according to the preference of the handler, generally by hand or in the pocket for at least 5 min. The dog had to match the odour profile on the control sample object to the correct tube and smell all the extra tubes. If the correct tube was retrieved before the dog had smelled all the extra tubes, a fresh tube with the scent of the control person was added to the row and the trial repeated. An incorrect retrieval led to disqualification of the dog and terminated the experiment.

After having correctly retrieved the control tube(s), the second trial was conducted. The experimental sample object (corpus delicti) was a tube held by hand for 5 or 30 s by the suspect. The dog had to retrieve the matching tube from the second trial row which contained the odour profiles of the 'suspect' and the five extras (the same six odour profiles that were extras in the first trial).

All of the tubes in the two rows were held by hand for five min. A faulty retrieval or no retrieval in the control row led to disqualification of the dog.

2.4.4. 'Reverse and check' design

In this design, the dogs first had to demonstrate their ability to match the scent of the suspect on an object (sample scent) with that on a tube in a row of six different odour profiles prior to the actual experiment. The sample object was fully scented and therefore the match should be relatively easy for the dog: if it failed, asking it to perform a more difficult match was useless. In the actual trial, the match was made in the reverse way as in the designs above: the sample scent for the dog was again the full odour profile of the suspect and the match had to be made by choosing from an array containing the corpus delicti and five new odour profiles that varied in strength (to prevent the dog from learning to choose the weakest scent in the row). The design combines the certainty that the dog gets a good sample scent with a check on the dog's performance. Special preference for the suspect is not an issue here, because the dog has to select the corpus delicti in the second row.

The first trial row can be seen as a 'positive control priming' trial: in this study the sample object was a tube that carried the full odour profile of the suspect (it was held by the suspect for 5 min), and the dog had to choose from a row of six tubes carrying the odour profile of the suspect and five extras, each held for 5 min (Table 1). An incorrect retrieval led to disqualification of the dog and terminated the experiment.

If the dog retrieved the correct tube, the second trial was conducted, using the same sample scent for which the dog is already 'primed'. This second row consisted of the corpus delicti tube (held for 5 or 30 s) and five new extras, two of which had been held as long as the suspect's corpus delicti (the other three had been held for 5 min). A faulty retrieval or failing to retrieve any tube terminated the experiment.

2.5. Evaluation of data and statistics

The results of the experiments were noted as Correct, Wrong or No choice. The overall differences between the dogs were tested using χ^2. Subsequently, percentages Correct and Wrong were calculated per experimental design per dog. Differences between the experimental designs were tested using the Wilcoxon signed rank test ($n = 8$ dogs). Since the percentages of Correct and Wrong were not completely

Table 2
Results of eight dogs in the four experimental designs

Dog	Negative check			Old			Positive check			Reverse and check			Total	
	C	*W*	*N*	*C*	*W*	*N*	*C*	*W*	*N*(*d*)	*C*	*W*	*N*(*d*)	*C* (%)	*W* (%)
A	2	5	7	3	3	7	4	0	6(0)	4	0	6(1)	50	31
B	3	4	7	3	3	7	2	2	4(2)	3	2	5(2)	48	48
C	1	1	4	2	3	6	3	0	4(1)	4	0	4(2)	55	22
D	4	2	7	4	3	8	2	1	4(4)	3	0	6(1)	52	24
E	0	4	5	1	4	5	3	1	6(1)	1	0	3(3)	26	47
F	1	5	6	2	2	4	1	2	3(2)	3	1	4(2)	41	59
G	0	6	6	4	2	6	2	1	5(2)	1	3	5(2)	32	55
H	4	2	6	4	2	6	5	0	6(1)	2	2	5(0)	65	26
Total	15	29	48	23	22	49	22	7	38	21	8	38		
(%)	(31)	(60)		(47)	(45)		(58)	(18)		(55)	(21)			

C, number of correct tubes retrieved; *W*, number of wrong tubes retrieved; $N(d)$, number of tests completed in that design (number of times disqualified by check); $N-(C+W)$, number of times no tube retrieved; $N+d$: total number of times dog participated per experimental design.

independent and the data sets were used in several tests, an improved Bonferroni procedure, as suggested by Haccou and Meelis (1994) was applied, leading to a significance level of $P<0.0083$ instead of $P<0.05$.

3. Results

The overall results varied between the dogs (Table 2: Correct varied between 65 and 26%, Wrong between 59 and 22%), but these differences were not significant (χ^2: $P=0.30$ for Correct vs. Not correct and $P=0.08$ for Wrong vs. Not wrong).

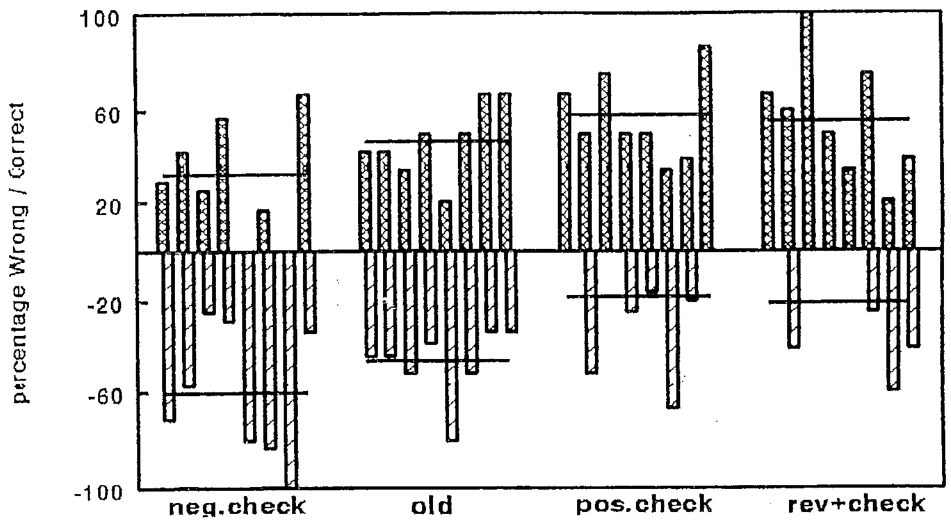

Fig. 1. Results of the eight dogs (vertical bars) over the different experimental designs and the averages of the experimental designs (horizontal line) (positive, % Correct; negative, % Wrong).

On average, the 'negative check' design had the lowest percentage of Correct and the highest percentage of Wrong, and the 'positive check' design the highest percentage of Correct and the lowest percentage of Wrong. The results of the eight dogs obtained in each of the three experimental designs ('old', 'positive check', 'reverse and check') were tested against their results in 'negative check' (Fig. 1) (Wilcoxon signed rank test, $N = 8$, $P < 0.0083$). The results of the 'old' design did not differ significantly from those of 'negative check' (% Correct $P = 0.03$, % Wrong $P = 0.11$). The results of 'positive check' were significantly better in both % Correct and in % Wrong ($P = 0.008$ and $P = 0.004$, respectively); 'reverse and check' was significantly better only in % Wrong (% Correct $P = 0.04$, % Wrong $P = 0.008$). In 'positive check' and 'reverse and check', respectively, 14/52 and 13/51 experiments led to a disqualification owing to an incorrect or no retrieval in the first positive control row.

4. Discussion

The results of the design currently in use, 'negative check', show a low number of positive identifications and a large number of mistakes. The idea of this design was to demonstrate a dog's ability to not retrieve a tube when no correct tube was available. This is important from a forensic point of view: the suspect may, of course, be innocent. However, 65.5% of the faulty retrievals occurred in the negative control row and this was significantly higher than the 50% one would expect ($P < 0.05$, binomial test). 'Negative check' can be divided into two variants: in variant 1, the tube to be retrieved was in the first row and the second row was the negative control row; in variant 2 the situation was the reverse. The handler was not informed of the variant prior to the experiment. Comparing the overall results of the first rows only, when the first row is negative (variant 2), twice as many incorrect retrievals are made as when the first row is positive (variant 1) (variant 2: 14 Correct, 10 Wrong, $N = 24$; variant 1: 17 Correct, 2 No choice, 5 Wrong, $N = 24$). In summary, the results of the negative control rows are poor.

The correct retrievals in the first positive row of variant 1, however, are very high (17/24, 70.8%). These results can be compared directly with the results of the first row of 'old' (28 Correct, 4 No choice, 17 Wrong, $N = 49$, i.e. 57.1% Correct). The only difference between these two first rows is the expectation of the handler: in 'old' he is sure that the correct tube is present in the first row, in 'negative check' he cannot be sure of this. So it seems that the slight uncertainty of the handler leads to a relatively better performance of the dog but this is completely masked in the overall results of the experiment owing to the poor performance in the negative control rows.

In the experiments following the 'old' design, the dogs retrieved a correct tube in 46.9% of the experiments and an incorrect one in 44.8%. Although the average results of 'old' seem better than those of 'negative check', one should realise that a faulty retrieval in 'old' is a choice out of six, and a faulty retrieval in 'negative check' is one out of 12. Refraining from retrieving a tube when no match can be made is extremely important: in forensic reality there simply may not be a matching scent because the suspect is, in fact, innocent. Any other reason for not making a correct match (e.g. the dog has a congested nose) should also lead to non-retrieval.

Incorporating a positive control trial prior to the actual trial seems to meet this 'restraint' prerequisite better: both 'positive check' and 'reverse and check' designs led to significantly less faulty retrievals than 'negative check'. In these designs the dogs refrained from retrieving a tube in more than half the cases where they did not make a correct match. One can argue that the first control trial selected dogs that were performing well; however, the number of correct identifications did not differ significantly from 'old' which was basically the same. However, the dogs had to perform an unusual task in the second row. In 'positive check' they had to switch to a novel scent to match, and this was not part of the usual training routine. In 'reverse and check' the dogs had to retrieve a (for them unusually) partially scented tube (the eight incorrect retrievals were all fully scented tubes). The selection of well-performing dogs may have been counterbalanced by these more difficult tasks. Another explanation for the lower amount of incorrect retrievals could be the changing motivation of the dog during these trials. Retrieving a tube is used as a reward by the handlers in different situations and the dogs try hard to obtain one. Retrieving a (correct) tube in the first row possibly lowered the dogs 'tube-drive', leading to more restraint in the second trial row. A third factor could be the changing motivation of the handler: he had seen his dog perform well in the first control row and this made him more confident and relaxed about his dog. This was not measured in any way but was communicated by the handlers. Any combination of these three factors may also be possible.

This study demonstrates, once again, that dogs are capable of discriminating and recognising human scent samples: they perform better than expected according to chance in the presented match-to-sample tasks. However, forensic science demands a higher level of validity, which ideally leads to 100% positive identifications when a match is possible (all correct positives), and 0% mistakes when no match is possible (no false positives). Since we can assume that each human being has a unique smell, it is possible to design experiments of each category. In this study all the experiments were of the type where a match was possible, and we would therefore expect 100% positive identifications. Unfortunately, we do not know which human scent components dogs use for their discrimination, nor if each dog uses the same components, nor if the dogs' olfactory acuity differs for these different components, nor do we know the mechanisms behind the observed attraction that some human scent samples seem to have for some dogs. Whatever the limitations were, the best results obtained in this study were approximately 75% correct in a single match-to-sample choice out of six (the positive control rows of 'positive check' and 'reverse and check'). This makes a positive identification by a dog a useful tool in police practice, but the police need to be aware that a non-identification does not always reflect reality.

The 0% mistakes we would like to see was not met in any of the designs, and there seems to be four kinds of problems that make it hard to reach this level. The first is that the tube that the dog retrieves is used as a reward by letting the dog play with it and retrieve it a number of times. Looking at it from the dog's point of view, a scent line-up is choosing between one of six potential rewards. Separating response from reward in some way could improve results. The influence of the handler is a second problem. A few efforts have been made in the past to eliminate the handler from the process but this did not lead to consistent results: social reward seems the most effective reward and the bond between handler and dog therefore inevitable. A third problem is the varying motivation of the dog. Incorporating a positive control trial in the experimental set-up seems a good beginning to reduce the number of mistakes. The fourth problem is more fundamental: all of the above experimental designs combine two distinct learning paradigms: a go/no go (negative control rows and forensic reality) combined with a match-to-sample choice out of six. Go/no go experiments with rats (Lu et al., 1993) showed that the rats quickly learnt a go-condition of matching scents but had significantly more difficulty with the no-go condition of non-matching scents. Not doing something might simply be more difficult, which is not of consequence in classical learning experiments but is of extreme importance in forensic situations. Confusion between the two learning paradigms could be another source of error. The fact that dogs make mistakes means that in a forensic case, a suspect could be falsely identified as perpetrator. How big this chance is cannot be calculated based on the experiments presented here, but requires further testing, incorporating both factually positive and factually negative line-ups.

Judges in the Netherlands carefully evaluate each piece of evidence that is presented to them, so knowledge of the scope of the performance of dogs in scent line-ups is essential to a correct appraisal of the results. However, the results of this study cannot be extrapolated directly to forensic practice since the experimental situations differ in too many aspects from forensic reality (e.g. nature of the corpus delicti, preparation of the experiment, video-taping trials). The results do indicate that care should be taken in evaluating the results of scent line-ups.

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References

Ferstl, R., Eggert, F., Westphal, E., Zavazava, N. and Muller-Ruchholtz, W., 1992. MHC-related odors in humans. In: R.L. Doty and D. Müller-Schwarze (Editors), Chemical Signals in Vertebrates, 6, Plenum Oress, New York, pp. 205–211..

Green, S.C., Stewart, M.E. and Downing, D.T., 1984. Variation in sebum fatty acid composition among human adults. J. Invest. Dermatol. , 83: 114–117.

Haccou, P. and Meelis, E., 1994. Statistical Analysis of Behavioural Data. Oxford University Press.

Halpin, Z.T., 1986. Individual Odors among Mammals: Origins and Functions. Advances in the Study of Behavior, 16: 39—70.

Hepper, P.J., 1988. The discrimination of human odour by the dog. Perception, 17: 549–554.

Kalmus, H., 1955. The discrimination by the nose of the dog of individual human odours and in particular of the odour of twins. Br. J. Anim. Behav., 3: 25–31.

Lu, X.-C.M., Slotnick, B.M. and Silberberg, A.M., 1993. Odor matching and odor memory in the rat. Physiol. Behav. , 53: 795–804.

Nicolaides, N., 1974. Skin lipids: their biochemical uniqueness. Science, 186: 19–26.

Schoon, G.A.A. and de Bruin, J.C., 1994. The ability of dogs to recognize and cross-match human odours. Forensic Sci. Int. , 69: 111–118.

Settle, R.H., Sommerville, B.A., McCormick, J. and Broom, D.M., 1994. Human scent matching using specially trained dogs. Anim. Behav., 48: 1443–1448.

Taslitz, E.A., 1990. Does the cold nose know? The unscientific myth of the dog scent lineup. Hastings Law J. , 42: 15–134