

J. BOGERS

On the scent detection of the search and rescue dog



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Abstract.

On the rescue dog symposia of Boulder 1995 and Vienna 1997 we introduced a method of focussing the search and rescue dog on a designated part of a scent complex. At that time a lot of rescue dog handlers had dealt with the problem of training a SAR-dog to discriminate between a dead and a living victim.

Our research started in 1992 and resulted into a first presentation in Boulder Colorado. At this presentation we introduced the so called scent complex which was a more elaborate description of the scents that are encountered by a working SAR dog. In Vienna 1997 we developed a test based on this scent complex. The purpose of this test is to find out for which part of the scent complex the SAR dog is searching, and if necessary to focus him to a designated part of the scent complex.

In the years from 1997 to 2003 we had the opportunity to test a great amount of dogs. Handlers came from all over the world to test their dogs.

In this paper we present the results of testing dogs for more than five years. We will also present some prudent conclusions.

A word of caution however is necessary. We realise that this is not a profound laboratory research but a test in the field. Consequently the conclusions should be seen within this context.

As a by-product we were able to make some interesting observations about the influence of the handler on the dog.

Introduction

During the last decade of the previous century much attention was paid to the scent complex on which a search and rescue dog was working (Bogers 1995,[1], Bogers 1997,[2]). Handlers in the field had met with serious problems to determine whether their dog was indicating a dead or a living victim. Especially in a disaster area this is an issue of major importance. We all know that under these circumstances it is the main goal for a SAR dog to locate the living victims as soon as possible in order to save their lives. The search for dead victims, which is very important as well, is in a disaster situation of second order. Consequently we believe that for SAR-dog handlers who realise the responsibility they are taking when they are searching in a disaster area, scent training of their dogs is of major importance.

However, during the years we worked in the field we noticed that for most SAR dog handlers scent training and discrimination is hardly an issue. Very much attention is paid

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on acquiring certificates, and on the always emerging question of who is actually going to the disaster area in case an earthquake or other disaster occurs.

We all know that in a real disaster situation our dogs will be confronted with dead and living victims and with a huge amount of distracting scents.

On the international rescue dog symposia of Boulder 1995 and Vienna 1997 we introduced a method of using the so called scent complex to indicate the most important scents which are encountered by a working SAR-dog. This is stated in a paper we submitted to the Boulder symposium (Bogers 1995, [1]). Using this scent complex we showed in the Vienna paper that it is possible, by scent discrimination tests, to get a fairly good indication on which scent(s) a SAR-dog is working and if necessary to focus the scent detection of the dog to particular scents (Bogers 1997,[2]).

In the year of the Vienna symposium we already had some good results with SAR dogs in our organisation. Some of them really didn't show any sign of an alert in case they were confronted with the scent of a dead victim. As a direct consequence of the Vienna lecture we got the opportunity to test a great amount of SAR-dogs in the years 1997 to 2004. Handlers came from all over the world to test their dogs, and to learn how the testing procedure was carried out.

This paper can be seen as the result of testing SAR-dogs for almost seven years. We will present the test method, the results, and some interesting conclusions.

Regarding the conclusions a word of caution is absolutely on its place. Please realise that the results are not coming from a profound research but from tests in the field. As we will see in the sequel of the paper the circumstances of testing are not like in a laboratory, as we tested on various simulated disaster locations. Consequently the conclusions should be seen within this context. As we tested a lot of dogs which were trained elsewhere we don't exactly know whether their behaviour is a consequence of the way they are being trained or whether it is the unbiased test result. However, we still think it is possible to draw some prudent conclusions.

As with most testing we also had interesting by-products. For instance we were able to make some interesting and quite important observations about the influence of the handler on the dog when he is working. Also we noticed some interesting things about scent transportation in a building which can be of great importance to locate a victim.

We organised the paper as follows. After this introduction we state in Section 1 our theory of the scent complex once more for completeness. Section 2 and 3 we describe the theory of the tests and we describe the set-up of the tests. In Section 4 we state some results of testing

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80 dogs and we analyse them as far as possible. Also we discuss in Section 4 some interesting observations. Section 5 we analyse some common problems and in the last section we draw some prudent conclusions.

1 The scent complex

In 1995 on the Boulder symposium (Bogers 1995,[1]) we introduced the theory of the scent complex. The main goal at that time, was to present a table which included the most important scents a dog is encountering when he is in a search and rescue mission.

Taking this table as a starting point we wanted to get a better understanding of what a SAR-dog is actually smelling when he gives an alert on a living victim or when he is alerting on a dead victim. Also we indicated that the table could be of use in case a dog gives any type of false alert.

At the Vienna symposium we introduced a test (Bogers 1997,[2]) based on this table which would enable us to get a sharp view of the scents a dog is alerting on and if necessary correct the dog.

In the time that followed a lot of research has been done in various settings to find out what the smelling and discriminating abilities of a dog exactly are.

Smelling abilities of Dutch police dogs where investigated in order to create a greater reliability in identifying criminals (A. Schoon 1997,[5]). This research, which was carried out independently from our research, confirmed the scent complex we formulated in the Boulder paper.

It was discovered that dogs where able to smell whether a person has skin cancer . Also researchers found out that a dog could smell abnormalities in the respiratory tract by smelling the breath that is exhaled by a person. In Holland dogs were trained to indicate if a person had tuberculoses (A. Schoon,1997,[5]).

Interesting is also the research project from Wageningen University on malaria bugs by W. Takken. Takken is investigating a hypothesis that the malaria bug is detecting a living person on a large distance by his coal dioxide output from his respiratory tract. After detection the bug flies to the person and then she makes a selection according to the fatty acids and the sweat production on the skin of the person (W. Takken, 2002 ,[7]).

The main goal of most of the research mentioned above, is to reduce the amount of scents from the complex in order to find one particular substance on which the animal is selecting. As stated in the Vienna paper it is our belief that this is only possible to a certain degree for a SAR-dog.

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We incline to believe in the hypotheses that the detection of abnormalities in the skin or in the breath coming out of the respiratory tract is not achieved by detecting a particular substance but is achieved by detecting an **irregularity** from the complex of scents a dog is used to smell. This is a different way of looking at observed phenomena.

All over the world rescue dogs are trained for various kinds of search work. For instance, searching for humans (dead and living) in a disaster area, searching for humans (dead and living) in a forest, searching for dead bodies in general, or searching for drowned people. Mostly rescue dogs are trained to perform more than one task and sometimes a SAR dog is trained to do **all** the possible jobs mentioned above! From the experience we gathered during the last decade we come to the following conclusion.

In order to reach the highest reliability the SAR dog should be focused to a particular scent.

What scent(s) we choose depends on the kind of work we want the dog to perform. This implies that a dog which is trained to search only for dead bodies will work on a different scent, than the dog which is trained to search only for living victims. As stated in the Boulder paper it is our experience is that rescue dog trainers and handlers do often not realize the fact that a dog which is trained to search for drowned victims is working on a different scent than a dog who is trained to search for living persons in a disaster area. Combining these two types of work without paying special attention to the possible overlapping scents, **can** lead to problems which are not properly recognized and consequently not properly dealt with (false alerts in a disaster area on recently worn clothes and recently used beds).

In the sequel of the paper we will return to this subject more than once. We now give a definition of what we mean when we talk about scent.

Scent is a mixture of substances in a gaseous state generated by one source.

As all substances this mixture consists of molecules, which are the smallest parts of a substance still having the physical and chemical properties of the particular substance. Because we are talking about a mixture it will be obvious that there are several kinds of molecules in a scent. Examples are the smell of sweat, perfume, soap, the smell of rubber,

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clothing etc. When a SAR dog is working in a disaster area he is confronted with a collection of smells. We call this the scent complex.

A scent complex is a collection of scents.

After these abstract definitions we will give a more practical presentation of the scent complex.

We present an improved version of the scent complex table which we introduced in Boulder 1995. In this table we divide the scent complex into four categories.

Scents from the surroundings, scents from clothes of the victim, scents from substances attached to the skin and last but not least biological scents coming from the victim itself.

Compared with the table we gave in Boulder table 1 below is more specified about the biological scents. We presented them in blue and red. It are those scents that are of major importance in focussing a SAR dog. We will return to this subject later in the paper. The table is far from complete, much more substances produce scents in a disaster area. Here we restricted ourselves to the most important ones.

Table 1

VICTIM			SURROUNDINGS	
BIOLOGICAL	SKIN	CLOTHES		
Breath	Deodorant	Cotton	Objects	Stones
Sweat vapor	Perfume	Wool	carrying	Concrete
	Soap	Leather	human	Iron
Skin fat	Shampoo	Synthetics	scents	Gas
Hair	Nail polish	Rubber	Dead	Masonry
Dandruff	Hair spray		animals	
Skin pieces	Mascara		Meats	Trees
Bacteria			Food	Grass
Insects			Rotting	Earth
Urine			plants	Water
Anal gasses				
Cadaver fat				

The first conclusion that can be drawn from the table is that in order to do his job properly a rescue dog, no matter what his specific discipline is, should be trained on the **biological**

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scents from the victim. It is victims we want to find and nothing else. A dog working in a disaster area is confronted with almost all the scents mentioned in the table above. From all these scents he must be focussed to alert on the proper ones out of the first column. In the sequel we will split the table to obtain a better view on possible problems.

Before we split Table 1, we will state some facts about a living victim. Substances on the body of a living victim are heated depending on the temperature of the body. The temperature on the outside of a living body is about 27^o C. Depending on the outside temperature this may vary. Due to this body temperature the victim will constantly generate a particular biological scent consisting of all those substances that are located on the skin. However, last but certainly not least we can conclude that a living victim is breathing and sweating! Consequently, compared to the scent coming from a dead victim we can conclude that there are some very important components missing: A dead victim is not breathing nor sweating!

Some interesting facts about a deceased victim. If the outside temperature is lower than 27^o then the temperature of the dead body is decreasing at a constant rate of about 0.5 degree Celsius per hour (of course this strongly depends on outside temperatures!). Due to this temperature change, a deceased victim will generate a changing scent until a stable temperature is reached. This is the temperature of the surroundings. After two days the destruction process starts. Again this depends strongly on the outside conditions such as temperature, humidity, etc. In this process bacteria and insects play an important role. There will be a different bacterial metabolism on a deceased victim compared to a living victim. Anal gases are produced. If the outside temperature is higher than 27^o then the process of destruction will start almost directly again causing the scent complex to change rapidly! Of course during the process of destruction the scent complex does not remain the same. It will undergo some major changes in time. For more detailed discussion see N. Sharp [4].

In order to get a clear view on the problem of discriminating a dead from a living victim by its scent we introduced the colours in Table 1. In the first column the scents which are only produced by a living victim have colour red. Blue are the scents that are produced by a living and a dead victim up to a certain degree.

Let us look at the first column more closely. The biological scents coming from the victim are specified in Table 2 below.

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Table 2

	LIVING VICTIM	DEAD VICTIM
VOLITILE	<p>Breath</p> <p>Sweat vapor (eccrine)</p>	<p>Bacterial metabolism</p> <p>Anal gasses</p>
LESS VOLITILE	<p>Skin fat (apocrine sebum)</p> <p>Hair</p> <p>Dandruff</p> <p>Skin pieces</p> <p>Bacteria</p> <p>Urine</p>	<p>Skin fat (apocrine Sebum)</p> <p>Hair</p> <p>Dandruff</p> <p>Skin pieces</p> <p>Insects</p> <p>Urine</p> <p>Cadaver fat (adipocere)</p>

Here we introduced a subdivision of volatile and less volatile. As stated in the introduction this might be of interest in detecting a victim over larger distance. We observed more than once that a search dog is taking scent from the air (air scenting dogs) , mostly with open or half open mouth, then he decides to go into the direction of the victim and as soon as he arrives in the neighborhood of the victim he starts taking scent with his mouth closed. This behavior looks like the behavior of the malaria bug described by W. Takken (W. Takken, 2002,[7]) as stated in the introduction. It might be that be that the dog is smelling for the more volatile substances first (carbon dioxide in case of a living victim) and then he starts smelling for the less volatile substances (sweat and fatty acids). This hypothesis is very interesting but more research has to be done on this subject.

As can be seen from Table 2 we gave some details about sweat, skin fat and cadaver fat. We will restrict ourselves to this first column of a living victim. More details about dead victims can be found in Arpad A. Vass et. al. [8].

Let's first have a look at some of the more volatile substances. Exhaled breath has a different composition than inhaled air. The composition of air is 21 vol. % oxygen, 0,03 vol. % carbon dioxide, 79 vol. % nitrogen gas and other gases. The composition of exhaled air is 16 vol. % oxygen, 4 vol. % carbon dioxide, 79 vol. % nitrogen gas and other gases plus the scents coming out of the lungs of the victim.

Eccrine is the watery substance that is produced by the body in order to keep our body on the right temperature. Victims which are under cooled produce hardly any eccrine.

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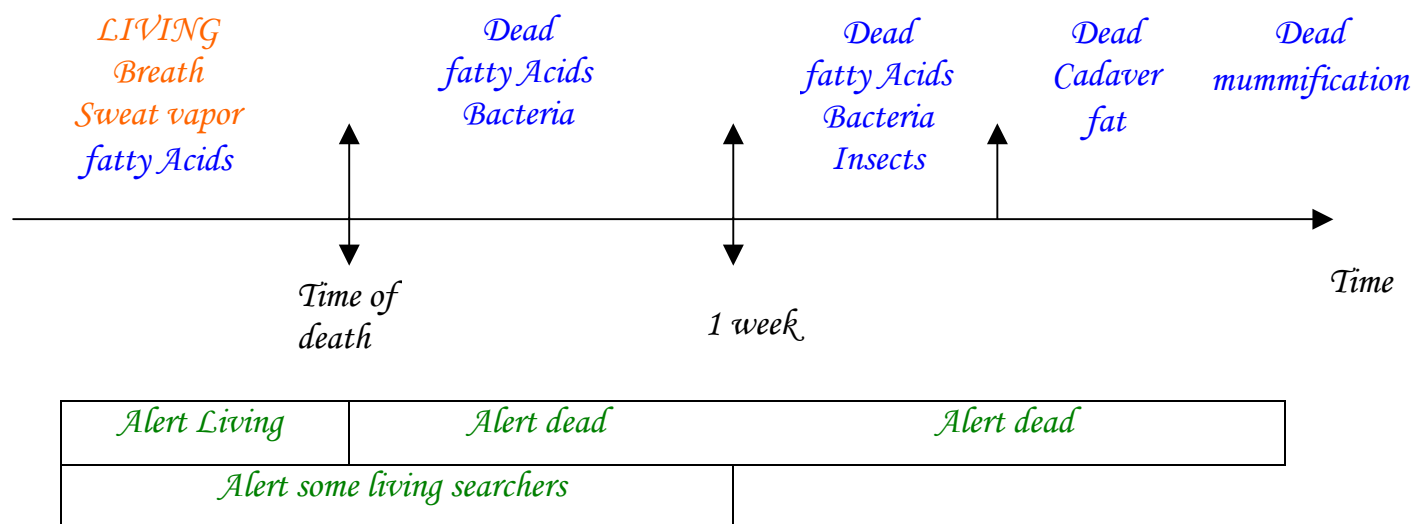
Next we will deal with the less volatile substances of the first column. Skin fat consist of at least two interesting substances. Apocrine and sebum. Apocrine is produced by the apocrine glands. These are located on particular body sections. These glands start working in the puberty. Not every human race has these glands. Korean people for example haven't. Sebum is actually what we call skin fat. It consist of more than one fatty acid. Every human being on the planet has the glands that produce sebum. For details see Stoddard [6].

As already stated there are common scents coming from a living and a dead victim. Hair, dandruff, skin pieces, skin fat etc. Of course this strongly depends on the time of death of the victim. When the victim has died recently there will be a lot of scents coming from the deceased victim that are the same as those coming from a living victim. It is these common scents that can trigger unexpected reactions of a search dog when he is confronted with a dead victim even when he is trained on living victims only!

However the word **unexpected** is of major importance. We don't know the reaction of the dog unless we confronted him with this situation before we go into a real search and rescue operation.

To get a better understanding of this let us look at the trajectory from living to dead more closely.

Trajectory from *Living* to *Dead*



From this we see that some SAR dogs have a tendency to give alerts on recently deceased victims. In the sequel when we will discuss the test results we will come back to this.

In 1997 A. Schoon [5] has shown that in identifying criminals the dog uses the scent coming from the fatty acids (sebum, apocrine, bacteria) coming from the criminal. Every person has its unique combination of fatty acids and bacteria on his or her body. By taking an object

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with your bare hands (you can see it quite well on a glass) everybody leaves skin fat on that object. Also the research on malaria bugs has shown that a bug chooses his supplier of blood by a selection on fatty acids. So science has proved that the smell of fatty acids is quite important for all type of beings (don't we humans like the smell of a fried steak!).

As we stated in the Boulder and Vienna paper the skin fat is one of common factor for both a living or a dead victim. This skin fat stays unmodified for at least a week in quite an amount on a human corpse. As we will see in the sequel when we discuss the test results fatty acids are a source of possible mistakes.

2 Scent discrimination tests: Theory

As a conclusion of the previous section about the scent complexes we can make some interesting observations.

-Discriminating between a living and dead victim according to the scent production can be achieved by realizing the fact that only a living victim is breathing and sweating.

-Fatty acids are a common scent for both a living and a recently deceased victim.

-Fatty acids can be a source of mistakes for a SAR dog.

-During the process of destruction the scent complex will undergo major changes in time.

This can generate problems in focusing a cadaver search dog.

A very important conclusion we made through the years that we are training SAR dogs and the time that we are doing scent discrimination tests is the following.

A dog is making a personal choice from the scent complex.

This choice can depend on various circumstances for instance, the age of the dog, his rank position in the group, his personal preference and of course the training method.

One of the main goals of the discrimination tests is to detect what choice is made by the dog and to correct it if necessary.

In order to get a high reliability of a search dog who searches for living victims we should **focus** the scents on which this dog is working, to those scents coming from a living victim, that discriminate between living and dead victims.

One way to focus a dog is to find one particular substance from the complex and train him only on the scent generated by this substance. This method is often used in the training of search dogs for other disciplines like explosive-search dogs or narcotics search dogs. This can be quite treacherous for a rescue dog. The problem is that all the scent components coming

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from a victim (living or dead) also occur in various settings in nature. We choose for another approach.

After a basic training of the dog (in case of a dog searching for living victims only this will be on living victims), we start doing **exclusion tests**.

By these tests we are excluding those scents, that could possibly lead to confusion.

From the Tables 1 and 2 introduced in Section 1 it will be obvious that a dog has a large amount of substances he can choose from in searching for human victims.

In most cases (in training SAR-dogs) the basic training of a search-dog on victims (dead or alive) starts with working on living victims. Looking at the scent complex belonging to a living victim (Table 2, column 1) it is obvious that a dog trained with living victims can choose those scents that are specific for a living person (breath, sweat vapor) or he can choose scents that are **both** on a living and on a dead victim (fatty acids). We do not know for sure what choice he made. The only way to find out is to do a test to see if the dog is alerting on the scents that both dead and living victim have in common or if he is alerting on those scents that are discriminating between a living and a dead victim.

As stated we choose for the exclusion approach. Dogs being trained to search for living victims are tested on those scents that possibly could cause confusion or false alerts, like objects carrying human fatty acids like clothes, recently used beds, shoes etc. Also they are tested on scents coming from a recently died victims, dead animals and fatty acids like old cheese, cream butter, vegetable oils etc. Dogs being trained to search for dead victims are tested as well on those scents that possibly could cause confusion or false alerts, like objects carrying human scents, clothes, recently used beds, shoes etc. Of course they are also tested on scents coming from **dead animals**, like pigs, chicken, etc.

In the beginning of the tests we regularly see dogs that give false alerts on misleading scents. Later on we see that the particular dog gets better and better focused. From this it will be obvious that dogs that are trained for more than one job need much special attention in scent training. In our organization (IRG) we have a tendency to stick to the conclusion made in Boulder Colorado 1995.

It has strong preference to train a SAR dog for a specific task, with its specific scent and not for a large scale of tasks.

As stated before we actually have two goals in doing these tests, one is to reveal the choice of the dog, and the other is to correct, if necessary, this choice in the direction we want.

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3 Scent discrimination tests: Practice

In this section we will give a description of the setup of the discrimination tests. As stated before we start with a basic training leading to a reliable alert.

Suppose we have trained a disaster search dog to search for **living** victims. We give this type of search dog a thorough basic training on living victims. After this we give the dog a first test on two scents. Here we give as an example a test between a living victim and Pseudo-Corpse scent formulation I from the Sigma company.

Hence, one scent is coming from Pseudo-corpse scent and one is coming from the living victim. For this purpose we create four hiding places in four separate apartments in an apartment building. We try to be as sure as possible that no mixture of scents can occur. In one hiding-place there is Pseudo-corpse scent whereas in another hiding place there is the victim. Mostly we introduce one or two empty hiding places as well.

If the dog is giving an alert on the hiding place with wrong scent (in this case the Pseudo-corpse) then we open up the hiding place, show the dog that there is nothing interesting in it and give him **no reward**.

After this we take the dog straightaway to the apartment with the victim. If he gives an alert on the victim he is very strongly stimulated and rewarded. In this way the dog is taught to choose for the scent coming from the victim by motivation (caused by the reward and stimulation).

During these tests the handler does **not know** in which hiding place the victim is located. It is forbidden for him to give **any signal** at all to the dog before the alert (this often turns out to be a problem in itself). Also the handler has to **wait** until the dog smells the scent coming out of the hiding place. Consequently, the dog has to make the choice all by himself.

The toy that is carried by the victim to reward the dog should be in a scent-proof glass jar. In the table 3 below I have noted some of our first results of this type of test (see also Bogers 1997, [2]). In this table, which is the same as in the Vienna paper, we give the results of some dogs of our own organization.

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Table 3. First test with Pseudo corpse-I. Living searchers.

HIDING⇒ DOG ↓	EMPTY	PSEUDO I	EMPTY	VICTIM
CHAOOT	NO	FEAR	NO	ALERT
KILLIK	NO	REACTION	NO	ALERT
LUCA	NO	NO	NO	ALERT
NOSEY	NO	NO	NO	ALERT
ATHOS	NO	NO	NO	ALERT
MARCO	NO	ALERT	NO	ALERT
JOEY	NO	REACTION	NO	ALERT

From these results of the first exposure to the Pseudo Corpse formula-I scent we see that there are some dogs that alerted on the wrong scent. These dogs need extra focusing. From the table you can see a fear reaction by the German Shepherd female Chaoot. This is often described in mission reports and in the literature. We have seen a reaction like that more than once. However at the second exposure to the Pseudo Scent-I this reaction was gone. Also in working with the "real scents" we had no fear reaction anymore.

Suppose now we train a disaster search dog to search for **dead** victims. As stated in the previous section we give this dog a thorough basic training on the scents coming from a dead victim. Again this training continues until we have a **reliable alert**.

When this phase in the training is passed we give the dog a first test on two scent-complexes. Here we give as an example a test between a scent coming from clothes that have been worn by humans and a scent coming from a dead victim. We use the same setup as with the previous test.

In one hiding-place there are scents coming from clothes whereas in the other hiding place there are scents coming from a dead victim. We introduce at least one empty hiding place. All these hiding places are in separated apartments. If the dog is giving an alert on the hiding place with wrong scent (in this case the clothes) then we open this hiding place, show the dog that there is no-body in it and of course give him no reward. In that case the dog is brought straight away to the room with the scent of the dead victim.

If he gives an alert on this scent then he is very strongly stimulated and given a toy which is in a scent-proof glass jar near the dead victim. In Table 4 below we give some results of one of these tests.

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Table 4. First test with clothes.

HIDING⇒ DOG ↓	CLOTHES	EMPTY	CORPSE SCENT
ASCHWIN	NO	NO	ALERT
YELLOW	REACTION	NO	ALERT
BONGO	ALERT	NO	ALERT

In this test there were two dogs, Yellow and Bongo which had just finished their basic training. Whereas Aschwin was a thoroughly trained search dog for dead victims. You can directly see from the results that Yellow and Bongo need some extra focusing.

After the first tests with two scents we can introduce tests with more and different scents.

One special aspect is introduced. During the tests the handler needs to be absolutely silent in order to let the dog do the job by himself. The alert has to come from the dog. After the dog has reached more maturity and a good contact with the handler the handler starts actually **showing with his hands where the dog has to check for scents**. When the team is working good, the dog will only give alerts when he smells the correct scent. Consequently we accomplish by these tests actually two goals.

-We can **focus** the scent on which the dog is working to those scents that he needs to do his job properly.

-We get a more reliable and **independent** alert of the dog.

4 Results

In the last seven years we tested about 100 dogs. These dogs came from all over the world. Friends from Germany (40 dogs) Norway, Holland (50 dogs) Canada, Israel came to us to do some testing on their dogs. In this paper we present some interesting results regarding the discrimination between the scent coming from a dead or a living victim.

Table 5 Results

Pseudo corpse-I	Number of dogs 80
Alert	15
Almost Alert	30
No alert	25
Miscellaneous: Fear	10

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Pseudo corpse-II	Number of dogs 80
Alert	0
Almost Alert	5
No Alert	60
Miscellaneous: Aggression/licking	15

Cadaver scent (old)	Number of dogs 80
Alert	0
No alert	60
Miscellaneous: Fear/aggression/licking	20

In table we presented the results of testing 80 dogs. All dogs were trained to search for living victims. We tested on three substances. Pseudo corpse scent formulation I and II of the Sigma Company and on real cadaver scent which was about 4 weeks old (human placenta). For every scent we tested we made a subdivision in the reactions that were observed. Alert, almost alert, no alert and miscellaneous. The category of miscellaneous was further subdivided in fear, aggression and licking.

Discussion of the results.

As can be read from Table 5 we can see that quite an amount of dogs reacted on the pseudo corpse scent formulation I. Interest was observed in 45 out of 80 dogs for the scent coming out of the hiding place. Most of them (30) however did not alert. Fear reaction was observed in 10 out of 80 tested dogs. This already shows the significance of this type of test. In our opinion dogs searching for living victims should be confronted regularly with this scent during their training. As we do not know exactly what substances are contained in this pseudo corpse scent formulation I we can not draw further conclusions. We suspect however that in this scent elements of fatty acids are contained. From earlier research (Schoon 1997, [5]) we already knew that a dog has a certain affinity to fatty acids.

Some living searching dogs that we tested more than once didn't show any interest at all in this scent during their lifetime. Some dogs that we tested more than once didn't show any interest in this scent in the beginning of their career but gradually developed interest as their age proceeded. This could be an indication that the dog gradually learns during the regular training sessions that fatty acids lead him also to the goal of the search. From this we conclude that regular testing is necessary even if the dog didn't react in the beginning.

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From Table 5 we can also see that there was hardly any significant reaction on the pseudo corpse scent formulation II. Interest was observed in 5 out of 80 dogs for the scent coming out of the hiding place. Most of them (60) however did not show any sign of interest. More interesting were the miscellaneous reactions. No fear reactions were observed. Some dogs reacted with a slight amount of aggression or stiffness some of them reacted with a licking of the mouth as we can observe when a dog smells the scent of a dead animal. Again as we do not know exactly what substances are contained in this pseudo corpse scent formulation II we can not draw further conclusions.

From Table 5 we also can see that there was no reaction on the scent coming from a four weeks old human placenta. Interest was observed in 0 out of 80 dogs for the scent coming out of the hiding place. The miscellaneous reactions showed hardly any difference with those from the pseudo Corpse scent II. Some fear reactions were observed. Some of the dogs reacted with a slight amount of aggression or stiffness and most of them reacted with a licking of the mouth as we can observe when a dog smells the scent of a dead animal. Comparing the reactions on the pseudo Corpse formulation II with those on the human placenta we may conclude that the pseudo corpse can be a useful training attribute to train cadaver dogs. From the training of cadaver dogs we learned that the pseudo scents are a useful training aid.

Influence of the handler.

As a by product of the testing we made some interesting observations concerning two major points in the training of SAR dogs.

First there is the influence of the handler on the dog, second there is the fact that the dog should be able to switch from a global search to a more fine search.

In many combinations we tested we saw that there is a too large dependence of the dog on the handler. We saw that dogs were constantly observing the attitude of the handler where he walks, if he is standing still, where he looks etc. Also we saw dogs that read from the attitude of the handler if they should alert or not.

On the other hand we have also seen combinations where there is hardly any influence of the handler on the dog. With these dogs it is impossible for the handler to control the dog when he is searching. The dog just runs off and starts searching according his own plan. Especially when you have to check a number of rooms in order to see if there is anything of interest in there this can be a problem. In our opinion both types of behavior is not optimal and should be corrected.

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Also we noticed that many SAR dogs have problems to switch from a global search to a more fine search. This is especially true for those dogs that are trained to give a barking alert. Sometimes these dogs start giving an alert as soon as they get a whiff of the scent in the hiding place. In some of these cases it was hardly possible for the handler to stop this barking and to bring the dog to a fine search. In our humble opinion a properly trained SAR dog should be able to make the switch between a global search and a fine search.

5 Problems

In this Section we will discuss some interesting problems in the work of SAR dogs. Every problem will be analyzed by using the scent-complexes presented in the tables above!

Problem 1. A dog that is trained to do tracking and searching for living victims as well is giving false alerts on recently worn clothes or recently used beds.

Analysis. Obviously by the combination of these two jobs (tracking and searching for living victims) this dog has chosen those scents from the scent-complex, that these two jobs have in common. Most likely this will be the fatty acids. One way to cope with this problem is stick to one job only or to try to focus this dog, by exclusion tests, on the breath of the victim when he is searching for living victims.

Problem 2. A dog that is trained to do water search (dead victims) by training him on the biological scents coming from hair and fatty acids, is giving false alerts in disaster search, on object that carry human scents like clothes or recently used beds.

Analysis. Obviously this dog is trained on those biological scents that both columns of Table 2 have in common, i.e., dandruff, skin pieces, sweat from feet, fatty acids. It will be obvious that these biological scents also can be found on clothing and recently used beds etc. Again the best way to get a high reliability is to do one job only with this dog. If you want to continue to do two jobs you should search for those biological scents that differentiate between the two columns of Table 2.. In case the dog is trained to search for **living** victims in a disaster situation you should focus the dog on breath and/or sweat vapor.

However it will be obvious that this can cause serious problems. In our organization (IRG) we never do these two jobs with the same dog.!

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Only in area search we allow a dog to do two jobs, living victims and dead victims because in this situation it is easy to verify the alert. However these dogs will never be used in a disaster situation because finding the survivors is item number one. Only if one wants to find the dead victims as well we will use these dogs **after** the dogs who search for living victims have done their job!

Question. Is it possible that a dog which is trained to search for living persons gives alerts on dead victims whereas it is trained to give no alerts on clothes, beds and other objects carrying human scents?

Answer. In order to give an answer to this question we must look at the columns of table 2 in order to find those scents coming from a living and a dead victim that are **not** on clothing and beds. We see that if the victim has died recently, then the bacterial metabolism has not yet radically changed. We already stated that the change in the scents follows a trajectory from the moment of death to some days after death. If the dog has picked the scent produced by the bacterial metabolism out of the scent complex or when he is trained to work on this scent, then it is possible that he gives alerts on recently died victims still producing this scent. Consequently training on sweat vapor (eccrine) and breath does **not** entirely exclude this possibility, however it is not likely. During the years we trained search dogs we noticed that quite an amount of dogs have tendency to work on fatty acids.

The only way to be absolutely certain what scents this dog is working on is to do exclusion tests on clothes and living victims and on clothes and recently died victims (Pseudo-I).

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6 Conclusions

-A large amount of SAR-dogs trained to find living victims turn out to be interested in fatty acids.

-Quite an amount of SAR-dogs trained to find living victims turn out to be interested in the scents coming from a recently deceased victim.

-The only way to find out what choice is made by the dog is to do discrimination tests.

-By these tests it is possible to focus the dog on a designated scent

-The influence of the handler on the dog while he is in a search is not optimal in many cases.

-Training of a dog to switch from global search to fine search is often neglected in the training of the SAR dog.

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