Scents and Sense-Ability

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Europeans have used scent-discriminating dogs to aid criminal investigations for over a century. Reputed to have a sense of smell 1,000 to 10,000 times more superior than that of humans, a dog's nose does offer a sensitive forensic instrument.

Traditionally, dogs contributed to police work by stalking a suspect's track. During the latter part of the twentieth century, investigators found a new way to employ the canine's olfactory skills: perform a scent lineup to connect a person with a crime via scent evidence. Dogs trained for scent identification are "specialist, biological devices," according to Tomasz Bednarek, the Head of the Warsaw Metropolitan Forensic Laboratory and an expert on oso-mology – a system of human scent identification.

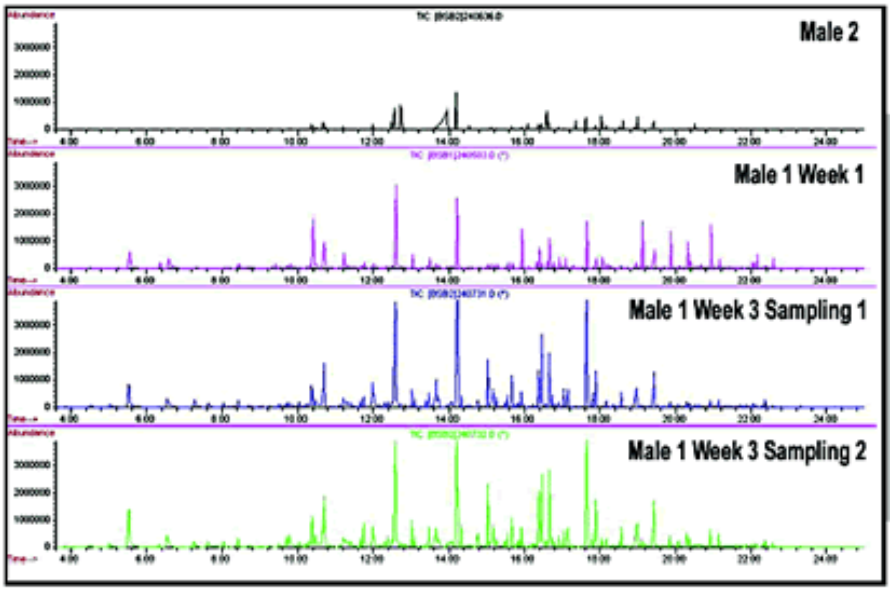

Figure 1. Chromatograms of armpit samples produced from different people and the same person at different times. Samples were taken from Male 1 ten hours apart (Sampling 1 vs. Sampling 2) and several weeks apart.[2]

The Specialist, Biological Device's Olfactory Abilities

Scent identification rests upon an assumption that humans have unique odor profiles that remain constant over time, and that dogs can be trained to recognize that unique scent in a mixture of other odors. What determines the uniqueness of human scent? "As far as the bloodhound is concerned," says Dr. Lisa M. Harvey, "it appears that their scent discriminatory abilities are based mainly on genetics." Harvey, a member of the Biology Department at Victor Valley College (Victorville, CA), points out that studies with rats, mice, and humans indicate that scent may be based upon the expression of genes in the Major Histo-compatibility Complex (MHC). "This is the most polymorphic genetic code in the human genome," she explains, and since everyone – with the exception of identical twins – has a different genetic code, variations in the MHC may provide the clues to the bloodhound's sensitive nose.

Other factors can contribute to the distinctiveness of a person's scent. Harvey's group plans to publish their findings "that nutrition and hygiene may play a minor contributory role if the individuals are related or identical twins." A

person's state of health may also contribute to a characteristic scent. A recent study showed that dogs can detect changes in physiology associated with human bladder cancer.

G.A.A. Schoon (Netherlands National Police Agency and Leiden University) investigated how the age of odor trace evidence affects the performance of Dutch and German scent identification dogs.1Although the dogs performed faultlessly in matching odors collected on the same day, their performance level dropped when presented with scent evidence stored for two weeks. After this initial drop, aging did not significantly diminish the dogs' performance even with scent evidence aged up to six months. Schoon suggests that the initial drop is due to the volatile nature of scent.

Allison Curran, Scott Rabin, and Kenneth Furton (International Forensic Research Institute, Florida International University) have used gas chromatography-mass spectroscopy to analyze the volatile components of human odor signatures (Figure 1). Dr. Curran explains that their work "has developed discriminating terminology for the elements of an odor profile to separate out the compounds which are present due to external factors such as perfumes (tertiary odor), internal environmental factors such as smoking or eating onions (secondary odor), and constituents that are stable regardless of diet and environmental factors (primary odor). Human scent can be described as a combination of volatile to semi-volatile compounds which differ in ratio from person to person, along with additional compounds which vary between individuals." The group also examined the effects of aging on scent samples and found measurable amounts of human scent compounds months after transfer to sterile gauze. These studies, Curran says, reveal "a relatively long persistence of the human scent compounds in a controlled environment." What happens to human scent in uncontrolled environments?

According to anecdotal information, identifiable human scent usually disappears from an environment after 24 hours. But human scent can persist for much longer than one day. In 2003, the FBI hosted a bloodhound research workshop that included a test to evaluate the feasibility of detecting aged human scent in a heavily populated residential area. Researchers selected a test subject who had lived in a Stafford, Virginia house for seven years before moving to Albuquerque, New Mexico. Six months after the subject had moved to New Mexico, researchers placed a bloodhound team at a Stafford intersection several houses away from the old residence. After sniffing a letter that the subject had mailed from New Mexico, the dog trailed to and identified the correct house. In this study, the distinctive scent traces withstood the deteriorating effects of weather. But scent can survive conditions much more extreme than weather.

Bombers and arsonists often use a time-delay device, which allows them to depart safely from the scene of the crime. In 2001, the FBI and Southern California Bloodhound Handlers Coalition performed a study to investigate whether human scent can connect a bomber or arsonist with the debris left behind. The researchers prepared four pipe bombs – each with a different type of explosive – and two containers of gasoline. Six test subjects then handled a bomb or gas can for one to two minutes. After detonating or burning the devices, researchers collected debris – such as that shown in Figure 2 – and transferred scents from the debris to gauze pads. They stored the pads for two to sixteen days.

On the day of the test, the bomb handlers and six decoys walked along trails in a public park. After placing 20 bloodhound teams at the start of a trail, the handlers gave their dogs sniff of a scent pad. The dogs trailed and identified the target person in 53 of 80 bomb debris experiments and in 31 of 40 arson debris experiments with no false identifications. The results showed that human scent can survive extreme mechanical and thermal stress.

Figure 2. Debris from a binary explosive used in the scent study.[3]

Figure 3. The STU-100®.
Courtesy of Larry Harris, Big "T" Enterprises, Inc.

Scent Detection Applications

The canine nose can aid police by tracking or trailing an individual, or by connecting a suspect with evidence in a scent lineup. Dogs can track a person without a scent sample of their quarry. They achieve this by following the odor of crushed vegetation and disturbed ground, indicators of a fresh track. Tracking dogs may also use traces of fresh generic human scent to aid their pursuit.

Trailing and scent lineups require a scent sample. Traditional scent collection techniques include direct scenting, swiping, and absorption. In the direct scenting method, a handler allows a dog to smell an article of evidence. In the swiping method, a sterile gauze pad is wiped across the surface of evidence, and the pad is then used as the scent source. The absorption approach relies upon the ability of a sterile gauze pad to absorb scent if placed upon an item of evidence for an extended period of time. These traditional methods have a drawback: collection of scent can remove or contaminate fingerprints, fibers, DNA, and other trace evidence.

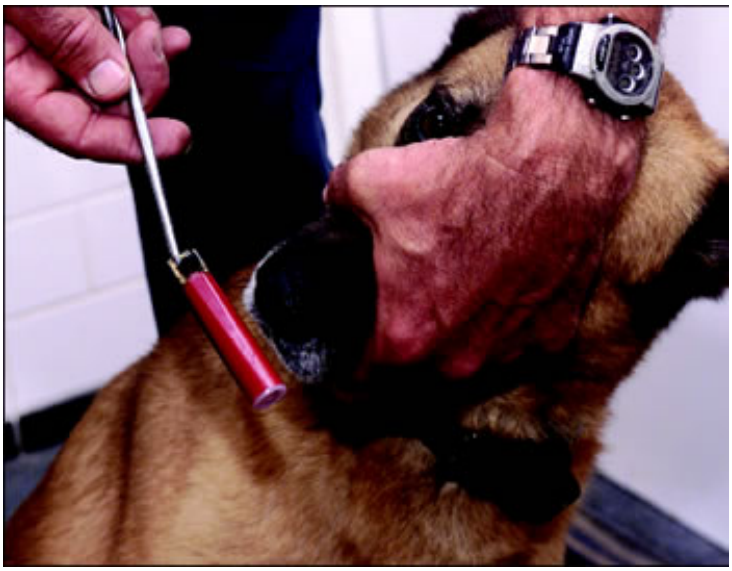

Figure 4. Presenting scent evidence to a scent identification dog.
Courtesy of the Netherlands National Police Agency.

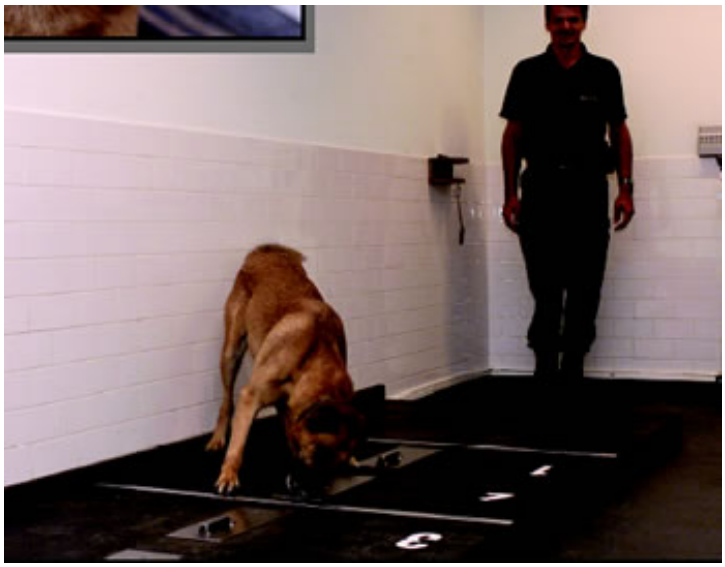

Figure 5. Scent identification dog investigating carrier tubes on a platform. Courtesy of the Netherlands National Police Agency.

The latest collection method requires the Scent Transfer Unit (STU) to create scent pads (Figure 3). The STU-100®– a portable vacuum – uses airflow to convey the components of human scent onto sterile gauze pads. The scent pads can then be stored in zip-lock or heat-sealable bags until needed. Police departments and the FBI use this device.

Supporters of the STU-100®say that the use of airflow to capture scents minimizes the loss of other forensic evidence and produces a consistent scent pad. When the FBI and the Southern California Bloodhound Handlers Coalition tested the STU-100®, they concluded that either no scent cross-contamination occurs from one pad to the next or, if contamination does occur, the amount falls below the detectable threshold of the trained canine.

Lisa M. Harvey and Jeffrey W. Harvey (San Bernardino Police Department) tested the STU-100®in a study designed to investigate whether anecdotal evidence about a trailing dog's ability could be justified.[4] Unlike tracking dogs, trailing dogs have been trained to follow an odor presented on an article that contains the scent of a particular individual. The dogs can identify this scent even when mixed with scents of other humans. At least, this is their reputation. The Harvey study presented bloodhounds with a challenge: identify and trail the scent of individuals remaining on two day-old paths in parks, college campuses, and urban environments. Veteran bloodhounds lived up to their reputation by trailing and correctly identifying individuals under various weather conditions and despite cross-trail contamination.

In the latest canine contribution to police investigations, a dog performs a scent identification lineup to link a suspect with crime scene evidence. The Dutch National Police devised a protocol to withstand the scrutiny of their courts. Their procedure requires a scent evidence object, a control object preferably made of the same type of material as the scent evidence object, and scent carriers, typically ten centimeter stainless steel tubes. To prepare scented test materials, a suspect and six foils - adults not associated with the suspect – hold two scent carriers for five to ten minutes. One of the foils is designated as the control person, who stores the control object in a pocket while handling two scent carriers.

An assistant prepares the test room for a scent lineup by clamping both sets of scent carrier tubes to a platform. The assistant arranges each set of tubes as a row with a random sequence. The dog and its handler enter the room, the handler lets the dog smell the control object, and the dog searches the first row for a matching scent. If the dog identifies a scent carrier handled by the control person, then the handler repeats the procedure with the second row. If the dog identifies the odor of the control person once again and has not shown particular interest in the carrier tube held by the suspect, then the dog may proceed to the suspect identification stage. Since the dog has retrieved both tubes held by the control person, six tubes remain on each platform: one handled by the suspect and five by the foils.

To start the suspect identification stage, the handler returns to the first row and allows the dog to smell the scent evidence. If the dog responds to the odor of the suspect in both rows, then police conclude that the scent evidence object and the suspect share an "odor similarity."

In this procedure, the dog's handler does not know who touched the scent carriers. The handler's ignorance avoids the so-called Rosenthal effect – a nonverbal, or even unconscious, suggestion to a dog working in a lineup. Polish forensic laboratories that perform human scent lineups also eliminate the Rosenthal effect by separating the roles of dog handler and scent identification expert.

Making Legal Sense of Scent Evidence

Human scent can be transferred from one person or object to another. Consequently, a scent relationship can establish a direct or indirect link between a person and an article of a crime, but cannot prove that an individual participated in a crime. While a scent lineup can aid an investigation, the results usually cannot justify an arrest. "A canine identification of a person is one reasonable suspicion indicator," says Terry Fleck, a Deputy Sheriff and Canine Handler in South Lake Tahoe, California. He explains that "the officer or investigator needs to develop other reasonable suspicion indicators in order to develop probable cause that the person committed a crime." That is, investigators will seek corroboration for scent identification.

U.S. courts have diverse views about the admissibility of scent lineup evidence. In Winston v. State (Tex. App. 2002), for example, an appellate court noted that 37 states and the District of Columbia admit scent trailing evidence to prove the identity of the accused. As a relatively new use of the canine's olfactory skill, the scent lineup will require scientific proof of reliability before identification evidence can withstand judicial scrutiny in all U.S. courts. Until then, the scent lineup remains a valuable tool for law enforcement during an investigation.

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