Sniffing walks can help build confidence:

Rehabilitation Guide to Help Blind Dogs Gain Independence Ver.6

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— Introduction —

The Hidden Power of a Dog's Brain: Reconstructing Lost Vision Through Other Senses

For dogs, sniffing isn't just playful nose work. It's a "3D sensor" that helps them understand where they are and what surrounds them—essentially, a way to perceive spatial depth.

Even after losing their sight, dogs' brains harbor astonishing capabilities. Recent research has revealed that canine brains possess a "dedicated direct pathway" that rapidly transports information from the nose to the 'image processing center'.

This means that even when a dog loses its sight, the brain's very structure possesses the innate ability to "reconstruct scenery" through scent.

This guide proposes steps to maximize this brain mechanism, helping your beloved blind dog regain the confidence to walk independently once

more. Based on the latest scientific evidence and behavioral science, it's a specialized program to cultivate the nose as a "new set of eyes."

Keywords: Blind dogs, vision loss, rehabilitation, olfaction, spatial memory, nose work, essential oils

Chapter 1: The Mysterious Relationship Between Smell and Vision: Exploring the Brain's Network

A dog's sense of smell is incomparably more powerful than a human's. The number of scent-catching sensors is dozens to hundreds of times greater than in humans, depending on the breed.

But dogs don't just sense smells with their noses. They use their entire brain to transform the information captured by their nose into a "three-dimensional image." It's as if most of their brain supports the role of their nose. Dogs hold the secret to seeing the world with their noses.

1. The Brain's "Five Scent Routes"

Using the latest brain scanning technology, it has been discovered that the canine brain has "five major dedicated **pathways**" connecting the nose (smell) to various parts of the brain.

Particularly noteworthy is a route that goes directly to the "eye (visual) area," something not seen in other animals.

Table 1. The "Five Major Dedicated Routes" Connecting the Sense of Smell to Different Brain Regions.

Brain Route Name	Connected Area	Role of This Route (Dog's Sensory Experience)
1. Visual Pathway	Eye Area	Feeling "the shape and depth of objects" through scent (★Dog-specific!)
2. Discrimination Route	Scent-Only Area	"What is this smell?"—identifying the source
3. Emotional Path	Emotional Zone	"I like it!" "I'm scared!" Feelings stir
4. The Memory Path	The Memory Area	Connecting to memories: "This is that place!"
5. Body Route	The spinal cord area	The body reacts instantly upon smelling (reflex)

This "scenery route" is a special brain circuit unique to dogs, not found in other animals.

Even if they lose their sight, thanks to this pathway, the brain's "area for seeing" automatically remodels itself into an "area for receiving information from the nose." This allows them to sense the size of a room and the distance to furniture just by smelling, as if they were seeing it with their eyes.

2. Brain Remodeling and New Role Division

For blind dogs, sensing their surroundings through their ears (hearing) and body and paws (touch) is just as important as smelling. Blind dogs use their ears like radar to understand their environment. They create mental maps using sounds like household appliances as landmarks and detect obstacles through sound reflections. They also gauge distance and emotion from their owner's voice, relying on sound to live with confidence.They also use their entire body as sensors, including whiskers and paw pads, to explore their surroundings. Facial whiskers detect air movement to identify obstacles, while differences in floor texture felt through paw pads pinpoint their current

location. Walking along walls provides a safe guide for movement. The coordination of nose, ears, and body creates a more perfect mental map, akin to a "personal 3D navigation system expanding within their mind."

This process of a blind dog moving around to build its mental map resembles the surveying work of **Tadataka** Inō (1745-1818) during the Edo period in Japan. Starting at age 55, he spent 17 years walking across Japan, surveying the land to create the nation's first accurate, measured map.

Chapter 2: The Intelligence That Links Memory and Scent

When blind dogs walk, they aren't just sniffing around aimlessly. They brilliantly use two things in their heads: the 'map of home (spatial memory)' and the 'scent markers (olfactory memory)' associated with it.

1. Moving by mental 'floor plan (map)' before the nose

Before using their nose, blind dogs first think, 'There should be a wall there,' and move based on that mental image.Therefore, rather than focusing intensely on scent training at first, the key to successful rehabilitation is to help them complete the blueprint in their brain by 'not rearranging the room' and 'walking a set course'. For this reason, the living space for a blind dog must be arranged with a layout where the positions of furniture and objects are always the same. Simultaneously, it must be made a safe space by removing any protrusions at eye level.

2. Using "Scent Signposts" to Correct Discrepancies in the Mental Map

When your blind dog walks, it's not just blindly guessing in the dark. It's moving forward, using scent as "solid evidence" to back up the map it has memorized with its body. By placing "scent stickers" at key points in the

room, your blind dog can find signposts in its mind that say, "This is where I am now," preventing it from getting lost.

Chapter 3: Rehabilitation Program

Stage 1: Ability Assessment (Checking Smell and Hearing)

Dogs can walk while sniffing because they can detect scents. Not all blind dogs possess this scent detection ability. Therefore, it is necessary to confirm that blind dogs do not have impaired olfactory function.If the dog exhibits symptoms like those in Table 2 while walking and sniffing, it may indicate a decline in the sense of smell. Additionally, if a decline in hearing is observed (Table 3), it can affect rehabilitation. If you suspect a decline in either sense of smell or hearing, please have your blind dog examined at your nearest veterinary hospital.

If there are no symptoms of reduced sense of smell, proceed to the next stage.

Table 2. Symptoms Indicating Reduced Sense of Smell in Dogs.

Changes in Items	Specific Symptoms
Appetite Changes	Weak reaction when sniffing food, change in favorite foods.
Change in Searching Behavior	Unable to find hidden treats.
Nasal Condition	Runny nose, nosebleeds, constantly dry nose, increased sneezing.
Decreased activity	Significantly reduced sniffing during walks.

Table 3. Symptoms in Dogs Indicating Hearing Loss.

Category	Specific Symptoms/Signs	Points Owners Are Likely to Notice
Response to Calls/Sounds	Loss or Diminished Response	Ignores when called by name, fails to notice sounds associated with walk preparation.
	No reaction to specific sounds	No longer startled by sounds like the doorbell, vacuum cleaner, or thunder.
Sleep and Wakefulness Behavior	Deep sleep	Doesn't wake up when you come home or when there's a loud noise, and stays asleep until touched.
	Excessive startle response	Jumps up at the slightest approach; flinches and becomes angry when touched.
Communication	Ignoring Commands	Voice commands like "Stay" or "Sit" no longer work.
	Change in Barking	Because they can't hear their own voice, their bark becomes louder or hoarse.
Body and Movement Signs	Ears stop moving	They stop turning their ears toward sounds or twitching them.
	Shaking or tilting the head	They may exhibit gestures indicating concern about their ears.
Mental Changes	Increased anxiety	Panics or becomes dazed when owner is not nearby.

Stage 2: Establishing Household Rules

Make your home a safe place so your blind dog thinks, "Okay, let's go for a walk!"

1. Turn Your Home into an 'Unchanging Town': Secure Furniture and Mark Landmarks to Prevent Getting Lost

For your blind dog, immovable furniture is a "reliable wall," and mats with different textures are "street signs." Simply setting up these two elements will instantly clarify the map in your blind dog's mind, allowing them to walk smoothly as if they could see.

Use non-slip mats or rough-textured rugs, and place them near doorways, feeding areas, and water bowls.

2. The "Notice Rule" to Eliminate Your Dog's Anxiety

The most important thing in rehabilitation is to take away the surprise of "suddenly" from your blind dog. No matter how small the action, always say something like "Stairs!" or "Pick me up!" before moving. By giving signals, your blind dog can judge the situation for themselves and move based on their own will. This is what best supports the brain's "compensatory development" (the ability to sharpen other senses).

Stage 3: The "Signposting" Strategy at Home

By creating 'scent trails' around the house, you help your blind dog use their nose to perceive their surroundings as clearly as if they were seeing them with their eyes.

1. Creating a 'Home Navigation System' with Scent Markers: Tips for Applying Scent Markers

Distinguishing scent types is like changing the color or shape of signs for us. For example, marking dangerous areas with the sharp scent of rosemary lets your blind dog sense, "Whoa, I need to be careful here," through their nose. Once they learn these 'scent rules,' their independence will increase remarkably.

For scent markers, you can use commercially available scent markers for blind dogs (scent stickers: Tracerz) or specific natural essential oils. Then, place the scent markers at your blind dog's nose height on furniture legs, door frames, wall corners, etc. For example,

Table 4. Examples of scent marker placement locations and their purposes.

Type of Scent	Location in the Home (Example Placement)	Message to the Dog	Main Effect/Purpose
Vanilla	Room Entrances, Door Frames	"This is where the space changes."	The starting point for everything. A sense of security as the beginning of movement.

Type of Scent	Location in the Home (Example Placement)	Message to the Dog	Main Effect/Purpose
Chamomile	Water bowl, feeding area	"Here's where you'll find water and food."	Identifying survival resources. Suppressing anxiety, confidence in quenching one's thirst independently.
Lavender	Bed, Cage	"This place is absolutely safe. Rest peacefully."	Deep rest. Calms the central nervous system and promotes high-quality sleep.
Eucalyptus	Around the toilet area	"This is the place to feel refreshed (toilet)."	Identifies the hygiene area. Distinguishes the elimination spot with a clean scent.
Rosemary	Training Area	"Time to focus using your nose!"	Brain activation. Enhances focus and motivation, supports cognitive function. However, do not use on dogs with a history of epilepsy (seizures).

The standard method for using natural essential oils is to dilute them with anhydrous ethanol and allow the alcohol odor to dissipate completely before use, ensuring the scent is conveyed clearly. A dog's nose is tens of thousands of times more sensitive than a human's. Start with a dilution concentration where we humans perceive only a faint hint of scent (0.1% to 0.5% dilution). For the rehabilitation in blind dogs, the golden rule is to use natural essential oils from a trusted manufacturer, properly diluted. Inexpensive synthetic aroma oils (fragrance oils) are synthetic chemicals made from petroleum and other raw materials to mimic scents. They are

harmful, potentially disrupting the endocrine system (hormones), irritating the respiratory system, and placing a burden on the liver and kidneys.

【How to Make and Set Up Scent Markers】

- **Dilution Solution:** Add 1-2 drops of natural essential oil to 5ml of anhydrous ethanol, mix well, then add 45ml of purified water and mix thoroughly.
- **Installation:** Spray the scent marker solution onto felt fabric and secure it with double-sided tape at your dog's nose height.
- **Important:** Always use "100% natural" essential oils.

When using natural essential oils, do not use different types at once. Use them one at a time, ensuring a "memory association (scent-based map)" forms between the scent marker and its designated location.

(Note) Natural essential oils are very expensive, so check the type and price before purchasing a small amount.

2. Safety First! Rules for Using Scent Markers

A dog's nose is extremely sensitive. When using scent markers, you must be mindful of the following three points:

- **Know** which **plant oils "must not be used"**: Oils made from the following plants are potentially toxic to dogs and must never be used. Tea tree, pine, citrus (such as lemon and orange), and wintergreen.

Table 5. Plant oils that should not be used and symptoms in dogs.

Plant Name	Danger to dogs and main symptoms
Tea tree	Adverse effects on the nervous system. Even small amounts can cause symptoms such as staggering, trembling, and loss of energy.
Pine	May damage the liver and kidneys. Can cause vomiting, skin inflammation, and difficulty breathing.
Citrus (Lemon, Orange, etc.)	The components found in citrus fruits (such as limonene) are toxic. They can cause vomiting, diarrhea, and loss of energy.
Wintergreen	Contains ingredients similar to aspirin, which are extremely dangerous to dogs. Can cause severe gastrointestinal disorders, liver failure, and kidney failure.

- **A little goes a long way!** Dogs' noses are tens of thousands of times more sensitive than humans'. If the smell is too strong, blind dogs may panic or dislike the place. Just a few drops diluted in water will be enough for your blind dog to smell it.
- **If your blind dog has health issues**, **consult your vet first**: Certain scents can worsen allergies or existing conditions. If you have any concerns, always check with your regular veterinarian beforehand.

3. Example of Targeted Training Based on Scent Marker Placement

- **Chamomile marker placed near the placemat where food is placed (edge of placemat, nearby wall or floor)**
  - **(1) Attempt without using scent markers (Simple approach):** The feeding spot is where the delicious smell

comes from. Placing meals in a consistent location may eliminate the need for scent markers. First, place the food bowl on the placemat.Then, bring your dog near the placemat where the bowl is placed. Next, pick up the bowl, let your dog sniff the food, and while saying "Dinner time!" guide your dog to the center of the placemat. Once guided, place the bowl on the placemat and let your dog eat. After finishing, don't let your dog leave immediately; pet them while speaking and praising them.The dog will identify the location by the feel of the placemat and the smell of the food. Once the dog gets used to this, place the food bowl on the placemat and gradually position the dog further away from the placemat before guiding it over. As the dog becomes more accustomed, simply saying the cue and placing the food bowl on the placemat may be enough for the dog to come to eat.

(2) **When setting up a scent marker**: First, place your dog on the lunch mat without food. Immediately after letting them briefly sniff the chamomile marker (attached to the edge or near the mat), place the bowl. Then, have your dog wait 1-2 meters away from the feeding spot. Say "Dinner, chamomile!" while tapping the chamomile marker with your finger and guiding them with "Where's dinner?" Once they find the bowl, let them eat immediately. After they finish eating, don't let them leave right away. Instead, pet them briefly and praise them while they're still near the spot with the chamomile scent.

- **Place the chamomile marker right next to the water bowl (at the dog's nose level).**

(1) **Attempt without using scent markers (Simple approach):** Since dogs often spill water at their drinking spot, place the water bowl on a dedicated mat. Over time, this mat will naturally absorb some scent. By consistently using a specific spot for drinking, the dog may learn to recognize it by the feel of the mat and its scent, making scent marking unnecessary. Lead your dog to the bowl, then tap the rim or the water

with your fingertips to teach them the location through sound.Once your dog finds the water and finishes drinking, praise them while petting them. You can also give them a treat as a reward.

(2) **When setting up a scent marker**: Place a chamomile marker (attached near the mat) close to the water spot. Bring your dog to the bowl, tap the rim or water lightly with your fingertips to teach the location through sound. Once your dog finds the water and finishes drinking, give a treat reward while positioning them so their nose touches the chamomile marker.

- **Lavender marker placed right next to the sleeping area (near a wall or bed leg)**: The best spot for a sleeping area is near a wall or in a corner of the room, where the dog feels protected from behind.If the lavender scent is too strong, it can cause "numbness/lethargy" instead of "relaxation." Therefore, the lavender marker should only be faintly noticeable within about 30cm around the bed. Also, using low-quality lavender for the marker can have the opposite effect, making the dog alert or causing aversion.
- **Eucalyptus marker placed immediately beside the toilet tray (at a low position)**

  (1) **Attempt without using scent markers (Simple approach):** Typically, pets are trained to urinate and defecate on dedicated pet pads. Therefore, placing a pet pad with just a trace of urine or feces scent can help them understand "this is the toilet spot," potentially eliminating the need for scent markers.Identify the toilet location and place a fresh toilet tray over the pet sheet with a very faint urine/feces scent. Then, at times when your dog is likely to eliminate, like after waking up or eating, take them to the toilet tray. If they successfully eliminate, immediately praise them with "Good job using the toilet!" and give a treat reward. Once your dog gets used to it, gradually start guiding them from further away from the toilet tray.

(2) **When setting up a scent marker**: First, identify the toilet location and place a scent marker near the potty tray. Take your dog to the toilet at times when they are likely to relieve themselves, such as after waking up or eating. If they successfully relieve themselves, immediately say "Good job using the toilet!" and give a treat reward right next to the scent marker.

- **The rosemary marker placed at the training area entrance:** Guide your dog to the training area entrance where the rosemary marker is placed. Let them sniff the marker, then begin training. After training ends, move your dog to an area where the rosemary scent cannot reach them to conclude the session.

Stage 4: Building Confidence Through "Sniffing Play" (Nose Work)

For dogs who cannot see, sniffing scents is like "seeing the scenery." Not just passively sensing drifting scents but actively seeking them out through "nose work" remarkably stimulates your blind dog's brain.

1． Ensuring Success: Creating a 100% Success Experience

For dogs facing the anxiety of blindness, the most crucial thing is "not to let them lose confidence even when they fail." Therefore, always create a situation where they "can absolutely succeed."

- **Place the treat right in front of their noses:** Start by placing the treat just inches away from their noses, where they can reach it without moving their head. This builds a sense of security and excitement: "Using my nose always leads to something good!"
- **Make it "just a little bit" harder without them noticing:** To avoid making your dog anxious with thoughts like "Huh? Did it

get harder?", gradually move the treat a few centimeters farther away each time.

2． Use the "delivery method" of the reward for mental exercise

When your blind dog finds the target (treat or food) and gets it right, create a system where you teach them "where and how the reward treat appears" using a fixed rule (cue).

- 【**Room Service**】**Delivery at the target location**: The moment your dog finds the target (treat or food), say "Good!" and give the reward treat right where your dog's nose is pointing.
- 【**Takeout**】**Retrieve the target** and **come back for** the reward: The moment your dog finds the target (treat or food), say "Come here (break)!" and give the reward treat when they return to you.

3. Technique for Following a Drifting Scent "River"

Smells don't stay still in one place. They drift with the air currents, spreading and changing shape like "cigarette smoke" or "incense smoke."

- **Pinpointing the location with the "right nostril" and "left nostril"**: Dogs instantly determine which nostril detects the stronger scent.
- **Start them downwind**: Since scent flows with the wind, its movement can change drastically depending on the environment. To make practice successful, the owner should be mindful of the "direction the scent is flowing from." In other words, start them from a position where the wind is blowing the scent toward you (downwind).

Stage 5: Challenging the outdoors and new locations

Inside the house, the fixed positions of furniture and other objects determine where smells are located. Outside, however, is a “complex world” where the wind blows, the feel of the ground changes, and new smells arrive every day. Practicing in this richly varied environment further hones your blind dog's adaptability.

1. Practice to "Perform at Their Usual Level Anywhere"

- **Repeat "the usual route" to complete the mental map:** Walking the same course daily helps your blind dog memorize unchanging "scent landmarks" like roadside grass, utility poles, or the hedge at the corner house.
- **In new places, teach the "return route" first:** When arriving somewhere unfamiliar, don't start walking immediately. First, have them thoroughly confirm the scent of a "safe return point" (like near the car or the entrance).
- **The leash is the "thread of information" connecting to the owner**: The leash isn't just a pulling cord; it's a "channel of information" replacing sight. Sometimes, the owner's footsteps or the sound of a bell also become part of the leash's role. Subtle signals from the owner become a "guide rail" for the blind dog walking in the dark, providing immense reassurance.

— Conclusion —

Blindness is not the beginning of the end

but an encounter with "new talents"!

Vision loss is never despair. Dogs possess an incredible "ability to see the world with their nose" beyond our imagination.

1. A "new map" is drawn within the brain

Recent research has revealed that dogs possess a special circuit in their brains connecting the "nose (olfactory system)" and the "area controlling vision." Even if their eyes are non-functional, by fully utilizing information from their noses, a "vivid, three-dimensional map created from scent" is formed within their brain. Rehabilitation is the process of awakening this dormant, remarkable power.

2. To Regain "Freedom" and "Authentic Self"

By preparing the environment, utilizing scent markers, and teaching the joy of moving independently through treasure hunts (nose work), this program is designed to help blind dogs regain the dignity of walking freely by their own will and living with confidence, rather than relying entirely on others.

3. We Can Become "Information Interpreters"

Technological advancements (collars with inertial measurement units, GPS tracking, the iDog intelligent harness, the VISA spatial recognition support system, etc.) also powerfully support this rehabilitation. However, what matters most is the owner believing that "even when the eyes close, the vast door of the nose remains open." By becoming a "guide who interprets and conveys information about the world," the owner transforms the blind dog from a creature afraid of darkness.

End

Recent Reference Papers

1. Andrews EF, Pascalau R, Horowitz A, Lawrence GM, Johnson PJ. Extensive Connections of the Canine Olfactory Pathway Revealed by Tractography and Dissection. *J Neurosci*. 2022;42(33):6392-6407.

doi:10.1523/JNEUROSCI.2355-21.2022 Overview: New discoveries regarding the integration of canine olfaction and the brain. This study used DTI (diffusion tensor imaging), an MRI technique, combined with anatomical verification to visualize connections from the olfactory bulb to various brain regions in mesocephalic dogs. The olfactory bulb was found to connect via white matter tracts to five brain regions: the occipital lobe, spinal tract, limbic system, piriform lobe, and entorhinal cortex pathway. Notably, the discovery of a direct connection from the olfactory bulb to the occipital lobe (the region governing vision) represents the first such finding across all species. This suggests that canine olfaction is not merely an isolated sense but is closely integrated within the brain with vision, motor functions, emotions, and other processes. This represents a major step toward elucidating how dogs integrate scent into cognitive functions.

2. Berg P, Mappes T, Kujala MV. Olfaction in the canine cognitive and emotional processes: From behavioral and neural viewpoints to measurement possibilities. *Neuroscience & Biobehavioral Reviews*. 2024;157:105527. doi:10.1016/j.neubiorev.2023.105527 Overview: The significance of understanding the canine olfactory world. This paper is a review summarizing current knowledge about dogs' exceptional olfactory abilities and future research directions. Canine olfaction is utilized across diverse fields, including detection work for police, military, and customs agencies; search and rescue; and support for individuals with disabilities. "Sniffing and exploring" is a natural, innate behavior for dogs, and fulfilling this urge is essential for their well-being. The review outlines the mechanisms of olfactory processing in the nervous system and the processes of odor detection and discrimination. It also summarizes how odors influence canine cognition, emotions, and the "bond between dogs and humans." To deepen our understanding of the "world of smells" perceived by dogs, it discusses research methods and technologies that should be developed in the future. While canine olfactory abilities are widely utilized, the underlying mechanisms and their effects remain poorly understood. Correctly understanding their world through smell contributes to improving animal welfare.

3. Hargrave SH, Keyser AJ, Kristal E, et al. Functional assessments of short-term spatial memory in the Dog Aging Project identify strong associations with age that are not moderated by body mass. *bioRxiv*. Preprint posted online September 16, 2025:2025.06.30.662397. doi:10.1101/2025.06.30.662397 Overview: New insights into dog size and cognitive aging. This study investigated the relationship between short-term spatial memory and aging in dogs using a large sample of 6,753 dogs and a citizen science approach. Test data collected by general owners at home proved to be as reliable as data collected by professional individual researchers. Memory decline (age-related deficits) was confirmed to begin in "middle age," regardless of dog size. Large dogs generally have shorter lifespans and faster physical aging than small dogs. However, this study found that the rate of cognitive decline is the same for both large and small dogs. The fact that brain aging does not accelerate in large dogs, despite their faster physical aging, suggests that large dogs' bodies may possess some kind of "neuroprotective advantage." This study presents a new mystery: why do large dogs' brains resist the pace of physical aging? It also demonstrates that citizen science research methods can significantly contribute to future elucidation of brain aging mechanisms.
4. Iotchev IB, Bognár Z, Bel Rhali S, Kubinyi E. Cognitive and sensory capacity each contribute to the canine spatial bias. *Ethology*. 2024;130(2):e13423. doi:10.1111/eth.13423 Abstract: Is the dog's "place" bias due to vision or intelligence? Unlike human infants, dogs show a strong tendency (spatial bias) to use "place" as a cue rather than object features (shape or color).This study investigated whether this tendency is a byproduct of dogs having lower visual acuity than humans. Two learning tasks (discrimination learning and reversal learning) were conducted, comparing learning speed when cues were "location" versus "object features."We analyzed correlations using "cranial index (head shape: reflecting breed-based visual acuity differences)" as an indicator of visual ability and "general cognitive ability (g factor)" as an indicator of intellectual ability. Dogs indeed learned faster when "location" was linked to reward rather than object features. The influence of visual acuity (cranial index) was only observed in low-difficulty tasks.

Conversely, in more difficult tasks, dogs with higher cognitive ability (g factor) demonstrated a greater capacity to overcome spatial bias (i.e., recognize object features). This spatial bias in dogs is not simply due to "poor eyesight." It is a cognitive characteristic unique to dogs, and it became clear that individuals with higher cognitive ability are better able to overcome this instinctive bias and learn flexibly.

5. Khan MZ, Mondino A, Russell K, et al. A novel task of canine olfaction for use in adult and senior pet dogs. *Sci Rep*. 2023;13(1):2224. doi:10.1038/s41598-023-29361-x Overview: A novel olfactory test utilizing dogs' spontaneous behavior. Conventional canine olfactory tests have faced challenges due to their susceptibility to training history and environmental factors. This study developed a new test method that minimizes these influences and measures olfactory function solely through dogs' "spontaneous exploratory behavior."Subjects included adult dogs (18), senior dogs (18), and dogs with nasal disease (1). The test method involved having dogs search for a hidden treat among three options in both "well-lit" and "dark" conditions. Overall results showed that accuracy improved and behavioral bias decreased in the "dark" condition, where vision is restricted, as dogs focused more on olfaction. Senior dogs could also select the correct choice, but their accuracy in the dark area was lower compared to adult dogs. A correlation was observed between owners' perceived cognitive decline and test results in the dark area. In conclusion, this test demonstrates an effective means to objectively compare and evaluate the olfactory levels of household dogs without requiring special training.
6. Muscosky L, Horowitz A. Distinguishing Doors and Floors on All Fours: Landmarks as Tools for Vertical Navigation Learning in Domestic Dogs (Canis familiaris). *Animals (Basel)*. 2024;14(22):3316. doi:10.3390/ani14223316 Overview: Vertical (multi-level) navigation ability and the effect of landmarks in dogs. Ground-dwelling animals like dogs have a characteristic difficulty grasping vertical (up-and-down) movement compared to horizontal (side-to-side) movement. For example, in multi-level buildings like apartment complexes, they often lose track of which floor they are on. This study investigated whether providing visual or olfactory landmarks enables dogs to learn vertical movement within buildings and identify their floor. Visual or olfactory

landmarks were placed outside the door of the owner's residence floor (home floor).We compared how dogs reacted (e.g., time taken to approach) to their "home door" versus "doors on other floors" before and after placing the markers. Initially, dogs could not distinguish their floor from others, showing no difference in approach time. However, after repeated testing, dogs that consistently approached doors showed a significant difference in the time taken to approach their home floor door versus doors on other floors. Although some results remain ambiguous, the data supports the hypothesis that "dogs can learn to navigate artificial vertical environments (multi-level structures) with landmarks."

7. Sunil A, Pedroncini O, Schaefer AT, Ackels T. How do mammals convert dynamic odor information into neural maps for landscape navigation? *PLoS Biol*. 2024;22(11):e3002908. doi:10.1371/journal.pbio.3002908 Overview: Mechanisms and applications of olfactory spatial navigation. This paper examines how mammals process the spatio-temporal structure of seemingly chaotic "odor plumes" as information for navigation. It functions as a vital spatial information source, extending beyond simple odor tracking to include detecting other individuals and predators, and integrating external environments with the brain's "cognitive map." Based on recent advances in physiology, behavior, and methodology, it examines the neural mechanisms by which dynamic olfactory inputs are converted into environmental maps. It presents the potential for applying the olfactory mechanisms observed in living organisms to cutting-edge technologies such as bio-inspired sensors, robotics, and computational models. In conclusion, it states that elucidating the dynamics of olfactory information not only deepens our understanding of nature but also yields innovative solutions that bridge biology and technology.
8. Turunen S, Paavilainen S, Vepsäläinen J, et al. Scent Detection Threshold of Trained Dogs to Eucalyptus Hydrolat. *Animals*. 2024;14(7). doi:10.3390/ani14071083 Overview: Limits of canine olfactory ability and enhancement through training.This study investigated the detection threshold of 15 dogs using eucalyptus hydrolat (aromatic distilled water), commonly used in sports (nose work). Using a method where dogs selected the correct option from three choices, the eucalyptus concentration was gradually reduced to measure the threshold point

where detection became impossible. Components in commercially available products were also precisely analyzed. Although individual differences existed before training, repeated training ultimately enabled detection of extremely low concentrations diluted to $10^{17}$to 10^{21}times. This demonstrated that with appropriate training, dogs can identify target scents at lower concentrations. Analysis also revealed that the concentrations of components in commercially available eucalyptus distillates varied between products. In conclusion, dogs possess a high capacity to identify extremely low concentrations of odors, a skill that can be further sharpened through training. Furthermore, the importance of using "consistently sourced odors" for training in nose work competitions and research is emphasized.