Real-time vapor analysis could improve training of explosive-detecting dogs

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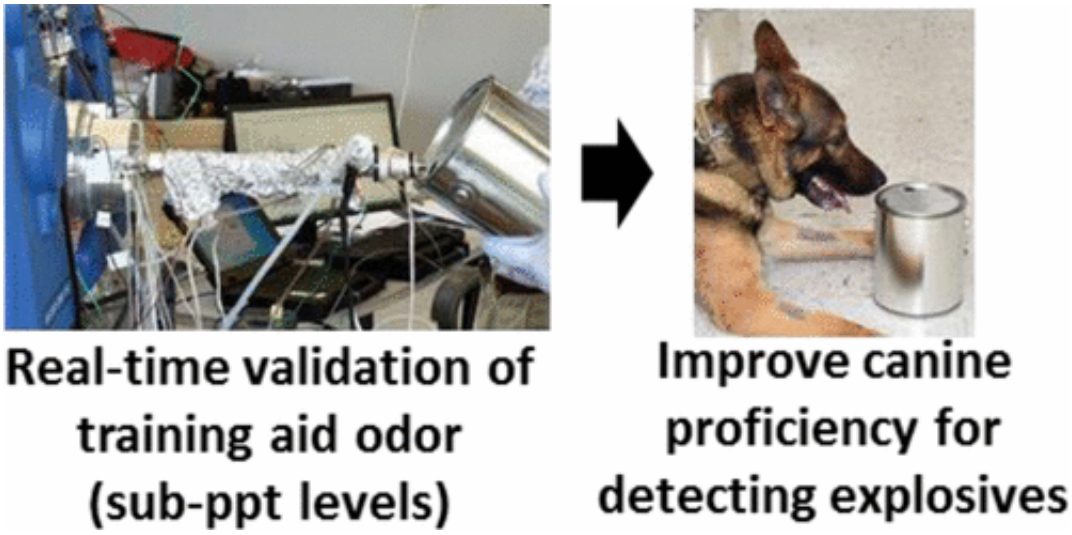

Credit: American Chemical Society

With a sense of smell much greater than humans, dogs are considered the gold standard for explosive detection in many situations. But that doesn't mean there isn't room for improvement. In a study appearing in the ACS' journal *Analytical Chemistry*, scientists report on a new, more rigorous approach to training dogs and their handlers based on real-time analysis of what canines actually smell when they are exposed to explosive materials.

Explosives are often used in terrorist attacks. Dogs trained to detect odors emanating from TNT, nitroglycerin and other explosives are a

crucial part of the first-line defense against these incidents. But delivering low-concentration vapor during training sessions is a challenging task. Cross-contamination of training materials with samples from different explosives can skew results and confuse both dogs and handlers. To address these concerns, Ta-Hsuan Ong and colleagues sought to better understand the components within explosive odors that cue a dog's reaction.

The researchers developed a real-time vapor analysis mass spectrometer to more accurately measure the vapor plumes from explosives that trigger a canine response. In field trials, they used the device and found that some mistakes the dogs made were indeed correct identifications. For example, some "blanks" were used that were ostensibly prepared without explosive material, but the dogs indicated an explosive was present. When the researchers used the mass spectrometer on such blanks, they found evidence of explosive vapors, indicating cross contamination occurred or other interferents were present. Based on these findings, the researchers suggest that use of real-time vapor analysis could help differentiate canine mistakes from cross contamination and other issues during training.

More information: Ta-Hsuan Ong et al. Use of Mass Spectrometric Vapor Analysis To Improve Canine Explosive Detection Efficiency, *Analytical Chemistry* (2017). DOI: 10.1021/acs.analchem.7b00451

Abstract
Canines remain the gold standard for explosives detection in many situations, and there is an ongoing desire for them to perform at the highest level. This goal requires canine training to be approached similarly to scientific sensor design. Developing a canine training regimen is made challenging by a lack of understanding of the canine's odor environment, which is dynamic and typically contains multiple odorants. Existing methodology assumes that the handler's intention is an

adequate surrogate for actual knowledge of the odors cuing the canine, but canines are easily exposed to unintentional explosive odors through training material cross-contamination. A sensitive, real-time (~1 s) vapor analysis mass spectrometer was developed to provide tools, techniques, and knowledge to better understand, train, and utilize canines. The instrument has a detection library of nine explosives and explosive-related materials consisting of 2,4-dinitrotoluene (2,4-DNT), 2,6-dinitrotoluene (2,6-DNT), 2,4,6-trinitrotoluene (TNT), nitroglycerin (NG), 1,3,5-trinitroperhydro-1,3,5-triazine (RDX), pentaerythritol tetranitrate (PETN), triacetone triperoxide (TATP), hexamethylene triperoxide diamine (HMTD), and cyclohexanone, with detection limits in the parts-per-trillion to parts-per-quadrillion range by volume. The instrument can illustrate aspects of vapor plume dynamics, such as detecting plume filaments at a distance. The instrument was deployed to support canine training in the field, detecting cross-contamination among training materials, and developing an evaluation method based on the odor environment. Support for training material production and handling was provided by studying the dynamic headspace of a nonexplosive HMTD training aid that is in development. These results supported existing canine training and identified certain areas that may be improved.

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