

OSAC Update -

Development of the term “exclusionary difference” and a more uniform use of spectral comparison language

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When the Materials (Trace) Subcommittee of OSAC was first established in 2014, much of the language used to describe differences between items being compared centered around the term “significant.” A significant difference was defined as “a difference between two samples that indicates that the two samples do not have a common origin.”

Obvious examples would be a marked difference in appearance, composition, or chemistry; such as a natural fiber versus a synthetic fiber, sheet glass versus container glass, human hair versus animal hair, an automotive paint versus an architectural paint, a black duct tape versus a black electrical tape, or a spectrum containing calcium carbonate versus one containing talc.

At an OSAC meeting in 2015, it was discussed that the term “significant difference” tends to convey to the wider forensic and legal communities that a statistical method was used to evaluate comparative data, particularly given the prevalence of DNA analysis and testimony where statistics are common. Therefore, a separate term was developed to describe differences that are observed through traditional non-statistical means. Such evaluations could include microscopy or the visual comparison of a spectrum for an unknown material that does not fall within the range of variation exhibited by the known material when the spectra are overlaid. This term “meaningful differences” was defined as “a feature or property of a sample that does not fall within the variation exhibited by the comparison sample, considering the limitations of the sample or technique, and therefore indicates the two samples do not share a common origin.” This definition was later adapted to include a final sentence “The use of this term does not imply the formal application of statistics” in order to distinguish it from eliminations that were based on statistical methods of comparison.

The Materials (Trace) Subcommittee began to implement both the “significant difference” and “meaningful difference” definitions into guidance documents being drafted for the trace evidence community. However, there were members of both the legal and statistical resource committees within OSAC who were concerned that the use of two definitions could be confusing in court and that there was a risk that they might not be used appropriately across the forensic community, particularly beyond the trace evidence disciplines that had become familiar with the use of both terms. Therefore, in 2019, a new term and definition were introduced and approved by the Materials (Trace) Subcommittee for use in all documents.

The new term is “exclusionary differences” and is defined as “a difference in a feature or property



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between compared items that is substantial enough to conclude that they did not originate from the same source.” Included with this definition are two notes that are used to further clarify the inclusion of both statistical and non-statistical evaluations within the context of this term. The first note reads as: “An exclusionary difference is statistically supported when an appropriate statistical analysis shows a result outside the range of what usually occurs when the items originate from the same source.” The second note is: “When a statistical analysis is not suitable, an exclusionary difference can be determined by expert judgment.”

The use of the word “exclusion(ary)” is intended to align with the legal community’s understanding of this term: to indicate that two or more items could not share a common source. The two notes were added so that it is clear that regardless of how the exclusion is made, the expert opinion is an elimination of common origin.

This term is being included throughout all current draft documents originating from the Materials (Trace) Subcommittee and will be used to replace the term “meaningful differences” in previously issued documents as well. It is expected to also be implemented in other OSAC disciplines, where applicable.

Of course, defining an exclusion is only one piece of the interpretation guidance necessary to compare data. Most trace evidence is still evaluated exclusively or in part using visual comparison of the data, usually in the form of spectral data collected through the use of spectrometers, chromatograms, or other physical parameters (e.g., TLC elution bands). As scientists and particularly those that interact with the legal community, it is imperative that the decision criteria used to inform an expert opinion on distinguishability is as objective and transparent as possible.

To this end, the Materials (Trace) Subcommittee has developed and approved a template of language to describe how spectral overlays are evaluated for distinguishability. Regardless of the methodology used to collect spectral data, the following process is being inserted into the spectral evaluation section of the Materials (Trace) guidance documents to explain how spectral comparisons are assessed and how that data fits into the overarching analytical scheme used to examine and compare materials.

Guidance to evaluate the comparison of spectral data:

A specific analytical technique is one part of a multi-step comparative approach. Though spectral data (collected by a given technique) alone can be used to distinguish sources, it is not used independent of data obtained from other analytical techniques to reach an overall conclusion of indistinguishable sources. If suitable spectra are produced, spectral comparisons can provide information regarding the potential relationship between the sources of the samples.

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Distinguishable sources:

Sources are distinguishable when differences in detected peaks or relative peak intensities between compared sets of spectra: 1) are outside the variability of spectra originating from the same source; and 2) are not explained by considerations such as sample heterogeneity, contamination, different sample conditions, or different sample histories.

Indistinguishable sources:

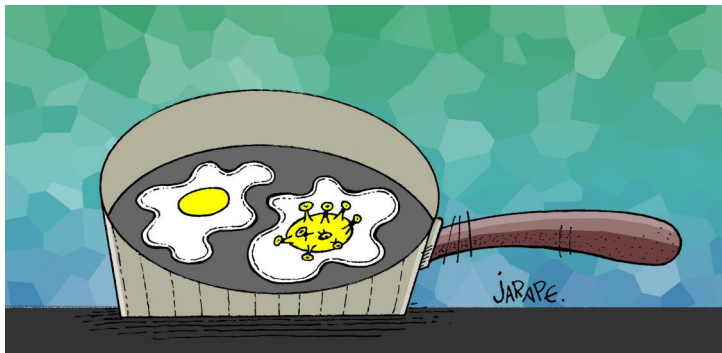
Sources are indistinguishable by spectral comparisons when differences in detected elements or relative peak intensities between compared sets of spectra: 1) are within the variability of spectra originating from the same source; or 2) can be explained by considerations such as sample heterogeneity, contamination, different sample conditions, or different sample histories.

This language will be forthcoming in guidance documents open for balloting within ASTM in the coming months. It is hoped that more consistent language across trace evidence technique-based documents will provide clarity as to the strengths and limitations of the science. Feedback on this language is welcome and can be directed to dmwright@fbi.gov.

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Important Dates

July 16	“Intact Low Explosives Analysis with an Emphasis on Microscopical Methods” webinar
July 27 - 31	3 rd annual Current Trends in Forensic Trace Analysis online symposium
September 1	Deadline for ASTEE Board of Directors positions
October	ASTEE Elections
October	NEAFS/ASTEE combined meeting





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