

## Article

# ACE+V: A Model

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“Most of us take completely for granted our ability to see the world around us. How we do it seems no great mystery: We just open our eyes and look! When we do, we perceive a complex array of meaningful objects located in three-dimensional space... We perceive all this so quickly and effortlessly that it is hard to imagine there being anything very complicated about it. Yet, when viewed critically as an ability that must be explained, visual perception is so incredibly complex that it seems almost a miracle that we can do it at all.” [1] We know we can perceive detail in images. We know we give varying attention to images as detail is perceived. We know we can compare images. We know we can make determinations about images. As forensic science experts, trying to explain how we perceive detail through the visual system of eyes to the brain and make determinations is the challenge.

Perceiving detail in an examination of physical evidence is the function of a forensic scientist. An explanation and method of perceiving detail is needed for the forensic scientist. The Scientific Working Group on Friction Ridge Analysis, Study and Technology (SWGFAST) recently published an explanation of a friction ridge examination methodology for latent print examiners. That methodology is “A recurring application of Analysis, Comparison, Evaluation and Verification (ACE-V) in each of the following: Analysis, Comparison, Evaluation and Verification....” [2] This explanation enables the examiner to follow and document a method to perceive detail in images.

“Analysis is the assessment of a friction ridge impression to determine suitability for comparison.” [2] Critical assessments and critical determinations take place by the examiner during the Analysis. The detail in the first image is perceived and represented in the visual system. Then, the detail in the second image is perceived and represented in the visual system. The Analysis phase normally includes the analyses of both images. Details of the images are represented in the visual system.

“Comparison is the direct or side-by-side observation of friction ridge detail to determine whether the detail in two impressions is in agreement based upon similarity, sequence, and spatial relationship.” [2] Comparison takes place by conducting comparative measurements of all levels of detail in images [3, 4]. The detail in the second image becomes the standard for comparison. Since there is variation in appearance of images from a source item, the examiner must critically compare the images. Tolerance for variation in appearances must be realized. Less clear images require the examiner to have more tolerance for variation in appearances. Clearer images require the examiner to have less tolerance for variation in appearances [5]. Critical determinations of similarity or difference must occur during Comparison.

During critical Comparison and before the final critical Evaluation, predictions of finding or not finding detail takes place. After reliable prediction [6] has occurred, the examiner is prepared for the final critical Evaluation.

“Evaluation is the formulation of a conclusion based upon analysis and comparison of friction ridge impressions.” [2] The expert needs to have the visual system, training, experience, knowledge, ability, and philosophy to make the critical determination. Critical Evaluation needs to rely on that foundation of expertise. Because of variation of appearance and tolerance, the expert must make a critical determination of agreement or disagreement between the images.

“Verification is the independent examination by another qualified examiner resulting in the same conclusion.” [2] If a different conclusion is reached, both examiners must assess their examinations using the application of ACE and determine why the variation in determinations had occurred.

ACE to ACE V has its origins and early evolution in Canada with explanations by R. A. Huber [7], Michael Cassidy [8], Harold Tuthill [9], and David Ashbaugh [10]. ACE methodology started as three separate and distinct phases. This early approach can be described as a linear process. Analysis is accomplished before moving to Comparison. Comparison is accomplished before moving to Evaluation. After Evaluation, the examiner is done. Later, Verification by another examiner was added to the method. Each phase would have been accomplished before moving to the next phase.

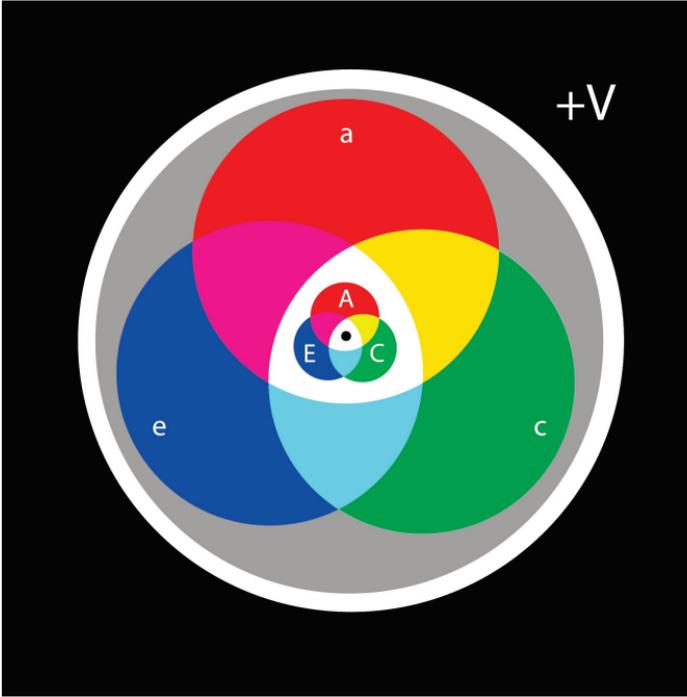
Other authors have presented a variation of ACE V. Stephen C. McKasson and Carol A. Richards write of recursive and reversible Examination, Comparison, Evaluation and Verification [11]. I first saw a recursive and reversible model in an explanation by David Grieve in 1998 [12]. McKasson and Richards' method and Grieve's explanation closely correspond to ACE V.

Stephen E. Palmer writes of four components of categorization. The first component is *Object Representations*: The relevant characteristics of the to-be-categorized object must be perceived and represented within the visual system. Next is *Category Representations*: Each of the set of possible categories must be represented in memory in a way that is accessible to the visual system. Third is *Comparison Processes*: There must be some way in which the object representation is matched or compared against possible category representations. Last is *Decision Processes*: There must be some method for deciding, on the basis of results of comparison processes, to which category a given object belongs [13]. Palmer's Object Representations and Category Representations correspond to the analyses that occur in the Analysis. Object Representation would be the analysis of the first image. The first image would be perceived and represented in the visual system. During this phase, the examiner does not yet know to which unique category or source the image will be assigned. Category Representation would be the analyses of the standard friction ridge images. The standard images would be perceived and represented in the visual system so that the examiner can access the variety of images in the Comparison and Evaluation phases. Palmer's Comparison and Decision Processes correspond very closely to ACE's Comparison and Evaluation.

## An ACE+V Model

For the remainder of this paper, I choose to represent Analysis, Comparison, Evaluation and Verification as *ACE+V*, not ACE V or ACE-V. The *ACE+V Diagram* is my attempt to depict a recurring, reversible, and blending ACE+V model. The recurring, reversing, and blending of phases seem to occur naturally in our visual system. We should be aware of that occurrence and deal with it. Our explanation of what occurs naturally should be an acceptable explanation of our examination. McKasson and Richards write of recurring and reversible application of phases. Others have described the blending concept. Ashbaugh writes, "There are times when the evaluation takes place at the same time as the comparison, especially if the comparison is terminated due to elimination. This type of comparison is especially common when the crime scene print is clear, needs little analysis, and there is an ample volume of unique details present to individualize or eliminate. However, it is a good practice to make an effort to separate the two steps." [14] Tuthill writes, "In fact, you will probably be making an ongoing evaluation while you are making your comparison and will gradually be forming an opinion as the information unfolds. But it is not until the comparison is complete that you will be in a position to finalize your opinion." [15] The human mind does have amazing ability when shape perception occurs. That is why the application of the process can recur, reverse, and blend. Also, ACE can be a model for subconscious shape perception, typical shape perception, or for the critical shape perception utilized by the forensic scientist. ACE can be used as a model for various levels of attention for visual or any other perception.

Various colors of light represent the phases in the model. Critical Analyses of images takes place in the red 'A'. Critical Comparisons of images occurs in the green 'C'. Critical Evaluations of the images occurs in the blue 'E'. However, critical examination of images is not that simple. During the Analysis of the first image and/or the standard images, an Evaluation of each image takes place almost simultaneously with each Analysis, represented by the magenta 'AE' blend. The examiner evaluates the significance of the analyses. Also, during the Analysis of the standard image, a mental Comparison with the previously analyzed first image starts to take place, represented by the yellow 'AC' blend. During the critical Comparison, a mental evaluation often starts to take place, represented by the blue/



### *ACE+V Diagram*

*The recurring, reversible, and blending primary phases of ACE are represented by the following colors of light: A = red; C = green; E = blue. The blending phases of A/C = yellow; C/E = blue/green; A/E = magenta; A/C/E = white.*

*The recurring, reversible, and blending complementary phases of ACE expertise are represented by the following colors of light: a = red; c = green; e = blue.*

*The blending phases of a/c = yellow; c/e = blue/green; a/e = magenta; a/c/e = white.*

*The black dot in the center represents subconscious processing of detail in which perception can occur. The gray that enspheres the ACE/ace spheres represents other expert knowledge and abilities. The white that enspheres that gray represents other knowledge and abilities.*

green 'CE' blend. During the critical Evaluation, the examiner often defers back to the Comparison at the blue/green 'CE' or can defer back to the Analyses at the magenta 'AE'. White 'ACE' blend represents almost simultaneously occurring Analysis, Comparison, and Evaluation. Application of each phase can recur, reverse, and/or appear to blend with the other phases.

During the perception, the forensic examiner relies on expertise or specific knowledge, training, experience, ability, and philosophy. This expertise is represented in part by the complementary spheres of previous analyses 'a', comparisons 'c', and evaluations 'e'. Also, each phase of ACE is analyzed 'a', compared 'c', and evaluated 'e' based on previous analyses, comparisons, and evaluations and expertise. Supporting expert knowledge, training, experience, ability, and philosophy are part of the outer gray sphere. Overall knowledge, training, experience, ability, and philosophy are part of the outer white sphere. Each sphere supports all of the other spheres.

Subconscious perception of images takes place in the black dot. The person is not even realizing perception is taking place. The person perceives visual images without even thinking about the images. Typical perception of images takes place in the white blending phases of ACE. Each phase of the blended ACE happens so quickly, the phases appear to be accomplished almost simultaneously. Little thought is required for typical perception. Critical perception and determinations made by the forensic scientist need to take place in the red 'A', green 'C', and blue 'E'. The expert must realize that blending phases of image processing does occur and default back to the critical thinking part of each phase when making a critical determination. Critical determinations by the expert must take place in the red, green, and blue phases of ACE. These primary colors of light represent the awareness of the need for critical determinations in each phase of ACE.

'+V' is an examination by another examiner using ACE methodology so '+V' takes place independently of the original ACE examination.

Palmer also writes in his book, "The reader is forewarned that all of the theories we are about to consider are inadequate to capture the astonishing power, versatility, and subtlety of human shape perception. How people perceive shape is certainly

among the most difficult problems in visual perception, so difficult that no satisfactory solution has yet been proposed.” [16] The explanation of ACE is very close to what occurs naturally with shape perception as explained by Palmer’s four components of categorization. ACE might not be the ultimate explanation of how the human visual system perceives detail in images. However, ACE+V is a very acceptable explanation of a method the expert forensic examiner can follow to critically examine and document the images and make critical determinations. Friction ridge, firearm, tool mark, and footwear examinations are some of the forensic sciences that utilize critical shape perception. Critical shape perception is what these examinations are about. Explaining the process of perception is the challenge.

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