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A Survey of the Evidential Value of Paint Transfer Evidence

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ABSTRACT: A survey of the evidential value of paint transfer in traffic accident cases is presented. 124 replies were tabulated for a series of 8 paint transfer scenarios. Various conclusions were invited from participants ranging from "slight support" to "conclusive." A brief discussion on the use of a scale of conclusions is included.

KEYWORDS: forensic science, paint, evidential value, survey

The examination of automobile paint and the assessment of its evidential value has been the basis of many studies over the years. Holden (1) stated that the evidential value of paint depended on such factors as type of paint, unusual pigments, and the probability of another car of the same color/model being at the scene at the same time as the suspect vehicle.

Tippett (2) counted almost 20,000 cars in an effort to know the distribution of car models of a particular color and to check this distribution statistically. His conclusion was that the results obtained fitted a Poisson distribution. Tippett also looked at flow rates of traffic and where flow rates are low the chance of seeing two or more of a particular colored model falls rapidly. Tippett states that with a two way transfer of "similar" paint flakes combined with a low flow rate and low frequency of the colored model then the scientific witness can give a firm opinion that these two cars have been in contact.

Gothard (3) looked at automobile paint flakes as evidence in a different way. That report stated that the layer sequence of paint flakes is the most significant point of comparison particularly because of the variety of ways in which cars can be refinished. The report further states that a large number of layers agreeing with regard to color, thickness and layer sequence can be taken as proof of common origin without further examination. That study was capable of differentiating all but 4 out of 500 samples. These 4 were two pairs from vehicles of similar make, model, and color. All refinished vehicles were easily differentiated.

Ryland et al. (4) conducted a similar study and examined the distribution of vehicles by topcoat color, year of manufacture, and vehicle make. This study also looked at the layer distribution in the samples studied. The conclusion of this report was that 94% of the samples were differentiated by microscopic examination and solvent reactivity tests. Of the remaining 6% that were undifferentiated, none of the paint chips had more than 3 layers. They further concluded that the probability of two paint chips originating from different sources is extremely remote when they have numerous layers (6 or more) consistent in color, tint, type of finish, layer thickness, and reaction to solvents.

Ryland et al. (5) examined the frequency of occurrence of topcoat colors in the eastern United States. This survey examined vehicles in transit and also vehicles parked in public parking lots. Fourteen colors were used as a classification system and these were further divided by the use of the terms light/medium/dark. Discrimination between metallic and non-metallic was possible for the stationery vehicles but not for the moving vehicles. These authors note that the distribution values will still not truly reflect the high power of discrimination offered by a careful microscopic comparison of two similar automotive paints. The authors attempt to relate their result to the presentation of evidence in a court of law. They highlight the difficult responsibility of properly interpreting the meaning of paint evidence. They state that this responsibility should not be avoided for it is the expert's true reason for being in court. They state that the use of the term "could have originated from" does not fully reflect the evidential value of paint results.

Buckle et al. (6) conducted a similar survey in Canada. A further study of a similar nature was conducted by Volpé et al. (7) in the province of New Brunswick. Their conclusion was that for comparisons containing physically and chemically indistinguishable original factory paint systems, the forensic conclusion "probably originated from the same source" is applicable.

Our laboratory conducted an internal survey of responses to hypothetical paint case scenarios. A reasonable spread of interpretations was found and it was felt that to broaden the survey to other laboratories would be of benefit to us and to other respondents also.

Lawton et al. (8) undertook a survey to elicit from other laboratories what conclusions were arrived at from various types of evidence. In that report the authors considered a range of case types and a descriptive interpretation was invited. The authors expressed their disappointment at the poor response. That report also stated that of all forensic examinations, paint evidence is one of the hardest to quantify.

We therefore decided to survey paint examiners on a series of hypothetical paint transfer scenarios. It was decided to request the respondents to use a scale of conclusions ranging from slight support to conclusive.

Experimental

A paint questionnaire Fig. 1 was drawn up and circulated to 235 paint examiners working in crime laboratories. We specifically targeted paint examiners by surveying respondents to a paint quality assurance trial which was circulated to forensic paint examiners.

We asked respondents to use the scale in Fig. 1 even if that was not the scale in use by them. We stated that the term "match"

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Paint Questionnaire

Given that car No 1 was struck by another car and it is alleged that car No 2 was the other vehicle, what significance do you attach to the following paint match scenarios:-

A. one layer of paint transferred in one direction

B. one layer of paint transferred in each direction

C. multilayer manufacturers finish transferred in one direction

D. multilayer manufacturers finish transferred in each direction

E. multilayer manufacturers finish transferred in one direction and one layer transferred in the other direction

F. multilayer non manufacturers finish transferred in one direction and single layer in the other direction

G. multilayer non manufacturer finish transferred in one direction

H. multilayer non manufacturers finish transferred in each direction

Scenario	Conclusion				
	2	3	4	5	6
A					
B					
C					
D					
E					
F					
G					
H					

Conclusions

	Tick box
Slight support	No. 2
Support	No. 3
Strong support	No. 4
Very strong support	No. 5
Conclusive	No. 6

Any additional comments are welcome.

FIG. 1—*Survey questionnaire distributed to participants.*

TABLE 1—*Results of survey.*

Scenario	Conclusion				
	Slight Support	Support	Strong Support	Very Strong Support	Conclusive
A	96(77.4)	24(19.4)	2(1.6)	2(1.6)	0(0.0)
B	19(15.3)	80(64.5)	19(15.3)	6(4.8)	0(0.0)
C	5(4.0)	85(68.5)	29(23.4)	5(4.0)	0(0.0)
D	1(0.8)	11(8.9)	64(51.6)	43(34.7)	5(4.0)
E	1(0.8)	27(21.8)	71(57.3)	24(19.4)	1(0.8)
F	1(0.8)	10(8.1)	44(35.5)	58(46.8)	11(8.9)
G	1(0.8)	24(19.4)	55(44.4)	39(31.5)	5(4.0)
H	1(0.8)	2(1.6)	13(10.5)	64(51.6)	44(35.5)

The above table shows the number of respondents for each scenario/conclusion. The figures in parenthesis are the % response for each scenario/conclusion.

was to refer to whatever criteria the respondent normally uses to establish a "match."

Results and Discussion

The results of the survey are displayed in Table 1 and Fig(s). 2–9. A total of 124 replies were received including 8 from this laboratory. These replies varied in geographic location. Replies were received from USA, Canada, Germany, France, Belgium, Switzerland, Colombia, Trinidad and Tobago, U.K., Israel and Austria. The highest concentration is for the USA.

It was clear to us from the outset that the scenarios posed by us were somewhat broad in their interpretation. However posing specific scenarios such as single layer green transfer or 5 layers in each direction would be too specific and would not cover the range of transfer types which we wished to explore. We must also be conscious that different respondents may use different match criteria.

It is obvious from the results that a high percentage of respondents agree that the lowest point on the scale is most appropriate for transfer of a single layer of paint in one direction (scenario A).

A higher number of people are prepared to give more strength to transfer of manufacturer's finish in one direction (scenario C) than exchange of single layers of paint (scenario B). The preferences are reversed when the number of layers are increased. A greater percentage use higher points on the scale to describe an exchange of manufacturer's finish (scenario D) than a single transfer of multilayer non-manufacturer's finish (scenario G).

Nine out of the 124 respondents ticked more than one box especially for scenarios F, G and H. In those circumstances the lowest value was used in our results e.g., if 4, 5 and 6 were ticked we counted that as 4, i.e., "strong support."

The results also highlight that scenario H, i.e., exchange of multilayer non-manufacturer's finish, is considered to be very strong evidence. The majority of respondents assign it either very strong support or conclusive. One in three respondents used the "conclusive" category for this scenario.

Many of the respondents made additional comments. Two stated that conclusions are a matter for the jury and another disliked the use of subjective conclusions. This reluctance to use conclusions in our opinion is an abdication of duty. Similarly Ryland (5) spoke of the onus of responsibility on paint examiners. Even a conclusive

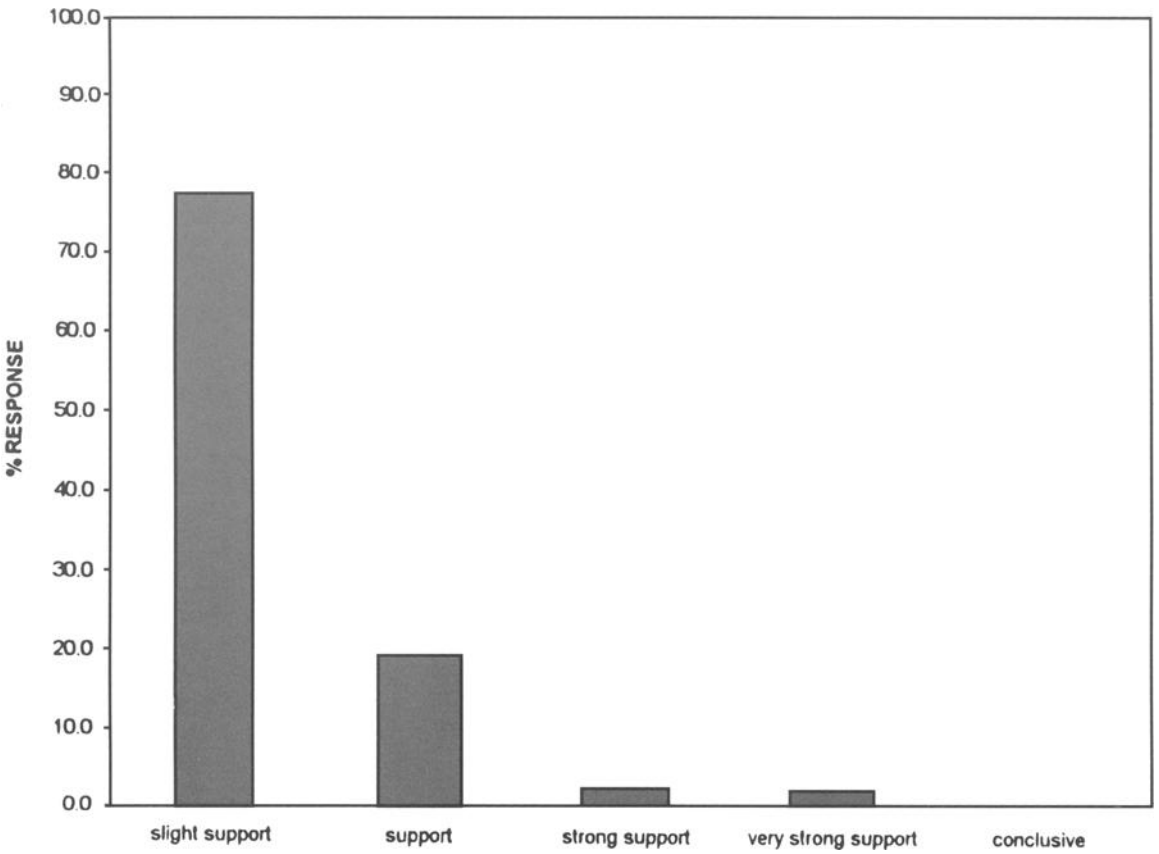

FIG. 2—*Results from scenario A (one layer of paint transferred in one direction).*

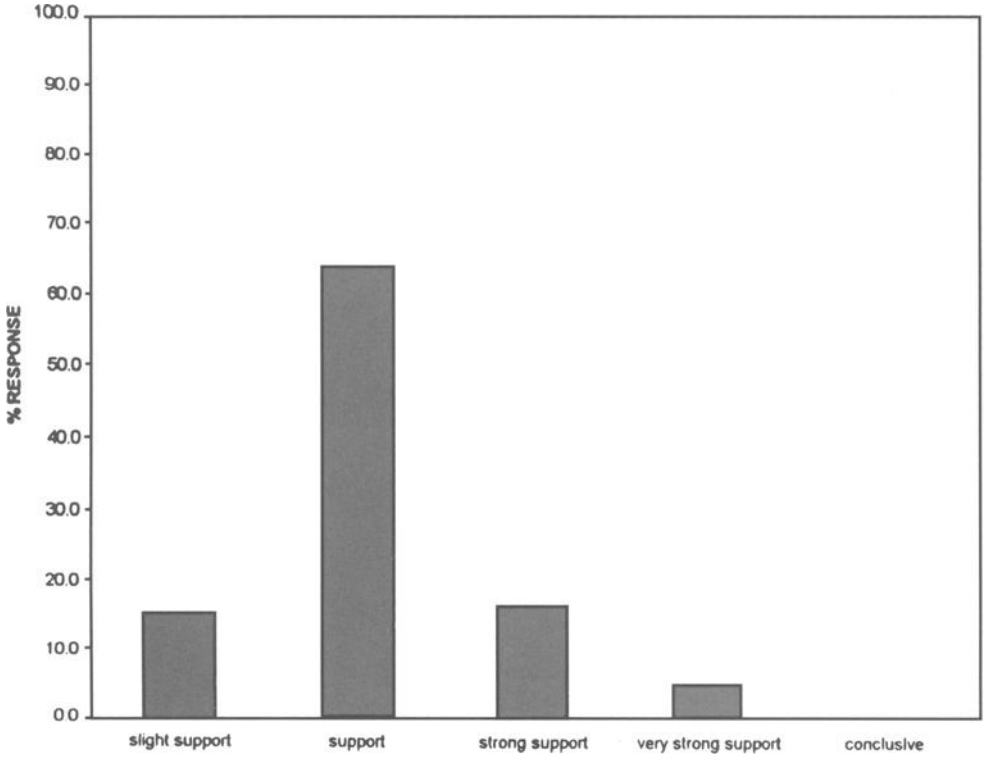

FIG. 3—*Results from scenario B (one layer of paint transferred in each direction).*

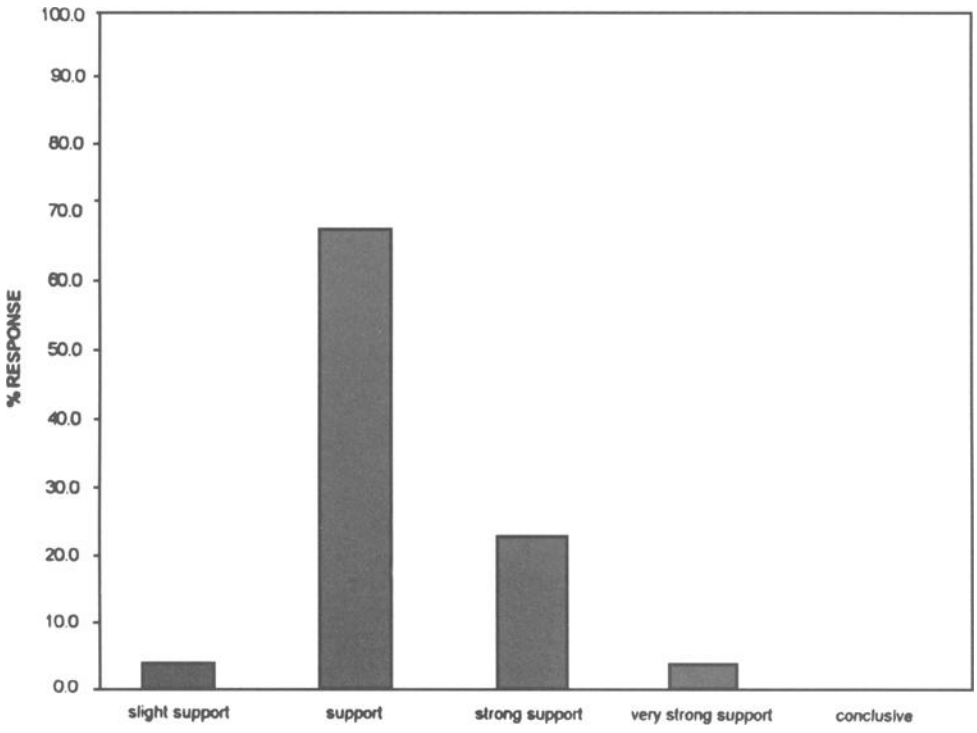

FIG. 4—*Results from scenario C (multilayer manufacturers finish transferred in one direction).*

comment does not in our opinion usurp the function of the jury. This issue and related issues are dealt with by Starrs (12) where he states that juries are authorized to act in the teeth of the facts or the law. He further states that it is a matter of law that juries are not compelled to accept the uncontradicted opinion testimony of an expert.

Five respondents stated that a "conclusive" statement would require some type of physical fit. Another stated that not enough statistical information was available on paint to use the term "conclusive." In the light of the above it is worthwhile looking at the use of language by forensic scientists in the interpretation of evidence.

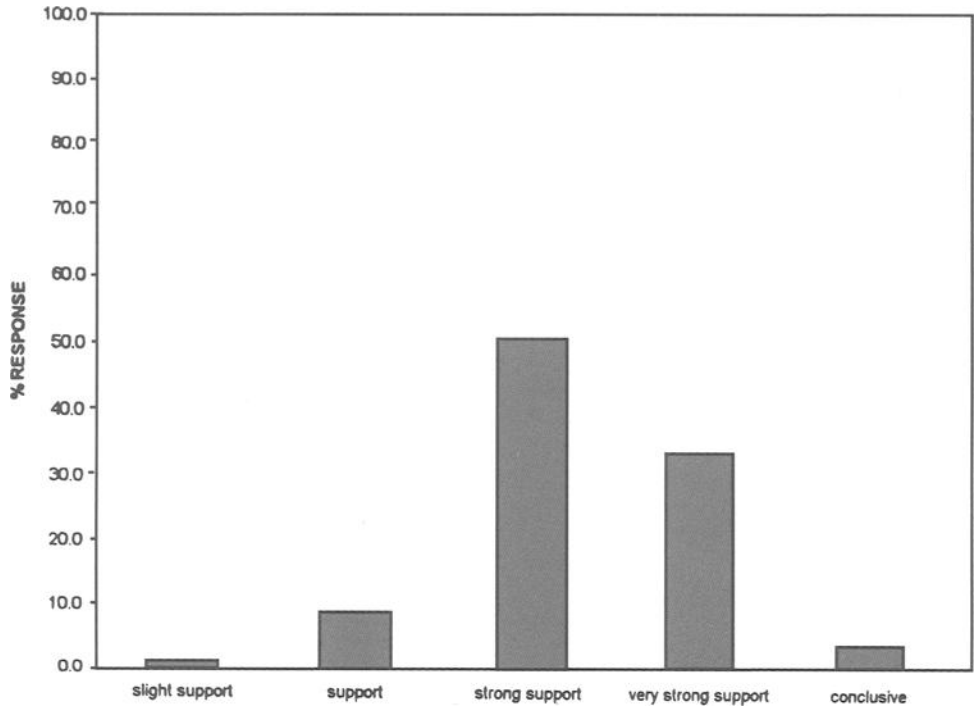

FIG. 5—*Results from scenario D (multilayer manufacturers finish transferred in each direction).*

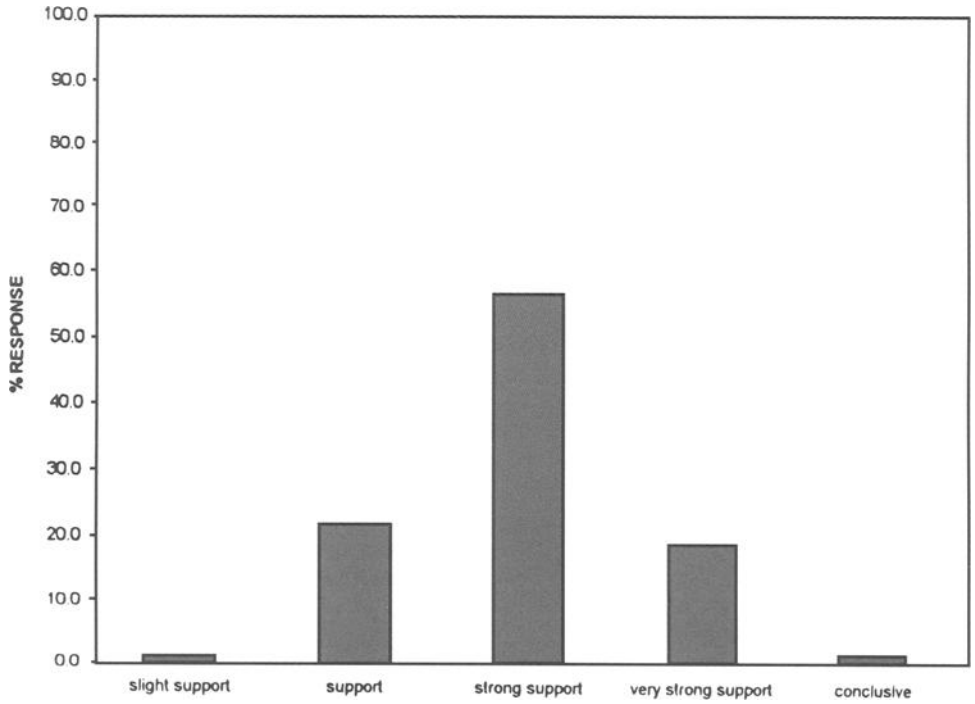

FIG. 6—*Results from scenario E (multilayer manufacturers finish transferred in one direction and one layer transferred in the other direction).*

Rudram (9) recently examined the formulation of conclusions by forensic scientists. This paper reviews the literature in the area and many authors such as Craddock et al. (10) and Satterthwaite et al. (11) recommend the use of a well publicized standard scale of words which reflect a Bayesian approach to the interpretation of evidence.

He points out that scientists present oral evidence in only a small minority of cases so a report will often be read aloud by someone else, therefore conclusions should be clear without being overstated.

Rudram concludes that putting final conclusions into context should reduce the level of misunderstanding of scientific reports. A published scale goes a long way towards openness and the author suggests that the use of a numerical scale of, for example, 1 (little evidence) to 10 (certain) should be avoided.

Many of the respondents stated that it was difficult to categorize

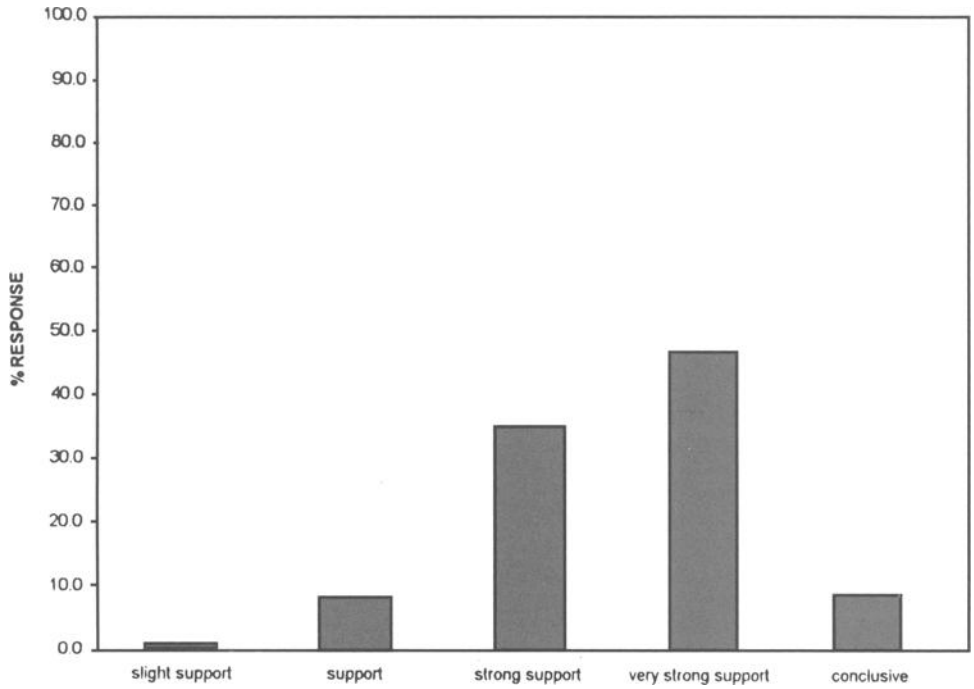

FIG. 7—*Results from scenario F (multilayer nonmanufacturers finish transferred in one direction and single layer in the other direction).*

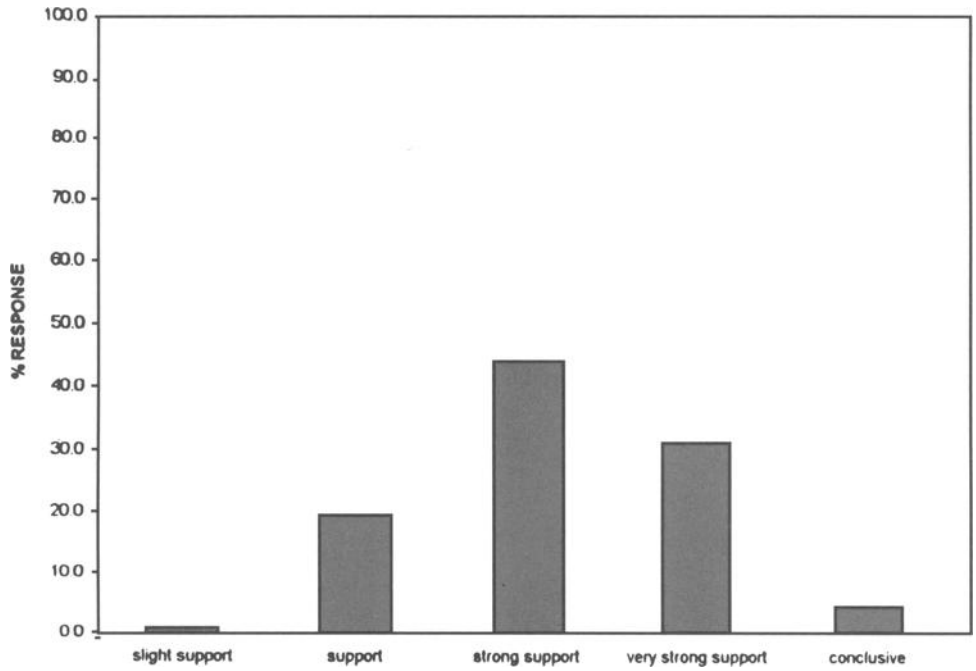

FIG. 8—*Results from scenario G (multilayer nonmanufacturers finish transferred in one direction).*

forensic conclusions in paint cases since each case is different. It was stated by many contributors that even in a single layer paint transfer the difference between, for example, white alkyd resin and pink metallic can be large. This, in the opinion of the authors, increases the need to use a suitable scale.

Most of the contributors who made additional comments stated that their results took a conservative view of the evidential values of the scenarios, i.e., common top coat color and/or common layer sequence. Many also stated that if enough layers were present then scenarios F, G and H could be elevated to conclusive.

One contributor stated his opinion that forensic scientists are generally a conservative group and tend to understate the significance of their findings. This could explain the use of the term "slight support" by the majority of respondents to Scenario A despite literature information on top coat finishes. The occurrence of a top coat single layer color match could in instances have an occurrence of less than 0.5% (5–7).

Conclusion

The response to the survey from paint examiners was positive in terms of the number of replies and the encouraging comments from

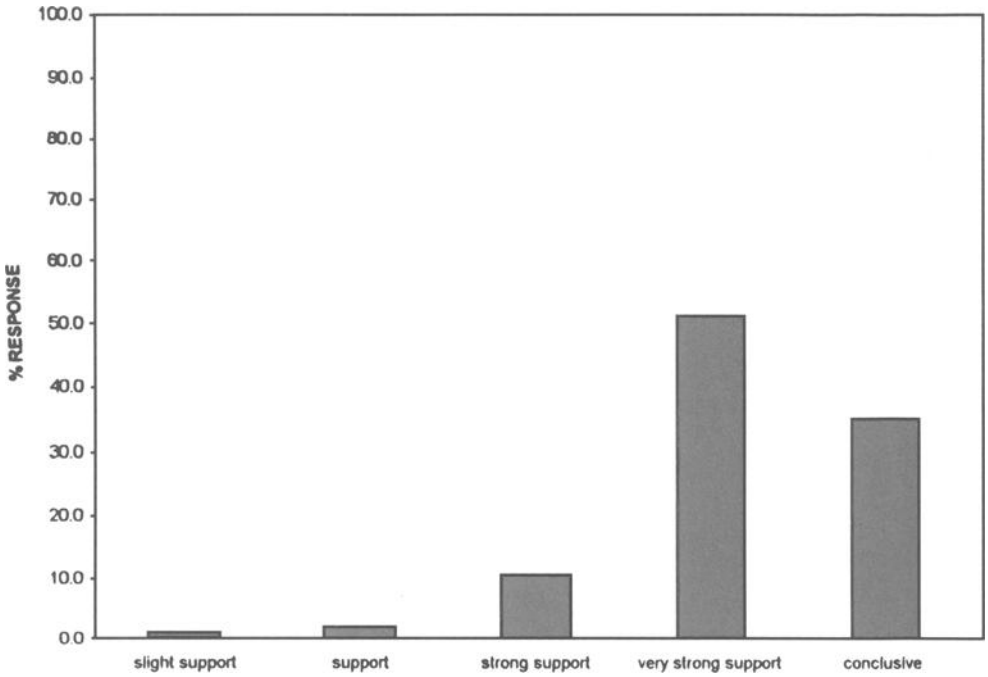

FIG. 9—*Results from scenario H (multilayer nonmanufacturers finish transferred in each direction).*

participants. Despite the fact that a large number of surveys exist on topcoat color distribution from various countries no assessment was available on the significance that forensic scientists attach to paint evidence. This survey gives an insight into the value placed on such evidence by forensic scientists working in the field of paint analysis.

Many of the problems associated with paint evidence are highlighted. One problem highlighted by some contributors is the lack of statistical information on paint transfer probabilities. Many of the surveys already compiled could be used to assess the significance of paint transfer evidence using a Bayesian approach. We are at present examining the area of paint transfer evidence from this perspective. We hope to relate likelihood ratios to the various scenarios. We are compiling the data at present and hope to bring the work to fruition soon.

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