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The Broken Telephone Effect

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SCIENCE MISCELLANY & FORENSIC FILLIPS

THE BROKEN TELEPHONE EFFECT

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A popular children's game is "the broken telephone". It involves a group of people who whisper from one to another a certain message. The last person then states out loud what message was heard. It is amazing how distorted the original message can become.

Although it is a children's game it does illustrate some problems which occur in the world of forensic science: when lawyers and scientists quote one another successively the original "message" can become distorted. The following, we feel, illustrates this problem.

The original "message" was an abstract by Dubowski and O'Neill, 1979 (1). Note: certain sections of the quotes have been italicized for emphasis:

> "The ratio of blood-alcohol concentration (BAC) to breath alcohol concentration (BrAC) is widely used to convert breath-alcohol analysis results to the presumed coexistent BAC in forensic and clinical practice and for research purposes. The mean BAC/BrAC value most commonly used during the past 25 years is 2100:1, but the literature contains values ranging from 1117:1 to 3240:1 (Mason and Dubowski, J. Forensic Sci. 21, 9, 1976). *We therefore determined this important ratio, in-vivo, in 149 experiments on healthy adult human males.*
>
> Paired specimens of end-expiratory breath and antecubital venous blood were obtained simultaneously (or nearly so) *during the proven postabsorptive phase of alcohol intake/distribution/elimination.* BAC was measured by automated CG(sic) headspace analysis and BrAC by infrared absorptiometry. The data were analyzed by statistical regression analysis for *397 paired specimens and 142 corresponding blank values.*
>
> The mean experimental in-vivo BAC/BrAC ratio for postabsorptive venous blood and end-expiratory breath, under our experimental conditions, was 2.28×10^3:1 in these subjects.
>
> *We conclude that the mean BAC/BrAC under these conditions is about 2280:1,* and that, in the postabsorptive state, a conversion factor of 2280 for alcohol analysis instruments employing end-expiratory breath should yield the best estimate of the coexistent BAC for a healthy adult male population with normal body temperature. (For forensic purposes, however, overestimation of the BAC must be avoided, and the measured breath-alcohol concentration should be reported.)"

Next, Dubowski in 1985 (2) quotes Dubowski and O'Neill (1):

> "*However, significant variations from this population mean exist during active absorption and in some individuals even in the postabsorptive phase.* The typical biological variability of human alcohol pharmacokinetic parameters is well illustrated by the data from studies of Dubowski and O'Neill (1979). These are summarized

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in Table 3, for the ratio of alcohol concentrations in whole blood and end-expiratory breath in healthy adult men *in the fully postabsorptive phase.*

"These experimentally determined ratios have a Gaussian distribution. Hence a postabsorptive blood alcohol: breath alcohol concentration ratio range of 1797 : 1 to 2763 : 1 can be estimated for 95% and 1555:1 to 3005:1 for 99.7% of such a population. Those statistical projections agree closely with the experimentally found range of values."

Table 3 in Ref. 2 shows n=393(sic), the mean BAC/BrAC ratio ± SD as 2280 ± 241.5, the CV% as 10.6% and the range as 1706-3063.

Since the original article was an abstract, the details of the experimental procedure are not known; such as what IR device was used to analyse the breath, what was the alcohol dose and drinking pattern and what were the BACs of the experimental subjects.

Next, Kupferschmidt in 1987 (3), quotes Dubowski (2) quoting Dubowski and O'Neill (1):

"Dubowski and O'Neill (11) indicate the variability of this ratio in their findings *during the absorption phase* and in some individuals during the elimination phase. *In 393 subjects*, the range of results was 1706-3063 :1, with an average of 2280:1. Dubowski (1) indicates that 95 per cent of a given population would have a partition ratio between 1797:1 and 2763:1 and that 99.7 per cent would have a partition ratio of 1555:1 to 3005:1."

There are several errors in this quote. Dubowski and O'Neill's original abstract (1) states that all the subjects are in the "proven postabsorptive phase" and that there were 149 experiments on an unstated number of healthy adult males, not 393 subjects in the absorption phase and some in the elimination phase as stated by Kupferschmidt(3). In the original abstract there is no mention as to the range of BAC/BrAC ratios, only the mean.

Next, Whitten (4), a lawyer, quotes Kupferschmidt (3) who quoted Dubowski (2) who quoted Dubowski and O'Neill (1):

"In studies reviewed by Kupferschmidt, the ratio of blood alcohol concentration to breath alcohol concentration ranged from 1555:1 to 3005:1."

There is only one study (Dubowski and O'Neill (1)) quoted by Kupferschmidt (3) on the variability of the BAC/BrAC ratio, *not* studies. The actual observed range was 1706:1 to 3063:1 and not 1555:1 to 3005:1 as stated by Whitten (4). The range 1555:1 to 3005:1 covers the mean ± 3 SD, and if the BAC/BrAC ratio distribution is Gausian, would apply for 99.7% of the population. Kupferschmidt and Dubowski quite properly qualify their statements about this range but Whitten does not. It might also be noted that the mean minus 3 SD produces an apparent ratio well below that actually observed in the experiment.

The next logical step will be a lawyer quoting to a forensic toxicologist witness from Whitten (4), who quoted from Kupferschmidt (3), who quoted from Dubowski (2), who quoted from Dubowski and O'Neill (1).

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