# Gene Frequencies of ABO Blood Groups with Partial Sub-classification of One Allele

A METHOD for calculating weighted estimates of gene frequencies from a population of two allelic autosomal genes with partial sub-classification of "dominants" is available[1]. In blood group studies, it is sometimes necessary to estimate gene frequencies from a population of three allelic autosomal genes with partial sub-classification of one allele. For example, when blood specimens are tested with antisera A and B, four phenotypic groups, O, A, B and AB, are obtained. Again, if portions of A and AB are examined with antiserum $A_1$, these groups may further be subdivided into $A_1$, $A_2$, $A_1B$ and $A_2B$ phenotypes. I have modified Bernstein's method to determine weighted estimates of gene frequencies of $A_1$, $A_2$, A, B and O jointly as follows.

| Phenotypes | Observed frequency | Expected frequency |
|---|---|---|
| $A_1$ | $a$ | $k_1(p_1^2+2p_1p_2+2p_1r)n$ |
| $A_2$ | $b$ | $k_1(p_2^2+2p_2r)n$ |
| A | $c$ | $(1-k_1)(p^2+2pr)n$ |
| $A_1B$ | $d$ | $k_2(2p_1qn)$ |
| $A_2B$ | $e$ | $k_2(2p_2qn)$ |
| AB | $f$ | $(1-k_2)(2pqn)$ |
| B | $g$ | $(q^2+2qr)n$ |
| O | $h$ | $r^2n$ |
| Total | $n$ | $n$ |

$$p_1 = \sqrt{\frac{a+b+k_1h}{k_1n}} - \sqrt{\frac{b+k_1h}{k_1n}} \qquad p_2 = \sqrt{\frac{b+k_1h}{k_1n}} - \sqrt{\frac{h}{n}}$$

$$p = \sqrt{\frac{a+b+c+h}{n}} - \sqrt{\frac{h}{n}} \qquad q = \sqrt{\frac{g+h}{n}} - \sqrt{\frac{h}{n}}$$

$$\text{and } r = \sqrt{\frac{h}{n}}$$

Where $k_1 = \frac{a+b}{a+b+c}$ represents the proportion of A phenotype classified as to $A_1$ and $A_2$ phenotypes and $k_2 = \frac{d+e}{d+e+f}$ the proportion of AB phenotype classified as to $A_1B$ and $A_2B$ phenotypes. $p_1$, $p_2$, $p$, $q$ and $r$ are the frequencies of alleles $A_1$, $A_2$, A, B and O respectively and $n$ is the total frequency.

In an investigation of ABO blood groups of the Chinese in Calcutta, Chaudhuri *et al.*[2] determined the gene frequencies of A, B, O and $A_1$, $A_2$, B and O separately. But in this communication I have shown that the gene frequencies of all the alleles can be determined jointly by applying the above formulae to their[2] data given below.

| Phenotypes | $A_1$ | $A_2$ | A | $A_1B$ | $A_2B$ | AB | B | O | Total |
|---|---|---|---|---|---|---|---|---|---|
| Observed frequency | 142 | 12 | 16 | 20 | 4 | 7 | 113 | 252 | 566 |

$p_1=0.179$, $p_2=0.018$, $p=0.197$, $q=0.136$ and $r=0.667$.

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Received October 8; revised November 25, 1968.

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# Interference between Low Information Verbal Output and a Cognitive Task

THERE have been many experiments in which the limited channel capacity of the human organism has been demonstrated by interference between two simultaneous tasks[1]. Brown[2] used this interference of a secondary task as a measure of the difficulty of a primary perceptual or control task; and in a recent study[3] he used a cognitive secondary task. The experiment described here was devised to investigate the effect of a secondary verbal task on a primary cognitive one.

The cognitive task used was the extremely convenient sentence checking test invented by Baddeley[4]. This test, performed with pencil and paper, involves the understanding of sentences of varying syntactic complexity. The subject has simply to tick one of two spaces ("true" or "false") after each sentence. The task is timed (3 min), and the recommended score[4] is simply the total number of items correct.

A verbal secondary task was used, so as to use a different motor output system. The subject had to repeat a particular sentence as he carried out the task in the experimental condition. The desiderata for a usable sentence seemed to be (i) utter familiarity, so that the information content should be minimal and (ii) emotional neutrality, so as to obviate unwanted motivational side effects. The one chosen as satisfying these requirements was "Mary had a little lamb". A meaningful sentence was preferred to nonsense material because of its higher face validity in any applied context.

Two groups, each of twelve Royal Navy ratings, whose ages ranged from 19 to 26 yr, acted as experimental subjects. The control group was given two versions of the test, one after the other. The experimental group was given the same two versions of the test in the same order, and also recited the given sentence while doing the second. Performance on the test used correlates very highly with intelligence, so each subject's score on the *AH*4 intelligence test was also measured. The scores of the two groups are shown in Table 1.

Table 1

| | Group mean scores | | |
|---|---|---|---|
| | | Sentence checking tests | |
| | *AH*4 | First | Second |
| Controls | 78·8 | 25·5 | 28·3 |
| Experimentals | 84·5 | 27·0 | 16·7 |

Student's $t$ test showed that the *AH*4 scores and first sentence checking test scores of the two groups did not differ significantly at the 0·05 level; but the scores of the experimental group for the second sentence checking test were inferior to those of the control group ($P<0{\cdot}01$). Similarly, the scores of the experimental group for the second test were inferior to those for the first ($P<0{\cdot}05$); whereas the control group showed a non-significant improvement.

This not unexpected result is additional confirmation of the limited channel capacity available to humans, and shows how slight a load, even in a separate output modality, can depress cognitive performance. It can also be considered in terms of the peripheral theory of cognition, although no result of this form could be decisive in that context[5]. It has not escaped my notice that, in an applied field, compelling people to chant slogans seems to be an excellent way of inhibiting their higher mental processes.

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Received January 15, 1969.

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