

curately a new and antagonistic order. This law of the decrease of interference as we pass from one order to the other is also expressed by a curve similar to that described above, only the approach to the limit where there is no more interference experienced in changing from one to the other, is much more gradual.

Other experiments were made with cards which corroborate the same fact of learning and interference.

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*Motor, Visual and Applied Rhythms.* JAMES BURT MINER.  
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The thesis brings together four lines of investigation related to rhythm. A revision of the explanation of rhythm is attempted on the basis of muscle curves obtained during involuntary movement. A beginning is made in the study of rhythms experienced from flashes of light. The reproduction of time intervals is tested under different conditions. Finally, from the more practical side, the effect of independent rhythms on mental work is approached by correlation methods.

The first part of the paper deals mainly with the explanation of the feeling of unity in the rhythmic group. Curves are given which demonstrate, at least for eight subjects, that the motor effect of listening to a series of like sounds was something more than a single muscular response to each stimulus. The involuntary activity of the muscle seemed to be a reaction which set off succeeding groups of stimuli. A kymograph record is printed which shows that electrical stimuli applied successively to the thumb may produce this same regular grouping activity of the muscles. It seems, therefore, to be a fundamental structural condition similar to that producing the grouped reactions shown by the experiments of Richet, Lombard and others. When actual movements are not recorded the writer concludes that they are replaced by strain conditions in the muscle. The absence of movement is accounted for by the fact that most people in the waking state always hold their muscles sufficiently tense to prevent any slight tendency to movement. This conclusion is supported particularly by movement curves obtained, without suggestion, from a subject in the hypnotic state, although none were found normally. The involuntary grouping activity in the muscles is interpreted as the physiological correlate which explains the 'unitary character' of the rhythmic group. The tendency of experimenters to relate rhythm more or less definitely

to muscular activity is traced through the work of Bolton, Meyer, Wundt, Smith, Stetson, MacDougall and others. The author rejects, as inadequate or incomplete, those explanations which are based on regular bodily rhythms, on attention or on expectation and satisfaction.

If a kinæsthetic explanation holds, it would seem that visual rhythms, or even rhythms of odors and tastes, might be experienced. Contrary to general opinion, a subjective experience of grouping within a uniform series of light flashes was found to be quite easily developed by the twenty-six subjects tested. Two naïve subjects seemed to perceive involuntarily the rhythmic grouping, without having received any external suggestion. In the essential characteristics of rhythm, the effect of the lights was apparently the same as that of the sounds; but the light rhythm was more vague and easier disturbed. On account of visual rhythm being a novel experience, it offers suggestions toward the general problem that are obscured in the introspection of the familiar auditory rhythms. The connection of rhythmic changes with muscular activity comes out more plainly; illusions due to rhythmic causes are separable, by means of tabular classification, from those due to other conditions; finally, rhythms of sight are especially helpful in tracing the genesis from simpler forms—the investigation here corroborates Squire's conclusion that the unaccented group is the most primitive. A silent electric contact wheel was devised to be used with a relay and incandescent lamp, in throwing a flash against a wall. With this apparatus it was possible to compare the appearance of a uniform series with one in which the lights varied in interval, duration or intensity.

The third part of the monograph includes two series of experiments in the motor expression of time intervals. Under a chance arrangement, intervals of 1, 2, 3, 4 and 6 seconds were reproduced once after each occurrence of the standard. The reproduction was made by two taps on a telegraph key. Tables are given for the results of five subjects making 100 reproductions of each interval. A marked difference (amounting on an average to half a second) is demonstrated between the reproduction of the intervals when the standard is bounded by like stimuli (two lights or two sounds) as compared with the same intervals when the standard consists of a light followed by a sound or vice versa. This result is in conformity with the theory held by Münsterberg and others that the reproduction of a time interval consists of an attempt to repeat the strain sensations remembered. The muscular adjustment following stimuli directed to different sense organs requires more effort and makes the interval seem longer. The

change necessary in merely perceiving first a sound and then a light would hardly account for the pronounced lengthening which occurs. A new 'Carbon-Ribbon Kymograph' is shown. It utilizes the common typewriter ribbon in making records with electric pens on a telegraph-ticker tape. Records were obtained at Columbia University for 140 subjects making reproductions of a one-second interval continuously for 40 seconds. These records of their memory of a time interval were then correlated with the reaction times of the same subjects, using the Karl Pearson formula. A correlation of .55 brings out the interesting result that there is a strong tendency for slow reaction time to be found among those who shorten the interval most in reproducing it. This agrees with Seashore's suggestion that a brief interval probably seems shorter to the slow person than it does to the quick. The results are further discussed in connection with the sense of time and the theory of indifference points criticised.

Does an independent rhythm, which is kept up [while we are working, hinder or aid us? In the last part of the thesis this question was answered, somewhat curiously, for groups of a hundred subjects, in respect to the effect of a metronome on a continuous choice reaction (distributing playing cards according to suits) and as to the effect of beating a rhythm with the fingers while filling words in blanks left in a poem. The correlations were .75 in the poem experiment and .32 and .39 in the choice experiment. These indicate an important principle which is suggestive for improving mental ability. Two classes of people are demonstrated, on whom the independent rhythm tends to have opposite effects. Those who were normally slow in the activities tested, tend to profit by the independent rhythmical stimulus. Those who were normally quick were seriously disturbed. The suggestion is made that the condition of very keen attention, found among the quick, is a more sensitive equilibrium which the secondary stimulus upsets. The slow person, on the contrary, is urged on by the accompanying rhythm.

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*Sociality and Sympathy.* J. W. L. JONES. Psychol. Rev., Mon. Sup., Vol. V., No. 1, April, 1903.

Sympathy is defined as the feeling accompanying a representation or memory state, when referred by the subject to an object. Sympathy in this view presupposes self-consciousness. It is involved in the conscious reference of a state of the subject to some object.