

**A QUANTITATIVE STUDY
OF RHYTHM: THE EFFECT OF
VARIATIONS IN INTENSITY,
RATE AND DURATION**

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649341528

A Quantitative Study of Rhythm: The Effect of Variations in Intensity, Rate and duration by
Herbert Woodrow

Except for use in any review, the reproduction or utilisation of this work in whole or in part in any form by any electronic, mechanical or other means, now known or hereafter invented, including xerography, photocopying and recording, or in any information storage or retrieval system, is forbidden without the permission of the publisher, Trieste Publishing Pty Ltd, PO Box 1576 Collingwood, Victoria 3066 Australia.

All rights reserved.

Edited by Trieste Publishing Pty Ltd.
Cover @ 2017

This book is sold subject to the condition that it shall not, by way of trade or otherwise, be lent, re-sold, hired out, or otherwise circulated without the publisher's prior consent in any form or binding or cover other than that in which it is published and without a similar condition including this condition being imposed on the subsequent purchaser.

www.triestepublishing.com

HERBERT WOODROW

**A QUANTITATIVE STUDY
OF RHYTHM: THE EFFECT OF
VARIATIONS IN INTENSITY,
RATE AND DURATION**

**A QUANTITATIVE STUDY OF
RHYTHM**

**THE EFFECT OF VARIATIONS IN INTENSITY,
RATE AND DURATION**

BY

HERBERT WOODROW, A.M.

Lecturer in Barnard College, Columbia University

**SUBMITTED IN PARTIAL FULFILMENT OF THE RE-
QUIREMENTS FOR THE DEGREE OF DOCTOR OF
PHILOSOPHY IN THE FACULTY OF PHIL-
OSOPHY, COLUMBIA UNIVERSITY**

**REPRINTED FROM THE ARCHIVES OF PSYCHOLOGY,
NO. 14**

UNIVERSITY
LIBRARY

NEW YORK

THE SCIENCE PRESS

1909

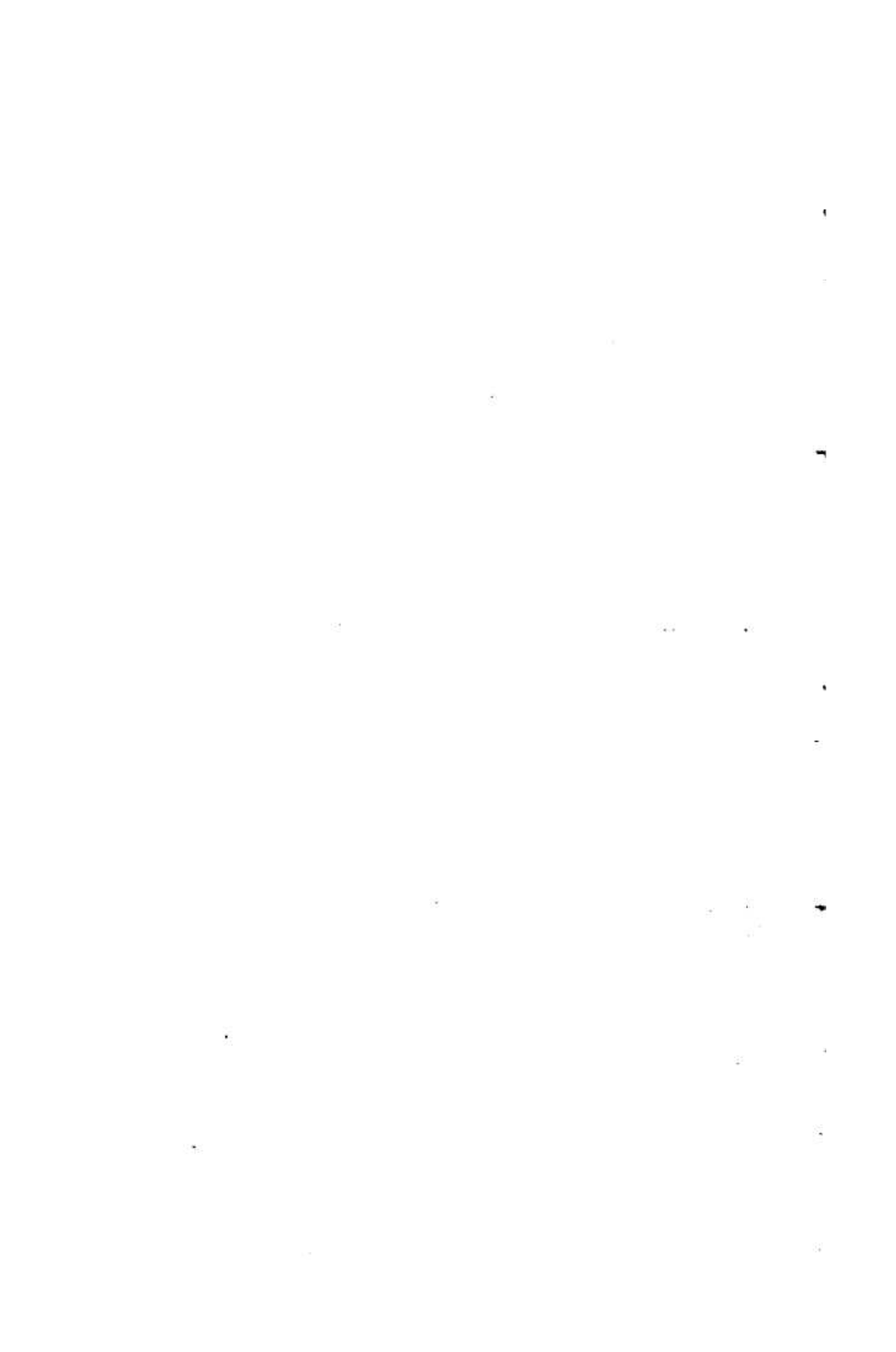
UNIVERSITY
LIBRARY
PRINCETON, N.J.

CONTENTS

I. HISTORICAL.....	5
II. APPARATUS AND PROCEDURE.....	12
III. INTENSITY.....	30
IV. RATE AND INTENSITY.....	34
V. DURATION.....	38
VI. THE MEANING OF RHYTHMICAL GROUPING.....	53
VII. SUMMARY.....	63

(RECAP)
6442
.954

FEB - 91910 251098



CHAPTER I

HISTORICAL

To produce an impression of rhythm, it is necessary to have a series of stimuli. These stimuli may be sounds, as in the case of poetry and music, muscular contractions, as in dancing and beating time, or lights and electrical shocks, as in some laboratory experiments. The stimuli which give the impression of rhythm, whatever their nature, may vary in intensity, in duration, and in quality, and may be separated by intervals of varying length. A fundamental task of the experimental investigation of rhythm is to investigate the part played by each of these factors. Only after each of them has been studied separately, may we study the effect when two or more of them are simultaneously involved, and when more complicated factors are introduced, as in melody and harmony.

The aim of the present study is to examine quantitatively the dependence of the rhythmical impression on the intensity and duration of the stimuli. Such an investigation is evidently along the same lines as much of the experimental work of Meumann, Bolton, R. McDougall, and others, who have studied the objective conditions of rhythm. It is necessary, therefore, to review the work that has already been done on the perception of rhythm as influenced by variations in the intensity and the duration of the stimuli.

Meumann¹ found that in listening to a series of sounds, some of which were louder than others, there was a strong tendency towards the formation of rhythmical groups. He studied the effect of accented sounds on the intervals preceding and following them. The most general conclusion at which he arrived is that the effect of the more intense sound may be very different according to its position in the rhythmical group.² He found that sometimes the interval following the accented sound is overestimated and sometimes underestimated, and also that sometimes the interval preceding the accented sound is overestimated and sometimes underestimated, and in the cases in which he used more than one subject, he gets quite different results under the same objective conditions. Meumann states, also, that, with *most* subjects, the sudden introduction of a loud sound into a series of weaker ones causes an underestimation of the interval preceding, and an overestimation of the interval following, the loud sound;³ but he does not

¹ *Philos. Stud.*, 9, 264-306, 1894.

² *Ibid.*, 9, 303 and 10, 311, 1894.

³ *Ibid.*, 9, 276, 1894.

say how many observers gave this introspection, what was the introspection of those who did not give it, how many judgments were made by each observer, or how they were instructed. Meumann made no investigation of the effect of duration in rhythm.

Bolton¹ presented sets of sounds of different intensities and durations, which recurred always in the same order, and asked the subject to point out where the series was grouped. In this way, he sought to determine what was the most natural order in which the different intensities and durations occurred in the group. These experiments led him to state the following general principle: "In a series of auditory impressions, any regularly recurrent impression which is different from the rest, subordinates the other impressions to it, in such a way that they fall together in groups. If the recurrent difference is one of intensity, the strongest impression comes first in the group and the weaker ones after. If the recurrent difference is one of duration, the longest impression comes last."²

Bolton calls attention, further, to the long interval which appeared between the groups, the intervals being objectively equal. The pause seemed to be due to the fact that a long interval generally preceded the accented sound. At the same time some subjects, especially 10 and 15, make a short interval after the strongest sound. But in another place, Bolton writes: "The accented long sound frequently appeared more prolonged than the unaccented of the same length: the accent had the effect both to increase the length of sound and of the interval which followed." And consulting his table of results,³ we find that his subjects often found the interval preceding the accented sound longer than the others, but more often did not. As regards the effect of duration, most of Bolton's subjects remarked upon the long interval or pause which seemed to follow the long sound, and for this reason it was found difficult to make the close of the group come at any other place.

Ettlinger⁴ has criticized Bolton for his tendency to generalize his results on duration, which, being limited to the single case in which one sound is twice the duration of the other, do not permit of much generalization. So far as they go, however, his results indicate that the effect of increasing the length of any regularly recurrent sound is to produce an overestimation of the following

¹ *Amer. J. of Psychol.*, 6, 222, 1894.

² *Ibid.*, p. 232.

³ *Ibid.*, p. 228.

⁴ *Ztschr. f. Psychol.*, 22, 132-133, 1900.

interval, while the effect of increasing the intensity is uncertain. To most of Bolton's subjects, the strongest sound seemed longer than the rest, and the long sound frequently seemed accented.

Schumann¹ asked his subjects to compare the second of two intervals enclosed within a series of three sounds with the first interval. He found, in the case of four subjects, that when the third sound was louder than the preceding, the second interval was underestimated as compared with the first. Three of those same subjects were also tested with regard to the effect of a loud sound which was unexpectedly introduced in a series of weaker sounds. In the case of all three, the interval preceding the louder sound was apparently shorter than the other intervals. Two subjects, on the other hand, obtained the opposite result in both experiments, that is, the interval preceding the accent was overestimated as compared with the other intervals. Schumann explains this apparent contradiction on the ground that the two last mentioned subjects perceived the sounds rhythmically. He made no investigation of the effect of the regular recurrence of a more intense sound every second or every third time in a long series, nor did he study the effect of variation in the durations of sounds on rhythm or on the judgment of intervals.

McDougall² found that a loud sound introduced into a uniform series of six beats causes a considerable underestimation of the interval following the loud sound, while it less often and less considerably lengthens the preceding interval. As regards the overestimation of the interval preceding the accent, of the four tables³ of results which are presented to prove this, one⁴ shows an underestimation; another⁵ shows practically no constant error, but an underestimation rather than an overestimation, while a third⁶ does not show that accent has any effect on the interval immediately preceding, but that a longer interval causes overestimation of the interval preceding that longer interval. As regards underestimation of the interval following the accented sound, we find one table⁷ which shows that when the interval following was 20 per cent. shorter than the interval preceding the accent, and 10 per cent. shorter than the remaining intervals, it was judged less than the remaining intervals 26 times,

¹ *Ztschr. f. Psychol.*, 18, 30-36, 1898.

² *Harvard Psychol. Stud.*, 1; *Monog. Sup. Psychol. Rev.*, 4, 309-412, 1903.

³ *Op. cit.*, Tables XXVIII, XXIX, XXXI and XXXII.

⁴ Table XXIX.

⁵ Table XXXI.

⁶ Table XXXII.

⁷ Table XXIX.