

Attention and Reaction  
James McKeen Cattell (1893)

Classics in the History of Psychology

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By James McKeen Cattell (1893)

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The difference between reactions with attention directed toward the movement to be executed, and reactions with attention directed toward the sense impression received from the stimulus, deserves careful investigation because of the important position that has been assigned to it in the third edition of Wundt's *Physiologische Psychologie*. Wundt assumes that almost all reactions that are shorter than the average are of the muscular type while all that are longer are of the sensorial type. The greater length of sensorial reactions was first noticed by Lange,[1] later by Martius[2] and by Titchener,[3] and recently the distinction has been extended by Münsterberg[4] to more complex mental processes.

I agree with Wundt that a muscular reaction is a brain reflex resulting from practice, but I am not convinced that an apperception process is added when attention is directed toward the sense impression or the sense organ. It is of course theoretically possible to attach an apperception time to the reaction, if the subject holds back his movement until the impression is apperceived. This form of reaction has been attempted in Wundt's laboratory by Friedrich, Trautscholdt, Tischer, Kraepelin, and Merkel; but although these experiments are not without interest, the great variation of the single time measurements bears witness to the lack of an objective criterion. I myself was unable to obtain any satisfactory results by this method, and its difficulties have been recognized by Wundt in the revision of the second edition of his *Psychologie*. Still Wundt insists that the same result is obtained with a sufficiently objective criterion, if the subject directs his attention to the sense impression. On theoretical grounds I would not expect this result. In the practiced automatic movements of daily life attention is directed to the sense impression and not to the movement. So, in piano playing, the beginner may attend to his fingers [p. 253] but the practiced player attends only to the notes or to the melody. In speaking, writing and reading aloud, and in games and manual work, attention is always directed to the goal, never to the movement. In fact, as soon as attention is directed to the movement, this becomes less automatic and less dependable. For this reason I was surprised at the results of the experiments which seemed to show that the reaction time becomes almost twice as long when attention is directed to the sense impression; for whatever makes the reaction less like a reflex will make it slower and more irregular. I have shown, for example, that when the stimulus follows the ready signal at intervals varying from 1 to 15 sec, the reaction time is approximately 25s a longer than when the interval amounts to only 1 sec. approximately. But in all such cases it would seem that the motor time is lengthened rather than that a process of apperception is added to the reaction. When the reaction time is lengthened by the subject's attention to the sense impression, the explanation would seem to be that the motor impulse is not held in readiness for discharge but has to be made ready after the arrival of the impression. In my experiments[5] with Berger, which were done before those of Lange, I did not find that the length or regularity of the reaction time was greatly influenced by the direction of attention, and at present, too, on repetition of such experiments, it seems to me to make little difference whether attention is directed to the movement, to the sense impression, or away from both of them.

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Recently (in July, 1892) I have made reactions to sound and to electrical stimuli, taking the greatest possible care to follow the instructions given by Lange and Wundt. Each average is based on 100 reactions which were made in series of 10 each. By *mv* is denoted the mean variation of the single reactions, and by *MV* that of the series averages. I have excluded no measures, and accordingly the series always contain the same number of reactions. No premature reaction occurred in either the sensorial or the muscular series.

	Muscular reactions			Sensorial reactions		
	<i>M</i>	<i>mv</i>	<i>MV</i>	<i>M</i>	<i>mv</i>	<i>MV</i>
Sound stimulus.....	105.9	6.9	3.9	105.4	5.9	3.0
Electrical stimulus.....	142.7	10.1	4.6	142.8	8.4	4.6

My own reaction time is thus the same whether attention is directed to the movement or to the sense impression, but the regularity both of the single reactions and of the different series was greater in the sensorial reactions. [p. 254]

This result could be attributed to my extensive practice in making these reactions, or even to theoretical preconception. For this reason I performed the experiment with two other subjects. In May, 1890 subject J (my wife) made 100 reactions to sound, 50 being muscular and 50 sensorial. The subject had never served in a reaction time experiment, apart from 20 practice trials, and knew nothing of Lange's experiments. The results were as follows:

	Muscular reactions			Sensorial reactions		
	<i>M</i>	<i>mv</i>	<i>MV</i>	<i>M</i>	<i>mv</i>	<i>MV</i>
Sound stimulus.....	105.9	6.9	3.9	105.4	5.9	3.0
Electrical stimulus.....	142.7	10.1	4.6	142.8	8.4	4.6

This year (July, 1892) the same subject, now acquainted with the results of the earlier experiments, made 100 muscular and 100 sensorial reactions to sound, and the same to an electrical stimulus, with the following results:

	Muscular reactions			Sensorial reactions		
	<i>M</i>	<i>mv</i>	<i>MV</i>	<i>M</i>	<i>mv</i>	<i>MV</i>
Sound stimulus.....	105.5	12.2	3.7	104.97	7.7	2.9
Electrical stimulus.....	119.0	9.4	3.8	121.5	10.1	3.4

J's reaction times agree with those of C in that they are short and regular and show no difference dependent on the direction of attention.

I was able to repeat the experiment with a third person, D (Dr. C. S. Dolley, Professor of Biology at the University of Pennsylvania), who had previously made some 2000 reactions to electrical stimuli but who had not heard of the distinction between muscular and sensorial reactions. The result of his 100 muscular and 100 sensorial reactions was the following:

	Muscular reactions			Sensorial reactions		
	<i>M</i>	<i>mv</i>	<i>MV</i>	<i>M</i>	<i>mv</i>	<i>MV</i>
Electric stimulus. . . .	281.4	58.3	17.1	201.6	31.2	11.3

These data show that subject D's sensorial reactions are about 3/4 as long as his muscular reactions, while their mean variation is scarcely more than half as great. Introspectively, also, he found the sensorial [p. 255] reactions quicker and easier. His reaction time, in comparison with C's and J's, is long and irregular, from which we can conclude that his reactions are not wholly reflex in character, but they have less of the reflex character when attention is directed to the movement than when it is directed to the sense impression.

It is clear, then, that the results published by Lange do not have universal validity. With subjects whose reactions are quick and regular the direction of attention seems to make no difference. With subjects whose reactions are slower and less regular the reaction time may be lengthened either when they attend exclusively to the movement, as in D's case, or when they attend exclusively to the sense impression, as in Lange's case.

Footnotes

[1] Phil. Stud., 4, 479-510.

[2] Phil. Stud., 6, 167-216.

[3] Phil. Stud., 8, 138-145.

[4] Beiträge zur experim. Psychol. Heft I, 84-188.

[5] Phil. Stud., 3, 305-335.

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