

*PSYCHOMETRIC EXPERIMENTS*

By Francis Galton, F.R.S.

Psychometry, it is hardly necessary to say, means the art of imposing measurement and number upon operations of the mind, as in the practice of determining the reaction-time of different persons. I propose in this memoir to give a new instance of psychometry, and a few of its results. They may not be of any very great novelty or importance, but they are at least definite, and admit of verification; therefore I trust it requires no apology for offering them to the readers of this journal, who will be prepared to agree in the view, that until the phenomena of any branch of knowledge have been subjected to measurement and number, it cannot assume the status and dignity of a science.

The processes of thought fall into two main categories: in the first of these, ideas present themselves by association either with some object newly perceived by the senses or with previous ideas; in the second process, such of the associated ideas are fixed and vivified by the attention, as happen to be germane to the topic on which the mind is set. In this memoir I do not deal with the second process at all, so I need not speak more in detail concerning it, but I address myself wholly to the first. It is an automatic one; the ideas arise of their own accord, and we cannot, except in indirect and imperfect ways, compel them to come. My object is to show how the whole of these associated ideas, though they are for the most part exceedingly fleeting and obscure, and barely cross the threshold of our consciousness, may be seized, dragged into daylight, and recorded. I shall then treat the records of some experiments statistically, and will make out what I can from them. I should be glad if the reader would refer to an article written by me in the 'Nineteenth Century' of last March, which was based on the observations I am about to describe. It travels somewhat further afield than the present memoir, but does not enter so much into details.

When we attempt to trace the first steps in each operation of our minds, we are usually balked by the difficulty of keeping watch, without embarrassing the freedom of its action. The difficulty is much more than the common and well-known one of attending to two things at once. It is especially due to the fact that the elementary operations of the mind are exceedingly faint and evanescent, and that it requires the utmost painstaking to watch them properly. It would seem impossible to give the required attention to the processes of thought and yet to think as freely as if the mind had been in no way preoccupied. The peculiarity of the experiments I am about to describe is that I have succeeded in evading this difficulty. My method consists in allowing the mind to play freely for a very brief period, until a couple or so of ideas have passed through it, and then, while the traces or echoes of those ideas are still lingering in the brain, to turn the attention upon them with a sudden and complete awakening; to arrest, to scrutinise them, and to record their exact appearance. Afterwards I collate the records at leisure, and discuss them and draw conclusions. It must be understood that the second of the two ideas was never derived from the first, but always directly from the original object. This was ensured by absolutely withstanding all temptation to reverie. I do not mean that the first idea was of necessity a simple elementary thought: sometimes it was a glance down a familiar line of associations, sometimes it was a well-remembered

mental attitude or mode of feeling, but I mean that it was never so far indulged in as to displace the object that had suggested it, from being the primary topic of attention.

I must add, that I found the experiments to be extremely trying and irksome, and that it required much resolution to go through with them, using the scrupulous care they demanded. Nevertheless, the results well repaid the trouble. They gave me an interesting and unexpected view of the number of the operations of the mind, and of the obscure depths in which they took place, of which I had been little conscious before. The general impression they have left upon me is like that which many of us have experienced when the basement of our house happens to be under thorough sanitary repairs, and we realise for the first time the complex system of drains and gas- and water-pipes, flues, bell-wires, and so forth, upon which our comfort depends, but which are usually hidden out of sight, and of whose existence, so long as they acted well, we had never troubled ourselves.

The first experiments I made were imperfect, but sufficient to inspire me with keen interest in the matter, and suggested the form of procedure that I have already partly described. My first experiments were these. On several occasions, but notably on one when I felt myself unusually capable of the kind of effort required, I walked leisurely along Pall Mall, a distance of 450 yards, during which time I scrutinised with attention every successive object that caught my eyes, and I allowed my attention to rest on it until one or two thoughts had arisen through direct association with that object; then I took very brief mental note of them, and passed on to the next object. I never allowed my mind to ramble. The number of objects viewed was, I think, about 300, for I have subsequently repeated the same walk under similar conditions, and endeavouring to estimate their number, with that result. It was impossible for me to recall in other than the vaguest way the numerous ideas that had passed through my mind; but of this, at least, I was sure, that samples of my whole life had passed before me, that many bygone incidents, which I never suspected to have formed part of my stock of thoughts, had been glanced at as objects too familiar to awaken the attention. I saw at once that the brain was vastly more active than I had previously believed it to be, and I was perfectly amazed at the unexpected width of the field of its everyday operations. After an interval of some days, during which I kept my mind from dwelling on my first experiences, in order that it might retain as much freshness as possible for a second experiment, I repeated the walk, and was struck just as much as before by the variety of the ideas that presented themselves, and the number of events to which they referred, about which I had never consciously occupied myself of late years. But my admiration at the activity of the mind was seriously diminished by another observation which I then made, namely that there had been a very great deal of repetition of thought. The actors in my mental stage were indeed very numerous, but by no means so numerous as I had imagined. They now seemed to be something like the actors in theatres where large processions are represented, who march off one side of the stage, and, going round by the back, come on again at the other. I accordingly cast about for means of laying hold of these fleeting thoughts, and, submitting them to statistical analysis, to find out more about their tendency to repetition and other matters, and the method I finally adopted was the one already mentioned. I selected a list of suitable words and wrote them on different small sheets of paper. Taking care to dismiss them from my thoughts when not engaged upon them, and allowing some days to elapse before I began to use them, I laid one of these sheets with all due precautions under a book, but not wholly covered by it, so that when I leant forward I could see one of the words, being previously quite ignorant of what the word would be. Also I held a small chronograph, which I started

by pressing a spring the moment the word caught my eye, and which stopped of itself the instant I released the spring; and this I did so soon as about a couple of ideas in direct association with the word had arisen in my mind. I found that I could not manage to recollect more than two ideas with the needed precision, at least not in a general way; but sometimes several ideas occurred so nearly together that I was able to record three or even four of them, while sometimes I only managed one. The second ideas were, as I have already said, never derived from the first, but always direct from the word itself, for I kept my attention firmly fixed on the word, and the associated ideas were seen only by a half glance. When the two ideas had occurred, I stopped the chronograph and wrote them down, and the time they occupied. I soon got into the way of doing all this in a very methodical and automatic manner, keeping the mind perfectly calm and neutral, but intent and, as it were, at full cock and on hair trigger, before displaying the word. There was no disturbance occasioned by thinking of the imminent revulsion of the mind when the chronograph was stopped. My feeling before stopping it was simply that I had delayed long enough, and this in no way interfered with the free action of the mind. I found no trouble in ensuring the complete fairness of the experiment, by using a number of little precautions, hardly necessary to describe, that practice quickly suggested, but it was a most repugnant and laborious work, and it was only by strong self-control that I went through my schedule according to programme. The list of words that I finally secured was 75 in number, though I began with more. I went through them on four separate occasions, under very different circumstances, in England and abroad, and at intervals of about a month. In no case were the associations governed to any degree worth recording, by remembering what had occurred to me on previous occasions, for I found that the process itself had great influence in discharging the memory of what it had just been engaged in, and I of course took care between the experiments never to let my thoughts revert to the words. The results seem to me to be as trustworthy as any other statistical series that has been collected with equal care.

On throwing these results into a common statistical hotchpot, I first examined into the rate at which these associated ideas were formed. It took a total time of 660 seconds to form the 505 ideas; that is at about the rate of 50 in a minute or 3000 in an hour. This would be miserably slow work in reverie, or wherever the thought follows the lead of each association that successively presents itself. In the present case, much time was lost in mentally taking the word in, owing to the quiet unobtrusive way in which I found it necessary to bring it into view, so as not to distract the thoughts. Moreover, a substantive standing by itself is usually the equivalent of too abstract an idea for us to conceive it properly without delay. Thus it is very difficult to get a quick conception of the word "carriage," because there are so many different kinds—two-wheeled, four-wheeled, open and closed, and all of them in so many different possible positions, that the mind possibly hesitates amid an obscure sense of many alternatives that cannot blend together. But limit the idea to, say, a landau, and the mental association declares itself more quickly. Say a landau coming down the street to opposite the door, and an image of many blended landaus that have done so, forms itself without the least hesitation.

Next, I found that my list of 75 words gone over 4 times, had given rise to 505 ideas and 13 cases of puzzle, in which nothing sufficiently definite to note occurred within the brief maximum period of about 4 seconds, that I allowed myself to any single trial. Of these 505, only 289 were different. The precise proportions in which the 505 were distributed in quadruplets, triplets, doublets or singles, is shown in the uppermost lines of Table 1. The

same facts are given under another form in the lower lines of the table, which show how the 289 different ideas were distributed in cases of fourfold, treble, double, or single occurrences.

Table 1: *Recurrent associations*

Total number of associations	Occurring in			
	Quadruplets	Triplets	Doublets	Singles
No. 505	116	108	114	167
% 100	23	21	23	33
Total number of different associations	Occurring			
	Four times	Three times	Twice	Once
No. 289	29	36	57	167
% 100	10	12	20	58

I was fully prepared to find much iteration in my ideas, but had little expected that out of every hundred words twenty-three would give rise to exactly the same association in every one of the four trials; twenty-one, to the same association in three out of the four, and so on, the experiments having been purposely conducted under very different conditions of time and local circumstances. This shows much less variety in the mental stock of ideas than I had expected, and makes us feel that the roadways of our minds are worn into very deep ruts. I conclude from the proved number of faint and barely conscious thoughts, and from the proved iteration of them, that the mind is perpetually travelling over familiar ways without our memory retaining any impression of its excursions. Its footsteps are so light and fleeting, that it is only by such experiments as I have described that we can learn anything about them. It is apparently always engaged in mumbling over its old stores, and if any one of these is wholly neglected for a while, it is apt to be forgotten, perhaps irrecoverably. It is by no means keen interest and attention when first observing an object, that fixes it in the recollection. We pore over the pages of a "Bradshaw," and study the trains for some particular journey with the greatest interest; but the event passes by, and the hours and other facts which we once so eagerly considered become absolutely forgotten. So in games of whist, and in a large number of similar instances. As I understand it, the subject must have a continued living interest in order to retain an abiding-place in the memory. The mind must refer to it frequently, but whether it does so consciously or unconsciously, is not perhaps a matter of much importance. Otherwise, as a general rule, the recollection sinks, and appears to be utterly drowned in the waters of Lethe.

The instances, according to my personal experience, are very rare, and even those are not very satisfactory, in which some event recalls a memory that had lain *absolutely* dormant for many years. In this very series of experiments, a recollection which I had thought had entirely lapsed appeared under no less than three different aspects on different occasions. It was this: when I was a boy, my father, who was anxious that I should learn something of physical science, which was then never taught at school, arranged with the owner of a large chemist's shop to let me dabble at chemistry for a few days in his laboratory. I had not thought of this fact, so far as I was aware, for many years; but in scrutinising the fleeting associations called up by the various words, I traced two mental visual images (an alembic

and a particular arrangement of tables and light), and one mental sense of smell (chlorine gas) to that very laboratory. I recognised that these images appeared familiar to me, but I had not thought of their origin. No doubt if some strange conjunction of circumstances had suddenly recalled those three associations at the same time, with perhaps two or three other collateral matters which may still be living in my memory, but which I do not as yet identify, a mental perception of startling vividness would be the result, and I should have falsely imagined that it had supernaturally, as it were, started into life from an entire oblivion extending over many years. Probably many persons would have registered such a case as evidence that things once perceived can never wholly vanish from the recollection, but that in the hour of death, or under some excitement, every event of a past life may reappear. To this view I entirely dissent. Forgetfulness appears absolute in the vast majority of cases, and our supposed recollections of a past life are, I believe, no more than that of a large number of episodes in it, to be reckoned in hundreds or thousands, certainly not in tens of hundreds of thousands, which have escaped oblivion. Every one of the fleeting, half-conscious thoughts which were the subject of my experiments admitted of being vivified by keen attention, or by some appropriate association; but I strongly suspect that ideas which have long since ceased to fleet through the brain, owing to the absence of current associations to call them up, disappears wholly. A comparison of old memories with a newly-met friend of one's boyhood, about the events we then witnessed together, shows how much we had each of us forgotten. Our recollections do not tally. Actors and incidents that seem to have been of primary importance in those events to the one, have been utterly forgotten by the other. The recollection of our earlier years are, in truth, very scanty, as any one will find who tries to enumerate them.

My associated ideas were for the most part due to my own unshared experiences, and the list of them would necessarily differ widely from that which another person would draw up who might repeat my experiments. Therefore one sees clearly, and I may say, one can see *measurably*, how impossible it is in a general way for two grown-up persons to lay their minds side by side together in perfect accord. The same sentence cannot produce precisely the same effect on both, and the first quick impressions that any given word in it may convey, will differ widely in the two minds.

I took pains to determine as far as feasible the dates of my life at which each of the associated ideas was first attached to the word. There were 124 cases in which identification was satisfactory, and they were distributed as in Table 2.

Table 2: *Relative number of associations formed at different periods of life*

Total number different associations		Occurring								Whose first formation was in
		Four times		Three times		Twice		Once		
No.	%	No.	%	No.	%	No.	%	No.	%	
48	39	12	10	11	9	9	7	16	13	Boyhood and youth
57	46	10	8	8	7	6	5	33	26	Subsequent manhood
19	15			4	3	1	1	14	11	Quite recent events
Totals:										
124	100	22	18	23	19	16	13	63	50	

It will be seen from the table that out of the 48 earliest associations no less than 12, or one quarter of them occurred in each of the four trials; of the 57 associations first formed in manhood, 10, or about one-sixth of them had a similar recurrence, but as to the 19 other associations first formed in quite recent times, not one of them occurred in the whole of the four trials. Hence we may see the greater fixity of the earlier associations, and might measurably determine the decrease of fixity as the date of their first formation becomes less remote.

The largeness of the number 33 in the fourth column, which disconcerts the run of the series, is wholly due to a visual memory of places seen in manhood. I will not speak about this now, as I shall have to refer to it further on. Neglecting, for the moment, this unique class of occurrences, it will be seen that one-half of the associations date from the period of life before leaving college; and it may easily be imagined that many of these refer to common events in an English education. Nay further, on looking through the list of all the associations it was easy to see how they are pervaded by purely English ideas, and especially such as are prevalent in that stratum of English society in which I was born and bred, and have subsequently lived. In illustration of this, I may mention an anecdote of a matter which greatly impressed me at the time. I was staying in a country house with a very pleasant party of young and old, including persons whose education and versatility were certainly not below the social average. One evening we played at a round game, which consisted in each of us drawing as absurd a scrawl as he or she could, representing some historical event; the pictures were then shuffled and passed successively from hand to hand, every one writing down independently their interpretation of the picture, as to what the historical event was that the artist intended to depict by the scrawl. I was astonished at the sameness of our ideas. Cases like Canute and the waves, the Babes in the Tower, and the like, were drawn by two and even three persons at the same time, quite independently of one another, showing how narrowly we are bound by the fetters of our early education. If the figures in the above table may be accepted as fairly correct for the world generally, it shows, still in a measurable degree, the large effect of early education in fixing our associations. It will of course be understood that I make no absurd profession of being able by these very few experiments to lay down statistical constants of universal application, but that my principal object is to show that a large class of mental phenomena, that have hitherto been too vague to lay hold of, admit of being caught by the firm grip of genuine statistical inquiry.

The results that I have thus far given are hotch-potch results. It is necessary to sort the materials somewhat, before saying more about them. After several trials, I found that the associated ideas admitted of being divided into three main groups. First there is the imagined sound of words, as in verbal quotations or names of persons. This was frequently a mere parrot-like memory which acted instantaneously and in a meaningless way, just as a machine might act. In the next group there was every other kind of sense-imagery; the chime of imagined bells, the shiver of remembered cold, the scent of some particular locality, and, much more frequently than all the rest put together, visual imagery. The last of the three groups contains what I will venture, for want of a better name, to call 'histrionic' representations. It includes those cases where I either act a part in imagination, or see in imagination a part acted, or most commonly by far, where I am both spectator and all the actors at once, in an imaginary mental theatre. Thus I feel a nascent sense of some muscular action while I simultaneously witness a puppet of my brain—a part of myself—perform that action, and I assume a mental attitude appropriate to the occasion. This, in my case, is a very

frequent way of generalising, indeed I rarely feel that I have secure hold of a general idea until I have translated it somehow into this form. Thus the word 'abasement' presented itself to me, in one of my experiments, by my mentally placing myself in a pantomimic attitude of humiliation with half-closed eyes, bowed back, and uplifted palms, while at the same time I was aware of myself as of a mental puppet, in that position. This same word will serve to illustrate the other groups also. It so happened in connection with 'abasement' that the word 'David' or 'King David' occurred to me on one occasion in each of three out of the four trials; also that an accidental misreading, or perhaps the merely punning association of the words 'a basement,' brought up on all four occasions the image of the foundations of a house that the builders had begun upon.

So much for the character of the association; next as to that of the words. I found, after the experiments were over, that the words were divisible into three distinct groups. The first contained 'abbey,' 'aborigines,' 'abyss,' and others that admitted of being presented under some mental image. The second group contained 'abasement,' 'abhorrence,' 'ablution,' &c., which admitted excellently of histrionic representation. The third group contained the more abstract words, such as 'afternoon,' 'ability,' 'abnormal,' which were variously and imperfectly dealt with by my mind. I give the results in the upper part of Table 3, and, in order to save trouble, I have reduced them to percentages in the lower lines of the table.

We see from this that the associations of the 'abbey' series are nearly half of them in sense imagery, and these were almost always visual. The names of persons also more frequently occurred in this series than in any other. It will be recollected that in Table 2 I drew attention to the exceptionally large number, 33, in the last column. It was perhaps 20 in excess of what would have been expected from the general run of the other figures. This

Table 3: *Comparison between the quality of the words and that of the ideas in immediate association with them*

Number of words in each series		Sense imagery	Histrionic	Names of persons	Purely verbal Phrases and quotations	Total
26	'Abbey' series	46	12	32	17	107
20	'Abasement' series	25	26	11	17	79
29	'Afternoon' series	23	27	16	38	104
75						290
	'Abbey' series	43	11	30	16	100
	'Abasement' series	32	33	13	22	100
	'Afternoon' series	22	25	16	37	100

was wholly due to visual imagery of scenes with which I was first acquainted after reaching manhood, and shows, I think, that the scenes of childhood and youth, though vividly impressed on the memory, are by no means numerous, and may be quite thrown into the background by the abundance of after experiences; but this, as we have seen, is not the case with the other forms of association. Verbal memories of old date, such as Biblical scraps,

family expressions, bits of poetry, and the like, are very numerous, and rise to the thoughts so quickly, whenever anything suggests them, that they commonly outstrip all competitors. Associations connected with the 'abatement' series are strongly characterised by histrionic ideas, and by sense-imagery, which to a great degree merges into a histrionic character. Thus the word 'abhorrence' suggested to me, on three out of the four trials, an image of the attitude of Martha in the famous picture of the raising of Lazarus by Sebastian del Piombo in the National Gallery. She stands with averted head, doubly sheltering her face by her hands from even a sidelong view of the opened grave. Now I could not be sure how far I saw the picture as such, in my mental view, or how far I had thrown my own personality into the picture and was acting it as actors might act a mystery play, by the puppets of my own brain, that were parts of myself. As a matter of fact, I entered it under the heading of sense-imagery, but it might very properly have gone to swell the number of the histrionic entries.

The 'afternoon' series suggested a great preponderance of mere catchwords, showing how slowly I was able to realise the meaning of abstractions; the phrases intruded themselves before the thoughts became defined. It occasionally occurred that I puzzled wholly over a word, and made no entry at all- in thirteen cases either this happened, or else after one idea had occurred the second was too confused and obscure to admit of record, and mention of it had to be omitted in the foregoing table. These entries have forcibly shown to me the great imperfection in my generalising powers; and I am sure that most persons would find the same if they made similar trials. Nothing is a surer sign of high intellectual capacity than in the power of quickly seizing and easily manipulating ideas of a very abstract nature. Commonly we grasp them very imperfectly, and hold on to their skirts with great difficulty.

In comparing the order in which the ideas presented themselves, I find that a decided precedence is assumed by the Histrionic ideas, wherever they occur that Verbal associations occur first and with great quickness on many occasions, but on the whole that they are only a little more likely to occur first than second; and that Imagery is decidedly more likely to be the second, than the first, of the associations called up by a word. In short, gesture-language appeals the most quickly to our feelings.

It would be very instructive to print the actual records at length, made by many experimenters, if the records could be clubbed together and thrown into a statistical form; but it would be too absurd to print one's own singly. They lay bare the foundations of a man's thoughts with curious distinctness, and exhibit his mental anatomy with more vividness and truth than he would probably care to publish to the world.

It remains to summarise what has been said in the foregoing memoir. I have desired to show how whole strata of mental operations that have lapsed out of ordinary consciousness, admit of being dragged into light, recorded and treated statistically, and how the obscurity that attends the initial steps of our thoughts can thus be pierced and dissipated. I then showed measurably the rate at which associations sprung up, their character, the date of their first formation, their tendency to recurrence, and their relative precedence. Also I gave an instance showing how the phenomenon of a long-forgotten scene, suddenly starting into consciousness, admitted in many cases of being explained. Perhaps the strongest of the impressions left by these experiments regards the multifariousness of the work done by the mind in a state of half-unconsciousness, and the valid reason they afford for believing in the existence of still deeper strata of mental operations, sunk wholly below the level of consciousness, which may account for such

mental phenomena as cannot otherwise be explained. We gain an insight by these experiments into the marvellous number and nimbleness of our mental associations, and we also learn that they are very far indeed from being infinite in their variety. We find that our working stock of ideas is narrowly limited, but that the mind continually recurs to them in conducting its operations, therefore its tracks necessarily become more defined and its flexibility diminished as age advances.