

Phineas Gage: At Least You Are Not That Guy!!

Takeaway

Aside from being inherently fascinating, abnormal psychology has been crucial to an understanding of how the normal brain works. It is unethical, of course, for scientists to induce injuries in parts of the brain in order to observe resulting behavioral changes. But when injuries like Phineas Gage's happened by accident, scientists got their first glimpse into what behaviors were governed by which parts of the brain.

Could you survive a small crowbar passing completely through your head? Most psychologists would answer 'Yes': almost all of them learned that Phineas Gage did. Although Phineas' accident occurred 164 years ago, its consequences are still discussed in most introductory textbooks of psychology, neuropsychology, and physiology. You might therefore think much has been learned since 1848, when the accident happened, and the publication 20 years later, in 1868, of a significant account of its psychological consequences. But in fact little has been added. Moreover, much of what has been written is completely wrong. So, why should Phineas still be of interest?

Phineas and the accident

At 25 years of age Phineas Gage was the foreman of a railway construction gang building the bed for the Rutland and Burlington Railroad in central Vermont in the USA. He and his gang were blasting a cutting through a large rocky outcrop about three quarters of a mile south of the town of Cavendish. It was Gage who decided where holes would be drilled in the rock, and how much powder with which to charge them. To focus the explosive force, the powder and fuse would be gently 'tamped' down before sand was added and a more vigorous tamping applied. Only then would the fuse be lit.



For tamping, Phineas used the larger end of a special crowbar-like tool called a tamping-iron. Three feet seven inches long, it weighed thirteen and a half pounds. It was a one-and-a-quarter inch cylinder, tapered to a point of about one quarter of an inch at one end.

At 4:30pm on Wednesday 13 September 1848 Phineas, apparently distracted, began tamping before the sand had been poured. The tamping iron struck the rock causing a spark to light the powder. The resultant explosion propelled the tamping iron out of the hole and completely through his head. It entered point first, under the left cheekbone, or zygomatic arch and next penetrated the base of the skull, just behind the bony socket of the left eye. Finally it emerged at the top of the skull, probably slightly in front and to the left of the bregma (the junction of the coronal and sagittal sutures), and landed about 20 to 25 yards behind him.

For a short time Phineas may have been unconscious. His gang carried him to a nearby ox-cart where, sitting against its head board, he was driven to the Cavendish Inn where he lived. Then from a chair on the 'piazza' he told his story to the bystanders. He greeted Edward Higginson Williams, the first medical practitioner to arrive, with 'Doctor, here is business enough for you'.

Dr John Martyn Harlow arrived about an hour later and he and Williams managed to stem the profuse hemorrhage. That action and Harlow's subsequent management of a severe infection undoubtedly saved Phineas' life. Three months later, Phineas was well enough to return to his parents' farm. After probably spending most of 1849 regaining his strength, he travelled to Boston in the November to be examined by Henry Jacob Bigelow, the Professor of Surgery at Harvard, and was presented to the medical students there (Bigelow, 1850; Boston Society for Medical Improvement, 1849; Harlow, 1848, 1868).

The post-accident history

After the accident Phineas was unable to regain his job as a foreman. Probably some time in 1850 he became an attraction at Barnum's American Museum in New York, and visited the major cities in New England to lecture and exhibit himself. He worked for some 18 months for Jonathan Currier who ran a livery stable and coach-line service from his Dartmouth Inn, in Hanover, NH. Then Gage went to Chile with a man who planned to set up a stagecoach line in Valparaiso (Harlow, 1868).



After many years driving stagecoaches, Phineas decided in June 1859 to return to his family, now living in San Francisco. He had had some kind of illness and arrived in a weakened condition. Several months elapsed before he was strong enough to work on farms south of the city. Not long after, in February 1860, and after ploughing the day before, 'while sitting at dinner, he fell in a fit'. 'Unquestionably epileptic', his seizures gradually increased in severity and on 18 May he returned to his mother's house where he suffered a successive series of them. By 21 May 1860 the seizures had killed him. He had survived for eleven and a half years (Harlow, 1868; Macmillan, 2000, pp.106–109).

How had Phineas survived the injury and lived for so long? Harlow adduced four factors:

- His 'physique, will, and capacity of endurance, could scarcely be excelled';
- The shape of the tamping iron left behind no 'prolonged concussion or compression';
- The entry of the tamping iron created an opening for draining the infection, without which 'recovery would have been impossible'; and
- The portion of the brain traversed by the iron 'was, for several reasons, the best fitted...to sustain the injury.'

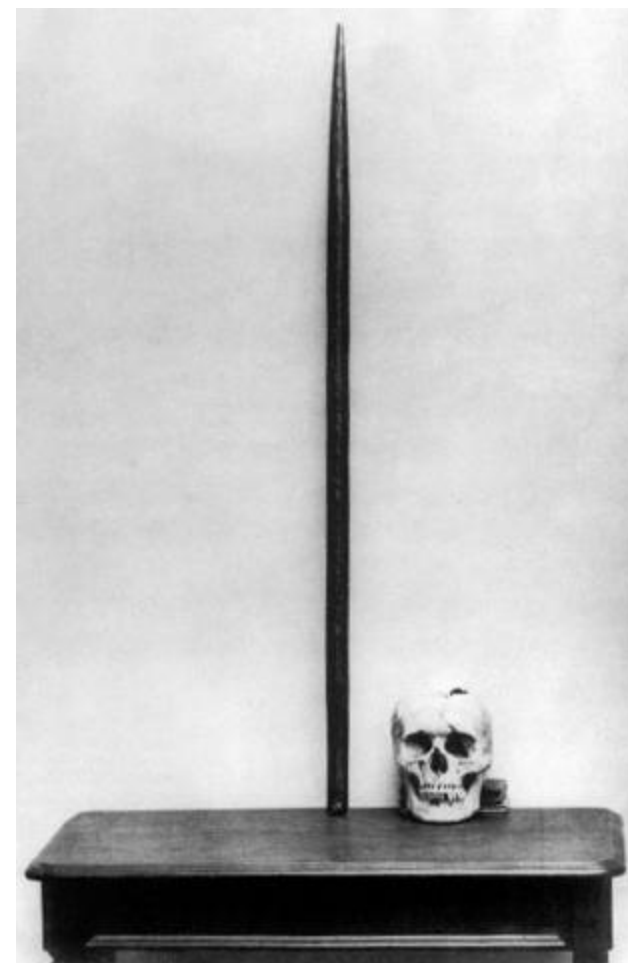
The psychological aftermath

The damage to Phineas' brain had profound psychological consequences. In 1868, in fewer than 200 words, Harlow summarized why Phineas' contractors would not re-employ him. That summary, together with a few words from his 1848 report, tell us practically everything we know about Phineas. Harlow said 'the balance between his intellectual faculties and animal propensities seems to have been destroyed'. Phineas became:

- 'Fitful', 'irreverent', grossly profane, and showed 'but little deference for his fellows';
- 'Impatient of restraint or advice' that conflicted with his desires;
- 'Pertinaciously obstinate, capricious, and vacillating' about his plans for the future – 'no sooner arranged than they are abandoned'; and
- 'A child intellectually' with 'the animal passions of a strong man'.

Previously he had been:

- 'Strong and active' with 'an iron will' and of 'nervo-bilious temperament';
- Of 'temperate habits' and 'possessed of considerable energy of



character’;

- A ‘great favorite’ with his men;
- ‘The most efficient and capable foreman’ employed by his contractors;
- In possession of ‘a well-balanced mind’; and

- Regarded as a ‘shrewd, smart business man, very energetic in executing all his plans’.

So ‘radical’ was the change, his friends and acquaintances said he was ‘no longer Gage’ (Harlow, 1848, 1849, 1868). Phineas’ mother told Harlow that Phineas entertained ‘his little nephews and nieces with the most fabulous recitals’ of his adventures that had no ‘foundation except in his fancy’. He ‘conceived a great fondness for pets, and souvenirs, especially for children, horses and dogs – exceeded only by his attachment to his tamping iron, which was his constant companion during the remainder of his life’. After his first seizure she said he often changed his employment, always finding ‘something that did not suit him’.

Twenty years after the accident, the physician who treated Gage correlated the behavioral changes with damage to the frontal region of the brain. At the time, the brain was thought to control language and movement, but the suggestion that the brain functioned to process emotions and social behavior was new. In addition, scientists at the time believed the brain lacked localized functions. Unknowingly, Phineas Gage contributed to our understanding of how the brain processes information.

In the 1990s, scientists used their improved understanding of brain function, computer modeling techniques, and new data from Gage’s skull. On the basis of this information, they found

that the accident damaged both hemispheres of the frontal lobe, which is the part of the brain that influences social behavior. Today, physicians see patients with damage to the frontal lobe that has occurred through motor vehicle accidents, gun accidents, or major falls. These individuals, like Phineas Gage, often have dramatic changes in their emotional and decision-making abilities.

