Simulations, both as a feasibility test and as a guide to experiment. The list would extend as far as the imagination of experimental neurobiology allows. For example, the response of the network to external stimuli against the background of spontaneous activity could be tested. Stimuli can be simple injections of current into separate neurons or can include effects of receptor fields and tuning curves. Such 'experiments' can consist of measuring response times of the system or of CCs and their relation to peristimulus phenomena. The model could be extended to test the effects of long-range inhibition as indicated in Ref. 22. The simulated neural dynamics might suggest a role for non-stationary action of potentiated synapses. It might propose a clear role for synaptic-conductance time constants (not included in the simulations described here). Simulations are now on the verge of modelling joint neural and synaptic dynamics (learning in large-scale networks, which might allow a more organic connection of the modelled cortical module to the external world. When feasible, they should be extended to include interactions between modules, thus introducing the computational dynamics of brain-like systems. All these phenomena will be expressed and measured on a well understood framework where proposed accounts can be tested, whereas in the living system they are often left as untestable metaphors. Moreover, given the simplicity of the system they might find a theoretical, predictive account.

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Acknowledgements I am deeply grateful to Dr. Paul Ginsberg for his critical reading of an earlier version of the manuscript which left deep impressions. I thank Dr. Valodya Yakovlev for help with the experimental data, Dr. Nicolas Brunel for discussions and simulation data and Dr. Sergei Kepstein, Mischa Druckin and Stefano Fusi for help with the graphics. This work was supported in part by a Human Mobility grant of the EEC and by grant 509/96 from the Israel Science Foundation.

Perspectives

Rembrandt’s ‘The Anatomy Lesson of Dr. Joan Deijman’

Charles G. Gross

Rembrandt’s striking painting of a human brain being dissected by a headless figure is actually a fragment of a larger work. The original was both a commissioned group portrait of a surgeon’s guild and an account of a public dissection. Such dissections served both educational and entertainment functions in 17th century Holland.


Rembrandt van Rijn’s painting of a brain dissection, 'The Anatomy Lesson of Dr. Joan Deijman' (1657) is undoubtedly the most famous portrayal of a neuroscience procedure (fig. 1). It is actually only a central fragment of a larger painting that was damaged in a fire in the 18th century, lost and then discovered in England in the 19th century, and badly slashed in the 20th. This painting represents a curious combination of two genres of European painting: the group portrait and the historical painting.

The great novelty of group portraits was a unique commissions available to artists were group portraits of the members of trading associations, hunting clubs, and guilds or other civil institutions. As the subjects were usually the organization officers or ‘board of regents’, these group portraits are often termed ‘regents’ portraits’. The ‘Night Watch’ (1642), one of the most famous of Rembrandt’s masterpieces, was such a commissioned group portrait of a company of Civic Guards in which the amount of money each subject contributed determined his prominence in the painting.
and had become common throughout the continent by the middle of the 16th century. In Holland, they were an elaborately regulated public ritual in the major cities. Because each city usually authorized only one such public dissection each year, it became a major event in the Dutch social, educational and entertainment calendar; it went on for three to five days following the execution.

The dissections were conducted by a leading surgeon in the community who had been appointed the city 'praecitor chirurghi et anatomic'. They were held in the winter to retard putrification of the bodies and were conducted in special anatomical theaters that held 200-500 spectators [as depicted in the drawing 'The Anatomical Theater in Leiden' (1610) by W. Swansensburgh after J.C. Woudanus]. The affairs were evening events, illuminated by scented candles, and often accompanied by flute music. The rival professional groups, the physicians and surgeons, sat separately from each other and from the lay public. Everyone was charged admission. The receipts were used not only to pay the fee of the praecitor but also for food, drink and tobacco at the major banquet of the Guild of Surgeons. The banquet was preceded by the end of the dissection and was followed by a torchlight parade through the streets.

In ordinances of 1605 and 1625 that regulated the dissections in Amsterdam, the audience was explicitly forbidden from talking or laughing during the dissections. They could ask questions as long as they were of a 'decent and serious nature'. Body parts such as the heart, kidney and liver (the 'membra naturalia') were gathered rather stiffly and artificially around a skeleton, skull, or body being autopsied (Fig. 2). In Rembrandt's hands, however, the 'anatomy lesson' developed beyond a group portrait to become a more or less accurate account of a significant historical event in the life of the bourgeois Dutch community, namely the public dissection of an executed criminal.

Public dissections as theater

The spectacle of public dissections in front of large audiences of both medical professionals and laymen began in the early Renaissance medical schools of Italy

Fig. 1. Rembrandt 'The Anatomy Lesson of Dr. Joan Deijman' (fragment) (1636). (©Amsterdam Historisch Museum, Amsterdam, The Netherlands.)
passed among the audience but stiff fines were in place to ensure their return. At least until the 17th century only male bodies were used.

These rare dissections were particularly valuable for the physicians and surgeons in the audience because anatomy was viewed then as the fundamental basis of medicine and surgery. In addition, contemporary accounts stress the educational value of the dissections for the general audience. For example, in demonstrating ‘the secrets of nature revealed by God’. They also continued the hoary practice of discouraging crime by mutilation of the criminal’s body after death. Finally, they were also very good theater.

Some historians have emphasized the more general scientific, artistic and cultural roles of the anatomical theaters. At that time, Holland, unlike Britain, France and Italy, had neither scientific societies nor scientific journals. Thus the anatomical theaters served as important venues for scientists to meet and discuss their work. Lectures on medical and other topics were routinely scheduled there. The anatomical theaters usually included attached libraries, museums (‘natural history cabinets’), and even botanical gardens. Major paintings were exhibited, particularly, of course, ‘anatomy lessons’.

‘The Anatomy Lesson of Dr. Nicolaes Tulp’

Rembrandt painted two anatomy lesson group portraits, both of members of the Surgeons’ Guild of Amsterdam. The first, painted in 1632, was ‘The Anatomy Lesson of Dr. Nicolaes Tulp’ (Fig. 3). It was commissioned by Tulp, the city praetor, and paid for by those portrayed in it (except for Aris Kindt, the cadaver, who had been hanged for robbery with violence). Although in the form of the usual group portrait, it was actually a strikingly original artistic triumph. For the first time, Rembrandt dramatically emphasized the dissection rather than just the dramatic personae. The lecture-dissection is shown as the dramatic event it must have been. The portraits do not look ‘pasted on’ as was usually the case before (Fig. 2); rather, they are portrayed as individuals with considerable variation in how much each is paying attention to the dissection.

In spite of its artistic superiority, the painting was typical of previous ‘anatomy lessons’ in deviating considerably from an accurate account of the real event. At the actual dissection, the guild members, other than the lecturer and perhaps his assistant, would have been in the front rows of the audience rather than on the stage around the lecturer. Tulp is shown starting by dissecting an arm when, in fact, the body cavity was always opened first and the limbs were usually not reached until the second day. Finally, Rembrandt’s rendering of the anatomy of the arm is rather distorted and inaccurate.

The painting was Rembrandt’s first group portrait and it was an immediate success. It established him as a major portrait painter, leading to many portrait commissions. In fact, medical professionals were ‘among the most faithful of Rembrandt’s patrons throughout his life.44
The fame of 'The Anatomy Lesson of Dr. Nicolaes Tulp' went beyond the world of art history. As first pointed out by the English art critic John Berger, it was the exact model for the picture of the murdered Che Guevara that sprung from the first pages of newspapers around the world in 1967: the Christ-like figure lying half naked and surrounded by Bolivian officers and soldiers, the commanding officer mimicking the stance of Dr Tulp.

'The Anatomy Lesson of Dr. Joan Deijman'

Twenty-four years later, Rembrandt painted his second and final anatomy lesson. Now the preceptor was Dr Joan Deijman, Tulp's immediate successor. This painting, originally measuring 245 × 300 cm, was badly damaged in a fire in the 18th century and only the central portion (113 × 135 cm) of the lower half survived (Fig. 1). After the painting was completed, Rembrandt made a sketch of it for the design of its frame. On the basis of this sketch, of contemporary accounts of the intact painting, and of Rembrandt's other portraits, the original painting has been reconstructed. Whereas the original consisted of the portraits of eight spectators in addition to Dr Deijman, his assistant, and the cadaver, in the fragment only the cadaver, the assistant, and a headless Dr Deijman survive. The body was that of Joris Fonteyn, who had just been hanged for his 'habitual criminality'.

The portrait is a more accurate account of the standard public dissection than Rembrandt's earlier painting. The dissection of the viscera has been completed first and Deijman has removed the top of the skull (which his assistant is holding), flapped back the dura, and is presumably about to start the usual next step, horizontal sections of the cerebrum. It is not clear whether Rembrandt actually sketched this or any other brain dissection from life. However, the view of the brain and the flapped-back tissue is virtually identical to Plate 67:2 of Andreas Vesalius in his 'On the Fabric of the Human Body' (1543), even in regard to the expression of the mouth. It is thus almost certain that Rembrandt depended heavily on this Vesalius figure, whether or not he also made his own observations.

The overall design of the painting also seems to have been influenced by the famous title page of Vesalius's great work. In the center of that woodcut, Vesalius is shown dissecting a human corpse in front of a Palladium-like stage. Although most of Rembrandt's other multiperson paintings are asymmetrical, the principal features of this painting, the body and the dissector, are placed in its very center. (Even Christ does not usually get this treatment in Rembrandt.)

The stage-like structure with which Rembrandt surrounds his picture may also be derived from the stage in the background of the Vesalius frontispiece; there does not seem to have been a similar stage in the Amsterdam anatomical theater.

Artistically, 'Dr Deijman' is considered an even greater masterpiece than 'Dr Tulp'. The radically foreshortened body is particularly dramatic, leading the viewer's eye from the confronting feet, across the open visera to the brain and the scalp. (This arrangement of the body is thought to be derived from Montagna's 'Dead Christ' in Milan.) The eyes are just enough in shadow to threaten to stare directly at the viewer. The blackish toes and lips, the yellow skin tone, and the rigor mortis are all of a reality never before seen in an 'Anatomy Lesson'. When the great English painter and critic, Sir Joshua Reynolds, saw the full original in 1781 he commented, 'There is something sublime in the character of the head which reminds me of Michael Angelo; the whole is finely painted, the colouring much like Titian'.

Today the original functions of anatomy lesson paintings are fulfilled by group photographs. The lay functions of the public dissection, namely entertainment, voyeurism and education, are largely carried out by television.

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Acknowledgements
The author would like to thank Greta Bernman, George Kautham, Michael Graziano and Shaloni Alitharan for their detailed comments.

LETTERS TO THE EDITOR

Intrinsic circuitry of the amygdaloid complex: common principles of organization in rats and cats

In a recent review article, A. Pitskanen, V. Savander and J.E. LeDoux described the organization of the intra-amygdaloid circuitry of the rat. Here, we would like to point out that, although the authors did not mention similar across species, particularly between rats and cats. Moreover, we argue that given the overwhelming similarities between rats and cats, investigators have much to gain by considering findings obtained in

Since the seminal study of Krettek and Price, it has been known that the amygdaloid complex of the rat and cat are characterized by a similar set of interneuronal connections. Using more sensitive tract-tracing techniques, recent studies have largely confirmed the main conclusions of Krettek and Price, but with some significant exceptions.

A first divergence from Krettek and Price's findings (common to rats and cats)