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LETTER TO THE EDITOR

Neurosciences in the ninth art

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Dear Editor,
Stan Lee (1922–2018), who recently passed away, was one of the most prolific comic book writers and publishers. He co-created numerous popular fictional characters mainly belonging to Marvel Comics. His works were often inspired by the most recent scientific discoveries, so it comes as no surprise that his comic books contained several references to the neurosciences.

Superheroes often show increased neural connectivity between brain areas—especially between the visual cortex and premotor and motor areas—with an improvement of hand-eye coordination, reflexes, motor speed, and muscle response (e.g., Captain America, Hawkeye, Black Widow). Similarly, expanded senses (super hearing, super smell, and telescopic vision) could be related to modifications in neural connectivity, but they could be also caused by additional receptors at the level of the sense organs. The spider-sense of Spiderman—an increased awareness of surroundings that allows the superhero to detect danger before it happens—could be another example of neural connectivity responsible of super-abilities. All these comic-book characters and their "neuropsychological" superpowers were mainly developed during the 1960s, in a period of fundamental studies in the field of cognitive neuroscience. In these years, for instance, the neuroscientists David H. Hubel (1926–2013) and Torsten N. Wiesel—Nobel laureates in 1981—studied the visual system in cats to better understand sensory processing [1].

The cognitive revolution of the 1960s also influenced the studies on emotions. Therefore, it comes as no surprise that the physical transformation of the scientist Bruce Banner in the Hulk, a green-skinned muscular humanoid, created by Stan Lee in 1962, happens when subjected to emotional stress. In this modern version of Dr. Jekyll and Mr. Hyde, the transformation is not caused by a chemical compound as described in the original nineteenth-century novel, but by anger and emotional distress. This neurocognitive pathogenesis connection is more clear in the 2008 film adaptation of the comic books, when one of the character, the supervillain Dr. Sterns, explains that "the gamma pulse [that awakens the Hulk] came from the amygdala."

Discoveries in the field of neuroscience could have influenced the stories of superheroes, but comic books themselves could have also anticipated innovative ideas. When the magnate Tony Stark assumes the identity of Iron Man, he wears a powered metal armor that he can activate using software that converts his brain signals into instructions that allow a better performance during the fight. The creation of this character by Stan Lee himself in 1963 seems to anticipate the studies on brain–computer interface conducted in the 1970s in the USA [2].

The link between comic books and neurosciences can be clearly evidenced in the character of Doctor Strange. The "Sorcerer Supreme," created by Stan Lee in 1963, was originally an egotistical surgeon whose hands had severe nerve damage in a car accident. The homonymous 2016 movie adaptation of the comic books is full of neurological references, including a description of neurotoxic effects of antimony, a proposal of using trans-sectioned spinal cords to stimulate neurogenesis in the central nervous system and the mentions of some neurosurgery interventions (suboccipital craniotomy and laminectomy procedure). The recent successes of the cinematic adventures of the sorcerer-neurosurgeon well evidence that the mysteries of the brain and its functioning still fascinate general population and that neurological processes are surrounded by magic in the eyes of the public. It should be also mentioned the recent interest of scholars toward magic tricks, which may offer new vistas in cognitive neuroscience [3].

In conclusion, the commemoration of Stan Lee could appear as a timely opportunity to evidence less-known conjunctions between neuroscience and the world of the so-called ninth art, comic books, which, as well as cinema [4], could provide unexpected suggestions for neurologists and neuroscientists.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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References

1. Hubel DH, Wiesel TN (1959) Receptive fields of single neurones in the cat's striate cortex. J Physiol 148:574–591
2. Vidal JJ (1973) Toward direct brain-computer communication. Annu Rev Biophys Bioeng 2:157–180
3. Quiroga RQ (2016) Magic and cognitive neuroscience. Curr Biol 26: R390–R394
4. Riva MA, Perciaccante A (2017) "Puttin' on the Ritz": Young Frankenstein and neurology. J Neurol Sci 373:16