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THE IMPACT OF SOCIAL LEARNING ON THE HUMAN BRAIN

* Antonie Schmelzeisen. Master neurosciences cognitives, Université de Fribourg, Département de Psychologie.

***Auteure correspondante** : Madame Antonie Schmelzeisen antonie.schmelzeisen@unifr.ch

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Compared to other species, human babies are born quite helpless. Due to their limited motor skills, very limited vision, and inability to warm or feed themselves, they are dependent on the care of their parents or caregivers from the moment they see the light of day. Even after learning to walk, children and young adolescents depend on their parents for a substantial part of their lives, in sum about 23% of their average life expectancy. Contrarily, many mammals, such as giraffes, can e.g. walk from day one of their lives and become independent much faster (Bogin & Varea, 2017, as cited in Faust et. al., 2020).

Despite their dependency on primary caregivers, human babies are quick learners and are already born with certain strengths in the social domain, as babies under a week old are capable of distinguishing human faces from other stimuli and seem to learn a preference for their mother's face over other faces shortly after birth (Easterbrooks et al. 1999, as cited in Faust et. Al., 2020) and by the age of 12 days are able to imitate facial expressions of adults (Meltzoff & Moore, 1977, as cited in Faust et al., 2020).

Growing older, we continue to learn through social interactions, thereby strengthening our ability to learn new behaviors and skills simply by observing our social network, e.g. family members, schoolmates, or even role models in the media. Imitation and observational learning have a great impact on our social learning and allow us to learn without direct experience, saving a lot of our resources and time. This works best when the person we're learning from is familiar to us (Swaney et al., 2001, as cited in Gariépy et al., 2014), and or popular among our community (Momennejad, 2022). The described effect of learning efficiency increasing with the familiarity of the 'teacher' can be observed in many species (Swaney et al., 2001, as cited in Gariépy et al., 2014).

Our learning is not just influenced by observing and imitating our social network, we're also shaped on a communal level by sharing the same experiences or living circumstances (e.g. by having the same environment, seeing and hearing the same entertainers, listening to the same teacher in class or playing the same games in our free time). Those common experiences shape how and what we remember, and consequently also have an impact on how our neuronal pathways form in the brain.

Additionally, shared beliefs (such as religion) play an important role in the decisions we make as individuals and groups, and can therefore shape our neuronal structures in more similar ways, lead us to applying the same motives and guidelines to everyday choices, and ultimately make us think more alike (Momennejad, 2022). In an fMRI study examining the brain activity of participants watching a video inside a scanner, their neural responses were similar to those of their close peers. While peers with a smaller geodesic distance showed more similar brain responses, community members who were more distant by geodesic distance showed less overlap (Coman et al., 2016, as cited in Momennejad, 2022).

These findings rather confirm the concept of neural homophily: people tend to be friends with individuals who see the world in a similar way (Parkinson et al., 2018, as cited in Momennejad, 2022). Another factor in forming similar brain responses is that community members brain activities become more similar to e.g. members of a community with high social influence (Sievers et al., 2020, as cited in Momennejad, 2022). Concluding, shared memories and experiences shape our identity as a group and enable collective action, which could explain why our brain encodes the topology of our social network in such a way that even similar neural patterns emerge between us and our social contacts (Momennejad, 2022).

To explore the impact that social learning and memory can have on our brain, let's take a brief look at how the brain processes social information and organizes new memories. When we have new experiences, what we learn is not stored in the same cortical structures where it was originally encoded but instead goes through a reorganization process called memory consolidation to become permanently stored. During sleep, the hippocampus and neocortex consolidate new experiences and make them more resistant to interference, which helps the brain to retain the memory.

In particular, great importance is attached to slow-wave sleep, as it reactivates memory traces in hippocampal networks again and again (Diekelmann and Born, 2010, as cited in Harand, 2012). Thus, memories are not stored in one part of the brain only but in a chain of engram cell ensembles, distributed across the brain. Especially the hippocampus, associated cortical brain structures and the amygdala have been found to be among the significant brain regions with elevated engram index values (Roy et al., 2022). The process of system consolidation is just one example of the neuroplasticity of the brain, which can modify and update existing memories, a process mediated by underlying neural plasticity.

Two main phenomena promote this ability – generalization and interference. While generalization concerns the case when a learned memory is extended beyond its specific characteristics, interference occurs when a new memory interferes with or is interfered with by another memory acquired in temporal proximity to it (Herzsage et al., 2012).

The former paragraphs show that the human brain is not a lifeless hard disk storing memories in the same place for eternity, but rather a complex and adaptable structure that is impacted by environmental and experience-dependent plasticity. As memories age, a network of approximately 18 brain regions changes along with them, while the functional connectedness with the hippocampal seed significantly declines with memory age. Systems consolidation theorizes that memories become hippocampus-independent as they are gradually reorganized in the neocortex (Tallman et al., 2022). Tallmann et al. also found relatively monotonic patterns of declining neocortical activity with memory age. Areas of increasing activity with memory age were located predominantly in the frontal lobe, while areas of declining activity with memory age were located dominantly in the parietal lobe. Furthermore, the examination of patients with hippocampal lesions showed that information is not only stored in the hippocampus, but also in the surrounding MTL cortices.

Although the exact plasticity mechanisms are not yet fully established, it appears that moderate to severe stress enhances the growth of several sectors of the amygdala, whereas the effects on the hippocampus and prefrontal cortex are rather opposite. Both structural and functional changes in the brain have been observed with e.g. cognitive therapy, leading to the suggestion that well-being and other prosocial traits may be bettered through training (Davidson et al., 2012).

All in all, the brain is plastic and changes depending on what we learn and what experiences we have. When we are born, we come into the world relatively helpless and with limited abilities, so we depend on our social network to take care of us and teach us how to function in a socially networked world. Our cortical structures and neurons change not only when we have experiences ourselves, but also when we observe others in our social network. In experiments, neurons in the premotor cortex discharged in the same way when a monkey performed an action or when it observed another monkey or a peer performing the same action (Ferrari et al., 2003).

The formation of similar neuronal structures could therefore not only be possible through the exchange of experiences and belief systems, but also simply through observational learning and imitation. The concepts already mentioned, from memory consolidation to engrams and neuroplasticity to mirror neurons, show just some of the mechanisms that shape our brains and change our topologies. This means that social learning not only helps us connect with our community and facilitates learning, but also influences our future thinking by shaping similar cognitive pathways. The huge impact of social learning on our brains shows the importance of creating safe learning environments for children as well as adults and providing psychological safety and security from stress and unsafe environments.

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