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# Effects of Botox Injections on Cognitive-emotional Experience

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*Emotional experience is a complex neurological process highly dependent on the ability to express emotion behaviorally. Facial expression, specifically, plays a critical role in interpreting others' emotions and responding appropriately. This review examines the current literature about the impact of botox injections on emotional experience, including recognition and empathy. Results show that botox may severely limit cognitive-emotional responses to others' emotions, especially stronger emotions such as anger. This leads to the conclusion that botox injections may inhibit emotional connections to others.*

Darwin (1872) was among the first to explore the "intimate relation which exists between almost all the emotions and their outward manifestations" (p. 366). Recent studies have confirmed this emotion-expression link and indicated that the ability to express emotion outwardly is essential for interpreting and empathizing with emotional stimuli (Havas, Glenberg, Gutowski, Lucarelli, & Davidson, 2010; Neal & Chartrand, 2011). In other words, cognitive-emotional experience is directly linked to the ability to display emotion through facial expression. Given this, one might ask about persons who cannot express emotion outwardly. Specifically, what effects do botox injections have on emotional experience?

Botox injections are a common cosmetic procedure for reducing facial wrinkles (Hexsel, Spencer, Woolery-Lloyd, & Gilbert, 2010). In the United States alone, the use of botox increased 8% in 2008 to 5 million injections per year. Botox is derived from a botulinum neurotoxin released by a spore-forming microbe that, in large doses, can cause paralysis and death (Hexsel et al., 2010). Though there are practical applications of botox in the treatment of neuromuscular diseases, the most frequent applications are cosmetic. Due to this broad use, the question of how botox injections affect emotional experience is potentially important emotionally and socially. This paper will briefly introduce the major pathways of cognitive emotion, describe the origins and cellular effects of the botulinum toxin, and examine botox's effects on cognitive-emotional experience.

## Cognitive-emotional Experience

A basic understanding of the emotional pathways in the human brain is crucial to understanding the effect of botox on emotion. Cognitive emotion is defined here as the processes within the brain that allow the experience of emotion. One meta-analytic study (Lindquist, Wager, Kober, Bliss-Moreau, & Barrett, 2012) found little supporting

evidence for the "locationist" hypothesis of emotion, which holds that specific emotions are located in specific parts of the brain. Instead, the study postulated that emotions of all types draw from the entire brain, both in regions considered emotional in function and in other areas of the brain. For example, the amygdala, orbitofrontal cortex, and ventromedial prefrontal cortex are all involved in the basic emotional process of analyzing whether or not a stimulus is appealing (Barrett, Mesquita, Ochsner, & Gross, 2007). This evaluative process relies heavily on interactions between the hypothalamus and brainstem. Other parts of the brain are involved in more complex emotional processing, such as relating past experience to present emotional stimuli, including the medial prefrontal cortex and the anterior cingulate cortex (Barrett et al., 2007). The pathways contained in the human brain are extremely complex, depending on many different locations to convey even the simplest emotions.

## Botulinum Neurotoxin

Botox injections are derived from the botulinum neurotoxin produced by Clostridium botulinum, an anaerobic, gram-positive, spore-forming bacterium found mainly in soil and animal intestinal tracts (Hexsel et al., 2010). The basic function of the neurotoxin at the cellular level is as an antagonist to the neurotransmitter acetylcholine, permanently preventing fusion of synaptic vesicles containing acetylcholine to the pre-synaptic cell, thereby preventing its release into the synaptic cleft (Hexsel et al., 2010; Nigam & Nigam, 2010).

In other words, the neurotoxin prevents neural transmission in cholinergic pathways in the peripheral nervous system. The neurotoxin is effective at four different sites in the body: the neuromuscular junction, autonomic ganglia, postganglionic parasympathetic nerve endings, and postganglionic sympathetic nerve endings (Nigam &

Nigam, 2010). Even in tiny, nanogram-level doses, botulinum neurotoxin can cause paralysis and death (Hexsel et al., 2010).

Two strains of neurotoxin currently exist in the United States (Hexsel et al., 2010). Type A is used for cosmetic purposes and Type B for neuromuscular diseases, such as hemifacial spasms and dystonia. Their effects generally last from three to six months (Hexsel et al., 2010). Although the toxicity of botulinum neurotoxin is high, the dosages used for so-called botox treatments are low enough to be relatively harmless in normal nerve cells (Nigam & Nigam, 2010). In fact, botox has been popularized as a cosmetic treatment that literally paralyzes facial muscles in an effort to obliterate wrinkles.

## Impact on Facial Expression and Emotion

The comparative loss of facial expression in botox users has been documented and shown to play a critical role in how they interpret and empathize with the emotions of others. For example, Hennenlotter et al. (2009) utilized botox injections to investigate how feedback from facial muscles during the imitation of fear and anger affects activation of the amygdala. They found that the botox-injected group displayed no difference in activity during imitation of facial expressions of fear, but did show decreased activity during imitation of anger, illustrating the possible role that the ability to express emotion has on emotional intensity. Another study examined self-reported emotional responses to visual emotional stimuli (Davis, Senghas, Brandt, & Ochsner, 2010). Results showed that, for moderate emotional stimuli, the botox group reported a statistically significant decrease in their level of emotional experience (Davis et al., 2010).

Other studies have also examined the effects of botox-dampened facial expression on emotional perception. Havas et al. (2010) found that using botox injections to selectively paralyze facial muscles inhibited the speed that participants read passages depicting emotions

which are expressed through the use of the paralyzed muscles. Additionally, Neal & Chartrand (2011) discovered that administering botox injections resulted in a decreased ability to match facial expressions with corresponding emotions. The fact that brain activity and self-reported emotional responses are correlated supports a conclusion that cosmetic botox injections impair emotional experience.

## A Suggestion for Future Research

There is little research on the effects associated with different botox-injection sites. Some are given in the corners of the mouth, others in the forehead, and others between the eyebrows (Davis et al., 2010). It could be that forehead injections result in weaker emotional experiences because forehead muscles are a large part of most facial expressions.

In summary, this paper has reviewed the major emotion pathways in the human brain involved in emotional processing, described the origins and cellular effects of botulinum neurotoxin, and surveyed studies of the impact of botox injections on cognitive-emotional experience. The results indicate that the dampening of facial expression by botox injections weakens the intensity of emotional experience. If the use of botox adversely affects the ability to feel emotion, then the rapid growth of the botox cosmetic industry may require further study of this unanticipated side effect.

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- The preferred format is Microsoft Word. All graphics or photos should be high resolution (300 dpi).

Types of submissions accepted:

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