Cacioppo, S., & Hatfield, E. (2013): From desire to love: New advances from social neuroscience. In L. Bormans (Eds). "*The World Book of Love*". Tielt, Belgium: Lannoo Publishers.

From Desire to Love:
New Advances from Social Neuroscience

Stephanie Cacioppo & Elaine Hatfield
University of Geneva
University of Hawaii

Although love and desire are two of the most powerful subjective feelings one may experience in a lifetime, there are still debates about the nature and origin of these two phenomena. For decades, scholars from a variety of disciplines have tried to disentangle these two experiences. Several studies have found behavioral similarities as well as differences between love and desire (Hatfield & Rapson, 2005). From a psychological viewpoint, love is defined as a complex mental state involving basic and complex emotions as well as chemical, cognitive, rewarding, and goal-directed behavioral components. More precisely the scientific definition of passionate love states that love is "*a state of intense longing for union with another. A complex functional whole including appraisals or appreciations, subjective feelings, expressions, patterned physiological processes, action tendencies, and instrumental behaviors*" (Stephanie Cacioppo & Elaine Hatflield, 2012), while sexual desire is most appropriately defined as a "longing for *sexual* union." (Hatfield & Rapson, 2005).

From a neuro-functional viewpoint, recent evidence from both human and nonhuman animal studies investigating the biochemistry and brain activity of love and desire shows a strong correlation between these two phenomena. Recently, neuroscientists have begun to collect some data indicating that these processes may be very similar in a variety of cultures. For instance, fMRI studies in humans find that both love and sexual desire spark increased activity in the subcortical brain areas that are associated with euphoria, reward, and motivation, as well as in the cortical brain areas that are involved in self-representation and social cognition (Stephanie Cacioppo et al., 2012). The co-activation of subcortical emotion-related areas and higher order cortical areas that mediate more complex cognitive functions (e.g., body image, mental associations, and self-representation) reinforces the top-down neuro-functional model of interpersonal relationships and the potential role of past experiences on future emotional feelings and behaviors. Interestingly, neural differences also exist between desire and love. Notably at the subcortical level, the posterior-to-anterior insula pattern, from desire to love, suggests that love is a more abstract representation of the pleasant sensorimotor experiences than desire. More precisely, comparing love with sexual desire, activity has been shown to be diminished in the ventral striatum, hypothalamus, amygdala, somatosensory cortex, and inferior parietal lobule. Those reductions are in keeping with sexual desire as a motivational state with a very specific, embodied goal,

whereas passionate love could be thought of as a more abstract, flexible, and behaviorally complex goal that is less dependent on the physical presence of another person. Love is associated with a more intense activation of the ventral Tegmental Area (VTA), and a specific recruitment of activity in more dorsal regions of the right striatum, two dopamine-rich regions involved generally in motivation, reward expectancy, and habit formation. Those findings reinforce the importance of specific goal-directed incentives if one's mind is to fall "head over heels in love." The activation of these subcortical dopaminergic-rich areas during experiences of passionate love is in line with psychological studies defining love as a rewarding, positive, and motivating experience. Interestingly, the anterior part of the insula has been shown to be activated significantly by feelings of love, whereas the posterior part of the insula is activated significantly by feelings of sexual desire. This posterior-to-anterior insular distinction between sexual desire and love reinforces the neuro-functional characteristic of a posterior-to-anterior progression of integrative representations of affective bodily feelings to an ultimate representation of all feelings. This is in line with the view that love is an abstract construct, which is partly based on the mental representation of repeated past emotional moments with another. This specific pattern of activation suggests that love builds upon a neural circuit for emotions and pleasure, adding regions associated with reward expectancy, habit formation, and feature detection. In particular, the shared activation within the insula, with a posterior-to-anterior pattern, from desire to love, suggests that love grows out of and is a more abstract representation of the pleasant sensorimotor experiences that characterize desire.

From these results, one may consider desire and love on a spectrum that evolves from integrative representations of affective visceral sensations to an ultimate representation of feelings incorporating mechanisms of reward expectancy and habit learning. Although love is not a prerequisite for sexual desire, these recent neuroimaging meta-analyses suggest that desire might be a prerequisite for love. Whether desire has to be conscious or subconscious is a question scholars need to further investigate in future research.

References and Further Readings

Cacioppo, Stephanie, Bianchi-Demicheli, Francesco, Hatfield, Elaine, and Rapson, Richard L. (2012). Social neuroscience of love. *Clinical Neuropsychiatry, 9,* 3-13*.*

Cacioppo, Stephanie. & Hatfield, Elaine. (2012). Passionate love and sexual desire.
In P. Whelehan & A. Bolin (Eds.) *Encyclopedia of Human Sexuality.* Wiley-Blackwell.

Hatfield, Elaine, & Rapson, Richard L. (2005). *Love and sex: Cross-cultural Perspectives.* Lanham, MD: University Press of America.