March 09, 2017

Neurobiology

# Our internal fight against loneliness

by **Gillian Matthews**[1] | Postdoctoral Research Fellow

[1]: Simons Center for the Social Brain, Massachusetts Institute of Technology (MIT), Boston, USA

This Break was edited by Carlos Javier Rivera-Rivera, Scientific Editor - TheScienceBreaker

*"A guy needs somebody -- to be near him... A guy goes nuts if he ain't got nobody."*
*Of Mice & Men, John Steinbeck.*

As social creatures, all aspects of our daily lives are powerfully shaped by our social experiences. The social bonds that we nurture throughout our lives provide us with protection, support, companionship, and enjoyment: enabling the human race to survive and flourish. Our innate craving for social connection is plainly revealed by the intensely unpleasant experience of loneliness - a concept that the characters of John Steinbeck's *'Of Mice and Men'* were only too familiar with. While, arguably, we all have an intuitive knowledge of what loneliness feels like, it can be defined as 'a perceived absence of satisfying social connections'. Given the vast array of social opportunities available in this day and age, it might seem paradoxical that loneliness is increasing throughout society. This comes with the burden of low emotional state and poor mental health, but also brings with it damaging effects to physical well-being.

Like any threat to well-being, our body is poised to counteract threats to our social network. Loneliness motivates us to seek out social contact, in a similar way to how we might be driven to find food if we felt hungry. So perhaps loneliness exists in order to encourage social contact in times of need...but then how does this occur? What makes loneliness so unpleasant, and how does this make us crave social contact? Whether it's eating, drinking, exercising, or socialising, the cells and pathways in our brain are crucial for guiding our every move. When we're hungry, for example, brain regions responsible for food-seeking become active, and direct our behaviour towards detecting and acquiring food. So when we're lonely, are there brain regions which encourage us to engage in social contact? And if so, what are these regions, and what neural machinery underlies this type of behaviour?

These questions lie at the intersection of psychology and neuroscience, but require deeper analysis than we are capable of in the human brain. In our study, we therefore chose to look at what happens in the brain of another social species - mice - who, like us, prefer to reside in social groups than in isolation. So how can we begin to study loneliness in mice? We first considered how the brain might respond to mice being unexpectedly isolated from their daily companions. This led us to find a group of cells in the brain that show changes in their activity levels just one day after mice are socially isolated. These cells were a group of dopamine neurons located in a region of the brain known as the dorsal raphe nucleus (DRN). This finding suggested that these cells are able to sense a lack of social contact in the animal's environment.

This led us to our second question - what happens to the behaviour of mice when we trigger activity in these cells? Remarkably we saw two distinct changes: firstly, mice became more social; and secondly, they chose to avoid activation of these cells when possible. While we cannot claim to know that these mice are experiencing loneliness, these changes are reminiscent of 'loneliness-like' behaviour, i.e. they suggest an undesirable emotional state, but also an increased motivation to be sociable. From this, we might therefore draw the conclusion that increased activity in these DRN is signalling the negative aspects of being lonely, and directing behaviour towards social opportunities.

However, just like humans, not all mice are created equally, and not all will experience the same social scenario in the same way. Social hierarchies quickly form in groups of mice, and this results in a different quality of social interactions for different mice. Dominant mice might be seen as the popular kid in the playground, or the school bully, with subordinates yielding to them in confrontations, and giving up their lunch money on demand. Remarkably, this difference in social rank was unveiled within our results: mice with a higher rank were more responsive to changes in DRN activity. Therefore, one possibility is that dominant mice value maintaining their current social group more than lower-ranking mice do, and so this makes them more sensitive to brain activity that signifies loss of that social contact.

Although there is a long history of loneliness discussion in literature dating back to ancient philosophers, it was not until the 1960's that we saw a flurry of investigation by psychologists. As loneliness research continues its transition into the neuroscience field, we continue to delve deeper into this phenomenon, and strive to understand how our brain activity shapes this experience, with its emotional and physical repercussions. Further study will enable us to appreciate how our brains are wired to make us social creatures, and how differences in social skills might arise in different individuals. This will ultimately contribute to our understanding of how aberrant social behaviours and a lack of motivation for socialising can arise in psychiatric disorders such as autism.