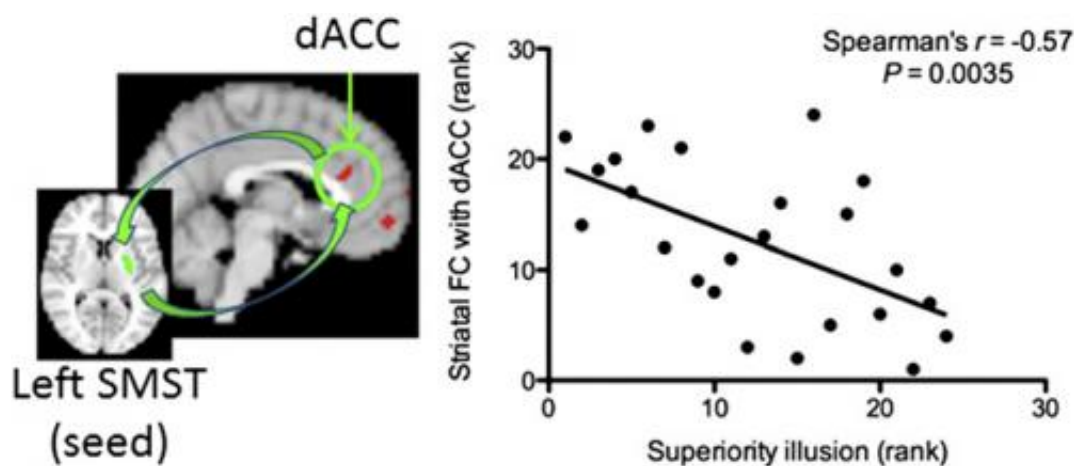


Anything you can do I can do better: Neuromolecular foundations of the superiority illusion (Update)

April 2 2013, by Stuart Mason Dambrot



Relationship between striatal FC and superiority illusion. A significant negative relationship between left SMST FC with dACC and superiority illusion can be seen ($r = -0.57$, $P = 0.0035$). Copyright © PNAS, doi:10.1073/pnas.1221681110

(Medical Xpress)—The existential psychologist Rollo May wrote that "depression is the inability to construct a future"¹ while Lionel Tiger stated that "optimism has been central to the process of human evolution"². These deceptively simple phrases are remarkable in their depth and the connections they form between philosophy, psychology and neuroscience. Both capture the essence of human nature by articulating their insight that our ability to imagine and plan for the future is not only one of the most striking aspects of our species, but also

that the inability to exercise this faculty is profoundly damaging to our happiness and sense of self.

Two concepts related to these observations are *depressive realism* – the assertion that people with depression actually have a more accurate perception of reality, and moreover are less affected by its counterpoint, the *superiority illusion*. The superiority illusion is a cognitive bias by which individuals, relative to others, overestimate their positive qualities and abilities (such as intelligence, cognitive ability, and desirable traits) and underestimate their negative qualities. (Other cognitive biases include optimism bias and illusion of control.) While mathematically flawed – given a normal population distribution, most people are *not* above average – the superiority illusion is a positive belief that promotes mental health. Recently, scientists at the National Institute of Radiological Sciences (Chiba, Japan), the Japan Science and Technology Agency (Saitama), and Stanford University School of Medicine used resting-state functional magnetic resonance imaging (fMRI) and positron emission tomography (PET) to study the default states of neural and molecular systems that generate the superiority illusion. They showed that resting-state functional connectivity between the frontal cortex and striatum regulated by inhibitory dopaminergic neurotransmission determines individual levels of the superiority illusion. The scientists state that their findings help clarify how the superiority illusion is biologically determined and identify potential molecular and neural targets for treating depressive realism.

Dr. Makiko Yamada discussed the research she conducted with her colleagues, starting with the main challenges they encountered in examining the default states of neural and molecular systems that generate the superiority illusion. "Our multidisciplinary approach is quite new to the investigation of the integrated neural and molecular systems of human behavior – that is, combination of three different neural stages: molecular systems, using PET; resting-state brain functions using

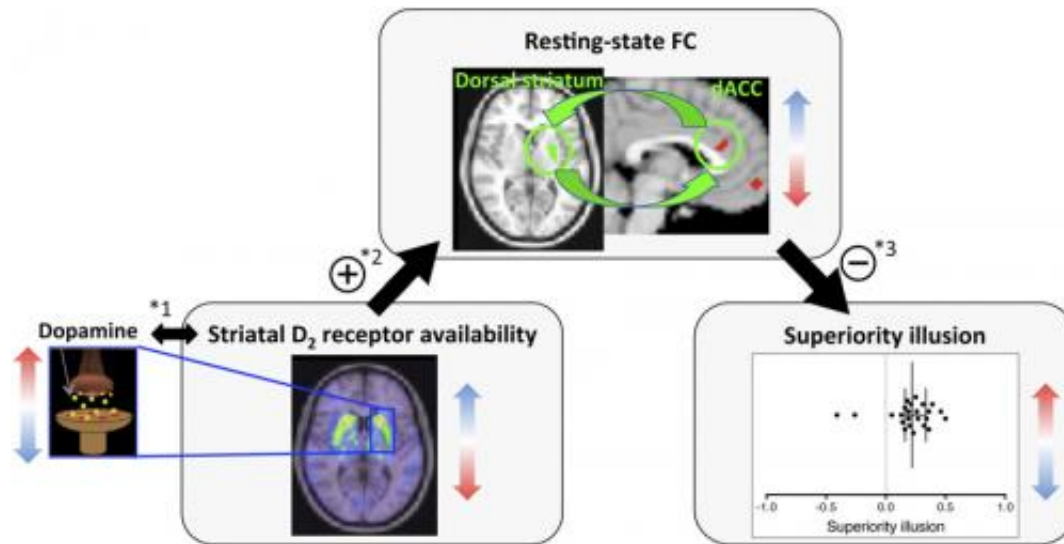
fMRI; and the degree of superiority illusion using a cognitive task," Yamada tells *Medical Xpress*. "Because these three stages have previously been approached separately using different research protocols, it was challenging to link them in the best possible way. In addition, the setup of the experiment is extensive in terms of time, money, supervising participants, and recruiting researchers from each required field."

A second challenge, Yamada continues, was determining the neuromolecular basis for the superiority illusion by demonstrating an interrelationship between dopamine neurotransmission and resting-state functional connectivity between the frontal cortex and striatum.

"Considering the indirect findings for the superiority illusion reported in the literature separately by PET and fMRI studies, we speculated an interrelationship between dopamine neurotransmission and frontal lobe function might be the key to identifying the neurobiological mechanisms underlying this cognitive bias. Because a combined approach has not been established yet," Yamada continues, "it was challenging to see if we could really obtain the results we have hypothesized. Also, although dopamine was the primary focus of the current study, there are other coexisting loops and different molecular systems, such as those based serotonin. Therefore, the superiority illusion could be the products of larger-scaled interactions of different loops and molecular systems. Such intertwined relationships might be resolved in the future studies."

To address these challenges, the researchers needed to develop several insights, innovations and techniques. "Not just in psychology or clinical domains, but also in other fields, such as philosophy and anthropology, the superiority illusion has been given widespread attention," Yamada explains. "Among its many meanings, the ancient Greek aphorism *Know Thyself*, inscribed in the forecourt of the temple of Apollo at Delphi, has long been employed by many scholars as a lesson for us, for instance, about our ignorance of ourselves. Anthropologists also suggest this

illusion to be central to [human evolution](#) – and recently, computer simulation³ showed that positive illusion is evolutionally advantageous, in that it maximizes individual fitness."



Influence of striatal D2 availability on superiority illusion is mediated through dACC- striatal FC. Assuming an inverse relationship between D2 receptor availability and presynaptic dopamine release (1), dopamine likely acts on striatal D2 receptors to suppress FC between the dorsal striatum and dACC (2). This connectivity predicts individual differences in the superiority illusion (3). The indirect effect of striatal D2 receptor availability on the superiority illusion is significantly mediated through dACC-striatal FC (IE = - 0.18; SE = 0.12; LL = -0.56; UL = -0.045). “+” indicates a positive relationship; “-,” a negative relationship. Copyright © PNAS, doi:10.1073/pnas.1221681110

For Yamada and her colleagues, all of these stories and findings imply that the superiority illusion is a normal human condition, and therefore the brain must support it. "This idea tempted me to search for the neurobiological bases of this phenomenon," Yamada says, "and in fact we're now collecting similar data to see how this illusion is related to

other molecular systems in healthy individuals as well as in patients with conditions such as depression and Parkinson's Disease. We're also planning to examine functional modulation through cognitive and pharmaceutical therapies."

Regarding innovations and techniques, Yamada notes that PET and resting-state fMRI are both the products of intrinsic states of brain and mind, and therefore were considered to be a good match. "Molecular systems can be viewed as the brain's functional architecture, and brain function can be seen as setting the stage for cognition," she adds. "We didn't try to find the correlations between stages, but our advanced analysis allowed us to relate them with causality links." The researchers regarded brain function as the mediator between molecular system and cognitive functions, and we applied mediation analysis to show the indirect effect of brain functions between dopamine neurotransmission and the superiority illusion. This advanced analysis made it possible for them to conclude that dopamine neurotransmission leads to the superiority illusion by modulating functional connectivity between striatum and frontal cortex...

Yamada also addresses research that comes to different conclusions about the relationships between cognitive biases and mental health. Such research suggests that mentally healthy people actually have fewer positive illusions (and illusions in general) than do those who are depressed; finds that all forms of illusion, positive or not, were associated with higher depressive symptoms; and rejects the idea of depressive realism by showing no link between positive illusions and mental health, well-being or life satisfaction, and thereby maintains that accurate perception of reality is compatible with happiness.

"Depressive realism was originally introduced by Alloy and Abramson using the illusion of control task in college students who differed in depression scores used to evaluate predictions made by Seligman's

learned helplessness theory of depression," Yamada comments. "Their findings have been replicated by several illusion of control tasks as well as by other tasks such as optimism bias – but it was also found that many other variables modulated the illusion of control, which may have resulted in negative findings." In addition, she adds, because this cognitive state is regarded as the borderline between healthy and severe conditions, findings may even be arbitrary. "Depression is caused by many different factors, and symptoms differ between patients; thus, depression is now regarded as not a single disorder. These factors cause varying results in the literature."

Also, Yamada continues, some of this research discusses the illusion of control. Although the illusion of control, optimism bias, and the superiority illusion are related to each other in terms of positive attribution toward oneself, these cognitive biases may differ in how they are generated or cognitively processed. "For instance," she illustrates, "in the superiority illusion, subjects have to explicitly judge themselves, which may recruit more conscious thoughts or s about oneself. On the other hand, in illusion of control tasks in which subjects report the degree of control of their response over the outcome – for example, control of button presses over flashing lights – conscious beliefs about themselves are not explicitly queried. This may recruit different processes, including unconscious ones. However, this is just a rough idea."

Moreover, Yamada continues, "It's often said that possessing a moderate, but not extreme, level of illusion is good. If the illusion of oneself is extremely positive, an individual may underestimate possible risks. There are many studies investigating this – for example, decreasing prevention behaviors, such as having a physical checkup – as well as increasing reckless behaviors, such as an unhealthy diet. However," Yamada acknowledges, "it's difficult to make a clear distinction between moderate and extreme levels, which could also introduce the different

results observed above."

Regarding possible treatments for depressive realism, Yamada points out that their current study is obtained only from healthy subjects, who differ in the level of hopelessness that is one measure of depressive symptoms – so it is too early to conclude about treatment protocols. "However," she adds, "if we could observe the same results in depressive subjects in future studies, dopamine might become a target for drug treatment for this specific symptom. Alternatively, we could apply a cognitive therapy to help them form positive beliefs about themselves, try real-time neurofeedback targeting the [functional connectivity](#) between striatum and [frontal cortex](#), or a combination of these two approaches."

Yamada notes that social comparative judgments studies are often conducted in the United States, where there are many studies exploring the superiority illusion in various sociocultural and socioeconomic contexts. "Broadly speaking, the illusion is observed in general – but there are also differences. Before starting our studies, we were unsure if we would observe strong superiority illusion in Japanese samples, but these were present in our preliminary subjects as well as in our current study's sample, which was all male, many of them students." The researchers can now expand this general knowledge to the more detailed examination of sociocultural and socioeconomic differences, Yamada concludes, through broader samples including males and females, various ages, different social classes, and other demographics.

More information: Superiority illusion arises from resting-state brain networks modulated by dopamine, *PNAS* March 12, 2013 vol. 110 no. 11 4363-4367, [doi:10.1073/pnas.1221681110](https://doi.org/10.1073/pnas.1221681110)

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¹Rollo May, [Love and Will](#) (1969)

²Lionel Tiger, [Optimism: The Biology of Hope](#) (1979)

³The evolution of overconfidence, *Nature* 477, 317–320 (15 September 2011), [doi:10.1038/nature10384](https://doi.org/10.1038/nature10384)

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