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An agent-based simulation of the nervous system's reflex response to pain

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Abstract

The reflex arc is an important process of the nervous system that helps protect the body from damage by responding instantaneously to external stimuli, and has undergone a lot of research in the last century. This arc has been represented and taught using a variety of methods including diagrams, graphs, animations and mathematical equations[1,2]. A missing connection in these methods can be seen between the complex mathematics used for research and a suitable visual representation for easier learning and understanding of the topic. A suitable combination could provide a powerful tool useful in both research and education. The Reflex Arc simulation, part of the Lindsay Virtual Human Project, proposes a novel way of combining a number of resources into one multi-scale model of the nervous system's reflex response to pain. Among some of the advantages of the model are its high quality visual components with a level of abstraction that still keeps them easily recognizable, and the user's ability to freely navigate around the three-dimensional space in which it is located and watch the path of the reflex arc from a distant or detailed perspective. The interaction processes are modeled following an agent-based programming paradigm[3]. Each agent, for instance the nociceptors in sensory neurons, act in accordance with the sharp object that triggers a response when the two collide. The agent-based model representation allows for user and global parameter changes while the simulation is running. This project and its future additions provides contents for a novel set of computational tools that can be used for a variety of research and educational purposes.

References

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