



LETTERS

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Neuroscience and the Soul

SCIENCE AND RELIGION HAVE HAD A LONG RELATIONSHIP, BY TURNS COLLEGIAL AND ADVERSARIAL. In the 17th century Galileo ran afoul of the Church's geocentrism, and in the 19th century Darwin challenged the biblical account of creation. The breaches that open at such times often close again, as religions determine that the doctrine in question is not an essential part of faith. This is precisely what happened with geocentrism and, outside of certain American fundamentalist Christian sects, evolution.

A new challenge to the science-religion relationship is currently at hand. We hope that, with careful consideration by scientists and theologians, it will not become the latest front in what some have called the "culture war" between science and religion. The challenge comes from neuroscience and concerns our understanding of human nature.

Most religions endorse the idea of a soul (or spirit) that is distinct from the physical body. Yet as neuroscience advances, it increasingly seems that all aspects of a person can be explained by the functioning of a material system. This first became clear in the realms of motor control and perception (1, 2). Yet, models of perceptual and motor capacities such as color vision and gait do not directly threaten the idea of the soul. You can still believe in what Gilbert Ryle called "the ghost in the machine" (3) and simply conclude that color vision and gait are features of the machine rather than the ghost.

However, as neuroscience begins to reveal the mechanisms underlying personality, love, morality, and spirituality, the idea of a ghost in the machine becomes strained. Brain imaging indicates that all of these traits have physical correlates in brain function. Furthermore, pharmacologic influences on these traits, as well as the effects of localized stimulation or damage, demonstrate that the

brain processes in question are not mere correlates but are the physical bases of these central aspects of our personhood. If these aspects of the person are all features of the machine, why have a ghost at all?

By raising questions like this, it seems likely that neuroscience will pose a far more fundamental challenge than evolutionary biology to many religions. Predictably, then, some theologians and even neuroscientists are resisting the implications of modern cognitive and affective neuroscience. "Nonmaterialist neuroscience" has joined "intelligent design" as an alternative interpretation of scientific data (4). This work is counterproductive, however, in that it ignores what most scholars of the Hebrew and Christian scriptures now understand about biblical views of human nature. These views were physicalist, and body-soul dualism entered Christian thought around a century after Jesus' day (5, 6).

To be sure, dualism is intuitively compelling. Yet science often requires us to reject otherwise plausible beliefs in the face of evidence to the contrary. A full understanding of why Earth orbits the Sun (as a consequence of the way the solar system was formed) took another century after Galileo's time to develop. It may take even longer to understand why certain material systems give rise to consciousness. In the meantime, just as Galileo's view of Earth in the heavens did not render our world any less precious or beautiful, neither does the physicalism of neuroscience detract from the value or meaning of human life.

MARTHA J. FARAH^{1*} AND NANCEY MURPHY²

¹Center for Cognitive Neuroscience, Department of Psychology, University of Pennsylvania, Philadelphia, PA 19104, USA. ²School of Theology, Fuller Theological Seminary, Pasadena, CA 91182, USA.

*To whom correspondence should be addressed. E-mail: mfarah@psych.upenn.edu

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An Optimistic Read on Digital Libraries

IN THE NEWS STORY "NSF RETHINKS ITS DIGITAL library" (Special Section on Education & Technology, 2 January, p. 54), J. Mervis captures the uphill struggle digital libraries have faced as they try to sustain funding and gain visibility among educators and students. However, the picture the article paints of sustainability in general and the Digital Library for Earth System Education (DLESE) in particular is too pessimistic. The process by which the National Center for Atmospheric Research (NCAR) assumed responsibility for the DLESE collection is attracting a good deal of attention through articles, presentations, and grants addressing models of sustainability for digital efforts. The advantages of curated digital libraries are clear to many users. DLESE's collections of Earth science materials, now managed by the NCAR Library, have been selected by educators and scientists specifically because they are scientifically accurate, grade-level appropriate, and effective for teaching.

The University Corporation for Atmospheric Research, which operated the technical arm of DLESE and continues to run the NSDL Resource Center, is very proud of the impact of these digital library efforts. Although DLESE has lost its NSF funding, the open-source DLESE technical infrastructure underpins initiatives at NASA, NOAA, DOE, and scientific

