havioral backgrounds of the great heroes of physics. Indeed, it would be considered impolite for one to note some who eagerly and successfully grasped for fame, contentedly took credit for the work of people under them, or reaped fat profits from commercial exploitation of their discoveries. I suspect that Moravcsik has actually succeeded in gauging what physicists think they should think about why they are in physics.

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THE AUTHOR COMMENTS: Curtis Michel's critique is one that can be heard often in connection with motivational surveys, including the presumably more "sophisticated" ones in which the respondent is asked to make decisions in hypothetical situations. It is a variant of the statement that an object which looks, sounds, feels, and tastes like an apple is really something else but perfectly disguised as an apple. It is sometimes thought that the difficulty can be resolved by studying what respondents actually do rather than what they profess, but that method is shaky also because the response in an actual situation is determined by which motivation is most seriously challenged or endangered and not by which is strongest.

While such a critique is logically unanswerable (see hidden variables), it appears to me to have little functional significance. In practice, the best one can do is, a) not to be submerged in a preconceived view of what the motivations are, even if such a view is attractive on account of the simplicity or ideology of a certain model, b) to carry out as many different types of studies as possible, in the hope that they eventually point at some consensus of views which then can and must be used in practical decision making in science policy until something better comes along.

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Spin and relativity

George Uhlenbeck in his charming reminiscences of the discovery of the electron spin (May, page 43) mentions two contexts in which special relativity played an essential role: (1) coupling between spin and orbital motion, and (2) Thomas factor.

Point (1) arises from the force resulting from Lorentz transformation to a coordinate system where the electron is at rest; point (2) is based on the fact that general Lorentz transformations with non-parallel velocities form a group only after adjoining rotations. Belated recognition of (1) caused delay in the acceptance of electron spin by Wolfgang Pauli and Niels Bohr. Belated recognition of (2) caused delay in the final acceptance of electron spin by Pauli. Both Pauli and Bohr were, of course, familiar with Lorentz transformations. However, Pauli was skeptical of the whole concept of electron spin, because of his emphasis on the "classical two-valuedness" of the fourth quantum number. Bohr, on the other hand, was prejudiced by his previous introduction of a "non-mechanical strain" to cause (1). Both Bohr and Uhlenbeck and Samuel Goudsmit learned from Einstein the basis for (1). But even the latter was surprised by (2), as Uhlenbeck notes.

Surprisingly, a survey showed that none of the great mathematicians Poincaré (who named the Lorentz group), Minkowski, Klein, Herglotz or Weyl stated explicitly the above property of the Lorentz group. Nor is it contained in Pauli's book. Equally surprisingly, however, Silberstein's *The Theory of Relativity* [MacMillan, London, 1914 (!)] does contain an explicit statement (pages 167–170), which is also contained in the second (1974) edition of his book. This fact, of course, does not the least affect the great merit of L. H. Thomas, who not only noticed the above property of the Lorentz group independently, but also showed how it led to the factor ½. A more detailed discussion, including the essentially quantum nature of the spin-orbit interaction, will be given elsewhere.

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Lunar studies continue

George Siscoe's review of *Lunar Science: A Post-Apollo View*, by S. Ross Taylor (in your February issue) contains one possibly misleading statement: "A program of intensive lunar study started in 1964 . . . The program was completed in 1972."

Although the Apollo program itself ended with the flight of Apollo 17 in December 1972, NASA's continuing lunar-science program is alive and flourishing. Over a hundred investigators are conducting studies of the 343 kilograms of lunar rocks and soil returned by the Apollo missions. Many of the scientific instruments placed on the Moon by the astronauts are still transmitting useful data and will continue to do so for a few more years. Ground-based laser ranging to the four retroreflectors placed on the Moon is producing important results in celestial mechanics, relativity and terrestrial geodynamics. There is also a vigorous data-synthesis program in which the whole body of geophysical, geochemical and geological information about the Moon is being analyzed to produce co-