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Students' dynamic geometric reasoning about quantum spin-1/2 states HUNTER CLOSE, CATHERINE SCHIBER, DAVID DONNELLY, ELEANOR CLOSE, Texas State University-San Marcos — Quantum states are traditionally cognitively managed exclusively with algebra rather than geometry. One reason for emphasizing algebra is the high dimensionality of quantum mathematical systems; even spin-1/2 systems require a 2-d complex number space for describing their quantum states, which can be hard to visualize. Using "nested phasor diagrams," which use nesting to increase the dimensionality of graphic space, we taught undergraduate students to represent spin-1/2 states graphically as well as algebraically. In oral exams, students were asked to identify which spin-1/2 states, expressed numerically, would generate the same set of probabilities as each other (i.e., they are the same except for a different overall phase factor). Video records of oral exams show that no students (N=13) performed this task successfully using an algebraic method; instead, all students solved the problem graphically. Furthermore, every student who succeeded used a certain gesture to solve the problem.

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