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Ambiguity in angular momentum and its relationship to gravitational-wave memory[1] DAVID NICHOLS, EANNA FLANAGAN, Cornell University — We show that the well known ambiguity in angular momentum in general relativity is universal—not restricted to asymptotically flat boundary conditions—by showing its existence in the context of Newtonian gravity supplemented by the geodesic-deviation equation (to describe the passage of bursts of gravitational waves). In this context, the difference between changes in angular momentum measured by different observers can be expressed in terms of the bursts' gravitational-wave memory. This connection between angular-momentum ambiguity and gravitational-wave memory extends to the context of asymptotically flat spacetimes that are stationary at early times and at late times, for observers near future null infinity, when using an appropriate operational definition of angular momentum at a point (calculated from the Riemann tensor and its first derivative). Our analysis relies on a generalized notion of a holonomy operator for closed curves, which is an affine map rather than a linear map. The deviation of this generalized holonomy from the identity map is a measure of the degree to which spacetime curvature prevents different observers from agreeing on a consistent definition of angular momentum. It is also a measure of the gravitational-wave memory.

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