Droplet friction found to be similar to that of solid objects

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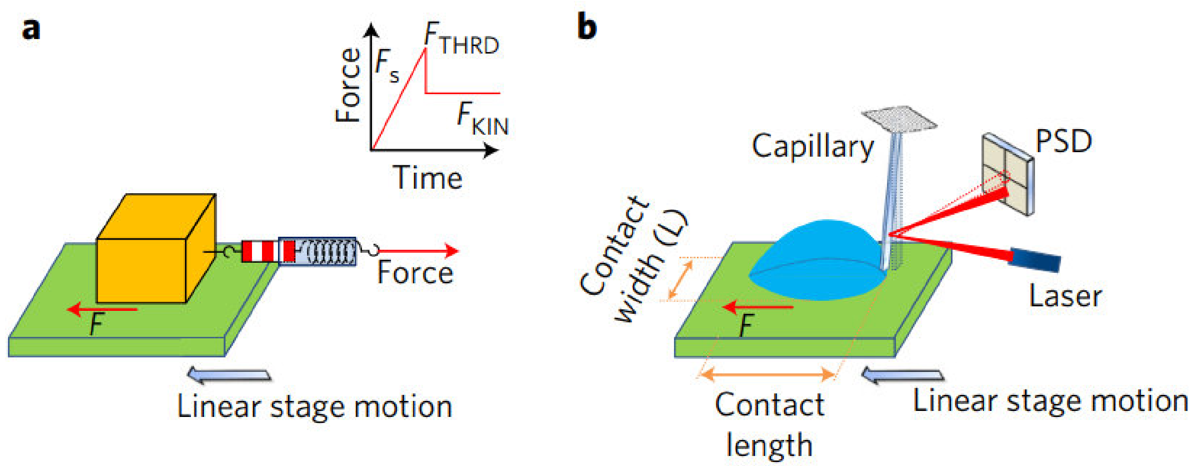

Schematics of friction force measurements. a, Textbook configuration for demonstrating solid–solid friction. b, Homemade set-up for measuring liquid–solid friction. A drop of liquid is placed on a solid substrate mounted on a linear stage driven by a step motor. A laser beam incident on the capillary is reflected to a position-sensitive detector (PSD). The contact width between the drop of liquid and the solid surface (orthogonal to the direction of motion) and contact length (parallel to the direction of motion) are simultaneously monitored by cameras (not shown). Credit: (c) *Nature Physics* (2017). DOI: 10.1038/nphys4305

(Phys.org)—A team of researchers working at the Max Planck Institute for Polymer Research has found through experimentation that friction in sliding drops is similar in some ways to that of solid objects. In their paper published in the journal *Nature Physics*, the group describes experiments they conducted in their lab with drops on solid surfaces and what they learned from them.

One of the things beginner physics students learn is that a certain amount of force is required to start a solid object sliding atop another, but less force is required to keep it moving—calculations can show how much for different materials using standard formulas. Unfortunately, as the researchers with this new effort note, the same cannot be said for liquids resting atop solid objects. In fact, despite having a clear understanding of friction between solid objects for over 200 years, researchers know little about applying similar principles to liquids resting on solids. In this new effort, the researchers sought to discover if there might be a similar relationship between them as has been found for solids.

One of the problems in measuring the force required to move a drop has been the nature of drops—you cannot just push it to cause it to move. In nature, drops tend to move downhill due to gravity, not a factor that can be easily adjusted. To get around this problem, the team set up drops with a capillary positioned in the center of the drop and then moved the substrate sideways against the drop—pressure against the substrate could be measured using a laser, offering a means of testing friction.

After running multiple experiments with different materials, the researchers found evidence suggesting that the relationship between a drop and a liquid did have something in common with the relationship between solids—namely that the initial force to get them to slide was greater than that needed to keep them moving once started. They report this to be the case for a wide variety of drops and substrates. The team acknowledges that their experiments are just the beginning in trying to fully understand the nature of friction between drops and solid objects.

More information: Nan Gao et al. How drops start sliding over solid surfaces, *Nature Physics* (2017). DOI: 10.1038/nphys4305

Abstract
It has been known for more than 200 years that the maximum static friction force between two solid surfaces is usually greater than the kinetic friction force—the force that is required to maintain the relative motion of the surfaces once the static force has been overcome. But the forces that impede the lateral motion of a drop of liquid on a solid surface are not as well characterized, and there is a lack of understanding about liquid–solid friction in general. Here, we report that the lateral adhesion force between a liquid drop and a solid can also be divided into a static and a kinetic regime. This striking analogy with solid–solid friction is a generic phenomenon that holds for liquids of different polarities and surface tensions on smooth, rough and structured surfaces.