Relationships between unintentional force drifts and surface texture

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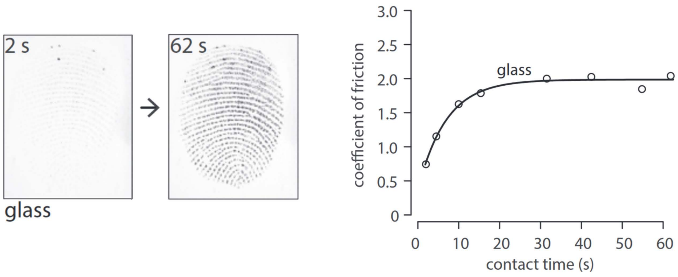
Are unintentional force drifts sensitive to the temporal evolution of fingertip friction?

Unintentional drifts in finger force production have been documented for over 20 years [1,2]

Force drifts have been ascribed to limitations in working memory [1,3] or reduction in potential energy [2]

When in contact with a nonporous surface, fingertip surface area increases due to hydration of fingerprint ridges, leading to increased coefficient of friction [4] on a timescale similar to force drifts



figs from Dzidek et al 2017 [4]

We investigated whether force drifts are affected by changes in fingertip coefficient of friction (μ)

Participants performed an isometric pressing task against porous (glass) and nonporous (PDMS polymer) surfaces

If coefficient of friction increases (nonporous surface), we expect larger force drift (to maintain safety margin)

Methods

Participants (n =20) performed an isometric pressing task

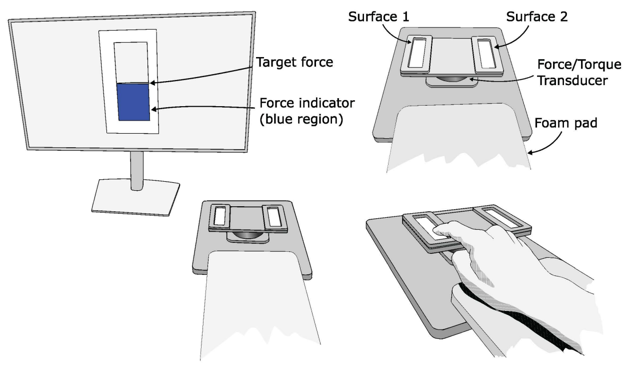
Participants produced 10N force on a glass surface and PDMS surface using dominant hand index finger

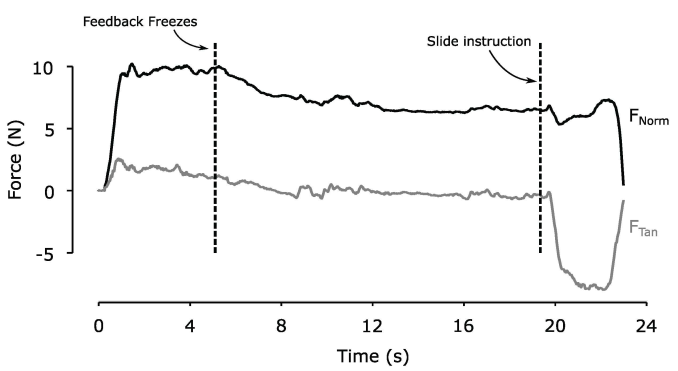
Force feedback froze after 2-5 s

Trial duration 2-20 s after feedback freeze

Participants slid their finger at trial end to compute μ over time

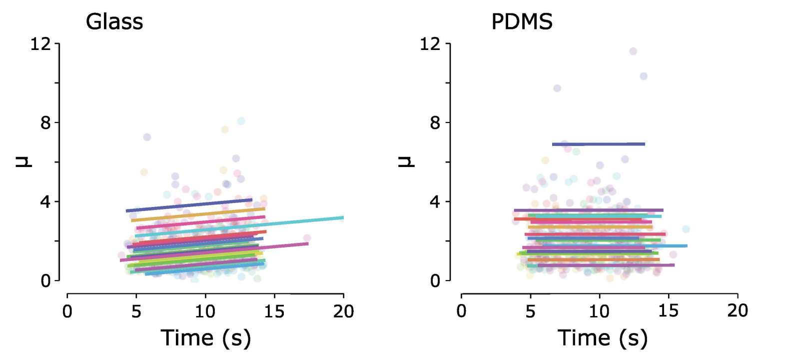
Participants performed 30 trials with each surface (random order)



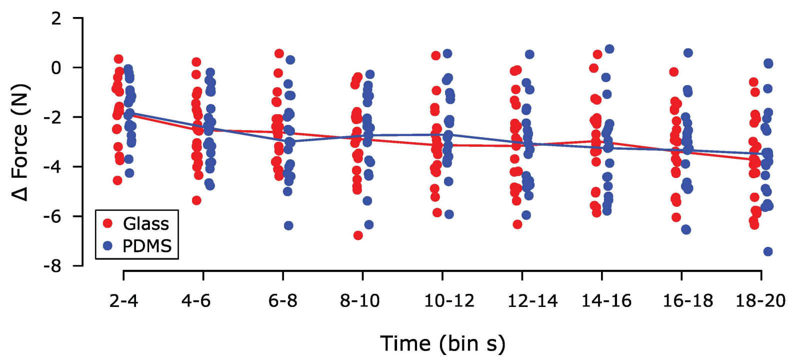


Results

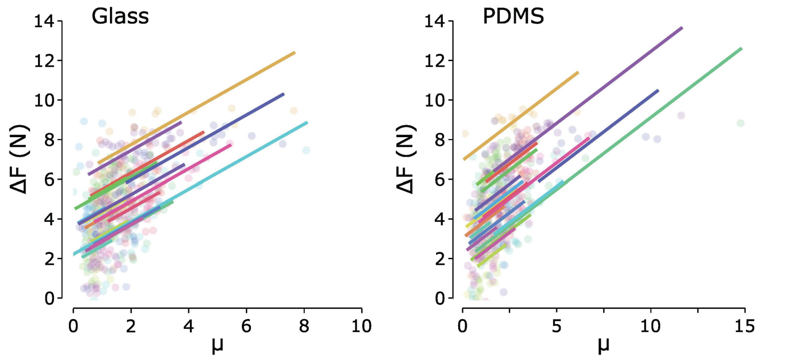
Coefficient of friction (μ) increased over time on glass but not PDMS



Force drifts did not appear to differ between surfaces



On both surfaces, force drift was associated with μ



Discussion

We did observe different time-varying changes in μ on different surfaces

We did not find evidence that force drifts were associated with different timecourses of μ

Association between μ and force drift could be causal but could also be related to computational artifacts or a number of known physical relationships between contact pressure and μ [5]

References

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3. Poon C, Chin-Cottongim LG, Coombes SA, Corcos DM, Vaillancourt DE. Spatiotemporal dynamics of brain activity during the transition from visually guided to memory-guided force control. *J Neurophysiol* 108: 1335–1348, 2012.
4. Dzidek B, Bochereau S, Johnson SA, Hayward V, Adams MJ. Why pens have rubbery grips. *Proc Natl Acad Sci* 114: 10864–10869, 2017.
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