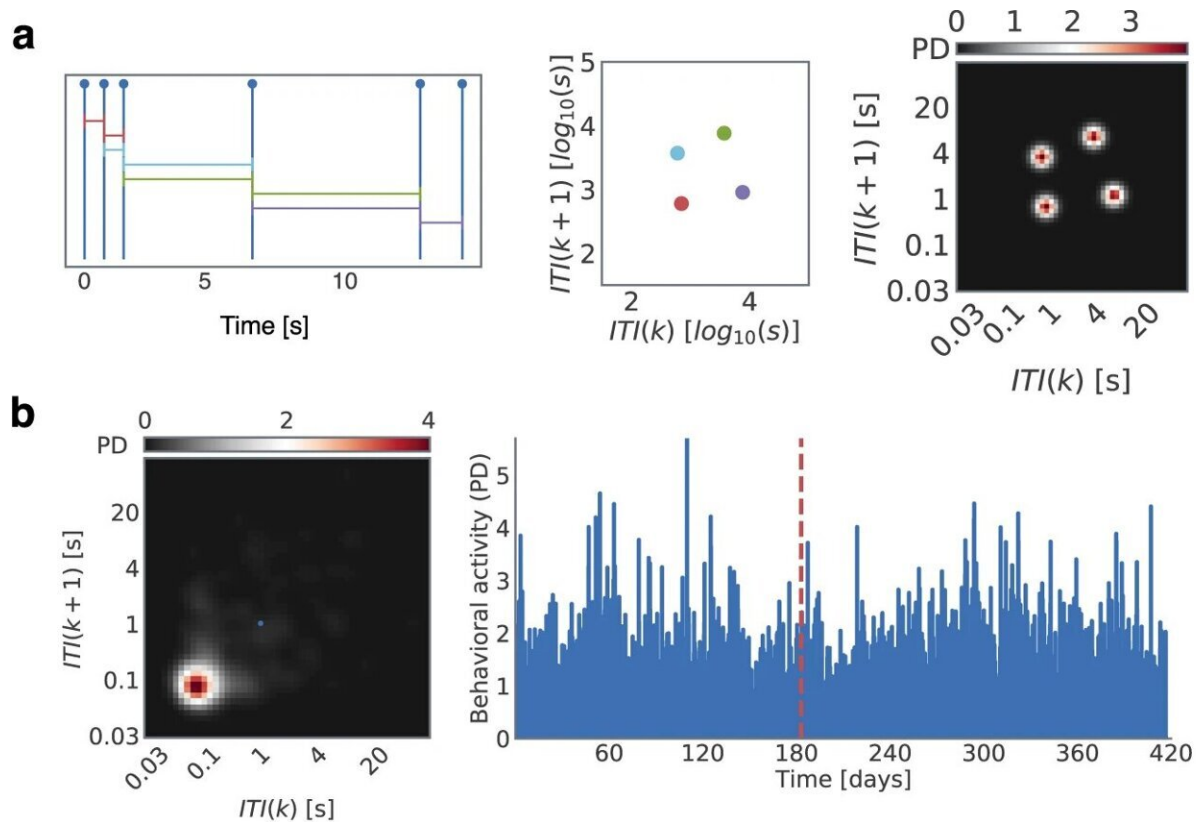


Smartphone study reveals that bodily rhythm affects behavior

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Spectral analysis of smartphone behavior based on inter-touch intervals. **a** We quantified smartphone behavior using the probability density of joint interval distribution (JID) in two-dimensional bins. An example of the probability density (PD) resulting from a series of 6 simulated interactions. **b** Example of behavioral activity of a subject captured by JID (left) accumulated over an hour-long window and (right) evolution of the probability density values at a select 2-dimensional bin over consecutive hourly windows (highlighted by using a small blue dot overlaid on the JID). **c** Periodogram for the two-dimensional bin

selected above, obtained by averaging the continuous wavelet transform spectrogram over time, some of the peaks are marked using red arrows (red dashed line shows the 97.5th percentile values based on block-bootstrap of the same data). **d** The power index (PI) of the selected periodogram peaks (red arrows in 'c') across the smartphone behavior. The two-dimensional bins that are not part of statistically significant clusters (multiple comparison correction, $\alpha = 0.05$, ~1000 block bootstraps) are masked with a translucent layer. The unmasked PI values are shown in the smaller inserts. Credit: *npj Digital Medicine* (2023). DOI: 10.1038/s41746-023-00799-7

Leiden researchers Arko Ghosh and Enea Ceolini analyzed the use data of hundreds of mobile phones and discovered that the body has rhythms ranging between seven and 52 days. These cycles influence how we behave. Their research resulted in an article in *npj Digital Medicine*.

"If people think they just live their lives, deciding their behavior for themselves, and that there is no overarching structure, they've got it wrong," says researcher Arko Ghosh. Together with his colleague Enea Ceolini, he carried out research on recurring [patterns](#)—rhythms—in [human behavior](#). Their research led to the unexpected outcome that absolutely everyone has these rhythms.

The idea of a rhythm that your body reacts to is not new. Women have the [menstrual cycle](#), for example, and some people also believe that the lunar cycle influences how we behave. There is a lot of scientific debate about the [lunar cycle](#), but it is a known fact that psychological and [neurological conditions](#) like bipolar condition and epilepsy follow a cycle of several days. A pattern can be seen, for example, in epileptic attacks that occur every so many days.

Discrimination of women

Ghosh and Ceolini have shown that recurring patterns do not occur only in these kinds of psychological and neurological conditions, but that everyone has cycles lasting several days. Ghosh says, "These cycles influence our behavior. How they influence that behavior and what behavior relates to what particular times in the cycle is something we haven't studied yet."

"But in our analyses of the data on the mobile phones of our test subjects, we made a striking discovery. We found that cycles of several days are very common: in old and young people, and in women and men. That last point is particularly remarkable."

"A lot of women face discrimination at work because their performance is often thought to suffer as a result of their menstrual cycle. Our research shows that women are not the only ones with a cycle. Men have a cycle, too, of 25 to 30 days, which also affects their behavior."

The results may also have an impact on the research on psychological and neurological conditions. Says Ghosh, "Are the cycles we see here caused by the illness, or are they 'normal' cycles that become more apparent as a result of the illness?"

Tracking on mobile phones

Some 400 subjects, aged 16 to 80, responded to a call to participate in the study. The prerequisite to participate? An Android [phone](#). An app was installed on it that allowed the researchers to track and analyze usage data.

Ghosh says, "We only looked at the times when people were actively using their phones and were swiping or typing. We couldn't see what they were doing with their phones, and we didn't need to see that. We didn't ask such things as what their mood was like at that point in time."

That's not what we were interested in."

Smartphone use can be divided into different kinds of behavior. By looking at this behavior on the basis of how people touched the screen and the time between touches, we distinguished 2,500 different types of smartphone use.

Some mannerisms had a pattern that repeated every 25 days, such as when there was a long pause between touches. Others had a pattern that repeated every 19 days, such as when there was a short pause between touches. In short, we found that people use their smartphones in many different ways and that some of these ways have a pattern that is repeated after a certain period of time.

Predicting behavior

It is not yet clear how the recurring patterns arise, but the complex interchange between our environment and our own cognitive skills may play a role. Ghosh stresses that two people may have the same cycle, but that they may respond completely differently to it. Further research can bring us more insights.

Ghosh says, "We might then be able to predict particular behavior on the basis of a person's cycle. This might in turn lead to a completely new definition of what is normal behavior and what is behavior that is related to a neurological or psychological condition."

More information: Enea Ceolini et al, Common multi-day rhythms in smartphone behavior, *npj Digital Medicine* (2023). [DOI: 10.1038/s41746-023-00799-7](https://doi.org/10.1038/s41746-023-00799-7)

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