# Frugal event data: how small is too small?
# A human performance assessment with shrinking data

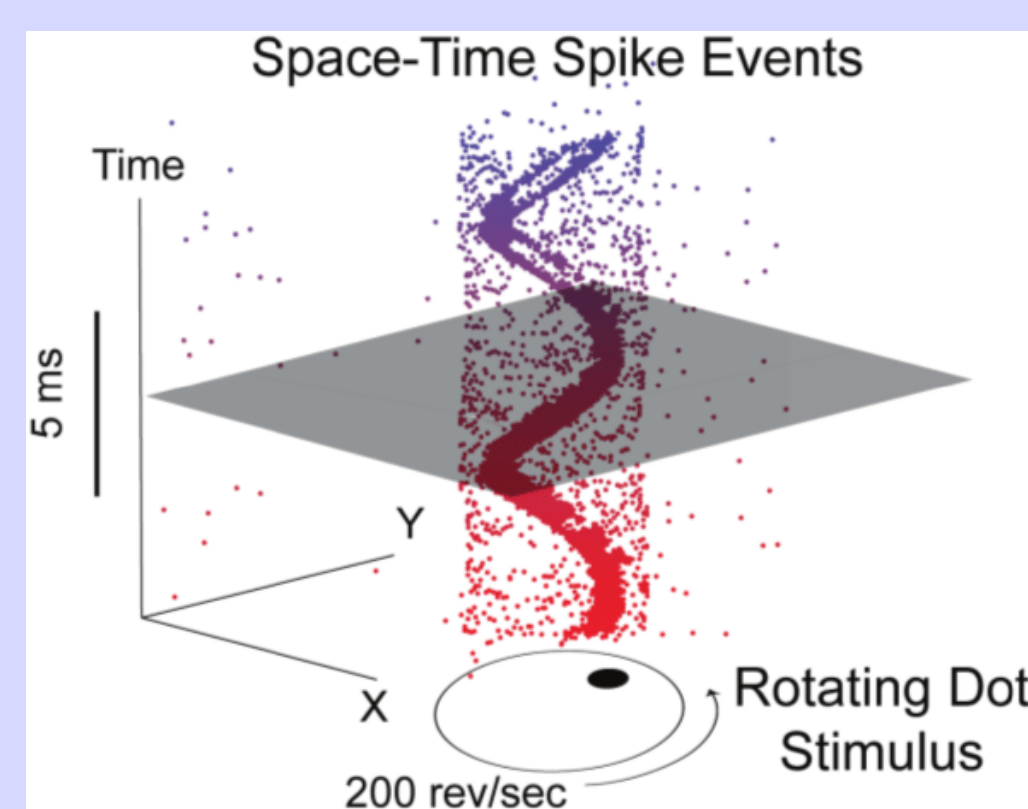Amélie Gruel      Lucía Trillo Carreras      Marina Bueno García      Ewa Kupczyk      Jean Martinet

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## Event camera



Space-Time Spike Events

[Lichtsteiner, 2008] & [Mueggler, 2015]

## Event data downscaling

Spatial downscaling methods [Gruel, 2022; Gruel 2023]:
- spatial funnelling
- event count
- log-luminance reconstruction
  - linear
  - cubic
- spiking neural network-based pooling
  - separate
  - mutual

Temporal downscaling methods:
- temporal funnelling
  - synchronous
  - asynchronous
- structural
  - stochastic
  - deterministic

References
[Amir, 2017] A. Amir B. Taba, D. Berg, T. Melano, J. McKinstry, C. Di Nolfo, T. Nayak, A. Andreopoulos, G. Garreau, M. Mendoza, J. Kusnitz, M. Debole, S. Esser, T. Delbruck, M. Flickner, and D. Modha (2017). A Low Power, Fully Event-Based Gesture Recognition System. CVPR.
[Fang, 2021] W. Fang, Z. Yu, Y. Chen, T. Masquelier, T. Huang and Y. Tian (2021). Incorporating learnable membrane time constant to enhance learning of spiking neural networks. ICCV.
[Gruel, 2022] A. Gruel, J. Martinet, T. Serrano-Gotarredona and B. Linares-Barranco (2022). Event data downscaling for embedded computer vision. VISAPP.
[Gruel, 2023] A. Gruel, J. Martinet, B. Linares-Barranco and T. Serrano-Gotarredona (2022). Performance comparison of DVS data spatial downscaling methods using spiking neural networks. WACV.
[Lichtsteiner, 2008] P. Lichtsteiner, C. Posch and T. Delbruck (2008). A 128x128 120 dB 15 us Latency Asynchronous Temporal Contrast Vision Sensor. IEEE J. of Solid-State Circuits.
[Mueggler, 2015] E. Mueggler, G. Gallego and D. Scaramuzza (2015). Continuous-Time Trajectory Estimation for Event-based Vision Sensors. RSS.

How small can event data be, while preserving sufficient information for the task at hand?

In this **first human perception study with event data**, we show:
→ the unequal data quality between event downscaling methods.
  → the existence of a size threshold under which human performance falls below the chance level.
  → some unexpected discrepancies in a comparison between human and machine performance.
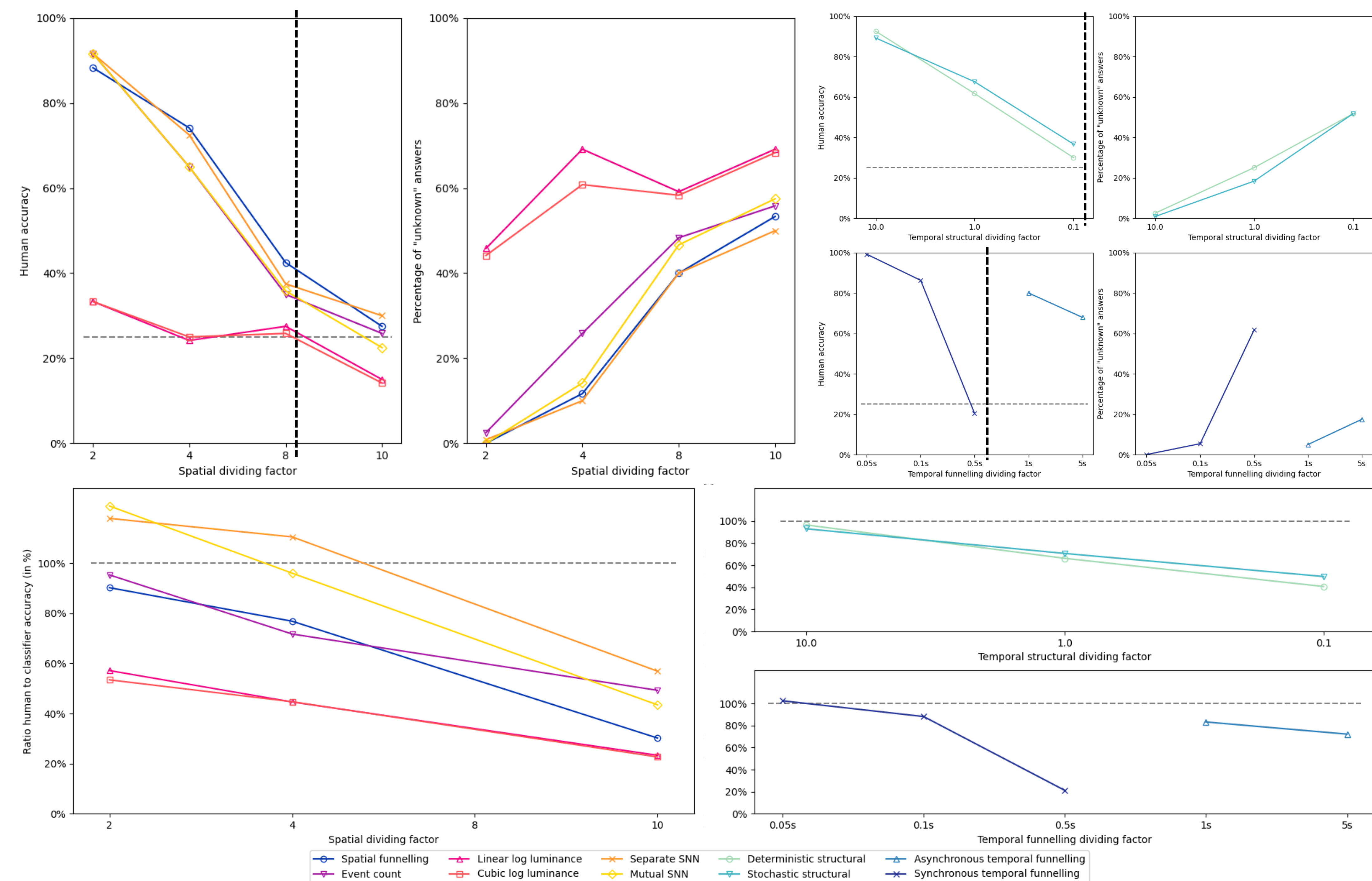
## Experimental setup
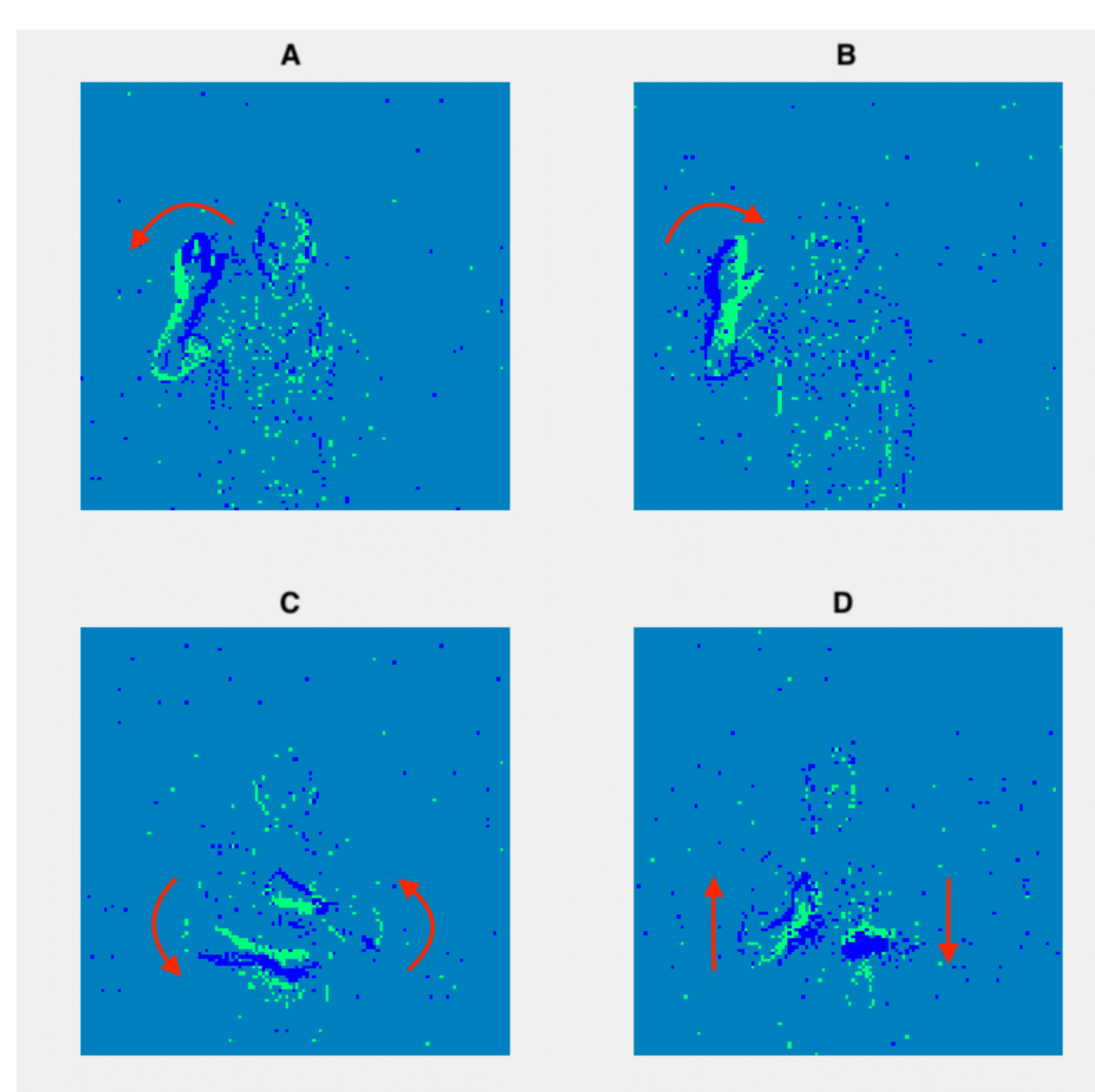




| Age | 18-25 y.o. | More than 25 years old | Total |
|---|---|---|---|
| Female | 11 | 11 | 22 |
| Male | 20 | 17 | 37 |
| Other | 0 | 1 | 1 |
| Total | 31 | 29 | **60** |

Choice between four gestures, displayed during 10s and selected in DVS 128 Gesture dataset [Amir, 2017]



What does the picture display?

☐ A
☐ B
☐ C
☐ D
☐ I don't know
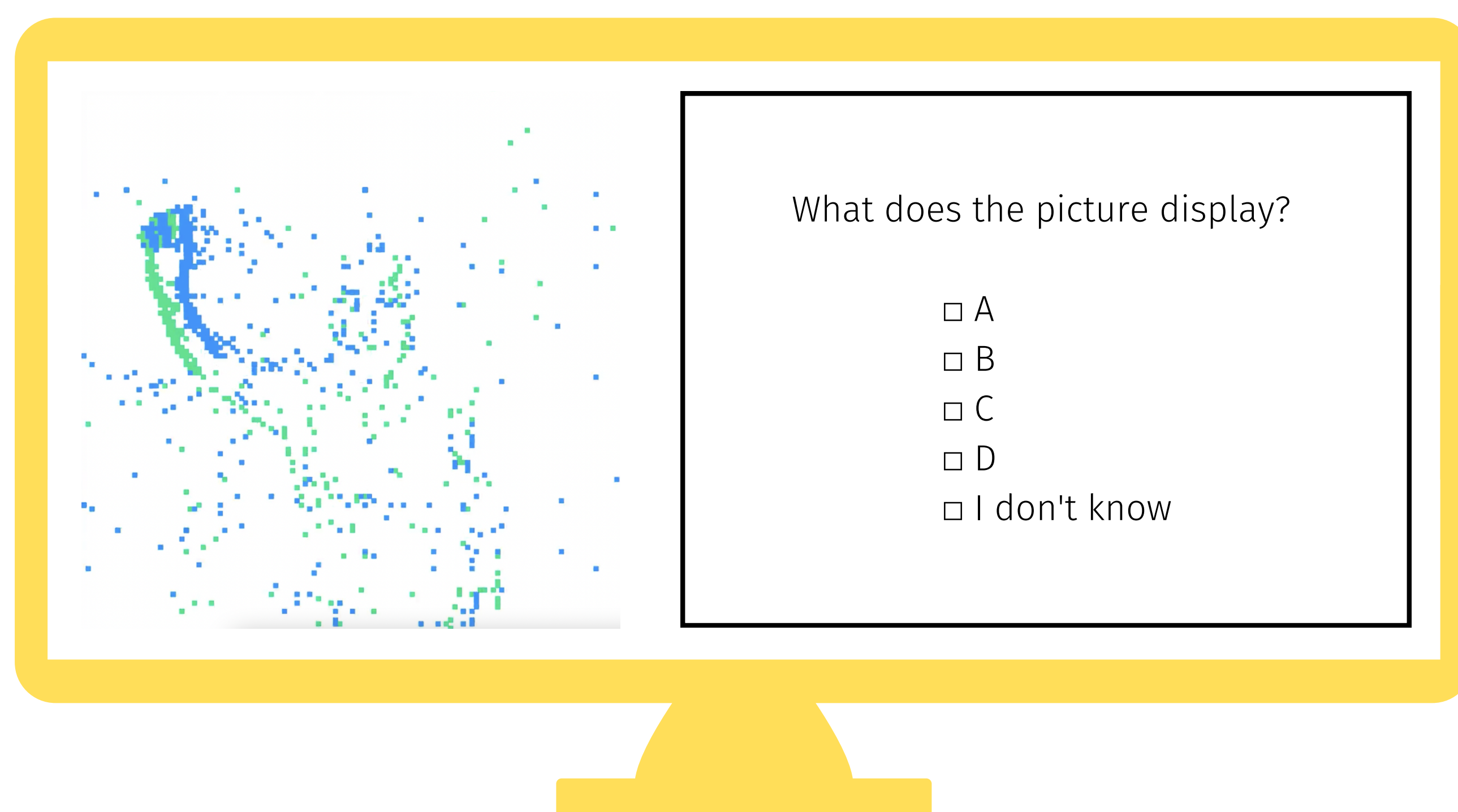
## Experimental results



**Top.** Human accuracy and rate of 'unknown' answers to event data downscaled spatially (left) and temporally (right)
**Bottom.** Ratio of the human accuracy to the PLIF classifier accuracy [Fang, 2021]
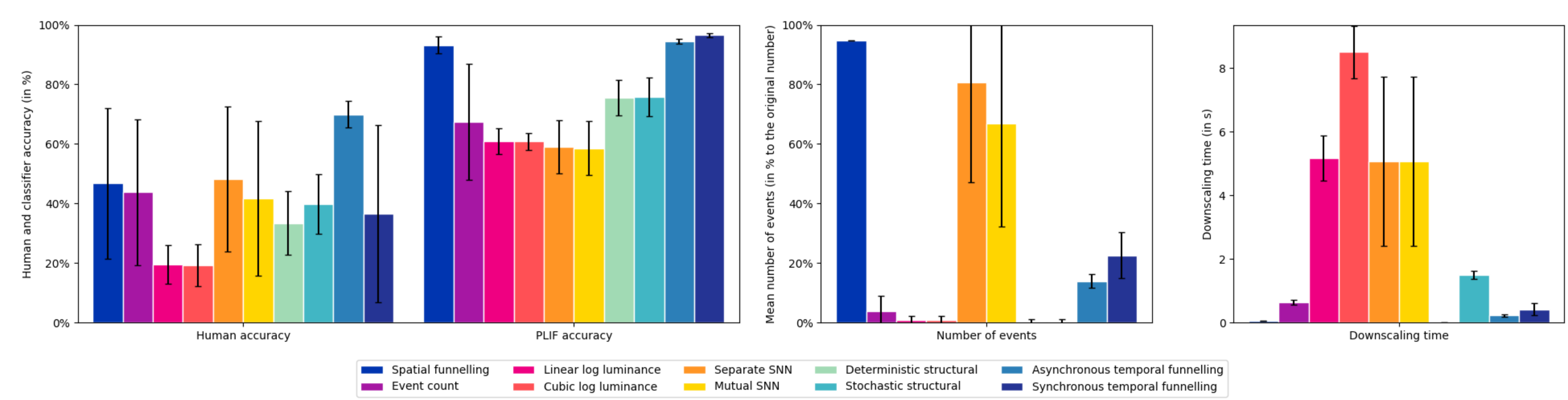


Global comparison between methods according to human and machine performance, number of events and runtime