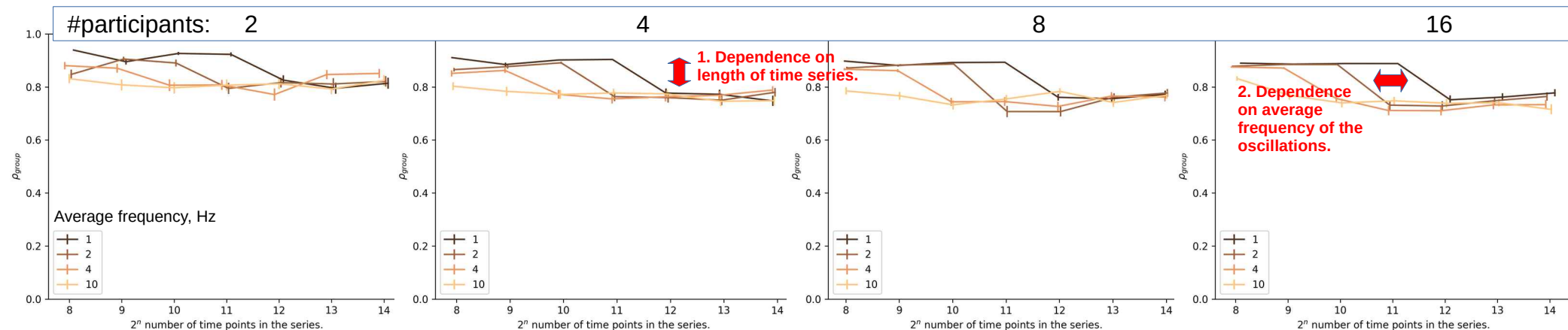Phase-synchronized oscillations with small additive variability