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Developing a Neural Network Model Generating Handwriting Motor Sequences Within Realistic Spatiotemporal Scales and Its Biological Implications

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Abstract

Human handwriting involves rich interactions of sensation, motor control, and conceptualization. State-of-the-art deep neural networks successfully mimic the shape of handwriting, but the dynamics during writing in the perspective of fine motor control have been overlooked. We thus propose a framework consisting of (1) the data collector, (2) the neural network that generates motor commands of handwriting endpoints and eventually writes letters in a spatiotemporally realistic manner as humans do, and (3) the evaluator of generated samples. We found that this framework indicated a similar learning curve to humans': learning overall letter shapes first, and then trying to reduce variability. Moreover, we found that the deprivation of previous movement feedback resulted in fluctuating handwriting with increasing speed inversions yet recognizable shapes as observed in a deafferent patient's handwriting, which opens the potential application to the early diagnosis of motor-related neurodegeneration.

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