

Do Afferent and Efferent Signals Separately Contribute to Hand Location Estimates?

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Knowing where your limbs are, is important for movement, reflected by the central role limb position takes in optimal feedback control. When people are asked to localize their unseen hand after reaching, they have two non-visual signals available: predicted sensory consequences, based on efference copies of motor commands, and felt hand position, (“proprioception”) based on afferent signals. People could combine these two using maximum likelihood estimates, increasing reliability compared to individual signals, i.e. decreasing variance of hand localization. While we can’t measure hand location based on predicted sensory consequences in isolation, we can measure hand location estimates based on both signals (lower variance) and based on proprioception alone (higher variance). In a previous paper ('t Hart & Henriques, 2016) we found no evidence of maximum likelihood estimation as the variance of the responses was approximately equal. However, with low numbers of trials and participants, any effects were potentially obscured. Here we have almost triple the measurements in 161 participants. In this larger dataset there is again no evidence of maximum likelihood estimation: the variance of responses in the two hand localization tasks is equal. Either the brain does not create a maximum likelihood estimate integrating predicted sensory consequences with actual sensory information the same way it would integrate two sensory signals, or passive movements also generate predicted consequences. If the signals are not integrated, perhaps it is optimal to keep both predicted and actual sensory information separately available, or the signals are combined in a different way.