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Presentation Abstract

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Title:	Simultaneous intracellular and optical recordings confirm blind separation of single neurons by independent component analysis
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Abstract:	Optical recordings obtained with photodiode arrays and voltage sensitive dyes allow us to "see" the firing of large numbers of neurons during behaviorally-relevant motor programs. While this technique has tremendous potential for network studies, the resulting data sets can be challenging to interpret due to the fact that multiple detectors often record the same neuron, and multiple neurons are often recorded by individual detectors. A prior study applied independent component analysis (ICA), a type of blind source separation, to "un-mix" such complex raw data sets into new sets where each neuron is extracted into a separate trace (Brown, et al, TINS, 2001). To determine the accuracy of this un-mixing, we recorded from individual neurons in the marine mollusks Aplysia californica and Tritonia diomedea with intracellular electrodes while simultaneously obtaining optical recordings with a 464-element photodiode array, using the fast voltage-sensitive absorbance dye RH-155. ICA was run on the 464 optical traces from each experiment, transforming them into a new set of traces where the individual neurons appeared in separate traces. ICA combined recordings of neurons large enough to be detected by multiple diodes into single new traces. In instances where individual diodes recorded more than one neuron, the individual neurons were automatically unmixed into new single-neuron traces. Our analysis method also returned maps of the array location of each ICA-resolved neuron. For each experiment, the accuracy of this procedure was confirmed by the fact that the intracellular recording was found to correspond

exactly to one of the unmixed ICA-generated single-neuron traces.
The ability of ICA to 1) eliminate redundancy by combining neurons recorded by multiple diodes into single traces, 2) unmix multiple neurons recorded by single diodes into separate single-neuron traces, and 3) provide the array location of each resolved neuron, represents a powerful, automated tool for analyzing data sets obtained with photodiode arrays and fast voltage sensitive dyes.

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