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A high-throughput machine vision-based univariate scale for pain and analgesia in mice

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Treatment of acute and chronic pain represent a widespread clinical challenge with poor therapeutic options. While rodents are an invaluable model to study pain, scoring nociceptive responses in clinically relevant paradigms and at high-throughput remains an unmet challenge. Therefore, there is a need for automated, high-throughput methods that sensitively and accurately assess pain and analgesia. Such objective and scalable technologies will enable the discovery of novel analgesics and yield mechanistic insights into the neural and genetic mechanisms of pain. Here, we adopt the open field arena to build a univariate scale for the formalin injection model of inflammatory pain by using a machine learning approach that incorporates 82 behavioral features. This tool outperforms traditional measures of licking and shaking in detection of formalin dose, and was validated using 4 diverse mouse strains. We detected previously unreported differences in formalin induced nocifensive behaviors that were strain and sex specific. This model also reliably identifies morphine induced antinociception. This novel, sensitive, and inexpensive tool provides a method for quantifying voluntary nociceptive responses to facilitate genetic mapping and analgesic compound screening in a high throughput manner.