



# Martial arts based meditative techniques reduce pain and emotional distress and modulate underlying cortico-limbic circuitry in children with cancer



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## Background

- Research shows that meditative techniques are effective for reducing pain and emotional distress in adults and more recently in children. However, compliance to meditation and other psychosocial interventions is low, particularly among children.
- Kids Kicking Cancer (KKC) is a nonprofit organization that provides free martial-arts based (MAB) meditative therapy to help children with cancer, other chronic illnesses, and their siblings cope with pain and emotional distress. Martial arts are inherently appealing to children, resulting in high compliance rates.
- Neuroimaging studies in adults show that meditation modulates activity and connectivity in cortico-limbic regions, which are involved in the subjective experience of pain and distress.
- Despite the widespread application of these techniques in pediatric samples, no neuroimaging studies have examined the effects of meditation on neurobiological mechanisms underlying pain and distress in children.



## Objectives

- To examine the effects of a brief (4-week) KKC intervention on pediatric pain and distress, and underlying cortico-limbic neural circuitry.
- To examine the effects of (MAB) meditative and non-meditative emotion regulation techniques on underlying cortico-limbic circuitry.

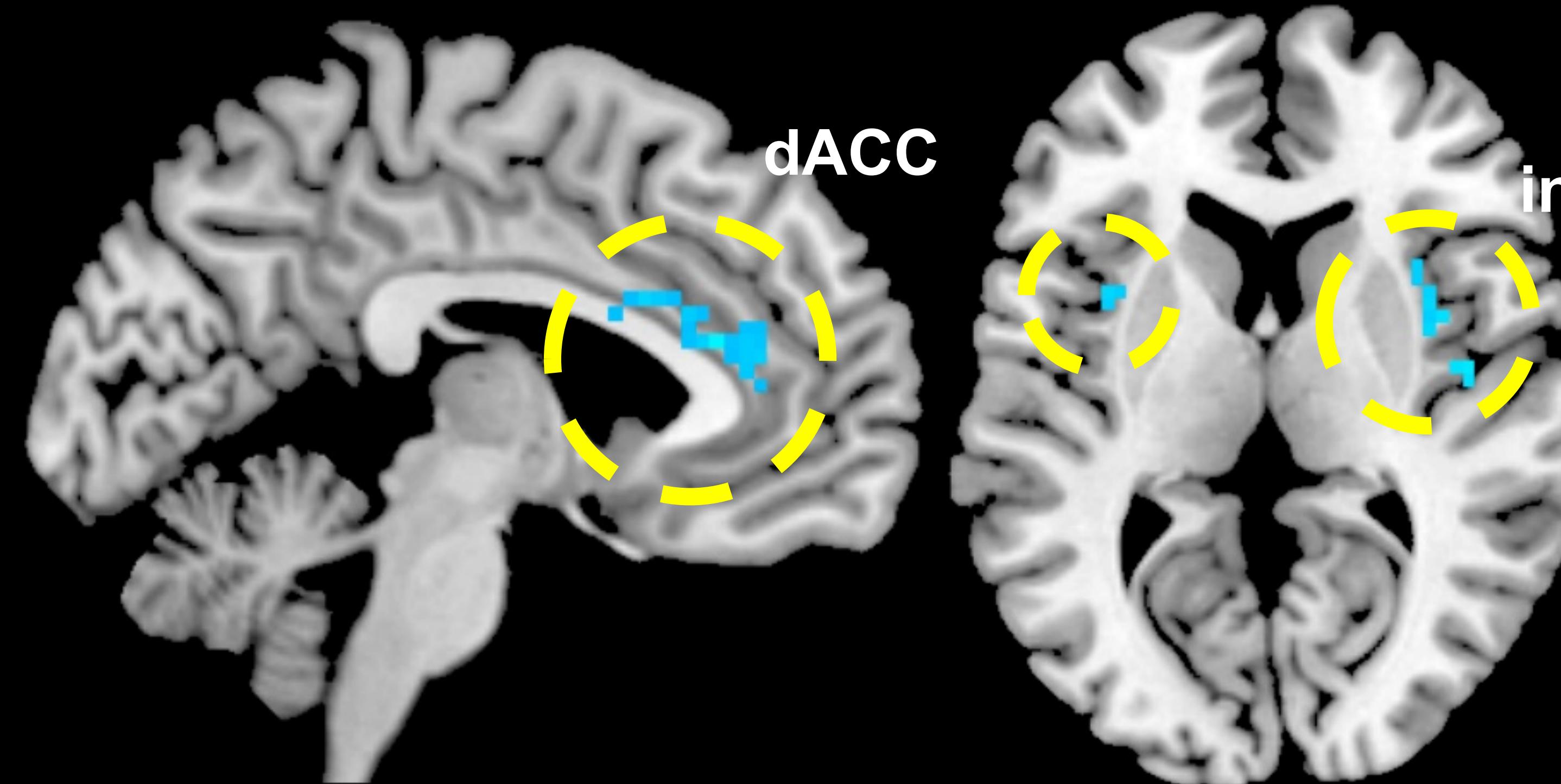
## Methods

- 14 youth with cancer (5-17 years, 6 females) completed 4 weekly Kids Kicking Cancer classes. Children reported pain and distress before and after each class using Likert scales. Pain and distress were also recorded for other class members, including children with other chronic illnesses (e.g., diabetes, chronic pain, sickle cell), and their healthy siblings.
- A subset of youth completed functional magnetic resonance imaging scanning before and after the Kids Kicking Cancer intervention. Functional connectivity of cortico-limbic neural circuitry was compared before and after the intervention.
- During the second scan, participants completed an fMRI task that involved viewing distress-inducing videoclips. Prior to each clip, participants received MAB meditative (attention to breath, mindful acceptance) or non-meditative instructions (distraction [count backwards from ten]) or to passively view the clip. Participants rated their distress after each clip using a Likert scale. Distress and cortico-limbic activity were compared between each instruction

## Results

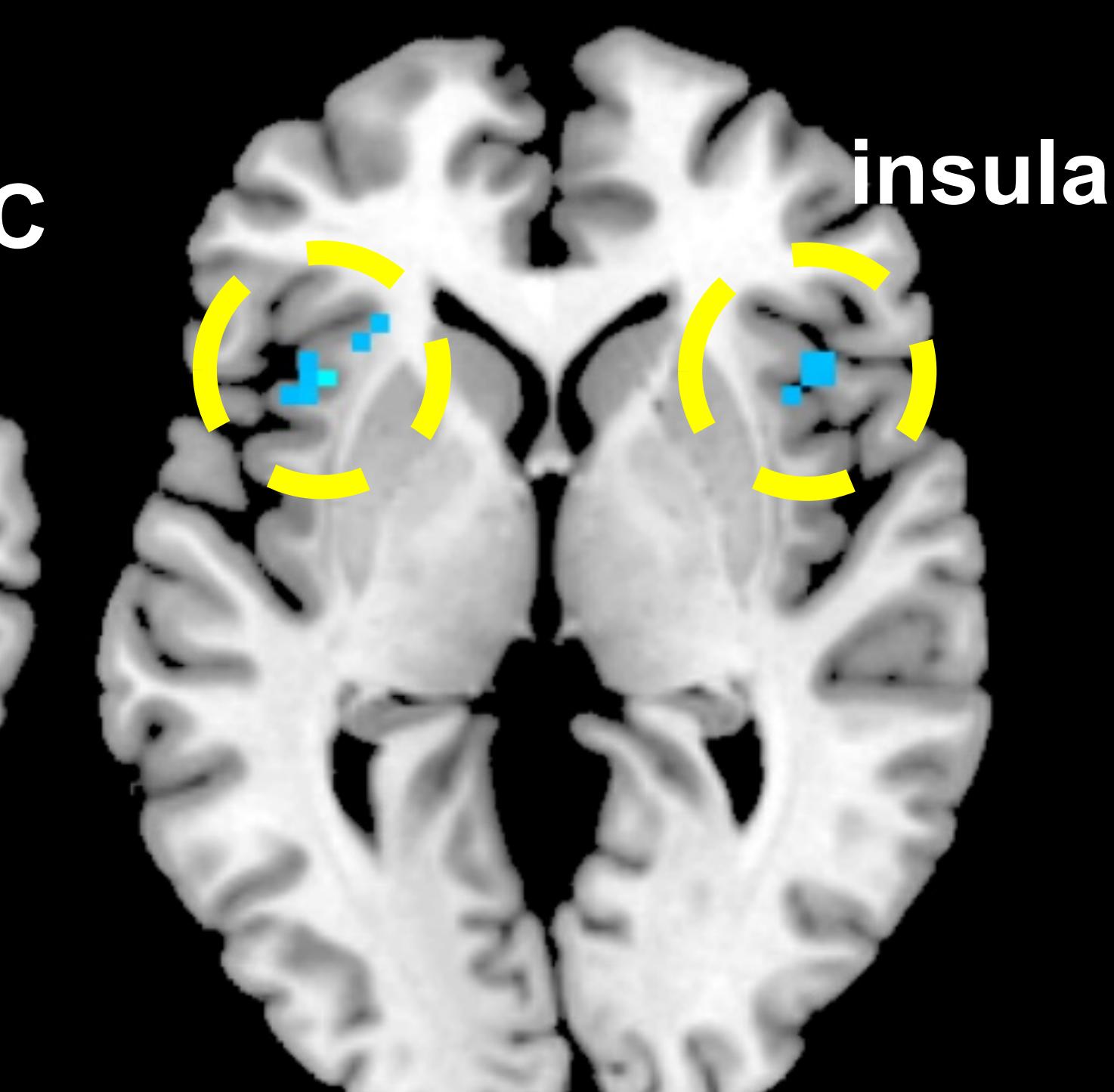
**MAB meditative relative to non-meditative instructions are associated with lower cortico-limbic activity**

Attention to breath < Count backwards from ten

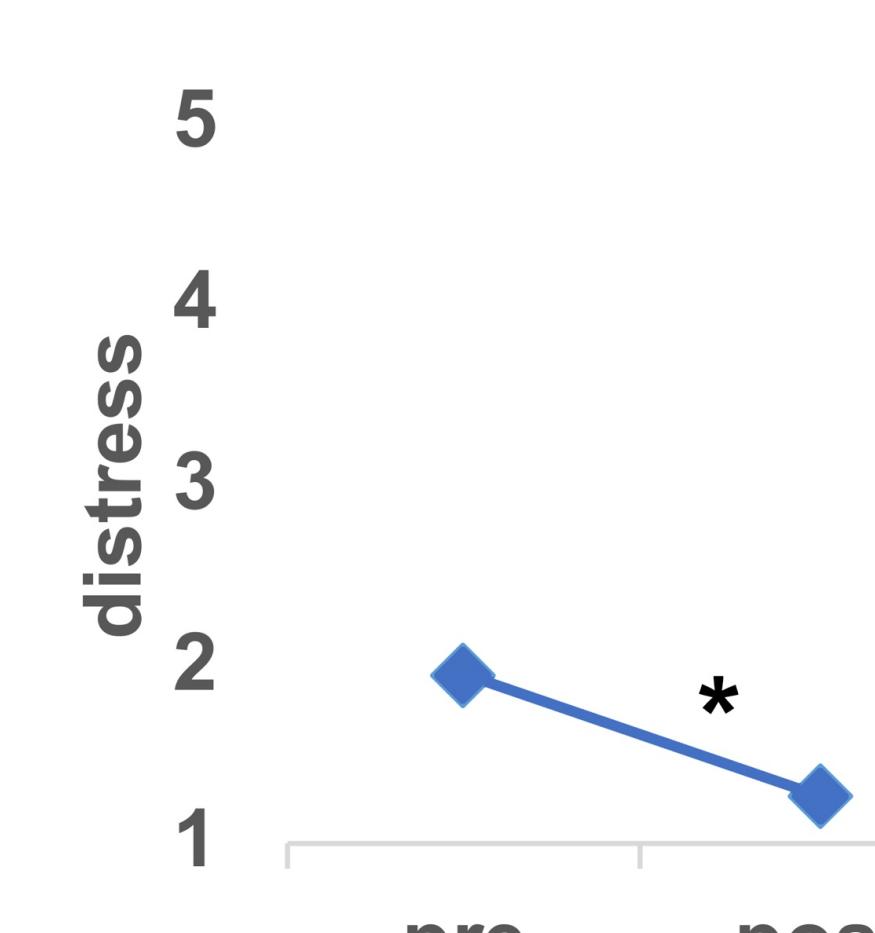
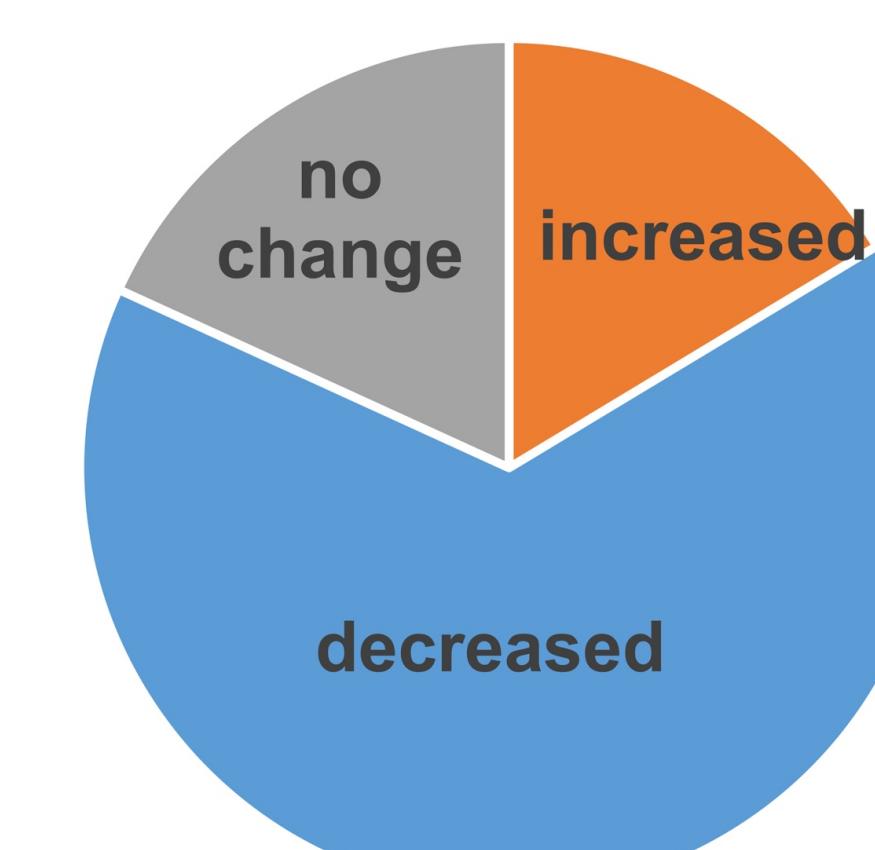
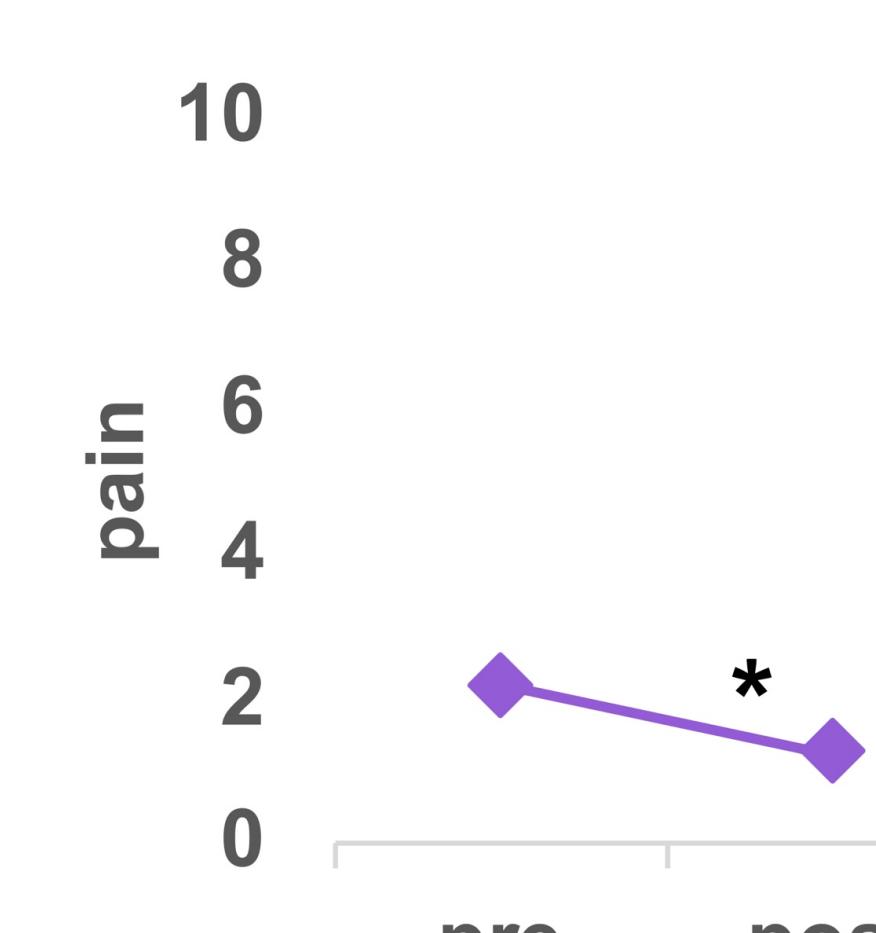
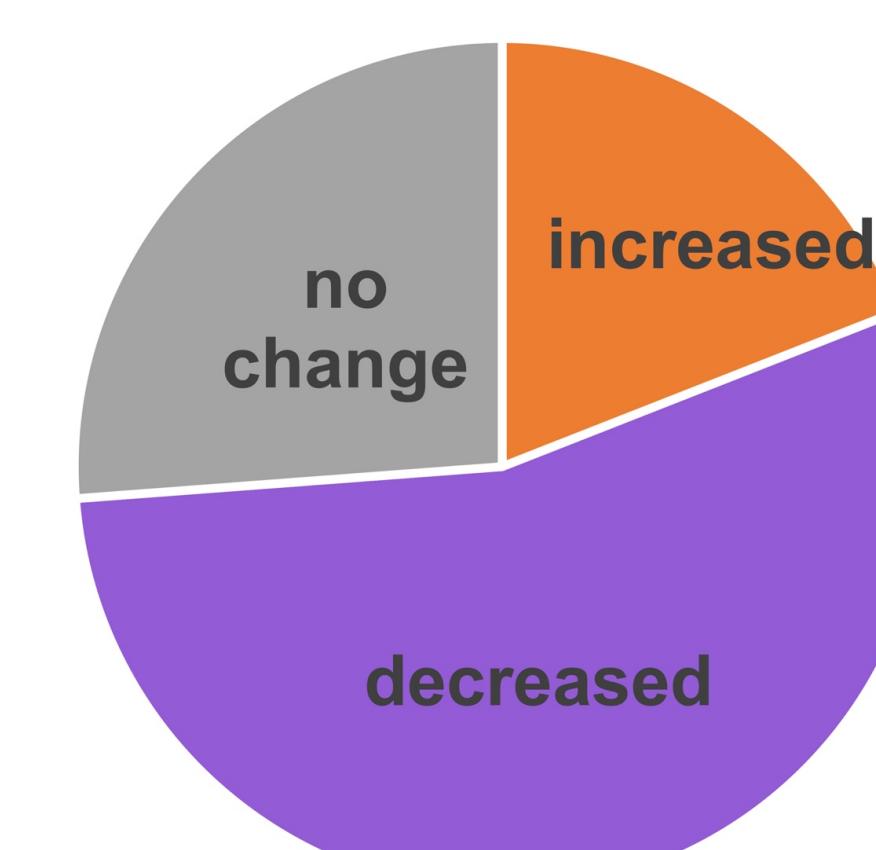


dACC, dorsal anterior cingulate cortex. Masked within anatomical dACC and insula regions of interest

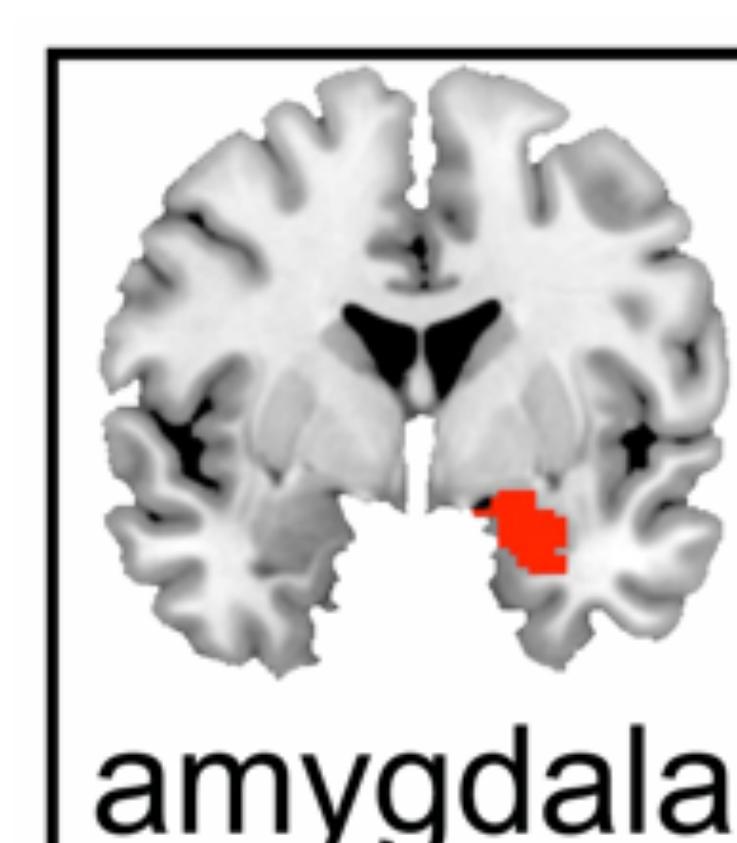
Attention to breath < Passive viewing



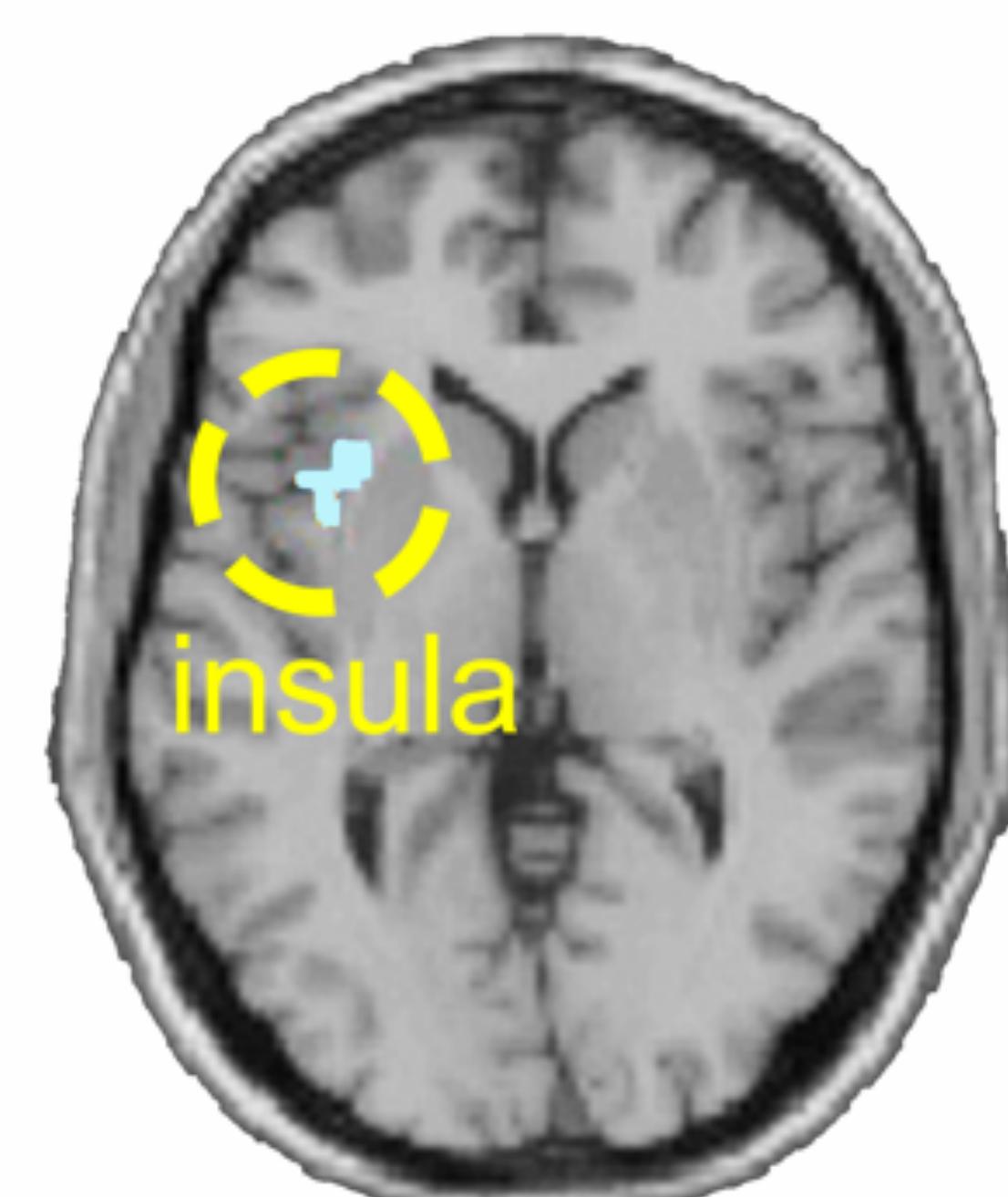
**Significant reduction in pain and emotional distress over the course of a 1-hr KKC class**



**Significant reduction in cortico-limbic connectivity after a 4-week KKC intervention**



amygdala



insula

## Conclusions

- These results provide new evidence that participation in KKC (1) lowers pediatric pain and emotional distress and (2) reduces functional connectivity in cortico-limbic brain systems critical for the perception and regulation of pain and distress. In addition, (3) active meditation, as taught in KKC, modulates the neural mechanisms underlying pain and distress.
- Importantly, the reduction in pain and distress over the course of a 1-hr KKC class was observed not only in children with cancer, but in children with other chronic illnesses (e.g., sickle cell) and their healthy siblings, suggesting that the therapy of KKC may be beneficial for a range of pediatric populations. For example, children with sickle cell experience frequent pain or sickle crises, and recent studies indicate that siblings of children with chronic diseases are at high risk of anxiety, depression, and other psychosocial problems.
- Although non-meditative techniques (e.g., distraction) have also been shown to reduce pediatric pain and distress and are widely used in pediatric healthcare settings, our data suggest that meditative techniques are more effective at modulating cortico-limbic circuitry.
- Given that meditative interventions affect the brain, meditative interventions may be longer lasting or stronger than non-meditative techniques. Future studies should test whether reduction of cortico-limbic response may help to alleviate long-term consequences of repeated pain exposures or distress (e.g., chronic pain, anxiety), and if these techniques are beneficial for reducing neural signatures of pain/distress during painful treatment-related procedures (e.g., lumbar punctures).

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St. Baldrick's  
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