The neuroanatomy of resilience when anticipating possible negative events

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Introduction

In spite of the well-known psychological benefits of having certain positive personality traits like optimism and resilience, very little is known about the mediating brain mechanisms.

Resilience is defined as effective coping and adaptation in the face of loss, hardship, or adversity.

Research by Fredrickson and colleagues (Tugade & Fredrickson, 2004; Fredrickson, 2005) have shown that resilient and nonresilient people do not differ physiologically when experiencing a stressor (anticipating having to give a speech).

We hypothesize that this ability to recover more quickly when a threat is removed relies on emotional regulation mechanisms of the Medial Prefrontal Cortex (mPFC) and/or Lateral Prefrontal Cortex (LPFC) (Ochsner et al., 2002).

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Participants

We recruited participants by first having them visit a website. There, participants were first screened for their eligibility to participate in an fMRI study (e.g., no metal inside body, no history of psychiatric disorders). Next, we were screened for resilience using the ERQ (Block & Kremen, 1994). Of the 242 people who visited the website and completed the questionnaire, 50 participants were selected who exhibited a score in the upper (raw score > 50) or lower (raw score < 45) quartiles of the sample. Also, participants who were not depressed (scored < 25 on CESD) were contacted. This was to ensure that the difference in our resilient group was not due to the presence/absence of depression. Of the 100 (50 Resilient, 50 Nonresilient) that were eligible, 50 participated in the experiment (15 Resilient, 15 Nonresilient).

Demographics

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<th>Resilient (n=15)</th>
<th>Nonresilient (n=15)</th>
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Demographic characteristics of the participants (mean ± SD).

Methods

Participant Screening

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MRI Technical Specs.

- 3T GE scanner, T2* - weighted reverse spiral (GRE, TR = 2000, TE = 30, FA = 90, 64 x 64).
- 18 trials per run, 5 runs per experimental session = 90 total trials.

Experimental Methods

- Event-related design.
- Subjects are initially trained on which cue represents which outcome - uncertain, could be aversive or neutral picture (50/50 frequency); certain: always followed by a neutral picture.

Results

People activate more LPFC (rIFG) when anticipating an uncertain negative event

Uncertain Cue > Certain Cue (Group activation; no sig. Resil diff)

- Superior Frontal (BA10; -25, 56, 30); z = 3.35, [k] = 14
- DMPFC (BA10; 0, 62, 33); z = 4.14, [k] = 19
- Cuneus (BA19; -3, -100, 33); z = 4.92 [k] = 13

Other areas activated in (Av. - Certain Neu.)/ Contrast:
- PVN of Thalamus (BA35; -22, -22, -24); z = 3.63, [k] = 14
- Superior Frontal (BA10; -25, 56, 30); z = 3.35, [k] = 14
- Inferior Parietal (BA40; -41, -47, 54); z = 3.6, [k] = 10

Nonresilient people activate more MPFC/OFC when anticipating an uncertain negative event

Uncertain Cue > Certain Cue (Nonresil > Resil)

- Dorsal MPFC (BA10; 0, 58, 30); z = 4.84, [k] = 19
- Superior Frontal (BA10; 6, 56, 32); z = 4.42, [k] = 23

Resilient people deactivate LPFC (rIFG) when viewing a neutral picture after uncertain anticipation

Uncertain Cue > Certain Cue (Resil > Nonresil)

- Superior Frontal Gyrus (BA10; 6, 56, 32); z = 4.42, [k] = 23
- Inferior Parietal (BA40; -36, -84, 33); z = 3.87, [k] = 27

Discussion

For both resilient and nonresilient people, anticipating a possible negative event seems to be associated with the LPFC [rIFG]. This area has been implicated in maintaining emotional regulation goals, although, usually, the activation is more diverse.

Nonresilient people seem to activate more MPFC/OFC when anticipating a possible negative event. The MPFC/OFC has been implicated in anticipating possible negative events. (Porns et al., 2003). The activation in our study may be due to an increased association for the nonresilient people of the uncertain cue with possible adverse outcomes.

When the participants see the neutral picture after the uncertain cue, the neutral picture represents a relief from threat. However, only in Resilient people did we see a deactivation in LPFC (rIFG). As we have shown, Resilient people are better at spotting a possible negative event. If this area represents the maintenance of emotion regulation goals, then its deactivation in Resilient people may be associated with a highly efficient emotion regulation process that no longer needs to maintain emotion regulation goals.

For Nonresilient people, the activation in this area is no different when viewing a neutral or neutral picture. Nonresilient people may have more trouble disregarding their already active emotion regulation goals when they see the neutral picture. In psychological terms, they may be less efficient (than Resilient people) at ‘letting go’ of the possibility that this picture represents a relief from threat. However, only in Resilient people did we see a deactivation in LPFC (rIFG) when viewing a neutral picture after uncertain anticipation.