Neural correlates of inspirational mentoring

R. L. CESARO[1], R. E. BOYATZIS[2], M. KHAWAJA[2], A. PASSARELLI[2], K. P. BARRY[1], K. BEGANY[1], A. I. JACK[1];
[1]Dept. of Cognitive Sci., Brain, Mind, and Consciousness Lab., Cleveland, OH; [2]Weatherhead School of Management, Case Western Reserve University, Cleveland, OH

Bridging Applied Psychology and Social Cognitive Neuroscience

Recent years have seen considerable advances in social cognitive neuroscience and neuro-economics. Most of these studies have used artificial games in order to control the psychological processes involved. Relatively few studies have attempted to relate our growing understanding of the neural processes underlying social cognition to 'real-life' or applied contexts.

Coaching occurs in multiple settings of everyday lives, and coaching theory has been a growing field within organizational psychology and other fields of applied psychology. However little is know about the neural mechanisms involved.

This study aims to identify the neural circuitry engaged when students interact with someone who is inspiring to them, as opposed to someone who deflates them. It is hypothesized that the more inspiring coach will engage cortical and the limbic regions associated with reward such as the nucleus accumbens (Knutson & Cooper, 2005). In contrast, it is expected that the compliance coach will produce a more self-conscious, defensive response, with greater markers of cognitive conflict in anterior cingulate (Kerns et al., 2004); and fear/anxiety related activity in the amygdala (Davis, 1992).

What is Inspirational Mentoring?

Coaching with compassion is oriented toward pulling the person into the Positive Emotional Attractor. This is done through invoking thoughts and feelings about the person's ideal future, values, and dreams. It is expected that this arouses the Parasympathetic Nervous System and corresponding neural systems. The contrast, which is more typical in academic and work settings is coaching for compliance. This pulls toward the Negative Emotional Attractor and the likely arousal of the Sympathetic Nervous System and corresponding neural systems. This is done through invoking thoughts and feelings about the person's academic or work performance, evaluation (grades), work load in courses and the like.

Experimental Design

Pre-scan Interviews

Participants were undergraduates of sophomore standing (Mean age = 19.55 yrs). Each individual was randomly assigned to one of two groups (N=31, 15 male, 16 female). Participants were told that they would be interviewed by two researchers regarding their undergraduate experience and future goals. Each participant had an initial 30 minute interview, following one of two scripts: a coaching with compassion script thought to produce a positive neuro-endrocrine, emotional, and psychological arousal (i.e., PEA); and a script based on the typical approach taken with undergraduates, which arouses the student's sense of guilt and performance expectations (i.e., NEA). The second interview was also 30 minutes and the second interviewer followed a script for the opposite condition (PEA or NEA) with the subjects.

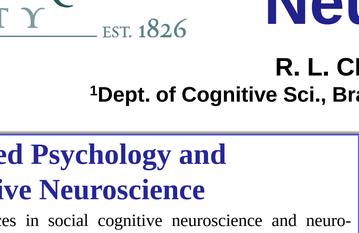
Self-Report Surveys and Manipulation Check

Upon arrival for the first interview, participants were asked to complete 3 computer-based surveys: the Depression, Anxiety and Stress Scale (DASS 21), the Berkeley Expressivity Questionnaire (BEQ) and the Interpersonal Reactivity Index (IRI). Immediately following the second interview, participants were asked to take a Post-Interview Questionnaire. This questionnaire was used as a manipulation check, to ensure that each subject did, in fact, respond to the PEA and NEA interviews.

Of the 31 who participated, 20 individuals were selected for the fMRI session on the basis of sensitivity to the manipulation as assessed by the post-interview questionnaire. Participants who showed very low empathy (IRI), expressiveness (BEQ) or elevated levels of anxiety, depression or stress (DASS-21) were excluded. Participants (n=20, 10 males, 10 females) were selected with the contraint that even numbers experienced a same-sex interviewer in the NEA and PEA condition.

fMRI Session

While in the scanner, participants took part in a mock video-conference interview with the same two individuals who had previously interviewed them. A 4-Tesla Siemen-Bruker hybrid research MRI was used for the fMRI session. After structural image acquisition (T1 and T2w), participants experienced three BOLD runs.



The timeline of individual events in a run is shown to the right. Each trial began with a video statement, in one of four conditions:

PEA: e.g. 'As a Case graduate you will have the tools to contribute positively to your work organization'

NEA: e.g. 'Generally you have little time for fun while you are at Case',

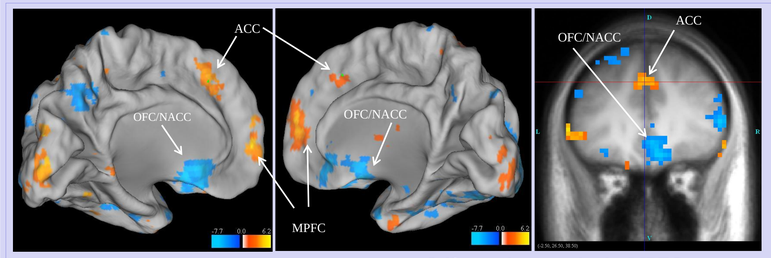
Neutral: e.g. 'You are learning at Case'.

The PEA/NEA statements were always spoken by the PEA/NEA interviewer. The Neutral statements were spoken by both interviewers.

After a brief fixation, participants were prompted to press one of four buttons to indicate the extent to which they agreed or disagreed with the statement in the video. Immediately after the participant's response, a short video clip was played in which the interviewer thanked them for their response, thus maintaining some of the interactive elements of a live interview.

Each of the three BOLD runs consisted of 12 statement-answer-thank-you sequences, each lasting an average of 13.62 seconds, and comprised of 6 statements/thank yous from each interviewer (3 NEA or PEA and 3 neutral). Participants also viewed 6 rest periods of 20 seconds each randomly interleaved with statement sequencesfor a total of 18 stimuli presentation sequences per run. Participants viewed a fixation slide during these rest periods.

Imaging Results



Negative Emotional Attractor

Positive Emotional Attractor

Conflict in the ACC

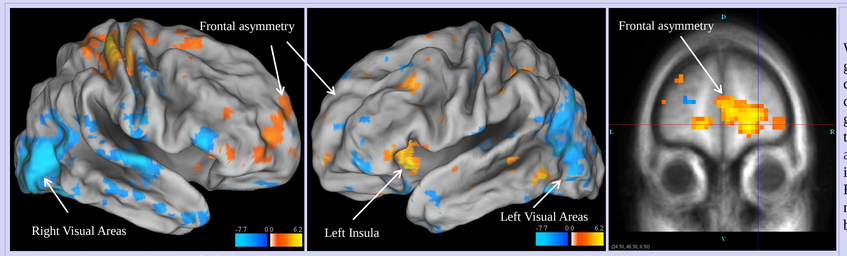
We found evidence of greater activity in the anterior cingulate cortex in the NEA as compared with the PEA condition. This region has been associated with cognitive conflict and both physical and social pain perception. It may reflect the greater conflict and emotional discomfort associated with the NEA condition.

Self-consciousness in the MPFC

We found evidence of greater activity in the medial prefrontal cortex (MPFC) in the NEA as compared with the PEA condition. This region has been associated with theory of mind and with social cognition broadly construed including explicit thoughts about the self and how we are socially perceived by others. Activity in this area may reflect greater social self-consciousness evoked by the NEA as opposed to the PEA condition.

Emotional Engagement in OFC/NACC

We found evidence of greater activity associated with the PEA condition as opposed to the NEA condition which extended throughout both orbitofrontal (OFC) and nearby limbic structures, including the nucleus accumbens (NACC). These areas have been associated with emotion and reward (refs from yesterday). This may reflect greater emotional engagement, which we predicted would be evoked by the PEA condition. While both OFC and MPFC regions may be broadly characterized as being involved in emotional processing, This stands in contrast to the more self-conscious emotional response seen in MPFC (see above), which might be characterized as a more defensive response.



Negative emotion & left insula

We found increased activity in the left insula during the NEA conditions. This area has been associated with negative self-regulated emotions such as sadness and guilt (Shin et. Al. (2000). As a result, the NEA condition elicited more feelings of guilt than the PEA condition. This is also supported by our behavioral data.

Frontal asymmetry & negative emotion

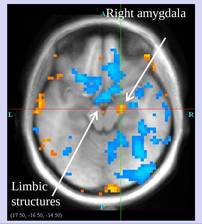
While the majority of the cortical activations were bilateral, we did see a marked asymmetry in the lateral frontal activity near the frontal pole, with greater activity in the right hemisphere associated with the NEA as opposed to the PEA condition. This fits with other findings of asymmetry associated with positive versus negative emotion where increased left frontal activity is associated with avoidance or withdrawal. (Coan and Allen, 2003; Davidson, 1993). This suggests that the NEA condition evoked these emotions in participants.

Visual analysis

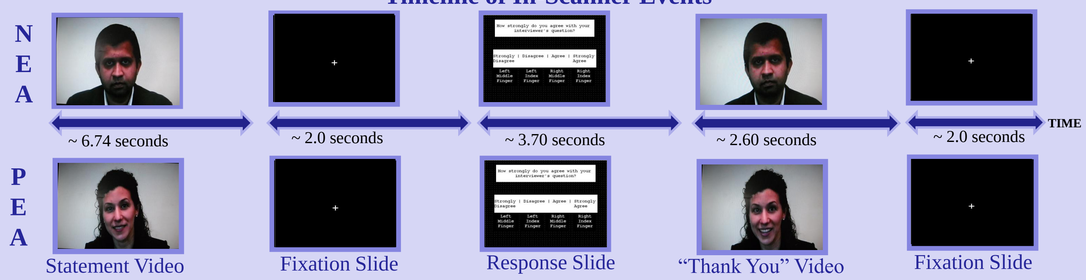
While there is a suggestion of greater early **visual** engagement (i.e. V1 and foveal confluence) in the NEA as opposed to the PEA, visual association areas in **lateral occipital and right superior temporal cortices** were more strongly engaged by the PEA than the NEA. This may reflect greater analysis of social cues encoded in the PEA condition, as opposed to the more threatening NEA condition.

Anxiety in right Amygdala

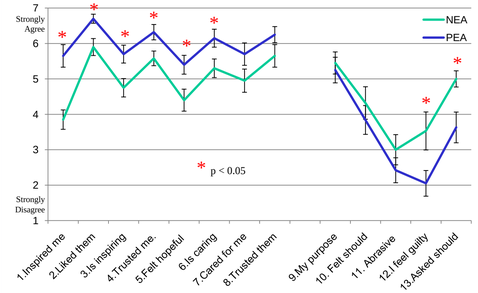
While many limbic areas demonstrated greater activity for PEA vs. NEA condition, we did find evidence of a circumscribed region demonstrating greater activity for the NEA. We have tentatively localized this to the right amygdala (pending verification on individual anatomy and accuracy of EPI to T1 coregistration). This may reflect greater anxiety and fear evoked by the NEA condition.



Timeline of In-Scanner Events



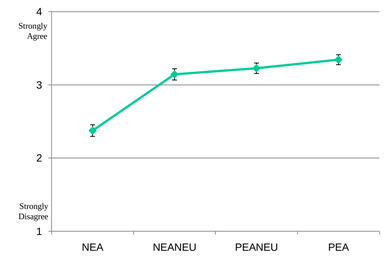
Behavioral Results



The mean responses to all 13 questions asked on the Post-Interview Questionnaire. The manipulation check shows that participants agreed that the PEA interviewer inspired, cared about, and evoked hope in them significantly more than the NEA interviewer. Participants also reported feeling significantly more guilty and self-conscious around the NEA interviewer than the PEA interviewer. This confirms that our NEA and PEA interview scripts were effective.

1. S/he inspired me about my future
2. I liked him/her
3. S/he is an inspiring person
4. S/he trusted me
5. S/he made me feel hopeful about my future
6. S/he is a caring person
7. S/he cared about me
8. I trusted him/her
9. S/he made me think about my purpose
10. S/he made me think that I should be working harder
11. S/he asked abrasive questions
12. S/he made me feel guilty about how much effort I am putting into my studies
13. S/he asked questions about things I should be doing at Case regarding my studies

While in the scanner, participants responded to statements made by the two interviewers by pressing 1 of 4 buttons. The mean responses to each of the 4 types of statements (NEA, PEA, Neutral statements spoken by the NEA interviewer [NEANEU] and Neutral statements spoken by the PEA interviewer [PEANEU]) were calculated. Statistical analyses revealed that participants agreed significantly less with NEA statements than with PEA statements There was also a slight trend where participants agreed with neutral statements more when posed by the PEA interviewer. This is consistent with the notion that participants were projecting their expectations of and past experience with each interviewer, even when they were not exhibiting a PEA or NEA behavior.



Conclusions

The contrast of NEA with PEA questions showed differences in a number of regions which have been implicated in prior cognitive neuroscience studies. Many of the observed differences fit well with prior theory about the role of limbic structures in coaching. This study demonstrates that the methods of cognitive neuroscience can be used to shed light in this area of applied research.

This research is significant because it is known that PEA coaching is more effective at achieving change in behavior than NEA coaching, however the mechanisms of this effect are not known. A better understanding of the mechanisms involved may feed back into improved theory and methods in coaching.

It is noted that there was greater activity in orbitofrontal cortex and nearby limbic areas, including nucleus accumbens, during the PEA. Activation of this reward circuitry may be important to motivating change. Future studies might examine the hypothesis that activation of this area serves as a marker for positive change.

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