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Evidence for Correlations Between Distant Intentionality and Brain Function in Recipients: A Functional Magnetic Resonance Imaging Analysis

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ABSTRACT

This study, using functional magnetic resonance imaging (fMRI) technology, demonstrated that distant intentionality (DI), defined as sending thoughts at a distance, is correlated with an activation of certain brain functions in the recipients. Eleven healers who espoused some form for connecting or healing at a distance were recruited from the island of Hawaii. Each healer selected a person with whom they felt a special connection as a recipient for DI. The recipient was placed in the MRI scanner and isolated from all forms of sensory contact from the healer. The healers sent forms of DI that related to their own healing practices at random 2-minute intervals that were unknown to the recipient. Significant differences between experimental (send) and control (no send) procedures were found ($p = 0.000127$). Areas activated during the experimental procedures included the anterior and middle cingulate area, precuneus, and frontal area. It was concluded that instructions to a healer to make an intentional connection with a sensory isolated person can be correlated to changes in brain function of that individual.

INTRODUCTION

From the beginnings of medical history, humans have held a belief in a spiritual connection to others separated from them at a distance. These beliefs have been held as the basis for the efficacy of prayer, so-called energy healing, and the ability to heal others at a distance ("nonlocal healing"). Despite the longevity of the concept, these phenomena are largely dismissed by the advocates of the biomedical model because they do not fit the current scientific paradigm. The purpose of this study was to determine whether brain changes may be measured using fMRI in the recipients of distant intentionality. In this paper, distant intentionality (DI) is used as a phrase that subsumes prayer, energy healing, healing at a distance, spiritual healing, Therapeutic or Healing Touch, transpersonal imagery, remote mental healing, and other practices based on putative connection in the absence of mechanisms of sensory contact.[1]

There is a growing interest in the scientific community to study different forms of DI. In a recent publication summarizing the current research on healing, at least 2200 published reports on spiritual healing, prayer, energy medicine, and mental intention effects were noted, as well as other examples of distant healing intentionality (DHI) or DI.[2] The researchers noted the weak designs of many of the studies

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reviewed, concluding generally that the results merit further study using sound methodology.

The neurophysiologic aspects of mystical, meditative, or spiritual states have been studied with imaging technologies. Numerous studies of mystical or religious experiences using single photon emission computed tomographic (SPECT) scans to capture brain function have been reported.[3,4] Several of the studies showed reduced regional brain metabolic activity in the posterior superior parietal lobe during intense or peak religious moments. Among the groups they studied were Tibetan meditators and Franciscan nuns at prayer.

In a study of five individuals who had practiced Kundalini yoga for at least 4 years, changes were found that occurred in many areas associated with attention and control of the autonomic nervous system (dorsolateral, prefrontal, and parietal cortices, hippocampus, temporal lobe, and the anterior cingulate cortex).[5]

Still more relevant to the current study is the evidence of correlative activity between the brain function of two individuals separated by distance, and in the absence of sensory mechanisms of contact. What has been referred to as "extrasensory induction" has been reported in 15 pairs of monozygotic twins who were sensory-isolated from each other and in separate rooms. In two of the 15 pairs, changes in EEG alpha rhythms in one twin were observed simultaneously in the other.[6]

A series of papers[7–9] reports several EEG studies showing that a visually evoked potential in one member of a pair of individuals who felt a close personal connection occurred at above chance rates in the nonstimulated brain of the other who was at a distance in an electromagnetically shielded room. Although these studies were highly criticized because of serious methodological issues, findings were later replicated using appropriate statistical detection methods and improved control conditions by two other independent laboratories using EEG technology.[10,11] An additional study that employed a similar paradigm reported significantly correlated fMRI signals between distant human brains.[12]

Nineteen (19) studies replicating an apparent effect of interconnectivity at a distance have been reported.[13] These studies show above-chance correlations in electrodermal activity (EDA), a measure of stress and arousal, between isolated subjects. In their protocol, one subject was instructed to randomly send anxiety provoking or relaxing images to the other subject who was located in a distant room. Electrodermal activity in the receiver subject was correlated above chance, suggesting that the mental images of senders influenced the state of arousal of receivers.

In summary, existing findings seem to suggest the positive effects of DI, the localization of brain areas activated during prayerful or meditative states, and the correlation of brain function between pairs of individuals. These data point to the next logical step, which is to investigate the effect of DI on the brain function of the recipient.

The research question investigated by this study is, "Is there evidence for correlations between distant intentionality and brain function in recipients of distant intentionality who are tested using fMRI?"

METHODS

Subjects

Twenty-two (22) participants (11 pairs of healers and recipients of DI) were recruited on the Big Island of Hawaii. Healers were chosen who claimed to have the skills to communicate in some "nonlocal" form. In this first effort to document the effect of DI, it was important to use participants who already had training and experience in DI within their traditions. There was no attempt to document their ability to heal within the confines of this study. Often healers attempt to heal illness of a psychological and spiritual nature, and the typical medical records are of little use. To reiterate, though, the study is not about healing per se, but whether there is some correlation in the intention to connect at a distance with a person. The authors asked each healer to name someone with whom they felt a bonded or close connection. This decision was based on research cited earlier that indicates close or bonded individuals may be more likely to show correlated physiologic effects.

Inclusion criteria for the healers included:

1. Acknowledgment within their communities for their healing abilities
2. Fulfilling cultural requirements for training, apprenticeship, and practice
3. Ability to name an individual with whom they claim a special connection, who understands the goals of the experiment and is willing to undergo an fMRI scan
4. A stated belief in their ability to turn on and off their intentions within a time frame of approximately 2 to 4 minutes

The inclusion criteria for the receivers of DI included:

1. Being selected by the healer as someone with whom they feel a close or empathic connection
2. Having the standard requirements for receiving an MRI (no implanted devices or metal objects such as pacemakers, joint pins) and no history of claustrophobia
3. Willingness to undergo an MRI scan of 34 minutes' duration and a postscan interview

Three (3) men and eight women with an age range of 46 to 71 participated as healers. The recipients of the healing ranged in age from 44 to 61; and included three men and eight women. On average, healers had been practicing their healing traditions for 23 years.

The healers represented a variety of practices, including Healing Touch (a practice of distant healing and laying on of hands, conducted primarily by nurses trained in the method); a traditional Hawaiian healing form termed *pule* that consists of prayer, chant, and song by a spiritual elder or Kahuna; Peruvian shamanic healing; Reiki (a form of energy healing that may have ancient origins and was purportedly rediscovered in the 19th century in Japan); vibration or sound healing, and three eclectic forms of DI that did not fit into established traditions. Additionally, three of the pairs represented a Chinese method of healing called *Qigong*, and all three trials were conducted by the same *qigong* master.

Procedures

with a call button and given instructions on using it if they were distressed, had questions, or needed to stop the procedure. However, no one used it for contact during the study trials. They were made aware that the healers would be performing DI. They were not provided with any information about the timing of the On/Off conditions. Because the healers were not informed about the timing of the On/Off signals before the trials, they could not have coached their receivers before the scan.

Experimental conditions. The healer was in the electromagnetically shielded control room and physically and optically isolated from the receiver in the scanner. The radiology technician, research nurse, and principal investigator were also in the control room. During the course of the experiment, the healer was verbally instructed by one of the researchers with cues to start and stop the DI. The random pattern of the twelve 2-minute intervals was determined prior to the onset of the study using a coin toss.

A single randomized sequence that had an equal number of on and off sessions was used for each session. The pattern was **off, on, on, off, on, off, off, on, on, off, on, off**, for a total of six 2-minute On periods and six 2-minute Off periods. In three instances, it should be noted that the length of the interval was 4 minutes because two of the On or Off conditions occurred back to back. This pattern remained the same for each healer. The total time the recipients of DI were in the scanner was 34 minutes, which included a 10-minute structural baseline of sagittal and transverse images. During the time in the scanner, no physical or sensory contact was made with the recipient by any member of the research team.

Postscan. The scan was followed by a semistructured interview of both healer and receiver to elicit their subjective experiences during the trial. Subjects in the study were paid $100 for their participation.

fMRI Data Acquisition and Analysis

Structural and functional magnetic resonance imaging was performed on a 1.5 Tesla MR imaging system (Siemens Symphony Magnetom, Software Numaris/4, version Syngo MR 2003BDHHS). The MR Symphony is up to specifications and is reliable as an MR unit. This has been verified through Siemens Medical Solutions Quality Assurance procedures, which are monitored and verified through a planned maintenance program and performed no less than four times a year. Site personnel perform quality consistency tests on a daily basis. In the facility where the scanner is located the RF attenuation factors are Magnetic: 90dB at 10.5 MHZ, Electric: 100dB at 10.5 MHZ. Blood oxygen level dependent (BOLD) functional MRI scans were acquired using a T2-weighted gradient echo version of the echo-planar imaging (EPI) pulse sequence to identify regional brain activation (transmits and receives radio waves, pulses the magnetic field). Scanner protocols that are optimized for measuring brain activation were used to maximize the BOLD response. Additional parameters of the fMRI data acquisition include TR (time between pulse sequence cycles) = 3, TE (time between the 90 degree pulse plus the occurrence of the spin echo) = 30 milliseconds; slice thickness 6 mm, skip 1 mm; 64×64 acquisition matrix; 21 slices positioned to cover the whole brain; and 408 brain volumes to cover the 24-minute acquisition period. Four hundred and eight (408) brain volumes were collected per subject.

Functional MRI scans were analyzed using the FSL software program (Functional Magnetic Resonance Imaging of the Brain, Software Library, Oxford Centre, Oxford, UK), which offers robust corrections for false-positives, autocorrelation, multiple voxel testing comparison, and cluster size detection. Analysis was carried out using FEAT FMRI Expert Analysis Tool, Version 5.1, part of FSL. The following prestatistics processing was applied: motion correction using MCFLIRT.[14] Time-series statistical analysis was carried out using FILM (FMRIB's improved Linear Model) with local autocorrelation correction.[15] Z (Gaussianised T/F) statistic images were thresholded using clusters determined by Z greater than a cluster significance threshold of $p = 0.01$.[16–18] The corrected p value of 0.01 generally should be found to be acceptable because it has been corrected for multiple comparisons using the extent of cluster-size algorithm.

Registration to anatomic images was carried out using FLIRT. General Linear Model (GLM) regression was applied to generate statistical p value maps based on the contrast between the On versus the Off variables. The expected response to changes in the healer/recipient protocol may be equated to the expected response to stimulation paradigms currently used in brain research. In these research paradigms, the responses follow a hemodynamic delay curve. The GLM regression can determine the extent to which the observed receiver's responses may be predicted by this model. A goodness of fit statistic (r squared) indicates the degree of fit between the hemodynamic model and the actual brain activity during the time course recorded. Both positive and negative β coefficients can result from this analysis.

The fMRI data were analyzed using the design matrix shown in Figure 1.

The final step was to create the group maps from the individual fMRI analyses and coregister the group z-score map to the MRIcro atlas (see ch2bet.hdr and aal.hdr from software package www.psychology.nottingham.ac.uk/staff/cr1/mricro.html) for the location and function of significant areas of activation. Then, software developed by one of the authors (TR) was used to quantify the average z-score and pixel activation counts within each of the 116 different brain regions in the MRIcro atlas.

TABLE 1. CLUSTER RESULTS FROM THE GROUP ANALYSIS

Cluster index	*Voxels*	*P value*	*-Log 10(P)*	*Max Z*	*COG x (mm)*	*COG y (mm)*	*COG z (mm)*	*Mean COPE*
2	1355	8.51E-09	8.07	3.82	−9.07	40.5	1.42	17.5
1	475	0.00127	2.9	3.55	−2.14	−52.1	33.8	14.4

These are the Cluster results from the group analysis of combining the 10 subjects. There are two main clusters.

Column definitions: COGx = center of gravity of the cluster in Talaraich space x direction; COGy = center of gravity of the cluster in Talaraich space y direction; COGz = center of gravity of the cluster in Talaraich space z direction; LOG10(P) = logarithmic transformation of the *p* value; MaxZ = maximum zscore within the cluster; Mean COPE = contrast of parameter estimates (the parameter estimated here is related to the change in brain signal intensity in comparing the on and off conditions in fMRI); *p* Value = probability of the null hypothesis that there is no significant activation which is based on cluster size and zscore values; Voxels = number of positive activation voxels within the cluster with zscore > 2.4.

Data were analyzed for both the intraindividual comparisons for the On/Off conditions (experimental versus control) and for the group effect as a whole during these procedures.

Ten subjects were included in the group analysis. One subject was omitted because the fMRI analysis differed slightly from the others in terms of number of volumes obtained. Group and higher-level analysis were carried out using ordinary least squares (OLS) for simple, mixed effects. Z (Gaussianized or normalized T/F) statistic images were thresholded using clusters determined by $Z > 2.3$ and a (corrected) cluster significance threshold of $p = 0.01$.[16,17,19]

RESULTS

The FSL software produces a quantitative table of cluster results that includes: cluster size, probability for each cluster, *z* scores, *x y z* coordinates of the cluster in Talaraich space and contrast of parameter estimates (see Table 1). If a cluster is significant in a group analysis it means that there were specific brain regions in which the combined subjects had enough activation to raise the *z* score above the noise level threshold.

In other words, if all of the subjects had random activation at different places in the brain, then there would be no group activation. One of the two clusters was highly statistically significant ($p = 0.000127$). Significant areas of apparent activation in the group analysis and total number of pixels activated for the group are reported in Table 2. A scan representing the group activation as a whole appears in Figure 2.

DISCUSSION AND CONCLUSIONS

Group analysis revealed significant activation in several areas of the brain, especially the anterior cingulate cortex, frontal superior areas, and the precuneus. The authors' anatomic definitions are correct if the Tzourio-Mazoyer atlas is used.[20] It was produced as a segmentation of the MNI atlas. This is available in MRIcro as ANALYZE files. The conventionally ascribed functions of the cingulate cortex are considered executive control, and decision making at this level determines both verbal and motor responses. The rostral anterior cingulate cortex area has been shown to be activated during the height of opioid and placebo analgesia response.[21] The frontal lobes are generally regarded as modulating information processing, judgment, and decision making. Little is known about the function of the precuneus; however, it has been recently argued that it, along with the anterior cingulate gyrus, may be a part of a neural network that is involved in resting consciousness and self-reflection.[22]

Overall, the results show significant activation of brain regions coincident with DI intervals. Even though the results of individual analyses and group analysis were statistically significant, the internal validity of these findings is challenged on several fronts. First, from the data accu-

TABLE 2. SUMMARY OF AREAS OF STATISTICALLY SIGNIFICANT ACTIVATION OBSERVED IN THE 10 RECIPIENT SUBJECTS

Brain region	*Number of activation pixels*
Frontal/superior/left	692
Frontal/superior/orbital/left	830
Frontal/mid/left	312
Frontal/mid/orbital/left	116
Frontal/inferior/orbital/left	335
Frontal/superior/medial/left	454
Frontal/superior/medial/right	122
Frontal/mid/orbital/right	368
Rectus/right	50
Rectus/left	438
Cingulum/anterior/right	866
Cingulum/anterior/left	1871
Cingulum/mid/right	163
Cingulum/mid/left	571
Olfactory/right	70
Olfactory/left	114
Precuneus/right	1466
Precuneus/left	1021
Caudate/left	139

mulated it is not possible to establish causal factors for the demonstrated effects. For example, three people (the radiology technician, research nurse, and principal investigator) were in the control booth and aware of the timing of the On and Off conditions. Given these facts, it is not possible to know to what extent they influenced the findings, even though they were not deliberately sending distant intentions. Second, because the study design used a variety of healing traditions, one cannot know whether the particular modality caused the effect or it was a function of some unique and idiosyncratic interaction between members of the pair. Finally, no independent measure of the healer's abilities is available. The healing traditions represented are poorly researched, and the empiric evidence for the prowess of any given practitioner is a matter of conjecture.

Given that there are no known biological processes that can account for the significant effect of the DI protocol, the results of this study may be interpreted as consistent with the idea of entanglement in quantum mechanics theory.[23] Entanglement has been confirmed to occur between photons, and many have speculated that certain highly organized macroscopic systems, including the brain, exhibit the property of entanglement with other complex systems. In a recent study evidence was found for nonlocal connections between separated preparations of human neurons.[24] These findings, plus the current study correlating brain activity in two sensory-isolated humans do not fit the classic model of physics and can be interpreted as consistent with entanglement at the macroscopic level.

Several future research directions are suggested, such as replicating the present study using the same healers and recipients; examining the importance of empathy or close relationship by pairing healers with subjects who are unknown to them; using a similar protocol to study possible relationships between DI and healing in a sample of patients with a particular medical diagnosis; studying possible group effects of several DI practitioners on a subject in the scanner and scanning healers during the DI protocol with the goals of identifying brain structures and functional brain changes during the DI state.

In summary, these findings support previous research on distant healing suggesting that human intentions may directly affect others in ways that are not entirely understood.

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