Compassionate Intention As a Therapeutic Intervention by Partners of Cancer Patients: Effects of Distant Intention on the Patients' Autonomic Nervous System

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Objective: This double-blind study investigated the effects of intention on the autonomic nervous system of a human "sender" and distant "receiver" of those intentions, and it explored the roles that motivation and training might have in modulating these effects.

Design: Skin conductance level was measured in each member of a couple, both of whom were asked to feel the presence of the other. While the receiving person relaxed in a distant shielded room for 30 minutes, the sending person directed intention toward the receiver during repeated 10-second epochs separated by random interepoch periods. Thirty-six couples participated in 38 test sessions. In 22 couples, one of the pair was a cancer patient. In 12 of those couples, the healthy person was trained to direct intention toward the patient and asked to practice that intention daily for three months prior to the experiment (trained group). In the other 10 couples, the pair was tested before the partner was trained (wait group). Fourteen healthy couples received no training (control group).

Outcome measures: Using nonparametric bootstrap procedures, normalized skin conductance means recorded during the intention epochs were compared with the same measures recorded during randomly selected interepoch periods, used as controls. The preplanned difference examined the intention versus control means at the end of the intention epoch.

Results: Overall, receivers' skin conductance increased during the intention epochs ($z = 3.9$; $P = .00009$, two-tailed). Planned differences in skin conductance among the three groups were not significant, but a post hoc analysis showed that peak deviations were largest and most sustained in the trained group, followed by more moderate effects in the wait group, and still smaller effects in the control group.

Conclusions: Directing intention toward a distant person is correlated with activation of that person's autonomic nervous system. Strong motivation to heal and to be healed, and training on how to cultivate and direct compassionate intention, may further enhance this effect.

Key words: Distant healing, autonomic nervous system, intention

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INTRODUCTION

A 2004 government survey of adult Americans, conducted by the US National Center for Health Statistics, showed that of the top 10 complementary and alternative medicine healing practices, the most popular was prayer for self and the second was prayer for others.[1] From a psychological perspective, the former may be thought of as a coping mechanism in the face of uncertainty or dire need. The possibility that prayer for self may promote one's own healing is not considered controversial because of the growing literature on the salutary effects of meditation and placebo and the plausibility of psychoneuroimmunological models of self-regulation.[2]

Prayer for others is likewise understandable as a practical coping mechanism, but the idea that it might be efficacious for another person remains contentious. To avoid unnecessary religious connotations, the descriptive phrase *distant healing intention* (DHI) is sometimes used in the scientific and medical literature to refer to this practice.[3] Distant healing intention effects are considered scientifically doubtful by some because the "distant" in DHI means shielded from all known causal interactions.[4,5] Science is beginning to reconcile with the concept of "spooky action at a distance" within fundamental physics, but so far the idea that nonlocal effects might also exist in living systems,[6] and be pragmatically useful in some way, evokes as much contempt as it does serious interest.

Because the mechanisms underlying postulated DHI effects are unknown, most DHI experiments have focused on the straightforward empirical question: does it work? Can DHI affect medical symptoms and outcomes? Some clinical studies of hospital inpatients and medical outpatients suggest that DHI might be medically efficacious,[7,8] but as a whole the clinical evidence remains uncertain.[9,10]

By contrast, when DHI is tested under controlled laboratory conditions, the evidence is less ambiguous. Meta-analyses indi-

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cate that DHI produces repeatable effects in the human autonomic nervous system, detected typically by monitoring fluctuations in one person's electrodermal activity (EDA) while a distant person mentally attempts to influence the target person's emotions or attention.[11,12] The literature also indicates that DHI effects can be detected in the central nervous system, as measured in brain electrical activity[13-17] and hemodynamics,[18,19] and also in the enteric nervous system.[20]

The laboratory evidence may be clearer than the clinical evidence because there are no "competing" intentions to interfere with the test results, such as the prayers of clinical patients' loved ones, and also because physiological fluctuations can be objectively monitored in real time, whereas healing responses in the clinic may progress over days or weeks. The context of laboratory studies is also quite different from that of clinical studies. In the lab, the person assigned to "send" DHI (hereafter called the sender) is typically a volunteer who is not especially motivated or trained to provide DHI, and the person assigned to receive DHI (the receiver) is often just curious to see what will happen (the terms sender and receiver are used for expository reasons; they do not imply a signaling model as the underlying mechanism). Given these low motivational factors, it should not be surprising that the magnitude of effects observed in such studies is rather small (eg, the meta-analytic effect size estimate reported by Schmidt et al[12] is Rosenthal's[21] $d = 0.11$; $P = .001$).

The goal of the present study was to see what would happen when the powerful, real-life motivations associated with clinical trials of DHI were combined with the controlled context and objective measures offered by laboratory protocols. In addition, most previous DHI studies assigned the sender's role to a laboratory staff member, so the sender and receiver were often strangers. The present study sought to enhance the ecological validity of postulated DHI-type connections between couples by recruiting long-term, bonded pairs and by exploring the role of training and motivation in potentially modulating DHI effects. Given the laboratory context, we did not test for distant healing per se, but rather the physiological effects of distant intention. With this caveat in mind, the term DHI will be used hereafter for ease of exposition.

METHODS

Participants

Pairs of friends, long-term partners, married couples, and mother-child pairs were recruited to participate in one of three groups: trained, wait, or control. Two of the groups were comprised of adult couples, one of whom was healthy and the other was undergoing treatment for cancer. The cancer patients and their partners were recruited throughout the San Francisco Bay area by healthcare provider referrals and newspaper advertisements. The study design was explained to interested parties, including the random assignment to different conditions, the data collection procedures, potential risks and benefits, and their rights as voluntary participants, including informed consent. Couples were excluded if they were participating in family therapy, were receiving any form of "energy healing," if the partner was enrolled in a cancer support group, or if they chose at any time to leave the study.

The healthy partner was assigned the role of the sender of DHI and the patient the role of the receiver. In the trained group, the sender attended a program involving discussion and practice of a DHI technique based on the cultivation of *compassionate intention,* defined as the act of directing selfless love and care toward another person, with intention to relieve their suffering and enhance their well-being.

The training program, developed and provided by second author, consisted of a daylong, eight-hour, group workshop, followed by a daily half-hour practice at home for three months. The program included a lecture on the healing potential of compassionate intention, discussion of common resistances to positive expectations about DHI, guided instruction in several meditation and mental focusing practices, and guided exercises in breath-based techniques for enhancing compassion, as variously practiced in Tibetan Buddhism (the practice known as tonglen meditation),[22,23] Judeo-Christian meditation,[24,25] and therapeutic touch.[26]

After attending the training session and practicing the DHI meditation daily for three months (healthy partners were asked to keep a daily log to verify their practice), these couples were tested in the laboratory. In the wait group, the couple was tested before the healthy partner attended the training program. A third group consisted of healthy couples who received no training (the control group). Of those recruited for the trained group and wait group, 10 couples eventually dropped out. Reasons provided included time constraints, dissolution of the couple's relationship, the couple was in search of a "quick fix," death of a patient, spouse was not available, complications of cancer, or because one or more concepts in the training program clashed with the couple's belief system.

When a couple arrived at the lab, informed consents were signed and then the experimenters attached electrodes to each person to monitor five physiological variables. The principal measurement was EDA, specifically, skin conductance level (SCL), as this is the variable most frequently employed in similar, previous studies. Electrodermal activity was monitored with two electrodes, each filled with an isotonic electrode gel (Biopac GEL101, Biopac, Goleta, Calif) and attached to the left palm by using double-sided adhesive collars (Biopac type TSD203, 8-mm Ag/AgCl electrodes). These electrodes were attached to a Biopac GSR-100C EDA amplifier set to the 0- to 2-μS range (2 μS per volt, or 0-20 μS for the full 10-volt range of the EDA amplifier).

For exploratory purposes, we also monitored one channel of electroencephalogram at C_z, fingertip blood volume on the left thumb, electrocardiogram, and abdominal respiration. Results of those measurements will be reported in other publications. All signals were recorded at either 500 or 1000 samples per second, and each person was monitored by a separate physiological recording system (Biopac M150, Biopac). To assist in the computational process, all raw physiological data were downsampled to 100 samples per second before analysis.

The couple was asked to maintain a "feeling of connectedness" with each other. To assist with this intentional focus, each person was asked to exchange a personal item, like a ring or watch, and to hold that object in his/her free right hand for the duration of the session. In the control group, couples were asked to decide which of the two might be more receptive, and that

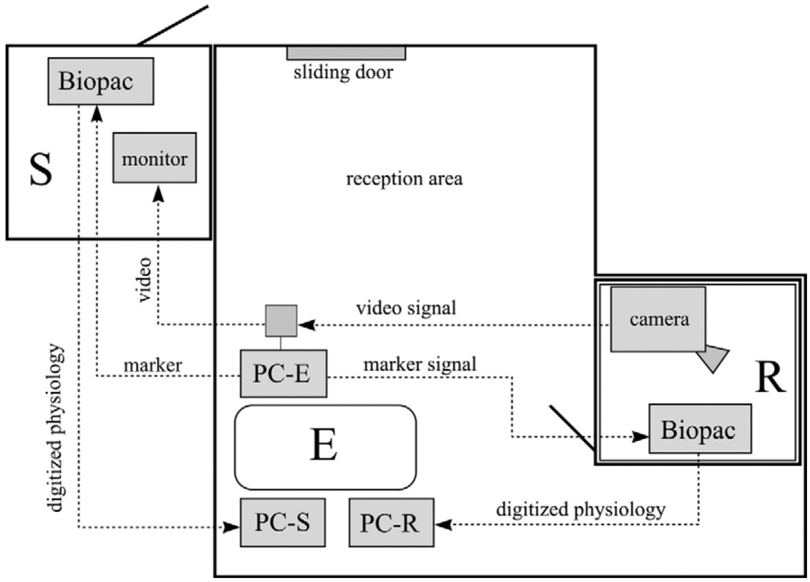

Figure 1. Laboratory layout. The experimenter's workstation (E) consisted of three computers: two recorded the physiological data from the sender (PC-S) and the receiver (PC-R) Biopac systems. The third (PC-E) controlled the random timing of the stimuli and a video switch. The receiver was in an electromagnetically and acoustically shielded room; the sender was in a distant room behind two doors and a double wall.

person was assigned the role of the receiver. In the trained group and wait group, the cancer patient was always the receiver.

Environment

The receiver was asked to relax in a reclining chair inside a double steel-walled, electromagnetically and acoustically shielded chamber, as illustrated in Figure 1 (series 81 solid cell, ETS-Lindgren, Cedar Park, Tex). The receiver was informed that the sender would be viewing his or her live video image at random times from a distant location, and that during those periods the sender would try to make a special intentional effort to mentally connect with him or her. No one involved in the experiment knew exactly when those random periods would occur, as they were selected by a computer (described below).

A low-light video camera was focused on the receiver's face, and the interior of the shielded room was illuminated with a 25-watt incandescent bulb. The physiology and video signals were routed outside the shielded room via optical fiber to two computers (SI Tech Models 2809/2010 and Model 2550, Batavia, Ill), one dedicated to recording the receiver's physiological signals and the other used to automatically run the experimental session, including switching the video image to the sender's location at random times.

To test for possible sensory cues between the sender and receiver locations, audio tests were conducted to check whether tones as loud as 110 dB at 1,000 Hz sounded in the sender's room could be detected inside the receiver's shielded chamber. Subjective hearing tests along with quantitative audio tests using a digital sound level meter confirmed that the test tones were indistinguishable from background noise inside the chamber (model 840028, Sper Scientific, Scottsdale, Ariz). To further isolate the shielded room from potential infrasound cues, the chamber rested upon a vibration-dampening vinyl mat in the basement of a building.

After the receiver was settled in the shielded room, the sender was led through two closed doors to a dimly lit room 20 meters away and asked to sit in a chair about a half meter in front of a video monitor. An experimenter explained that when the video monitor showed the receiver's image, the sender was to try to mentally "connect" with the receiver with as much intensity as possible. The principal experimenter (D.R.) was blind to whether a couple was in the trained or wait group but was aware of the condition for the control group participants, the majority of whom were recruited by and guided through the experimental sessions by L.K., D.M., and G.H.

The sender's electrodes were connected to the same model Biopac system as the receiver's, using the same type of amplifiers, settings, and data sampling rates. The digitized outputs from both Biopac systems were transmitted over a local area network and streamed to two Windows-based PCs, each running Biopac's Acknowledge 3.7.1 data collection software (Figure 1).

Stimulus Procedure

The timing of the viewing periods was controlled by a Windows PC running a program written by D.R. in Microsoft Visual Basic 6.0. When that program was launched, it created a random timing schedule for either 25 (control group) or 36 (motivated groups) 10-second visual stimulus epochs. Epochs were separated from one another by a randomly determined five to 40 second interepoch interval (Figure 2; the random source in both cases was based on Visual Basic 6.0's pseudorandom algorithm, seeded by the PC's CPU clock at the beginning of each session). To synchronize the sender and receiver physiological signals, at the beginning of each stimulus epoch the computer switched the video signal from the receiver's chamber to the video monitor in front of the sender and simultaneously sent onset marker signals to both the sender and receiver Biopac systems (using signals generated by an analog to digital circuit; model ADR-100, On-

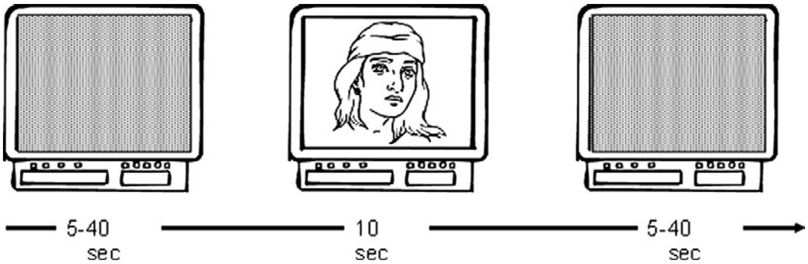

Figure 2. Protocol for sender stimulus. Random interepoch intervals ranged from five to 40 seconds, separated by 10-second distant healing intention periods. The receiver's live video image appeared on the monitor during the sending periods, otherwise the monitor was black.

trak Control Systems, Sudbury, Ontario, Canada). At the end of each stimulus epoch, the computer switched the video signal off and sent offset markers to the two Biopac systems. After both participants were secured in their respective rooms, the experimenter checked to see if the physiological recordings, marker signals, and video switch were operating properly. When everything was in order, an experimenter started the controlling program and attended to other tasks while waiting for the session to end.

Hypotheses and Analyses

The principal hypothesis was that the sender's DHI directed toward the distant, isolated receiver would cause the receiver's autonomic nervous system to become activated. A secondary analysis explored whether the factors of motivation and training modulated the postulated effect.

In the following description, the term *epoch* refers to the 20-second period from five seconds before stimulus onset to five seconds after stimulus offset (this range was used to examine the physiological responses in temporal context), and *stimulus epoch* refers to the 10-second DHI period between stimulus onset and offset. The analysis examined changes in SCLs averaged across epochs (ensemble average) to see how the sender and the receiver responded to DHI in time synchrony.

To determine the statistical significance of the observed results, the following procedures were independently applied to the receiver and the sender SCL data. This bootstrap analysis, a common method within the larger domain of computational statistics, is a nonparametric way of analyzing physiological data because it makes no assumptions about the underlying structure of the data, and because it answers precisely what we wish to know: did SCL change in an unexpected way during the actual stimulus epochs, as compared with other, randomly selected times? All SCL data were smoothed using a one-second sliding average window (±500 msec), then a sequence of steps was applied as follows:

- for each SCL sample in a given session, subtract the SCL value at stimulus onset to form a measure of change in SCL during that epoch
- calculate the ensemble mean of the baseline-subtracted epochs in step one for each session
- calculate the grand ensemble mean across all sessions of interest (eg, trained group sessions)
- select random starting points in each session, one for each epoch in the original session, and from those create new, 20-second random epochs; subtract the baseline from each of these random epochs as in step one
- form the ensemble mean of the random epochs
- do the same for the other sessions, then calculate a grand ensemble random epoch mean
- repeat steps 4 to 6 10,000 times to build up a bootstrap distribution of ensemble random epochs that *could have occurred* in the experiment if the original epochs had occurred at different times than they did in the actual experiment[27]
- normalize each sample in the original ensemble average curve (20 seconds × 100 samples/second = 2,000 samples) by using the mean and standard deviation of the bootstrap distribution formed in step seven, as $z_i = (x_i - \mu_i)/\sigma_i$, where i ranges from 1 to 2,000 samples, x_i is sample i from the original ensemble mean, and μ_i is the mean and σ_i the standard deviation of the associated sample from the bootstrap distribution; this step essentially creates a z score for each sample in the original ensemble epoch; basing the results on normalized scores weights each epoch equally

Under the null hypothesis, the precise timing of the epochs should not matter because the receiver was thoroughly isolated from the sender. Thus, if at stimulus offset the normalized ensemble epoch for the receiver significantly deviated from chance (as determined by the bootstrap process), it would suggest that the receiver had responded to, or more generally was correlated with, the sender's DHI. To avoid multiple testing problems, the preplanned hypothesis examined the normalized deviation only at stimulus offset.

RESULTS

Participants

Seventy-two people participated in the study (Table 1), including two minors (a mother-son and mother-daughter pair: 36 couples who together conducted a total of 40 sessions, 38 of which were usable (two control sessions could not be analyzed because the senders' physiological data failed to record properly). Ideally, the three groups of participants would have been matched by gender and age, but in practice this was difficult to achieve as the clinical groups mostly involved women with breast cancer, and this tended to skew the age and gender of

Table 1. Participant Demographics[a]

Group	Sessions	Couples	Age of Sender, y (average)	Age of Receiver, y (average)	Gender of Sender	Gender of Receiver
Control	16	14	7–71 (41)	24–58 (39)	11M/7F	5M/13F
Trained	12	12	37–84 (55)	38–78 (54)	7M/5F	4M/8F
Wait	10	10	42–77 (57)	41–79 (53)	9M/1F	1M/9F

M, male; F, female.

[a]Two of the 18 control sessions did not produce usable data.

those groups. In addition, two couples in the control group switched roles as the sender and the receiver, and all individuals in the control dyads were healthy.

All participants in the trained group and wait group filled out demographics questionnaires upon beginning the study, then before and after the training periods they filled out questionnaires on mood,[28] marital satisfaction,[29] and spiritual well-being,[30] and the patients only filled out the Functional Assessment of Chronic Illness Therapy (FACIT, Version 4), a self-report measure designed for cancer patients to assess various factors associated with well-being.[31,32] Analysis of the demographics indicated that the trained group and wait group were well matched in terms of gender, ethnicity, family history of cancer, income, prior participation in a cancer therapy group, and involvement in a religious practice.

Analysis of the psychosocial data showed no significant differences in well-being, mood, or quality of life between healthy partners in the trained group or wait group. However, trained group patients showed both a *decline* in physical well-being as compared with wait group patients ($P < .01$, two-tailed), and an *improvement* in spiritual well-being ($P < .01$, two-tailed; both results survive Bonferroni corrections for multiple tests). We might interpret this apparently contradictory outcome to imply, purely as a metaphor, that distant intentions might act as church bells that are rung incessantly to assist in healing the ill. The benevolent intentions associated with such chimes may be perceived and appreciated by the mind, thereby raising one's spirits, but they may also prevent the body from getting the rest it needs, making the body feel worse.

Data Conditioning

To reduce the potential biasing effects of movement artifacts, all data were visually inspected, and SCL epochs with artifacts were eliminated from further consideration (artifacts were identified by D.R., who was not blind to each epoch's underlying condition). This analysis slightly reduced the potential total of 1,170 to 1,140 epochs (97%) as follows: 387 of 410 trained epochs (94%), 360 of 360 wait epochs (100%), and 393 of 400 control epochs (98%). The first two trained trials consisted of 25 epochs, the last 10 consisted of 36 epochs, for 410 possible epochs.

Electrodermal Activity

The sender's SCL across all epochs, sessions, and groups increased substantially after stimulus onset, confirming the expected activation in the sender's sympathetic nervous system as a result of the increased mental effort associated with providing DHI (Figure 3). About two seconds after stimulus onset, the sender's SCL began to increase, peaking three seconds later at more than $z = 12$ standard errors above the baseline. In addition, as predicted by the DHI hypothesis, the receiver's SCL also significantly increased. A half second after stimulus onset, the receiver's SCL began to rise, peaking by stimulus offset at $z = 3.9$ standard errors over the baseline ($P = .00009$; all P values cited are two-tailed).

Motivated Versus Control Groups

Figure 4 is the same analysis applied to just the motivated group (trained group, N = 387 epochs; wait group, N = 360 epochs; 747 epochs combined, 22 participants). The receiver SCL significantly increased to $z = 3.45$ ($P = .0006$) at stimulus offset, peaking at 7.8 seconds at $z = 4.481$ ($P = 7.4 \times 10^{-6}$).

By comparison, Figure 5 shows that the receiver SCL for the control group (16 sessions, 393 epochs) increased to $z = 2.4$ ($P = .02$) at stimulus offset. The difference between the motivated and control group outcomes at stimulus offset was not significant ($z = 0.73$; $P = .46$). When comparing effect sizes per stimulus epoch (where $e = z/\sqrt{N}$, N being the number of epochs) as shown in Figure 6, the receivers' SCL at stimulus offset was observed to be about the same magnitude in all of the groups.

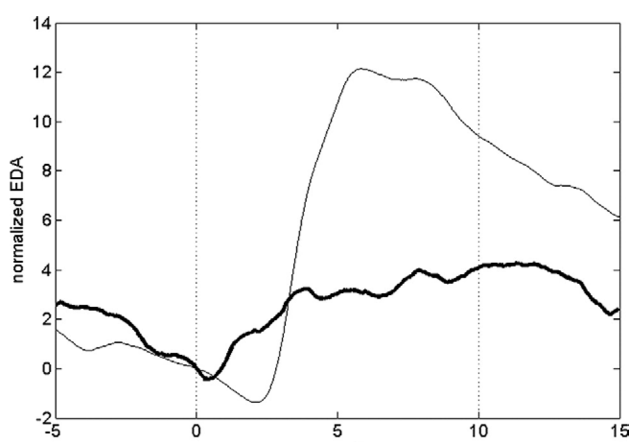

Figure 3. Sender (thin line) and receiver (bold line) normalized mean skin conductance levels across all 38 sessions (N = 1,140 epochs), from five seconds before stimulus onset (at 0 seconds) to five seconds after stimulus offset (at 10 seconds), to show the effect in context. EDA, electrodermal activity.

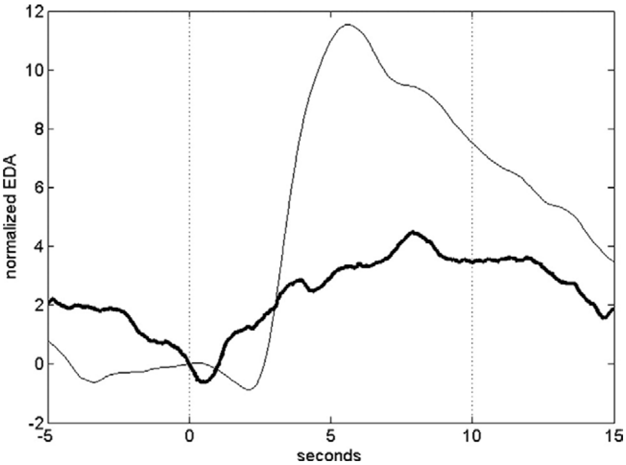

Figure 4. Sender (thin line) and receiver (bold line) normalized mean skin conductance levels for all motivated sessions (n = 736 epochs). EDA, electrodermal activity.

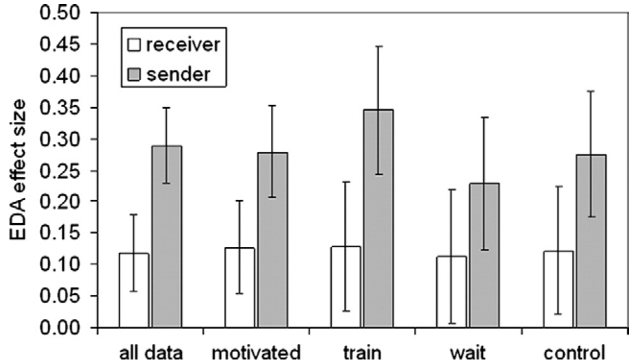

Figure 6. Comparison of sender and receiver effect sizes (per epoch) measured at stimulus offset (with ±2 standard error confidence intervals) for all sessions, motivated sessions (trained group and wait group combined), and trained, wait, and control groups separately. EDA, electrodermal activity.

Comparison of the receiver SCL time course among three groups reveals a more interesting trend, as shown in Figure 7. Receivers in all three groups responded quickly at stimulus onset, but (1) the control group's response subsided after four seconds, (2) the wait group's response was initially stronger and subsided after five seconds, and (3) the trained group's response continued to progressively rise for eight seconds, reaching the maximum deviation among all three groups (in this comparison, the number of epochs in each curve is approximately the same, so the normalized curves are not biased by differences in sample size: trained = 387 epochs, wait = 360 epochs, control = 393 epochs). These differences were not predicted in advance so they must be interpreted with caution. However, if future replications continue to show similar patterns, then training plus motivation would appear to enhance receiver's response over motivation alone, and motivation would appear to enhance the response over interest alone.

DISCUSSION

Analysis of all skin conductance data indicates that the sender's DHI had a measurable effect on the receiver's autonomic nervous system. Inspection of the time course of SCL over the average epoch suggests that the trained group had a slower but more sustained effect, followed by a more moderate wait group response, and an even smaller control group response. The overall SCL effect size per session for the motivated groups was $e = 3.45/\sqrt{22} = 0.74$, some 6.7 times larger than the earlier meta-analytic estimate of $e_{ma} = 0.11$, and surprisingly even the control group effect size was some 5.4 times larger than e_{ma} ($e = 2.4/\sqrt{16} = 0.60$). It might be noted that the absolute magnitudes of the observed effects were still rather small, for example, for the receiver's SCL, the peak changes over baseline amounted to fractions of a microSiemen (of course, small magnitude effects do not imply no effects; statistically speaking the results are unambiguous).

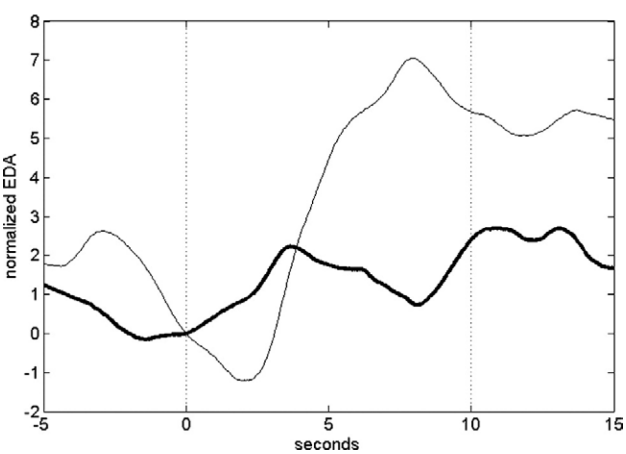

Figure 5. Sender (thin line) and receiver (bold line) normalized mean skin conductance levels for control sessions (n = 393 epochs).

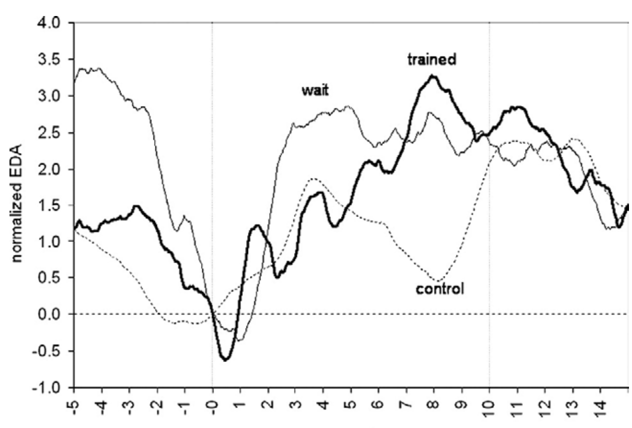

Figure 7. Normalized comparison of receiver skin conductance levels in the three groups. EDA, electrodermal activity.

Alternative Explanations

Many artifacts can produce outcomes that mimic DHI effects. In order of decreasing likelihood, they include measurement artifacts, sensory leakage between the sender and receiver, the receiver's anticipation of the timing of stimulus epochs, software artifacts, violation of statistical assumptions, selective data reporting, and collusion between the sender and the receiver.

Potential measurement artifacts include electrical crosstalk that can arise between amplifiers in the same monitoring device, or artifacts induced into the equipment due to electromagnetic (EM) pulses associated with switching the video monitor signal at stimulus onset and offset. The possibility of crosstalk was precluded by using two independent Biopac monitors located 20 meters apart, each with its own data recording computer. Potential effects of EM pulses were significantly diminished by the use of a double steel-walled EM-shielded room and 20-meter separation between the sender and the receiver. The shielded chamber was designed to effectively block all EM radiation above 10 kHz, but it did not block extremely low frequency EM or magnetic fields. Living systems are known to be sensitive to weak EM and magnetic fields, so bioelectromagnetic factors cannot be absolutely ruled out as potential artifacts.[33] However, prior successful studies (in distant perception tasks) conducted with the sender on land and the receiver in a submarine under many meters of seawater raise doubts that extremely low frequency signals are sufficient to explain this type of "nonlocal" outcome.[34] Further doubts are raised because of evidence suggesting that DHI effects can be observed even when the sender and the receiver are displaced in time.[35-37]

Sensory leakage artifacts can include conscious or unconscious visual, auditory, or vibratory cues that might pass between the sender and the receiver. Such artifacts were precluded from the present experiment through the use of separate rooms for the sender and receiver, the latter being a heavily shielded chamber, and through prior sound leakage tests. In addition, the experimenters were located between the sender and receiver locations, with no other points of access between the two sites, so any attempt by the couple to communicate through ordinary means would have been detected. Moreover, the physiological condition of both participants was continually monitored during the experiment, allowing detection of the smallest bodily movements in either person. No gross motor movements consistent with attempts at surreptitious signaling were detected in any of the sessions.

For other potential artifacts, could the receiver have anticipated when the stimulus epochs were about to occur and then respond accordingly? This possibility was prevented through the use of random interepoch timing and double-blind conditions. No one knew in advance of a session when each DHI epoch would begin. The random timing and blinded design is also relevant to assessing the impact of a potential bias due to the awareness of D.R. of which couples were in the control group, and to the fact that most of the data from the control couples were collected by L.K., D.M., and G.H. Could different interpersonal styles among these four investigators have influenced how couples responded in this experiment? The question arises because investigators holding different a priori opinions about the likelihood of DHI effects have reported results, even in jointly run experiments, that fell into alignment with their individual beliefs.[38] However, a replication study designed to examine the role of interpersonal interactions in more detail failed to support the earlier results, thus the influences that different investigators may have on DHI outcomes remain uncertain.[39] In any case, all investigators in the present study were open to the concept of DHI, so although some interpersonal bias cannot be ruled out, it seems unlikely that the knowledge of D.R. on which couples participated in the control group would have had much impact on the outcome. Indeed, all three groups showed significant results in the preplanned outcomes.

Potential violations of the assumptions underlying parametric statistics were avoided by using a nonparametric, computational bootstrap procedure to normalize the ensemble averages. To prevent selective reporting biases, data from all usable epochs across all sessions were analyzed and reported for the measure of principal interest (SCL). Collusion between the sender and the receiver would have been exceedingly difficult to carry out, not only because the EM shielding prevented obvious signaling methods such as sounds and cell phones, but because almost all of the couples participated in only one session, so they did not know what to expect in advance about the laboratory setup or the experimental protocol.

Interpretations

If not due to conventional explanations, then how do we interpret these results? Sloan and Ramakrishnan[5] have asserted that "Nothing in our contemporary scientific views of the universe or consciousness can account for how the 'healing intentions' or prayers of distant intercessors could possibly influence the [physiology] of patients even nearby let alone at a great distance."

Is it really true that *nothing* in science suggests the presence of connections between apparently isolated objects? Quantum entanglement, a far from common sense effect predicted by quantum theory and later demonstrated as fact in the laboratory, shows that under certain conditions, elementary particles that were once connected appear to remain connected after they separate, regardless of distance in space or time. If this property is truly as fundamental as it appears to be, then in principle everything in the universe might be entangled.[40] Everyday objects and humans certainly do not appear to show such entanglements, and there are nontrivial arguments for why small-scale entanglement would be difficult to sustain in large, living systems. But still, one cannot help wondering what if this concept *did* apply to humans? In a casual, indifferent, unmotivated couple, entanglements between their minds and bodies may be difficult to detect, not only in a fundamental physics sense, but even in an ordinary psychodynamic sense. By comparison, in a long-term, highly motivated, bonded couple, and with the sender specifically trained to provide compassionate intention, the underlying correlations might be far more evident. Such a relational model is appealing because it does not require anything (force, energy, or signals) to pass between the sender and the receiver. Instead, it postulates a physical correlation that is always present between people (and everything else) due to the "nonlocal threads" from which the fabric of reality is woven.

Another possible interpretation is that the outcomes of this and similar experiments are due to precognition on the part of the investigators, who manage to begin each session at just the right time so as to match natural fluctuations in the receiver's physiology with the randomly determined moments of stimulus onset and offset. Although such an explanation may seem implausible, independent evidence in favor of retrocausal effects in humans continues to accumulate,[41-46] so it is not inconceivable. Indeed, because there are as yet no adequate theoretical models that would predict macroscopic correlations akin to DHI, we are obliged to remain open to a wide range of possible explanations.

A key limitation in the present study was the lack of closely matched demographics among the three groups. Given this limitation, it would be imprudent to draw strong conclusions about performance differences among the groups. However, based on the overall support of the formal hypothesis, it is possible to draw one conclusion: directing one's attention toward a distant person apparently causes measurable changes in that person's nervous system. This suggests that DHI provides more than a psychological coping mechanism, and that prayer for others is the second most popular complementary and alternative medicine modality for a very simple reason: it has an effect on the human body, presumably an effect that is usually perceived as beneficial in some way. Whether it specifically promotes healing remains to be seen.

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