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Spectroscopic analysis of water treated by and in proximity to energy medicine practitioners: An exploratory study

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ABSTRACT

Previously reported experiments suggest that healing intention focused toward water, or merely taking place in the vicinity of water, affects the hydrogen-oxygen (H–O) covalent bonds. This claim was explored in the context of a clinical energy medicine pilot study involving 17 practitioners and 190 participants. In a “direct” test, samples of water were directly treated by the practitioners; in an “indirect” test, aliquots attached to lanyards were worn by practitioners and participants as they were engaged in healing sessions. Samples of laboratory-grade distilled water and Fiji brand water were used in the tests, and the water was analyzed using an Attenuated Total Reflection (ATR) Fourier Transform Infrared (FTIR) spectrometer equipped with a liquid nitrogen-cooled detector. The comparison of interest was the ensemble average spectrum recorded during pre- vs. post-intentional healing periods in the primary infrared absorption portion of the water spectrum.

The analyses indicated that distilled water directly treated by the practitioners resulted in a change in the H–O bond at the wavenumber 3200 cm^{-1} ($p < 0.03$, two-tailed). No effect was observed with the Fiji water. The distilled water in aliquots worn by practitioners also resulted in a significant change at the same wavenumber ($p = 0.0004$, two-tailed). No effects were observed in Fiji water aliquots worn by practitioners or participants, or in distilled water worn by participants.

This study contributes to previously reported observations suggesting that the structure of water reacts in an anomalous way to healing intentions. Such effects appear to involve some form of energetic influence, but that is not yet well established. Nor is it certain that the observed effect can only be due to intention; it is conceivable, for example, that an unidentified environmental factor may have been responsible for the observed comparisons. However, given similar results observed in several experiments so far, including the present study, further research seems warranted.

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Introduction

Water is H₂O, hydrogen two parts, oxygen one, but there is also a third thing that makes it water and nobody knows what it is. – D H Lawrence (1885–1930)

The idea that water might be influenced by human intention has been experimentally explored since the 1960s.^{1,2} A prime motivation for these studies is that the adult human body is composed of about 70% water, thus investigators interested in studying the effects of energy medicine and similar healing modalities have used water as a convenient proxy for the body.³ Another motivation may be that while water is ubiquitous and essential for life, it is also one of the least understood liquids, with over 50 anomalous properties, including its phases, density, material, thermodynamic, and physical properties.⁴

Methods used to study intentional effects on water have included (a) assessing the aesthetics of frozen water crystals,^{5–7} (b) examining the residue of evaporated water drops,⁸ (c) using differential electrochemical impedance spectroscopy,⁹ (d) measuring changes in plants hydrated with intentionally treated water,^{10,11} (e) collecting subjective mood assessments while individuals consume intentionally treated tea or wine,^{12,13} (f) measuring structural changes via scattered laser light,¹⁴ and the motivation for the present study, (g) measuring changes in molecular bonds by the absorption of infrared light.^{15–17} The preponderance of evidence from these studies suggests that to a small magnitude, but statistically significant degree, water is affected by intention.

In the most recent relevant study using infrared spectroscopy, aliquots filled with water were taped to the hands of energy medicine practitioners while they were engaged in treatment sessions.¹⁵ A multi-bounce attenuated total reflection Fourier transform infrared (ATR-FTIR) spectrometer was used to examine the water. This type of

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instrument sends a beam of infrared light a fraction of a micron into the surface of a sample of water, where it reflects multiple times between the water and a crystal with a high refractive index.¹⁸ The light produced by this process, called an “evanescence wave,” is absorbed by resonance with vibrations in the water’s molecular bonds. The resulting absorption spectrum reveals information about the molecular structure of water. The results of that study suggested that healing intention was correlated with a change in the hydrogen-oxygen (H—O) covalent bonds at the primary infrared absorption spectral band, from 3200 cm^{-1} to 3400 cm^{-1} wavenumbers.¹⁵ That range is associated with stretching of the H—O bonds.

The cause of this stretching effect, or possibly a bond-breaking and reforming effect, and its possible relevance to understanding the mechanisms of energy medicine, remains uncertain. But based on the earlier study’s observations, as well as similar results reported in previous experiments, the purpose of the present study was to again explore the possibility that H—O bonds in that same region would change as a result of exposure to healing intention. To do this, we invited energy medicine practitioners to directly “heal” samples of water. We also asked those practitioners and recipients of healing intention to wear aliquots attached to nonmetallic lanyards during the healing intention sessions. In each case, we obtained pre-session and post-session water samples, and we determined the infrared spectrum for each sample. Then we created normalized ensemble averages of the spectra and compared the pre- vs. post-session results at the aforesaid location of the infrared spectrum. The research question was straightforward: Did the molecular structure of water change as a result of direct or indirect healing intentions?

Method

The detailed methods for the clinical trial, in which these water tests played a small role, are presented in an accompanying paper in this issue of the journal. In brief, 17 energy medicine practitioners performed a half-hour treatment session on 190 participants who presented with hand and wrist pain. A series of measurements were taken during the experiment to explore the effects of healing intention on various subjective and objective outcomes.

Instrument and water

To measure changes in the molecular structure of water we used a ThermoFisher Nicolet iS20 FTIR Spectrometer with a Zinc Selenide multi-bounce hATR (horizontal attenuated total reflection) module and a liquid nitrogen cooled DTGS (deuterated triglycine sulfate) detector. The spectrometer was programmed to repeat each spectral sweep 32 times and to return the average spectrum. The spectrum was extracted into csv files using Omnic v 9.2 software.

The water used in the study were from bottles of Fiji brand water (purchased from a Safeway grocery store in Petaluma, California) and laboratory reagent grade distilled water (RPI Research Products International, Mt. Prospect, IL; Lot 82901-83714). Each analysis required only a few drops of water. Fresh distilled water was used to clean the DTGS crystal between each sample scan, and a new background scan (also averaged over 32 sweeps) was taken before each sample to account for possible changes in ambient atmospheric conditions.

The spectrometer was located about 10 feet from the chamber where the practitioners performed their treatments for the Indirect test, and about 6 feet from a table where the Direct test was performed. The water samples were transported from the chamber to the spectrometer in a plastic rack.

Direct test

Two types of tests were conducted: direct and indirect. The *direct* test invited practitioners to directly influence a vial of water for

10 min. The vial was placed on a table and the seated practitioner attempted to “treat” it in a manner similar to how they would treat a participant, but without touching the vial. Another vial containing water from the same source was placed out of sight, about 6 feet away from the first vial, to provide a no-influence control. This test was conducted once by each practitioner for each type of water. The experimental and control vials were prepared for analysis immediately after the treatment period by placing them in the same water bath at room temperature for 20 min, ensuring that they were at a uniform temperature before analysis.

Indirect test

For the *indirect* test, practitioners and participants each wore 1 ml aliquots attached to non-metallic lanyards during the treatment sessions. A few drops of water from each aliquot were taken before the session and set aside as a pre-test control. Immediately after the session, another few drops were taken from the same aliquot for measurement as a post-session sample. Both pre- and post-session samples were placed in the same water bath for 20 min, and then the spectroscopic analyses were conducted. The order of the pre- and post-session analyses, i.e., which sample was analyzed first, was counterbalanced so that half of the sessions used the order pre-post, and the other half used post-pre. For the first two practitioners, the lanyard worn by both practitioners and participants had two aliquots, one with Fiji water and the other with distilled water. The workload required to analyze eight water samples per session (each person had two pre- and two post-session samples) was found to be burdensome, so for the next eight practitioners only Fiji water aliquots were used, and for the remainder of the practitioners only distilled water aliquots were used. It should be noted that the analyst who operated the spectrometer was aware of the conditions of the water (i.e. pre-post, Fiji vs. distilled, direct vs. indirect).

Analysis

All analyses were performed using custom scripts written in Matlab (version R2020a, Mathworks, Natick, MA). Perhaps the most common application of spectroscopy is to determine the molecular composition of a sample, which is accomplished by examining the location of the spectrum’s peaks and troughs. But a different approach can be used to determine how the structure of a sample changes as a result of being exposed to an external influence, for example, heat.¹⁹ In our case, we were interested in how exposure to intentional healing might influence the principal infrared absorption band of water, which is associated with H—O bond stretching (wavenumbers 3200 cm^{-1} to 3400 cm^{-1}).²⁰ To evaluate the pre- vs. post-session spectra, an ensemble average spectrum was formed for all spectra within each condition: type (pre vs. post), water (Fiji, distilled), and in the case of the indirect tests, the person wearing the aliquot (practitioner, participant).

Because the magnitude of spectra can vary from one spectrographic sweep to the next (see Fig. 1 left), to determine the ensemble average each spectral array (i.e., a single spectrum formed by the average of 32 successive sweeps) was first z-score normalized to ensure that when creating the ensemble mean the values of each array would be weighted the same (i.e. $z = (x-\mu)/\sigma$, where x is the value of each sample in the array, and μ and σ are the mean and standard deviations of the entire array, respectively). Then each array was inspected to ensure that it was a transmittance spectrum rather than an absorption spectrum (the spectrometer occasionally returned absorption spectra). These two types of spectra provide the same information, the only difference being that the y-axes are inverted. The transmittance curve was arbitrarily selected for use in this analysis; the absorption curve would have resulted in the same statistical result with inverted signs. Note that the variation in peaks at the

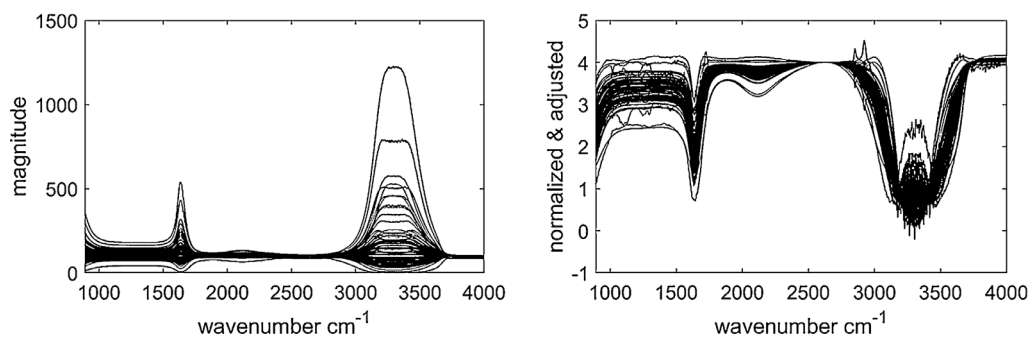


Fig. 1. (Left). Spectra (each an average of 32 sweeps) returned from the spectrometer for the indirect test involving the practitioner and distilled water samples (Right). Same data after normalization, adjusting the vertical axis to uniformly provide transmittance spectra, and clamping at the maximum transmittance wavenumber (2600 cm^{-1}) for water.

Table 1

Nonparametric comparisons between pre and post energy medicine sessions at wavenumber 3200 cm^{-1} in terms of z and two-tailed p -values, and number of significant comparisons surviving multiple comparisons at $p < 0.05$ within the H—O bond stretching band from 3200 cm^{-1} to 3400 cm^{-1} .

Test	Practitioner or Participant	paired samples	water type	significant results out of 417 comparisons	ranksum or signed rank z	effect size (z/\sqrt{N}) at 3200 cm^{-1}	p (two-tail)
Indirect	Part	104	Distilled	0	0.13	0.01	0.90
Indirect	Pract	107	Distilled	413 (99%)	-3.57	-0.32	0.0004**
Indirect	Part	123	Fiji	0	0.30	0.03	0.76
Indirect	Pract	122	Fiji	0	1.87	0.17	0.06
Direct	Pract	17	Distilled	352 (84%)	-2.20	-0.53	0.03*
Direct	Pract	17	Fiji	0	-0.34	-0.08	0.73

** Survives FDR correction for six comparisons at $p < 0.05$.

* Individually significant at $p < 0.05$, but does not survive FDR correction for six comparisons.

H—O band in Fig. 1 (left) suggested that fluctuations in ambient carbon dioxide gas (in the water and/or the air) may have introduced noise into those measurements.

The next step was to adjust the baseline of each normalized spectrum so the wavenumber at the maximum transmittance of water (2600 cm^{-1} , based on the infrared spectrum for water provided by the US National Institutes of Standards^{20,21}) was the same for each array (Fig. 1, right). To perform this adjustment, each normalized spectrum was raised or lowered so the value of the spectrum at 2600 cm^{-1} was clamped to the constant 4.0. This constant was arbitrarily selected so that all values of the normalized spectrum would be positive, but any constant would have resulted in the same statistical outcome.

For the indirect test, the pre vs. post ensemble means were compared using a Wilcoxon signed rank test, a nonparametric analog of a paired t -test (Matlab 2020b *signrank* function). A paired test was deemed appropriate because water from the same aliquot was measured twice (i.e., pre-treatment vs post-treatment). For the direct test, the ensemble means were compared using a Mann-Whitney U test, a nonparametric analog of an unpaired t -test (Matlab 2020b *ranksum* function). An unpaired test was deemed appropriate because the water used in the test was obtained from the same source, but the comparison was between samples placed in two separate test-tubes.

This analytical approach was capable of comparing all wavenumbers across the spectrum, but only the portion of the spectrum associated with H—O bond stretching was of interest, as this was the range that previous studies had focused upon. We considered all pairs of comparisons within that range and adjusted the results for multiple comparisons using the False Discovery Rate (FDR) algorithm.²² For simplicity in reporting the results, we also considered just the difference observed at wavenumber 3200 cm^{-1} .

Hypothesis

The hypothesis for both the direct and indirect tests was that the H—O bonds in the spectroscopic band associated with bond

stretching would differ when samples were compared pre- vs. post-healing intention. Because no directional change was specified, two-tailed p -values were employed.

Results

Table 1 shows that two of the six tests showed statistically significant differences when examining the transmittance values at wavenumber 3200 cm^{-1} . One of those six tests survived FDR correction for (six) multiple comparisons. That result was the indirect aliquot test by practitioners using distilled water ($z = -3.57$, $p < 0.0004$, two-tailed). The negative z score indicates that on average the pre-session transmittance was less than the post-session transmittance, or put another way, less infrared energy was absorbed. This suggests that the H—O bonds were altered due to the energy medicine treatments. The other test that was significant but did not survive FDR correction was also contributed by practitioners in the direct test, again using

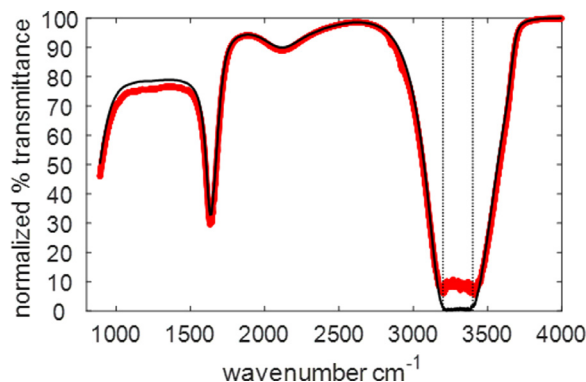


Fig. 2. Mean spectra for the indirect test with pre-test (black line) and post-test (red line) distilled water worn by the energy medicine practitioner. The dotted vertical lines represent the principal absorption band associated with H—O bond stretching.

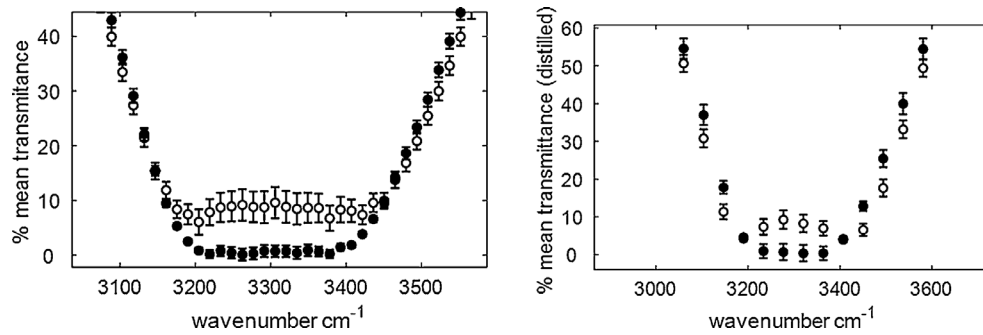


Fig. 3. (Left) Means and one standard error bars from the curves in Fig. 2, focusing on the area of principal H—O stretching, from wavenumbers 3200 cm^{-1} to 3400 cm^{-1} . The black dots are pre-test distilled water and the white dots are post-test distilled water from the same aliquot worn by practitioners. For ease in visualization, these data were downsampled by a factor of 30. (Right) Practitioner direct test results with distilled water. These data were downsampled by a factor of 60.

distilled water. Table 1 also shows that when considering all wavenumbers compared from 3200 cm^{-1} to 3400 cm^{-1} (this amounted to 417 tests given that the resolution of the spectrometer was 1.97 cm^{-1}), that 413 (99%) of those comparisons remained significant at $p < 0.05$ after FDR correction in the data for practitioners performing the indirect test with distilled water, and similarly 352 (84%) tests were significant after correction for the practitioners performing the direct test with distilled water.

Fig. 2 shows the mean ensemble spectra for the practitioners' indirect test with distilled water. Fig. 3 (left) provides a closer look at the H—O bond stretching portion of the spectrum, from wavenumbers 3100 cm^{-1} to 3500 cm^{-1} , in terms of means and one standard error bars, and Fig. 3 (right) provides a similar view for the practitioners' direct test with distilled water.

Discussion

This study successfully replicated previously reported experiments suggesting that certain properties of water change when exposed to healing intention. In the present case, H—O covalent bonds were apparently influenced in such a way that distilled water absorbed significantly less infrared energy in the bond stretching region of the spectrum. Notice that the effect sizes for distilled water treated by the practitioners suggest that the magnitude of the effect in the direct test was more robust ($es = -0.53$) than in the indirect test ($es = -0.32$), and thus the p -values associated with those tests primarily reflect differences in sample size.

It is unknown why these effects only appeared for water in proximity to or directly influenced by the practitioners, and not in water near the participants, but such observations do add to a body of evidence indicating that water may be a useful marker for appears to be an “energetic influence” associated with healing intention. That said, the use of quotes around words like *energetic* and *influence* highlight the fact that we do not know if the observed effects are causal in the usual sense of “influence,” nor if they are due to a form of energy as that word is commonly used in physics. It is also the case that hydrogen and oxygen in water interact in enormously complex ways, so what is observed using present spectrographic methods can at best hint only indirectly at the underlying mechanisms.

One observation that may be useful in designing future studies is that the Fiji water in our study did not show any significant effects. This may be because a more uniform substance, like distilled water, introduces less distortion into the spectrum as compared to commercial sources of spring water, which may obscure the “signal” of interest through added minerals. This speculation is supported by comparison of the mean spectra for all pre-session distilled vs. pre-session Fiji water samples in the indirect task. A Mann-Whitney U test within the primary infrared absorption band (3200 cm^{-1} to 3400 cm^{-1}) showed significant differences throughout that entire range at $p < 0.01$ after correction for multiple comparisons. The direction of

those differences indicated that distilled water showed greater absorption of infrared in the H—O bond stretching region than the Fiji water. The same comparison applied to post-session samples showed effects in the same direction, but those tests did not survive correction for multiple comparisons.

Given these results, to possibly enhance the ability to detect the effects of healing intention in future experiments based on spectroscopy, it may be useful to employ ultra-pure water, otherwise known as ASTM (American Society for Testing and Materials) Type I water. In addition, it might be interesting to have practitioners and participants both wear multiple aliquots distributed at different points around their bodies. This might provide the equivalent of a topographic map of the healing effect. It could also be useful to periodically test samples of the post-session water to see how observed differences persist over time, to explore the effects of “dose” by repeatedly exposing the same water samples to healing intention, and to employ a negative control protocol to test for possible systematic measurement errors.

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Data repository: Open Science Framework

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