Advance Access Publication 25 October 2007

eCAM 2009;6(3)379–391
doi:10.1093/ecam/nem102

Original Article

How Far Can Ki-energy Reach?—A Hypothetical Mechanism for the Generation and Transmission of Ki-energy

S. Tsuyoshi Ohnishi[1] and Tomoko Ohnishi[2]

[1]Philadelphia Biomedical Research Institute, King of Prussia, PA 19406 and [2]Department of Biochemistry and Biophysics, University of Pennsylvania School of Medicine, Philadelphia, PA 19104, USA

'Ki-energy', which can be enhanced through the practice of Nishino Breathing Method, was reported to have beneficial health effects. Although Ki-energy can play an important role in complementary and alternative medicine (CAM), as yet it is unknown how Ki-energy is generated, transmitted through air and received by another individual. We previously proposed that Ki-energy may include near-infrared radiation, and that the wavelength was between 800 and 2700 nm. Since Ki-energy is reflected by a mirror, we believe that the 'Ki-beam' has a small divergence angle. It can also be guided in a desired direction. The acrylic mirror reflection experiment suggests that the wavelength may be between 800 and 1600 nm. Using a linear variable interference filter, we found that Ki-energy may have a peak around 1000 nm. We have also observed that 'sensitive' practitioners responded to Ki sent from a distance of 100 m. All of these results suggest that (i) Ki-energy can be guided as a directional 'beam' with a small divergence angle; (ii) the beam can be reflected by a mirror and (iii) Ki-energy may have a specific wavelength. Since these properties are characteristics of the laser radiation, we propose a quantum physics-based mechanism of 'Light Amplification by the Stimulated Emission of Radiation' (i.e. LASER) for the generation of Ki-energy. Volunteers responded to Ki even with a blindfold. This suggests that the skin must be detecting Ki-energy. We propose that the detector at the skin level may also have the stimulated emission mechanism, which amplifies the weak incident infrared radiation.

Keywords: Ki as an infrared laser radiation – Ki detector at the skin level – Ki energy – Ki pumping – Ki reflection by a mirror – Ki wavelength – Nishino breathing method – population inversion of electrons – stimulated emission – Taiki practice

Introduction

In China, Qi has been known for 4000 years. In Japanese literature, the documentation of Ki (Japanese equivalent of Qi) goes back 1500 years (1). This is not limited to the East. In the West, Biblical literature suggests that curing sickness by extending a hand was practiced by a gifted individual. Since then, thousands of accounts have been published, and millions of people have talked about Qi-energy or Ki-energy. Practical, clinical, philosophical and scientific studies have been actively reported in journals of complementary and alternative medicine (CAM) (2–13). However, no reasonable mechanism, which can be examined or refuted from the scientific point of view, has been presented.

Without having a scientific model, we cannot advance the research. Therefore, we will present in this article a hypothetical model for the mechanism of how Ki-energy is generated, transmitted through air and received by another individual. Obviously, this model is still preliminary, and it needs further

For reprints and all correspondence: S. Tsuyoshi Ohnishi, PhD, Philadelphia Biomedical Research Institute, Suite 250, 100 Ross Road, King of Prussia, PA 19406-0227, USA. Tel: +1-610-688-6276; Fax: +1-610-254-9332; E-mail: stohnishi @ aol.com

rigorous investigation. However, we decided to present this model for two reasons, namely, (i) currently there is no model to explain how Ki-energy is generated and transmitted through air and (ii) we hoped that the presentation of our model will stimulate the progress of scientific investigation of Ki-energy.

Since both of the authors have practiced Ki at the school of the Nishino Breathing Method (NBM) in Japan under the instruction of Master Kozo Nishino, our topics are limited to Ki which is generated by his method (14–19). It has been known for 20 years that the practitioners of Ki experienced beneficial health effects (20–22). It was shown that the practice increased immune activity and decreased the stress level of the practitioners (23). From the collaboration with Master Nishino, we showed that 'Ki' is not a paranormal or parapsychological phenomenon, but a natural phenomenon. Using established biochemical and cellular models, we demonstrated that Ki inhibited cultured cancer cell division (24), it protected isolated rat liver mitochondria from oxidative injury (25), and it may have a beneficial effects on osteoporosis (26).

One of the unique methods that was developed by Nishino is called the Taiki-practice. It is a method of enhancing the level of a students' Ki through Ki-communication between an instructor and a student. When Nishino emits his Ki in the Taiki-practice, many of his students respond to it with various body movements. They jump, step back, run or roll on the floor (15,20,21). By analyzing his Taiki-practice, and by performing experiments, we came to the conclusion that Ki emitted by him or by others carries Ki-information. These students receive the information and perform various body movements in response. Therefore, we proposed that the healing effects of Ki may be related to (i) an energy aspect '*E*' and (ii) an information aspect (or an entropy aspect) '*S*' of Ki (27,28).

An interesting observation from the standpoint of CAM was that the Ki-energy, which inhibits cell division of cultured cancer cells (24) or protects isolated mitochondria from oxidative injury (25), was the same as that which could move other individuals in the Taiki-practice (27). This suggests that the training gained from the Taiki-practice may produce beneficial health effects. This is the reason why we are studying the mechanism behind the Taiki-practice.

We observed that the propagation of Ki could be inhibited by a black vinyl curtain, a black acrylic plate, aluminum foil and a visible range optical filter (360–760 nm), but it was not inhibited by a near-infrared filter (800–2700 nm)(24,25,27). Therefore, an energy aspect of Ki seems to be represented by near-infrared radiation. In order to build a model, we analyzed various properties of Ki-energy by using the Taiki-reaction. In brief: one of the authors (STO) emitted Ki toward a volunteer, and we measured the time between the start of emitting Ki and the time when the volunteer made a significant body motion. We made several measurements under each condition and analyzed the data using statistical technique. In other words, we used a human being as a 'detector device' for Ki-energy.

Since we used a human as a 'device,' our greatest concern was how to avoid human error, because humans are always prone to feeling, emotion, psychological conditions and hypnotic suggestion. In order to avoid these problems, we set up the following rules: (i) we chose volunteers who are very sensitive to Ki emitted by STO. We used volunteers who can respond to his Ki with an unmistakable body motion (for example, fall down or run backward) so that multiple individuals can identify it as a true 'response' to Ki. (ii) When we tested an individual, if his or her response was weak or not clear, we did not use that individual for further testing. (iii) With a stop watch, we measured the time intervals between the onset of Ki-exposure and the time when the volunteer started a significant body motion. We made several measurements, and calculated the mean and the standard deviation. By adopting these criteria, we believe that we were able to avoid situations in which a subject's response might have been based upon some ambiguous 'feeling' or 'emotion.' We will describe in this article how we tried to avoid these factors and searched for the essence of Ki-phenomena in order to build a quantum physics model for Ki-energy.

Materials and Methods

Volunteers

The project was approved by the ethical committee of the Philadelphia Biomedical Research Institute. All volunteers read the consent form and signed it before participating in the project.

Four students and one ex-student (who practiced several years ago) of the Osaka School of the NBM, who happened to be very sensitive to Ki emitted by one of the authors (STO), participated. Since their response was very clear (a vigorous step backward), it was easy to measure the time between the onset of Ki-emission and the time of the start of their body movement with a stopwatch. The time interval ranged from about one second to several seconds. This may be as much as an order of magnitude greater than physiologic response time of an observer who operated a stopwatch. For each test, we performed several experiments and calculated the mean and the standard deviation.

Methods of Giving a Signal to the Observer

In order to send the signal of starting Ki-emission to both the Ki-emitter and the stopwatch operator, one of the following three methods was used.

(i) Hand signal: An assistant, who stood behind the volunteer, raised a hand, waved for three seconds and quickly swung down.

(ii) A push-button event marker: For indoor experiments, we built a simple battery operated device which turned on two LED's (light emitting diodes) when the Ki-emitter pushed the button. One LED was used by the observer who operated the stop-watch, and the other was mounted near the edge of the lens of a digital camcorder (see Fig. 1A–C).

(iii) Light signal triggered by a delay-timer: In some experiments, the light signal was produced by a powerful battery-operated light (with a lamp of 6V $\times$ 0.7A). A circular cam was mounted on a spring-driven 'delay-timer' (which was once used for taking a self portrait). As shown in Fig. 2A and B, the signal was produced by means of the rotation of the cam actuating a micro-switch. This gadget produced a 3 s-long preliminary signal followed by a one-second off-signal and then, a one-second on-signal. Ki was sent at the start of the one-second on-signal. Since the light beam was strong and well collimated, the light signals could be easily seen at 200 m in daylight. By changing the setting of the delay timer cam, the start of the signal was randomized between 5 and 15 s. This randomization of the timing helped to avoid a psychological expectation effect for the volunteer, because he/she did not know when the Ki was sent. We put a small mirror in front of the light to reflect a part of the beam to the stopwatch operator and the camcorder (Fig. 2A and D).

Mirrors used for Ki-reflection Experiments

A glass mirror ($20 \times 30 \times 0.3\,cm^3$) was used to reflect the Ki-beam by 60° in an indoor test, and an acrylic mirror ($40 \times 55 \times 0.3\,cm^3$) was used to reflect by 90° in outdoor tests (Fig. 3A and B). Both mirrors are back coated. When Ki-energy was reflected by these mirrors, the length of the optical paths inside glass and acrylic mirrors were 6.9 and 8.5 mm, respectively.

Transmittance Spectra of Glass and Acrylic Plates in the Near-infrared Region

Since Ki-energy passes through the mirror materials (glass or acrylic) when it is reflected, it is important to know how much is absorbed by these materials. For that purpose, we obtained transparent glass (6.5 mm thick) and acrylic (9 mm thick) plates. The thickness of these plates was very close to the actual path length of the Ki-beam in the mirrors. The transmittance spectra of these plates in the near-infrared region (Fig. 4) were measured with a Bruker infrared spectrophotometer (ISP-66v/S by Dr K.S. Reddy at the Dept. of Biochemistry/Biophysics, University of Pennsylvania School of Medicine).

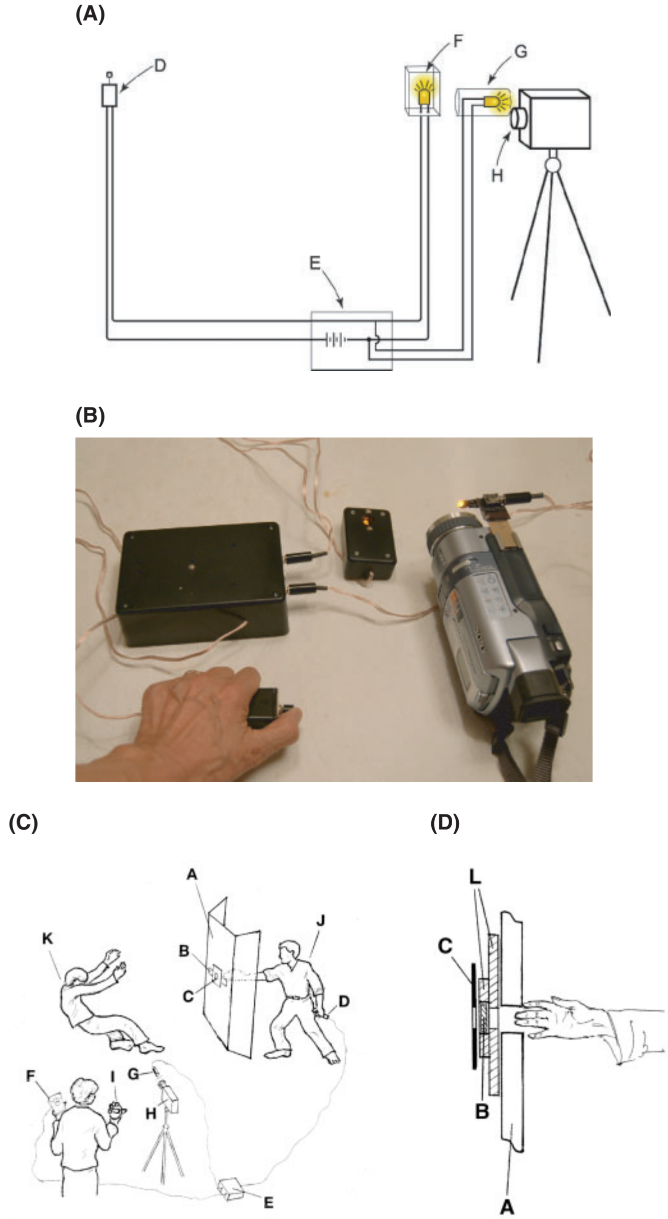

Figure 1. (**A**) Circuit diagram for the push-button switch device to turn on and off LED's. D, hand-held push button; E, battery box; F, LED to be used by a stop-watch operator; G, LED mounted near the edge of the camcorder lens; H, camcorder. (**B**) Left front, Push-button switch; left back, battery box; middle, LED in a box to be held by the stopwatch operator; right, LED placed near the edge of a camcorder lens. (**C**) An example of the set-up in which the push-button switch was used. A, infrared radiation shield; B, linear variable filter; C, aluminum slit; I, stopwatch; J, Ki-emitter; K; Ki-receiver. From D to H are the same as shown above. (**D**) The linear variable interference filter is mounted at the center piece of the infrared radiation shield. C, aluminum plate in front of the filter with a slit of 3 mm wide and 22 mm high; L, black acrylic plate. See text for further details.

Linear Variable Interference Filter

By sliding the linear variable interference filter (400–1100 nm; Edmond Optics; Barrington, NJ) over a slit (3 mm wide $\times$ 22 mm high), the transmission wavelength was changed from 700 to 1100 nm.

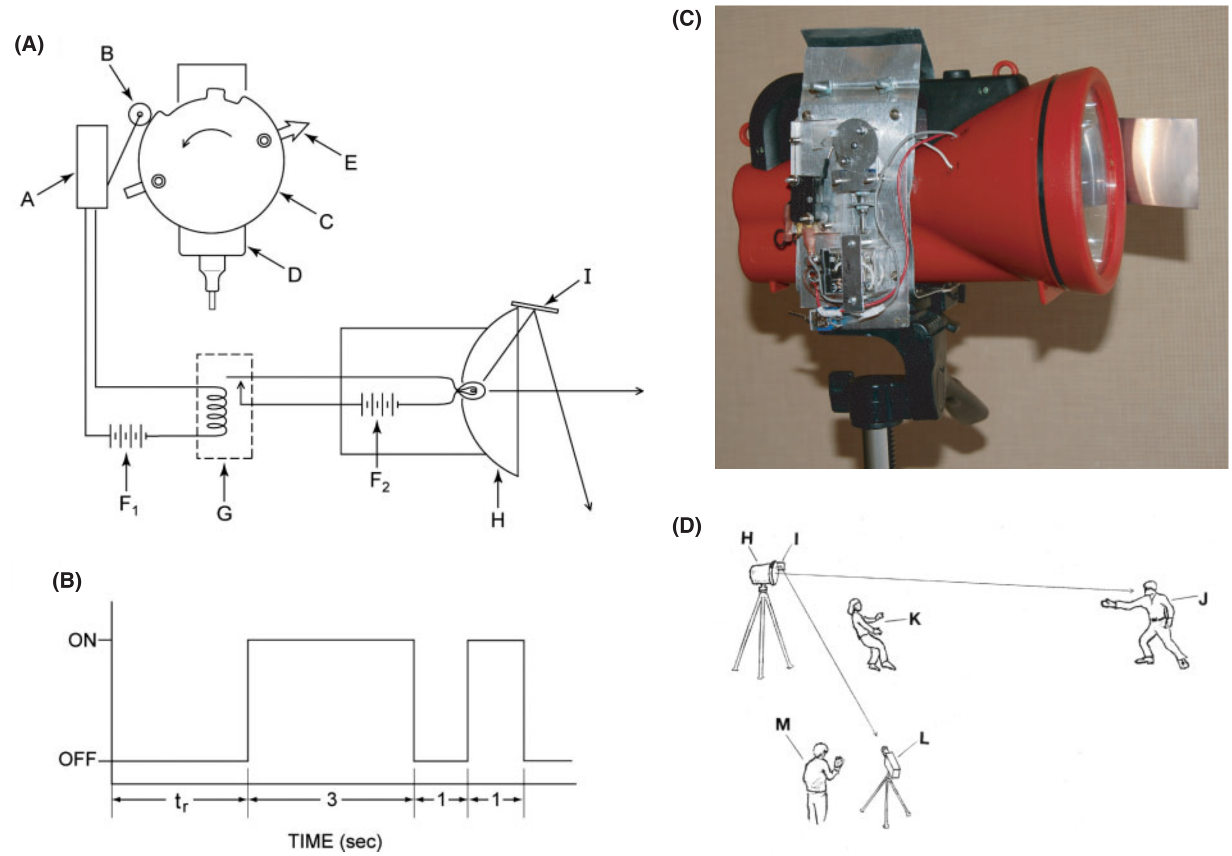

Figure 2. (**A**) Circuit diagram for the delaytimer-driven cam/microswitch device to turn on and off a strong collimated light. A, microswitch; B, roller; C, cam; D, delay timer; E, delay-timer pointer; F_1, battery for a relay; F_2, battery for the light; G, relay; H, lamp reflector; I, small reflecting mirror. (**B**) The pattern of the light-signal from the light. The time interval (t_r) from the start and the first 3 s signal can be randomized from 5 to 15 s by changing the rotation angle of the delay-timer pointer. After the 3 s on-signal, there is a 1 s off-signal followed by 1 s on-signal, which was used as the sign to send Ki. (**C**) Delay-timer controlled light and a small reflecting mirror. (**D**) An example of the set-up for straight line experiment in which the delay-timer controlled light was used. I, a small mirror which gives a light signal to both the stopwatch operator and the camcorder; J, Ki-emitter; K, Ki-receiver, L, camcorder; M, stopwatch operator.

The change occurs linearly with the position of the filter. The half bandwidth (the bandwidth of a transmission peak where the intensity is the a half of the peak value) was 50 nm according to the manufacturer's catalog. The wavelength was calibrated with two diode lasers (637 and 785 nm; Edmond Optics) and also with a monochromatic light, which was produced by putting a fixed interference filter (diameter ½ in.; wavelength 450, 470, 500, 560, 670, 700 nm; Edmond Optics) in front of a pencil-type incandescent flash light.

Infrared Radiation Shield

We shielded the body of the Ki-emitter with an infrared blocking wall (Super Tuff-R^{TM} heat insulator; Dow Chemical Co, Midland, MI, which is made of 12 mm thick polyisocyanureate covered by aluminum foil on both sides). As shown in Fig. 1C, three sides of the emitter's body were blocked by panels of this heat insulator. On the center piece, a hole (15 mm wide and 30 mm high) was made to which two fingers could be inserted (Fig. 1D). Over the hole, a black acrylic plate (thickness 6 mm) was mounted, on which the linear variable interference filter was attached. Over the filter, a 1mm thick aluminum plate with a slit (3 mm wide and 22 mm high) was placed. Ki was emitted from the middle and ring fingers through the hole, and then, it passes through the filter and the slit and reaches the Ki-receiver (Fig. 1C and D).

Camera

We used a Nikon digital camera model D-50 which has the feature of taking serial shots every 0.4 s.

Camrecorder

We used a Sony Digital Camcorder TRV340 for recording the body movement of the Ki-receivers.

Timing Devices

The time interval between the start of sending Ki by the emitter and the volunteer's response was measured with a digital stop-watch (Casio, Japan).

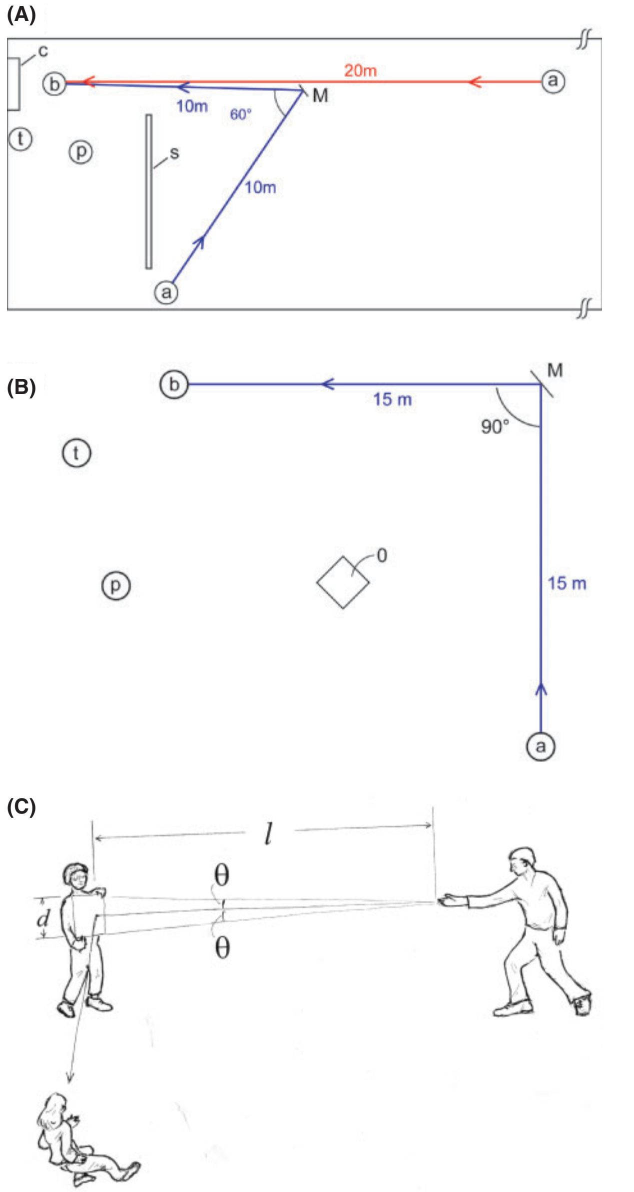

Figure 3. (**A**) Room set-up for the indoor experiments. The conference room (30 × 11 m) had partitioning made of sliding panels (s). We arranged those panels as shown in this figure so that in the mirror reflection experiment (the path of the Ki-beam is indicated in blue), the Ki-receiver (b) could not see the Ki-emitter (a). The angle of reflection was 60°. For the straight-line 20 m experiment, the path of the Ki-beam is indicated in red. Person (t) gave a hand signal to the Ki-emitter to start sending Ki. This person also measured the time-interval between the signal and the Ki-receiver's response with a digital stopwatch. Person (p) took a photograph. The symbol (c) indicates the safety cushion, and (M) a glass mirror (20 × 30 × 0.3 cm). (**B**) In outdoor mirror reflection experiments at Sumiyoshi Park, we chose a configuration in which a large statue base (o) is placed between the Ki-emitter (a) and Ki-receiver (b) so that they could not see each other directly. A plastic mirror (M; 40 × 55 × 0.3 cm) was held by TM. (t) was the stopwatch operator, and (p) the photographer. (**C**) Estimation of the divergence angle θ of the 'Ki-beam' in the mirror reflection experiment. l shows the distance between the Ki-emitter and the mirror holder, and d the height of the mirror.

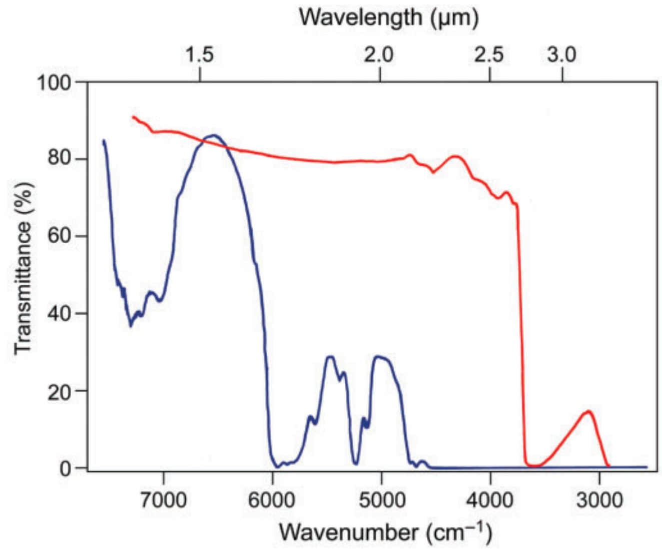

Figure 4. Transmittance spectra of glass (6.5 mm thick; red line) and acrylic (9 mm thick; blue line) plates in the near-infrared region.

Statistical Analysis

Data were expressed as the mean ± SD (calculated from several measurements). The significance of the difference between two groups was determined by the Student's *t*-test, and the differences between multigroups by ANOVA with Fisher's PLSD. Calculations were done using StatView^{TM} software. A difference with $P < 0.05$ was considered to be statistically significant.

Results

Experiments to Show that a Mirror can Reflect Ki

Indoor Experiments

Figure 3A shows the set-up of a conference room ($10 \times 30\,m^2$) which had two partitions with sliding panels in the room. The straight experiments (red line) with a distance of 20 m served as the control for the mirror reflection experiment. The arrangement for the mirror reflection experiment is indicated by the blue lines in Fig. 3A. The distance between the emitter and a glass mirror and that between the mirror and the receiver were both 10 m. The angle of reflection was 60°. We arranged the panels in such a way that the Ki-emitter and the Ki-receiver could not see each other.

Straight Line Experiment

As shown in Fig. 5A, KO was very sensitive to STO's Ki. He jumped backward and fell down when he received Ki from distances of both 2 m and 20 m (see Fig. 5A, A1, A2, B1, B2). At 20 m, the use of blindfold slightly elongated the response time from that without blindfold.

Figure 5. (**A**) Photos show KO's responses toward STO's Ki in the indoor experiments. (For 2 m experiments) A1, before Ki was sent; A2, after Ki was sent. (For 20 m experiments) B1, Ki was sent; B2, after Ki was sent. (For the glass reflection experiments with KO) C1, STO sent Ki toward the mirror; C2, a glass mirror (20×30 cm) was fixed on the table; C3, before Ki was sent; C4, after Ki was sent to the mirror. (**B**) Photos show responses of the Ki-reciever (MH) and the mirror-holder (TM) to STO's Ki. A1, STO on the right side of the picture sent Ki toward an acrylic mirror (40×55 cm) held by TM in the middle. The Ki-receiver (MH) is standing on the left; A2, After about 1.8 s, MH lost a balance; A3, MH started running backward; B1, STO sent Ki to the mirror; B2, As long as TM held the mirror, TM did not feel anything even though MH ran backward; B3, If TM did not hold the mirror, TM fell down on the ground when STO sent Ki to TM. In this case, the Ki-receiver, MH, did not feel anything.

However, as shown in Table 1, the difference was not statistically significant. The difference between (2 m blindfold) and (20 m blindfold) was not significantly different either. This suggests that Ki-phenomenon is not a hypnotic effect. The result also indicated that Ki-energy does not diverge much with the distance.

Mirror Reflection Experiment

A glass mirror ($20 \times 30 \times 0.3\,cm^3$) was used, and the total distance between the Ki-emitter and the Ki-receiver was 20 m. As shown in Fig. 5A, C1, C2, C3, C4 and Table 2 (upper panel), the response time of KO for the mirror experiment was the same as that for the 20 m straight line experiment. This showed that a 'Ki-beam' can be reflected by a glass mirror, and that the efficacy of Ki was not lost by the reflection. As a negative control experiment, we inserted randomly the test in which the Ki-emitter did not send Ki for 15 s. The Ki receiver did not move for 15 s indicating that the body movement is not caused by psychological expectation factors.

Table 1. Response time (s) of KO to STO's Ki in the straight line experiments

Distance	Without blindfold	With blindfold	With blindfold (no Ki)
2 m	1.45 ± 0.15	1.53 ± 0.20	> 15.0
20 m	1.55 ± 0.13	1.84 ± 0.12^{a}	> 15.0

This experiment was conducted at Okayama. Values show the mean ± SD (n = 3).
[a]The value for (20 m with blindfold) was not significantly different from that for (20 m without blindfold) or (2 m with blindfold). When no Ki was sent to the Ki-receiver who wore the blindfold, he did not move for 15 s (n = 3). We interpreted this to mean that Ki caused the body movement.

Table 2. Response time of KO and MH to STO's Ki in the mirror reflection experiments

Distance	Response time (s)
Indoor with KO without blindfold	
20 m straight	1.55 ± 0.13
10 m-mirror-10 m	1.56 ± 0.16
10 m-mirror-10 m (no Ki)	> 15.0
Outdoor with MH with blindfold	
30 m straight	1.83 ± 0.04
15 m-mirror-15 m	1.81 ± 0.08
15 m-mirror-15 m (no Ki)	> 15.0

In the indoor experiment (Upper half), the blindfold was not used. However, the Ki-receiver could not see whether Ki was sent or not from his position because the mirror was so small that it did not reflect the entire body of the Ki-emitter. There is no statistically significant difference between the straight and mirror reflection tests.
In the outdoor experiment (Lower half) conducted at Sumiyoshi Park, MH wore a blindfold in both straight and mirror reflection tests. There is no statistically significant difference between the straight and mirror reflection tests.
In all experiments, values of the response time (s) show the mean ± SD (n = 3). In both experiments, when Ki was not sent, the Ki-receiver did not move for 15 s (n = 3).

Outdoor Experiments

An Acrylic Mirror Helped to Narrow down the Range of Ki-wavelength

Table 2 (lower half) shows that the response times for the straight line and mirror reflection experiments were also the same when these tests were performed at Sumiyoshi Park with MH as a volunteer (Fig. 5B). It is important to mention that an acrylic mirror ($40 \times 55 \times 0.3\,\text{cm}^3$) was used in this reflection experiment. Since the mirror was made with the reflecting coating in the back surface, the incident Ki-energy had to travel inside the acrylic before exiting the mirror. The reflection angle was 90°, and therefore, the light-travel distance was 8.5 mm. The transmittance spectrum of the same materials with a similar thickness (9 mm thick acrylic pate) had a cut-off wavelength around 1600 nm (Fig. 4, blue line). Therefore, it shows that the wavelength of Ki-energy would be shorter than 1600 nm.

Another interesting observation in this experiment was that a person who held the mirror did not receive any Ki-effect (Fig. 5B, B2). This person, TM, was the same person as identified as Ms M in our previous paper [(27); She was very sensitive to Ki, and even if she received Ki at her foot, she fell down]. If the Ki-beam directed to the mirror missed the target and hit her body, she would have fallen down. This suggests that the Ki-beam was only hitting the mirror, but not her body. In other words, a Ki-beam can be guided in the desired direction, and it seems to have a small divergence angle (see Discussion section). In fact, if she did not carry the mirror, she fell down as soon as she received Ki from the emitter (Fig. 5B, B3), while the volunteer MH did not receive any Ki-effect. This also indicates that the 'ki-beam' can be directed to a desired direction.

Experiments to Show that Ki has a Peak Wavelength

We attempted to determine the wavelength of a 'Ki-beam' using a linear variable interference filter with which we can vary the pass wavelength between 400 and 1100 nm (Fig. 6A). For this experiment, we built an infrared radiation shield which covers the front and both sides of the Ki-emitter (Fig. 1C). In the center panel, a black acrylic plate (6mm thick) was mounted. Then, the filter was attached on which an aluminum plate (1 mm thick) with a 3×22 mm slit was placed (Figs 1D and 6B). First, we conducted a test in which the slit opening was covered with an additional 1mm aluminum plate to block infrared radiation. When the Ki-emitter sent Ki to the volunteer KO, he did not react (Fig. 6C). Subsequently, the cover aluminum plate was removed and the wavelength was changed from 800 to 1100 nm by sliding the filter. At each wavelength, the Ki-emitter sent Ki through the aluminum slit for five times, and the time between the start of sending Ki and the time when KO responded with a significant body motion was measured (Figs 6, D1–D3). As shown in Table 3 (center column), the response time had a minimum at around 1000 nm. A similar tests was also performed with Mh, the result of which was similar (Table 3, right column). If we express the 'intensity' of the bean by I_a, and the response time of the volunteer by t_a, then, the total energy W_a (which is required to initiate a response by the volunteer) would be $W_a = I_a \times t_a$. Therefore, the intensity would be expressed by

$$I_a = \frac{W_a}{t_a}$$

In other words, the intensity of the Ki-beam would be inversely proportional to t_a. Figure 7 shows the relationship between the wavelength and the inverse of the response time (which is related to the intensity of the Ki-beam) for two individuals, KO and Mh. The results suggest that the Ki-beam had a peak intensity at around 1000 nm.

Test to Show that the Divergence of the Guided Ki-beam is Small

In order to test how well we can guide Ki in a particular direction, we increased the distance between the emitter and the receiver to 30 and 100 m.

Straight Line Experiment at Daisen Park

Figure 8 shows that KH responded to STO's Ki even from the distance of 100 m.

Straight Line Experiment at Sumiyoshi Park

Table 4 (upper half and lower half) show that both KH and MH responded to STO's Ki at 100 m in a similar manner. On comparing with the response time at 30 m, the one at 100 m increased slightly. However, the statistical differences between values at 30 and 100 m did not quite reach the significant level ($P > 0.1$).

Discussion

Why do we Study the Nature of Ki-energy?

Since the same Ki-energy seems to cause both health-related beneficial effects in *in vitro* laboratory experiments and the body movement in the Taiki-practice (27), we decided to investigate the nature of Ki-energy by

Table 3. Relationship between the Ki-wavelength and the response time (s)

Wavelength (nm)	Response time (s)	
	KO ($n = 8$)	Mh ($n = 5$)
700	–	5.75 ± 0.42
800	8.25 ± 2.94	2.93 ± 0.34
900	3.88 ± 1.00	1.71 ± 0.18
1000	1.17 ± 0.37[a]	0.75 ± 0.12[b]
1100	2.21 ± 0.58	0.94 ± 0.30

The values (s) are shown in the mean ± SD. The wavelength was changed by sliding the linear variable interference filter.
For KO, the data for 700 nm was not taken.
[a]indicates that the value is significantly different from the values at 900 and 1100 nm. [b]indicates that the value is significantly different from the value at 900 nm.

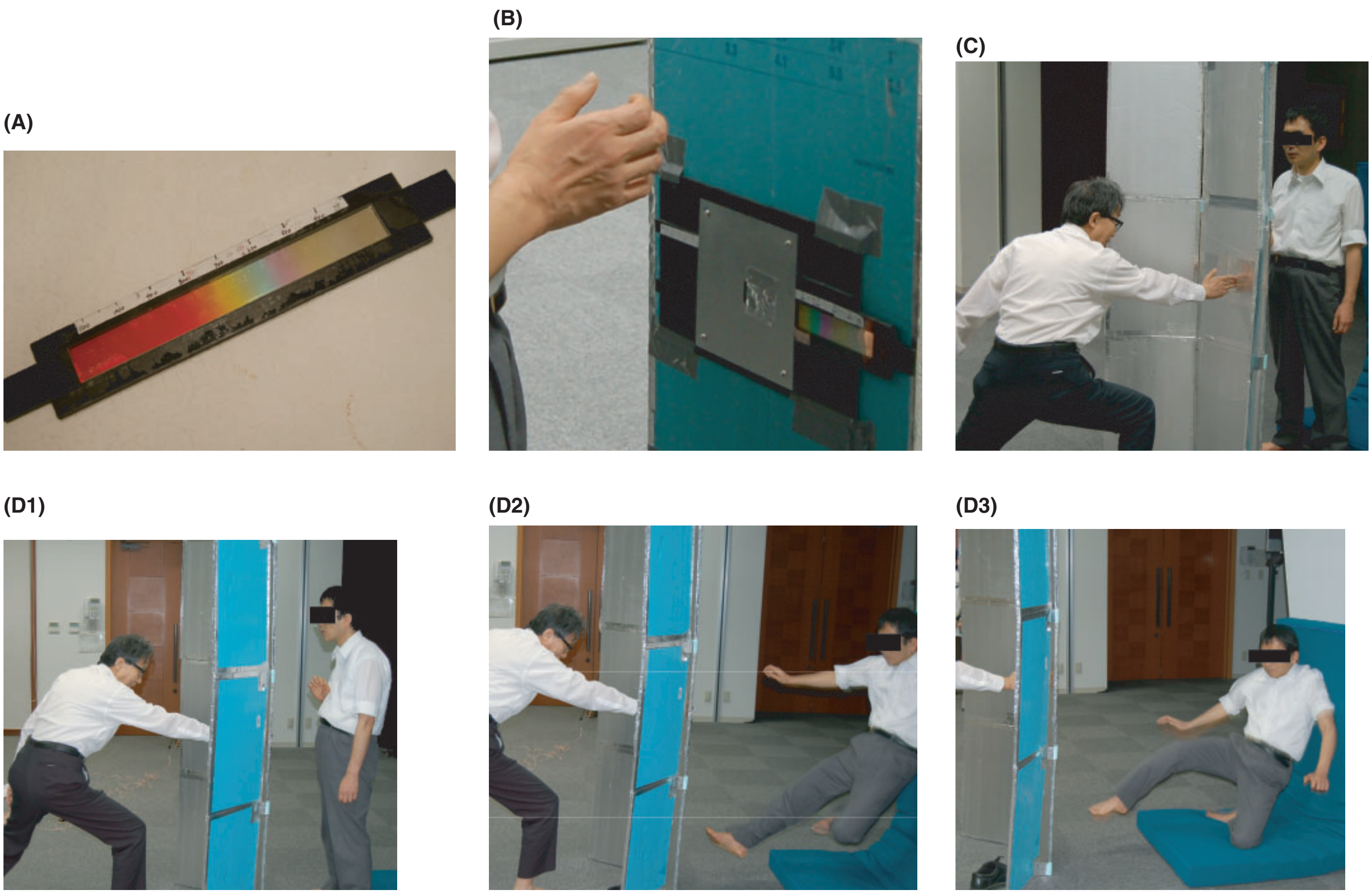

Figure 6. Response of KO in the experiment to determine the wavelength of the 'Ki-beam.' (**A**)Linear variable interference filter (400–1100 nm); (**B**)This picture shows how the filter was mounted; (**C**)When an additional 1mm aluminum plate covered the slit, STO's Ki did not reach KO; (**D1**)When the filter was set at 1000 nm, and STO started to send Ki through the slit; (**D2**)and (**D3**)After about 1 s, KO was struck down on the floor.

analyzing the mechanism behind the Taiki-practice. A popular criticism on the Taiki-practice has been that this must be caused by psychological or hypnotic effect. In order to avoid this criticism, we asked the Ki-receiver in the Taiki-practice to wear a blindfold, and the Ki-emitter sent Ki-energy without touching the Ki-receiver. We observed that the receiver's body moved both with and without the blindfold, indicating that the Taiki-reaction was caused by neither psychological nor hypnotic effects.

We measured the response time between the start of the Ki-emission and the time when the receiver made a substantial body movement. We assumed that the effect of Ki-energy is inversely proportional to the response time. In some volunteers, the response time did not change at all with the use of a blindfold, while in others, the response time was slightly elongated. Although this may be simply caused by variability of the individual sensitivity, the exact reason of this difference is not clear at this point. A possible explanation is that, in some individuals, a psychological effect of watching the movement of the Ki-emitter has a greater effect on his or her response, while in other individuals, it has not. Although further study is needed with more number of volunteers to clarify this issue, our results suggest, at least, that the Taiki-practice is not caused by a hypnotic effect.

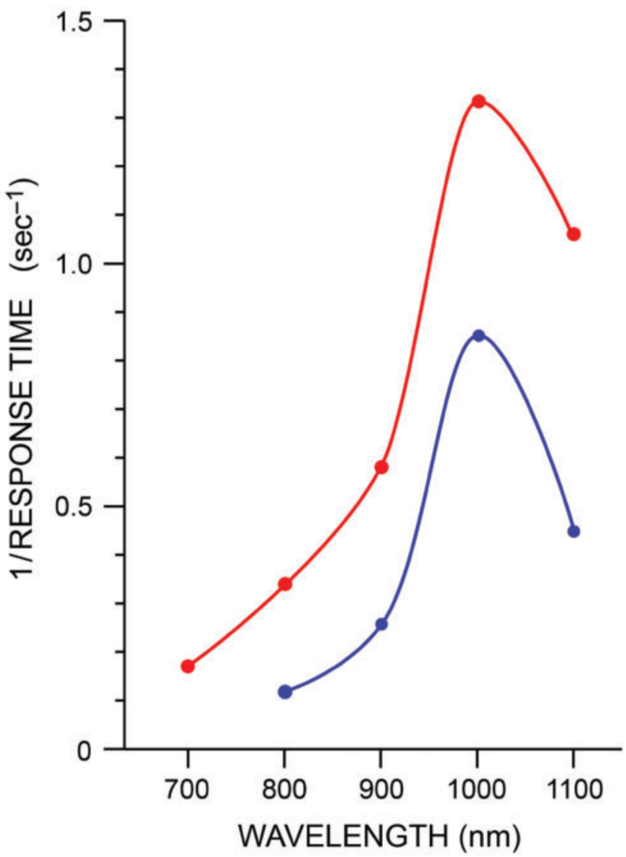

Figure 7. The relationship between the wavelength chosen by the filter and the inverse of the response time t_a. Blue line is for KO and red line for Mh. These data are obtained from those in Table 3. For the sake of simplicity, the error bars were omitted.

Table 4. Response time of KH and MH to STO's Ki in the outdoor straight experiments without a blindfold

Distance	Response time (s)
With KH:	
30 m	1.37 ± 0.13
100m	2.13 ± 0.79[a]
100 m (no Ki)	> 15.0
With MH:	
30 m	1.49 ± 0.04
100 m	1.91 ± 0.45[a]
100 m (no Ki)	> 15.0

The experiment with KH was conducted at Daisen Park. That with MH was performed at Sumiyoshi Park. Values show the mean ± SD (n = 3). When no Ki was sent, the Ki-receiver did not move for 15 s (n = 3).
[a]indicates that the value at 100 m was not significantly different from that at 30 m (P > 0.1).

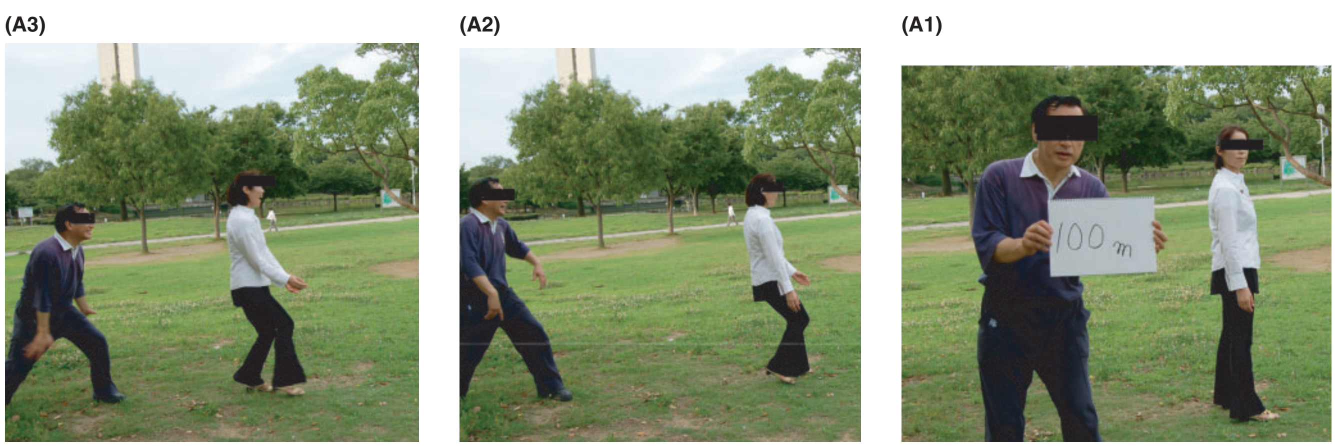

Figure 8. Outdoor experiment at Daisen Park with KH. (**A1**) The assistant was showing that Ki is going to be sent from 100 m away; A2 and A3, in 2 s after Ki was sent, KH started to run backward.

Determination of Ki-wavelength

A Chinese Qigong research group found that Qi-energy has an infrared component (29). This was confirmed by Japanese scientists (30). There are reports that Qi-energy may have components represented by electrostatic energy, magnetic energy, low frequency sound energy and so on (30–33). We also observed that Ki-energy seems to have a component of near infrared radiation because it was blocked by a black acrylic plate and aluminum foil (24). It was blocked by an optical filter in the visible range (400–760 nm) but not blocked by a filter in the near-infrared range (800–2700 nm) (25,27).

For the outdoor reflection experiment, we used a 3 mm thick acrylic mirror in which the light had to travel through an acrylic layer of 8.5 mm. Since the transmittance spectrum of a similar acrylic plate (9 mm thick) had a cut-off wavelength around 1600 nm, we concluded that the wavelength of Ki-energy should be shorter than 1600 nm. Combining with previous results (25,27), the wavelength range would be between 800 and 1600 nm.

We decided to further narrow down the Ki-wavelength. We used a linear variable interference filter which can cover from 400 to 1100 nm, and found that the Ki-energy had a peak around 1000 nm (Table 3 and Fig.7). Since we did not measure the wavelength between 1100 and 1600 nm, there is still the possibility that another Ki-wavelength peak may exist. However, at this point, we can say that Ki-energy has, at least, one peak wavelength at around 1000 nm.

Another interesting result of our experiment was that a 'Ki-beam' seems to have a small divergence angle. As shown in Fig. 3C, if a light beam spread to the size of d at a distance of l, the divergence angle θ is defined by

$$l \tan\theta = \frac{d}{2}$$

If θ is small, this can be approximated as

$$l\theta = \frac{d}{2} \quad \text{or} \quad \theta = \frac{d}{2}l$$

where θ is expressed in radians.

In the outdoor reflection experiment, θ against the mirror which was held by TM (Fig. 5B, B2) was $0.55/30 = 0.018$ radians or 1.05°. Although we do not know the exact divergence angle of the 'Ki-beam' yet, an important notion is that it may be very small.

A divergence angle of 1° seems to be small, but it is not an impossible number. For example, in baseball, the distance between the pitcher's mound and the home plate is approximately 18 m. If we assume the size of the catcher's mitt to be 30 cm, then the divergence angle would be about 0.5°. An expert pitcher can command control of the ball to an angle smaller than 0.5°. If a ball can be thrown with accuracy $< 0.5^\circ$, then, to 'throw' Ki with an accuracy of 1° may not be too difficult.

Might Ki be a 'Laser' Radiation?

We observed that the response time of the Ki-receiver might increase with the increase of the distance. Although the response time at 100 m was not significantly different ($P > 0.1$) from that at 30 m (Table 4), a preliminary test suggested that the difference may reach the significant level at above 100 m (Ohnishi *et al.*, unpublished result). The cause for the increase may be: (i) Because of the divergence of the Ki-beam, at a distance of 100 m or above Ki-energy was diverged, and its effect on the receiver seemed to be weakened; (ii) Ki energy may be absorbed by humidity and/or dust particles in the air. Although further study is required to identify the exact cause, it was rather surprising that the intensity of the Ki-beam did not decay too much at 100 m.

All of our results suggest that Ki-energy has the following properties: (i) The Ki-beam is directional with a small divergence angle and can be aimed in a desired direction; (ii) the beam can be reflected by a mirror; (iii) Ki-energy may have a specific wavelength. All of these properties are characteristics of laser light. Therefore, we have to examine whether it is possible for the human body to generate laser-like infrared radiation.

In order to pursue this possibility, let's quickly review the principle of laser radiation. The term 'laser' is the abbreviation for '*L*ight *A*mplification by the *S*timulated *E*mission of *R*adiation.' Let us assume that the electrons in an appropriate material have two energy levels, the lower level (E_1) and the excited level (E_2), and that the difference is ΔE. If a photon with the energy given by

$$\Delta E = h\nu$$

comes in, then, quantum physics tells us that an electron in the lower level is excited to jump up to the excited level (Fig. 9A). In this equation, h is the Planck constant and ν the frequency of the light. This electron spontaneously returns to the original lower level, concomitantly emitting a light (Fig. 9B). This is called spontaneous emission. Under normal condition, the number of electron in the excited level is less than that in the lower level. However, if we could 'pump in' sufficiently high energy, for example, by applying electric energy or by illuminating the material with very intense light (called a 'pump light'), then the situation may occur where the number in the excited level becomes larger than that in the lower level. This inverted electron distribution is called 'population inversion' (Fig. 9C). Under this condition, when a photon is produced by a 'spontaneous emission,' then, the photon thus produced forces another electron to drop from the excited level to the lower level by emitting a photon. This process is called a 'stimulated emission of radiation,' in which the emitted light has the same frequency and the same phase as that of the incident light. The stimulated photon causes, in turn, another stimulated emission, and the light is kept being

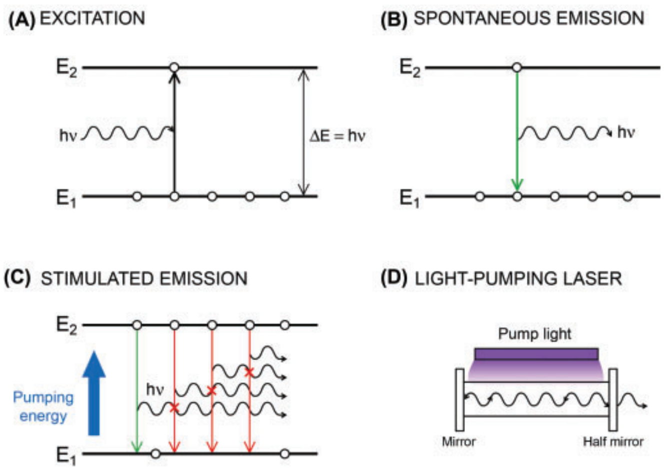

Figure 9. Simplified explanation for the laser emission. (**A**) When a photon comes into a material which has two electron levels, lower level (E_1) and the excited level (E_2), an electron is excited to jump up to the excitation level. (**B**) When that electron spontaneously returns to the lower level, a photon is emitted. This is called 'spontaneous emission.' (**C**) If a sufficiently high 'pumping energy' is supplied to the system, a 'population inversion' of electrons takes place where the number of electrons in E_2 is greater than that in E_1. When a photon is produced by a spontaneous emission (shown by a green arrow), it forces another electron drop to the lower level (shown by a red × symbol), and concomitantly, emit another photon which has the same wavelength and the same phase (shown by a red arrow). This is called 'stimulated emission.' The photon thus produced further produces another stimulated emission, and the number of photon is kept increasing as long as we have enough electrons in the excited level. (**D**) Two mirrors placed on opposite ends of the laser material serve as a 'light resonator.' Under a sufficiently strong pump light, the stimulated emission takes place. This light reflects back and forth between these mirrors so that the light becomes intensified and coherent (i.e. all light has the same phase).

amplified. In a conventional laser, a pair of mirrors (one is a full mirror and the other, a half-mirror) are mounted on the opposite ends of the laser material. The stimulated light is reflected between these mirrors back and forth so that the light intensity is kept amplified, and the phase of the light becomes coherent (Fig. 9D). A certain percentage of the light (normally about a few percent) which comes out through the half mirror is used for the laser experiment. This is the basic principle of laser emission. [For the sake of simplicity, the explanation was somewhat oversimplified. For those who need more information, please see a text book, such as (34)].

There are many chromophores in the energy transduction systems of biological organisms, for example, cytochromes, iron-sulfur clusters, flavins, ubiquinones and other pigments. If we assume that the generated Ki-energy in our body can excite electrons from the ground state to the excited state in such a chromophore, the 'population inversion' may take place so that the 'stimulated emission' phenomenon would happen. Then, though it may seem like a strange notion, a laser-like amplification of stimulated emission of radiation may be possible. In this regard, it is interesting to note that a solution of an organic compound, Rhodamin 6G (or similar compounds), can emit laser light at around 600 nm if sufficient light energy is pumped into the solution by a strong flash of light (35).

In a conventional laser, two reflecting mirrors mounted on the opposite ends serve as a 'light resonator' to amplify the induced radiation to make a strong, coherent light beam. However, there is no mirror in our body. Therefore, even if a laser-like mechanism may operate in our body, the emitted 'Ki-beam' may not be a perfect monochromatic light and the divergence angle may not be as small as that in a laser beam. This may leave room for the characteristics of the Ki-beam being 'laser-like,' but not as perfect as that of a real laser. Regarding the possibility of a laser-like light emission from our body, it is interesting to note that an essential secret in the practice of NBM is to keep muscles of our body in a completely relaxed state. If the hand of the emitter is stiff, Ki will not be emitted. Can our skeletal muscle serve as a 'light resonator?' It has a repeating striation of about 2500 nm, and the length of the thin filament (actin-filament) is 1000 nm. If these repeating structures of the skeletal muscle could cause the production of a standing wave with a wavelength of 1000 nm, it may enhance the 'laser' radiation. Further pursuit of this possibility may prove interesting.

Detection of Ki-energy

Now, let's discuss the detection of Ki-energy. It is possible that a similar 'stimulated emission' might take place in the skin of a Ki-receiver. We showed in our previous paper that different parts of the body can detect Ki-energy (27). Therefore, the skin cells have a 'detector' which can sense near-infrared radiation. Assume that the Ki-receiver has the same chromophore as that in the Ki-emitter. If the electrons in such a chromophore are already pumped by the Ki-energy of the receiver, then, a similar 'population inversion' of electrons would be established. Then, when an incident Ki-beam comes in, it would trigger 'stimulated emission' as in the case of the Ki-emitter. Then, the light energy is amplified through the same mechanism (see Fig. 10). When the amplified light energy becomes sufficiently great, it would trigger the nervous system to send a signal to the brain. Then, depending on the signal (or the information which the incident infrared radiation carries), the brain would send out the signal to the skeletal muscle to respond. We believe that this may be the mechanism by which Ki-receiver makes a body motion in response to Ki sent by the Ki-emitter. In brief: Ki is generated and transmitted by these electron-photon-electron conversion mechanisms.

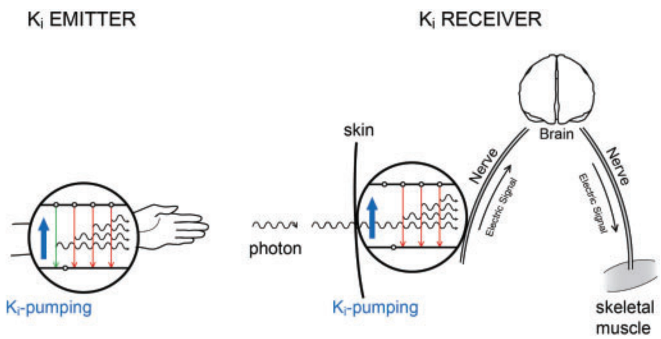

Figure 10. Hypothetical diagram for Ki generation and Ki transmission. (Ki-emitter side), The electron distribution of chromophores in the emitter's hand (or fingers) is in the state of 'population inversion' by the Ki energy of the emitter ('Ki-pumping' as indicated by a blue arrow). This will trigger 'stimulated emission' of photons in the near infrared region. (Ki-receiver side),The electron distribution of chromophores in the Ki receiver's skin is also in the state of 'population inversion' by his/her own Ki energy. Then, the incident photon would trigger the 'stimulated emission', through which the incident light energy would be amplified by the same mechanism as in the Ki-emitter. When the energy becomes sufficiently high through the amplification process, this would excite the central nervous system to reach the brain. Subsequently, the brain would send out signals to skeletal muscle to respond to the signal.

Effects of Ki-training

The laser-like mechanism in the generation and reception of Ki-energy can explain several interesting but 'hard-to-explain' phenomena which are observed on daily basis at the school of NBM. For example, (i) in general, students are not so sensitive to an instructor's Ki-energy when they first begin to practice. However, with training, they will become more and more sensitive to the instructors' Ki-energy. Perhaps, training may make the 'population inversion' of electrons to happen more easily so that the students' receptivity toward Ki-energy may be enhanced; (ii) it is observed that some students are very sensitive to Ki, but others are not. This difference might be related to the difference of the amplifying power of the Ki-detector at the receiver's skin; (iii) why are some students not sensitive to Ki at all? This may be caused by the difference of the laser frequencies between the emitter and the receiver; (iv) we have observed that a student's Ki cannot move the instructor. Since instructors are always emitting strong Ki-energy, their 'receiver' might be saturated with their own Ki-energy. If so, their receiver cannot detect a weak Ki-signal from the student. In other words, the balance between the individual's emitter's power and receiver's gain may be a determining factor, and this balance is affected by training; (v) students are more sensitive to the Ki of other individuals when they come to the class room (not only to Ki of instructors, but also to that of their friends). This might happen because Ki-energy (or near-infrared radiation emitted from everyone's body) fills the class room, and it activates every one's electrons in the receiver to the excited level; (vi) when a student receives Ki-energy from Master Nishino, that student subsequently can move other students using his or her own Ki-energy (while outside of the class room, they cannot). Probably, the student's Ki level was enhanced and activated by receiving Ki-energy from Nishino. Therefore, the degree of 'population inversion' of excited electrons is increased, and as a result, the intensity of the student's Ki-energy was enhanced. This may be regarded as an 'Induction of Ki-energy', and is an interesting subject for future study.

In the pioneering work by Shinagawa (31) and Kawano *et al.* (36), it was shown that Qi-energy emitted from a Qigong healer carried some form of information. They demonstrated that the brainwave distributions of both the volunteer and the healer became synchronized even when *Q*i was sent from behind the volunteer. (Late Prof. Shinagawa was our good friend for many years. It was their work which stimulated our interest in scientific research on Ki). Perhaps a similar phenomenon is taking place in the Taiki-practice. We proposed that in the Taiki-practice, the Ki-receiver moves in accordance with the Ki-information (or Ki-entropy) sent by the Ki-emitter (27,28).

Suggestions for Future Studies

A future step in Ki research would be to identify the chromophore which may play the central role in the mechanism of the laser-like Ki-emission and Ki-reception processes. If such a chromophore is found, then, the next task might be to find the mechanism of how the practice of NBM can 'pump' electrons from the ground level to the excited level to establish 'population inversion.' We have a long way to go, but at least, we now have a model which is based upon quantum physics. With this, we can advance our search to understand the mechanisms of Ki-related phenomena and Ki-healing processes, which have been known for 4000 years.

Acknowledgements

We thank Master Kozo Nishino for instructing and inspiring us in our search for nature and effect of Ki-energy. We also thank the students of the Osaka School of the Nishino Breathing Method for their participation, especially Mr Kinzo Fujimoto, for his dedicated assistance in this project. We also appreciate the criticism and suggestions given by two anonymous reviewers. Their guidance helped us to improve our manuscript. Thanks are also due to Dr K.S. Reddy of the Department of Biochemistry and Biophysics, University of Pennsylvania School of Medicine for taking transmittance spectra of acrylic and glass plates, Ms M.J. Leonard and Mr S. J. Dennis for preparing illustrations, Mr M. Singer for editing the manuscript and Mr H. Kokubo for his suggestions.

References

1. Ikegami S. *Miracle of Ki*. Tokyo: Kodansha Publishing Co., 1991 (in Japanese).
2. Chang S.-O. Meaning of Ki related to touch in caring. *Holist Nurs Pract* 2001;16:73–84.
3. Chang S.-O. The nature of touch therapy related to Ki: practitioners' perspective. *Nurs Health Sci* 2003;5:103–14.
4. Lee M. Effects on in vitro and in vivo qi-therapy on neutrophil superoxide generation in healthy male subjects. *Am J Chin Med* 2003;31:623–8.
5. Chen K. An analytic review of studies on measuring effects of external QI in China. *Altern Ther Health Med* 2004;10:38–50.
6. Kobayashi H, Ishii M. Mind-Body, Ki (Qi) and the Skin: Commentary on Irwin's 'Shingles immunity and health functioning in the elderly: Tai Chi Chih as a behavioral treatment'. *Evid-based Complement Altern Med* 2005;2:113–6.
7. Olalde JA. The systemic theory of living systems and relevance to CAM. Part I: The theory. *Evid-based Complement Altern Med* 2005;2:13–8.
8. Flowers J. What is Qi? *Evid-based Complement Altern Med* 2006;3:551–2.
9. Kuramoto AM. Therapeutic benefits of Tai Chi exercise: Research review. *WMJ* 2006;105:42–6.
10. Hankey A, McCrum S. Qigong: Life energy and a new science of life. *J Altern Complement Med* 2006;12:841–2.
11. Shinnick P. Qigong: Where did it come from? Where does it fit in science? What are the advances? *J Altern Comp Med* 2006;12:351–3.
12. Weze C, Leathard HL, Grange J, Tiplady P, Stevens G. Healing by gentle touch ameliorates stress and other symptoms in people suffering with mental health disorders or psychological stress. *Evid-based Complement Altern Med* 2007;4:115–23.
13. Abbott RB, Hui K-K, Hays RD, Li M-D, Pan T. A randomized controlled trial of Tai Chi for tension headaches. *Evid-based Complement Altern Med* 2007;4:107–13.
14. Nishino K. Ki-energy in health. *Proceedings for the 4th International Congress on Traditional Asian Medicine* 1994;1:148–70.
15. Nishino K. *The Breath of Life: Using the Power of Ki for Maximum Vitality*. Tokyo. New York, London: Kodansha International, 1997.
16. Nishino K. *Le Souffle de Vie, Utiliser le Pouroir du Ki*. Paris: Guy Tredaniel Editeur, 1998.
17. Nishino K. *Il Respiro Della Vita, La massima vitalita dalla forza del Ki, Esercizi di Respirazione facili, effieaci, completamente illustrati*. Rome, Italy: Edizioni Mediterranee, Via Flaminia, 1999.
18. Nishino K. Antiaging effects of the Nishino breathing method (Symposium speaker). In *Symposium on Anti-aging, 27th Annual Meeting of Japanese Medical Society*, Osaka, Japan, April 2, 2007.
19. Nishino K. The possibility of respiration in the 21st century (Keynote speech). In *47th Annual Meeting of the Japanese Respiratory Society*, Tokyo, Japan, May 10, 2007.
20. Nishino K. *Nishino Breathing Method*. Tokyo: Kodansha, 1987 (in Japanese).
21. Nishino K. *Nishino Breathing Method: Elevation of Self Energy*. Tokyo: Gakushu Kenkyu Pub.Co, 2005 (in Japanese).
22. Yumi K. *The Ultimate Example of Nishino Breating*. In: Nishino K. (ed). *Method: Everyday of Yumi Kaoru with Slim and Bouncing Body*. Tokyo: TAKE Shobo Pub. Co., 2005 (in Japanese).
23. Kimura H, Nagao F, Tanaka Y, Sakai S, Ohnishi ST, Okumura K. beneficial effects of the Nishino breathing method on the immune activity and stress level. *J Altern Complement Med* 2005;11:285–91. http://members.aol.com/philabiomed/publication/kimura.pdf
24. Ohnishi ST, Ohnishi T, Nishino K, Tsurusaki Y, Yamaguchi M. Growth inhibition of cultured human carcinoma cells by Ki-energy (Life Energy): Scientific study of Ki-effect on cancer cells. *Evid-based Complement Altern Med* 2005;2:387–93. http://ecam.oxfordjournals.org/cgi/reprint/2/3/387
25. Ohnishi ST, Ohnishi T, Nishino K. Ki- Energy (Life-Energy) protects isolated mitochondria from oxidative injury. *Evid-based Complement Altern Med* 2006;3:475–82. http://ecam.oxfordjournals.org/cgi/reprint/3/4/475
26. Ohnishi ST, Nishino K, Uchiyama K, Ohnishi T, Yamaguchi M. Ki-energy (life-energy) stimulates osteoblastic cells and inhibits the formation of osteoclast-like cells in bone cell cultured models. *Evid-based Complement Altern Med* 2007;4:225–232. http://ecam.oxfordjournals.org/cgi/reprint/nem037
27. Ohnishi ST, Ohnishi T. The Nishino breathing method and Ki-energy (Life-energy): A challenge to traditional scientific thinking. *Evid-based Complement Altern Med* 2006;3:191–200. http://ecam.oxfordjournals.org/cgi/reprint/3/2/191
28. Ohnishi ST. Ki: A key to transform the century of death to the century of life. *Evid-based Complement Altern Med* 2007;4:225–232. http://ecam.oxfordjournals.org/cgi/reprint/nem021v1
29. Kiang T. Chinese "Nature Magazine": Chinese style. *Nature* 1978;275:697.
30. Machi Y. *The Science of Ki*. Tokyo: Tokyo Denki University Press, 1993 (in Japanese).
31. Shinagawa Y. *The Science of Qigong*. Tokyo: Kobunsha, 1990 (in Japanese).
32. Yuasa Y. *The Body, Self-Cultivation and Ki-energy* (translated by S. Nagatomo and M.S. Hull). Albany, NY: State University of New York Press, 1993.
33. Yount G. Biofield perception: aseries of pilot studies with cultured human cells. *J Altern Complement Med* 2004;10:463–7.
34. Hecht J. *Understanding LASERS*, 2nd edition. New York, Toronto, Singapore: Wiley-Interscience, 1994.
35. Kurosawa K. *Basic Foundation of Laser*. Tokyo: Optronics Pub. Co., 1999 (in Japanese).
36. Kawano K, Koito H, Fujiki T, Shinagawa Y. EEG and topography during Chinese "Qigong" training. *Neurosciences* 1990;16:503–8.

Received February 20, 2007; accepted July 3, 2007