

Acupuncture *De Qi*, from Qualitative History to Quantitative Measurement

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ABSTRACT

De qi is an important traditional acupuncture term used to describe the connection between acupuncture needles and the energy pathways of the body. The concept is discussed in the earliest Chinese medical texts, but details of *de qi phenomenon*, which may include the acupuncturist's and/or the patient's experiences, were only fully described in the recent hundred years. In this paper, we will trace *de qi* historically as an evolving concept, and review the literature assessing acupuncture needle sensations, and the relationship between acupuncture-induced *de qi* and therapeutic effect. Thereafter, we will introduce the MGH Acupuncture Sensation Scale (MASS), a rubric designed to measure sensations evoked by acupuncture stimulation as perceived by the patient alone, and discuss some alternative statistical methods for analyzing the results of this questionnaire. We believe widespread use of this scale, or others like it, and investigations of the correlations between *de qi* and therapeutic effect will lead to greater precision in acupuncture research and enhance our understanding of acupuncture treatment.

INTRODUCTION

“*De qi*” is the traditional acupuncture term used to describe the connection between acupuncture needles and the energy pathways of the body. It is a central concept in Traditional Chinese Acupuncture.¹ The *de* component of the word compound means “obtain,” and the *qi* component is an untranslatable word signifying the potential of a phenomenon to transform from 1 state to another state and/or retain its identity. (For convenience, *qi* is often translated as “vital energy”²). Traditionally, other terms have been used for the same phenomenon including *qizhi*, which indicates “arrival” of *qi*. Both concepts originated from the *Neijing*, or *Yellow Emperor's Inner Classic of Internal Medicine*, a canonical book that will be subsequently described.

Historical debates dispute the range of sensations en-

compassed by *de qi*. Some posit that *de qi* refers only to the sensations of the patient receiving acupuncture,³ while others argue that sensations of both the patient and the administering acupuncturist comprise *de qi*.^{4,5} In recent years, researchers have put more weight on the patient's rather than the acupuncturist's experience during needling.^{6–11} This may be due in part to the rising popularity of new acupuncture modalities such as electroacupuncture. In electroacupuncture, the acupuncturist is prevented from perceiving *de qi* because stimulation is not delivered manually, but by means of an automated current passing through a needle. (Routinely, the acupuncturists should first evoke *de qi* before the electricity is applied. Despite this fact, it is generally believed that stimulation parameters such as frequency and intensity are more important than the acupuncturist's subtle perceptions.¹²

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De qi, particularly the sensations evoked by acupuncture stimulation on patients/subjects, has recently drawn the attention of many scientific researchers.^{6–11,13} These investigators have attempted to assess the phenomenon through different scales,^{6–11} and most importantly, begun to investigate *de qi*'s relationship to therapeutic effects.^{9,14,15} Such studies are helping to clarify our understanding of the *de qi* phenomenon.

This paper is designed to expand our current understanding of acupuncture *de qi* in four ways. Section 1 will trace the historical perspective of *de qi* as an evolving concept through time. Section 2 will briefly review the current clinical perspective regarding investigations of the relationship between *de qi* and acupuncture therapeutic effect. Section 3 will present a novel *de qi* scale designed to quantitatively measure sensations derived from acupuncture needle stimulation. Finally, we will discuss future directions of this field.

HISTORICAL PERSPECTIVE OF DE QI

De qi and needling sensation

Traditionally, *de qi* refers to the excitation of *qi* through the acupuncture channels/meridians by means of needle stimulation, moxibustion, massage, or other procedures. According to Traditional Chinese Medicine (TCM), both the administering acupuncturist and the patient may be able to detect signs of *de qi*.^{4,5,16} Typically, the acupuncturist would perceive *de qi* as heaviness or tenseness about the needle he or she is stimulating, and in response to being punctured, the patient would perceive *de qi* as soreness, numbness, heaviness, and distention at the site of needle placement, though these sensations may spread to other parts of the body as well.

De qi's fundamental role in TCM acupuncture cannot be overstated. Its significance was first mentioned circa 100 B.C., in the *Neijing* (*The Yellow Emperor's Classic of Internal Medicine*). (This ancient text is recognized as the first major compilation of Chinese Medicine and continues to serve as the canonical acupuncture text to the present time. The *Neijing* is divided into two books: *Su wen* (*Plain Questions*), which mainly describes Chinese medical theory and *Ling shu* (*Spiritual Pivot*), which focuses on acupuncture more specifically). Much can be revealed about the historical roots of acupuncture and *de qi* by consulting this text. For example, in *Ling Shu* (chapter 9)¹⁷ it is advised that: "The acupuncturist should devote all his/her concentration to the needle, keep the needle on the surface and move it gently, until the *qi* has arrived (*qizhi*)."¹⁷ A more famous saying from this text *Ling Shu* (chapter 1) reads, "For acupuncture to be successful, the *qi* must arrive (*qizhi*). Acupuncture's effects come about like the clouds blown away by the

wind." *Ling Shu* (chapter 3) states, "The acupuncturist must obtain the *qi* (*de qi*). If *qi* has arrived, fastidiously hold it and do not lose it." As indicated by the above excerpts, the earliest sources clearly viewed *de qi* as fundamental to acupuncture treatment. However, as will be elaborated below, these quotes leave ambiguous whether *de qi* sensation is something felt by the acupuncturist, patient, or both during treatment.

De qi affects yin-yang balance to restore health

Having noted the significance of *de qi* according to ancient texts, it is also important to consider how these texts explain the relationship between *de qi* and the therapeutic efficacy of acupuncture.

A major foundation of Chinese medical philosophy is the concept of the contradictory yet complementary forces of *yin* and *yang*. These forces are manifested as *qi* in the body and it is understood that each *yin* and *yang* (and corresponding *qi*) can exist in a state of excess or deficiency. Furthermore, health is thought to be a result of a balanced *yin–yang*, or "harmonious" *qi*.² When *qi* is overabundant, absent, blocked or unbalanced, problems arise. The proper functioning of the internal organs, for example, depends on *qi* being in a state of dynamic equilibrium.

Qi traverses the body by means of meridians that connect organs and organ systems to one another and to the external body surface. Acupuncture points are understood to be major confluences of *qi*. Stimulation of these critical junctions can awaken and modulate *qi* in the channels so as to regulate and restore *yin–yang* balance (and thus health) to the body.

This process is summarized in *Lingshu* (chapter 9): "When the acupuncturist needles the patient, the first needle insertion can dispel the *yang* evil, the second needle insertion can dispel the *yin* evil and the third needle insertion can draw the grain *qi*. When grain *qi* (*gu qi*) arrives, the needling should be stopped. How do we know of the grain *qi*'s arrival? When the deficient patient is reinforced and becomes fuller, or when the excess patient is reduced and becomes weaker. The status of *yin–yang* balance shows the arrival of grain *qi*." This passage ties together several points from above. After mentioning the dispelling of pathologic essences (*yin* and *yang* evils), it more relevantly describes the therapeutic awakening of *qi* and the resultant restoration of balance. (Please note that *qi* itself is a broad concept in Chinese Medicine, and that historical texts distinguish between several different forms. The *qi* that is referred to in *de qi* may be grain *qi* that is derived from digestion of food, or antipathologic *qi* (*zheng qi*), which arises from a normally functioning human body, one in *yin–yang* balance.) The arrival of *qi* marks an effective acupuncture treatment in this passage.

More than 1000 years later, *de qi* was described more precisely and with even more clinical precision. During the

Ming dynasty (1368–1644), in the famous acupuncture poem, *Jin Zhen Fu (Ode to the Golden Needle)*, recorded in *Zhen Jiu Da Cheng (Great Compendium of Acupuncture and Moxibustion)*,¹⁸ it is written: “If the *qi* comes quickly, the effect will be quick. If the *qi* comes slowly, the effect will be slow. If it does not arrive at all—it is a fatal sign, for sure.” Here, *de qi* signified not only an effective treatment, but also indicated the speed of and potential for recovery. Most contemporary TCM doctors still seek *de qi* and regard it as a sign of efficacy.

De qi from different perspectives

Although the authors of the *Neijing* regarded *de qi* as a vital concept and critical part of acupuncture, its description in the classical text is quite vague. At different points, the *Neijing* seems to indicate that the acupuncturist, patient, or both are to feel the *de qi* sensations. *Suwen* (chapter 25) states, “During acupuncture, [the acupuncturist] should concentrate on the changes of *qi* and blood after the needle is inserted. Usually, the changes are too subtle to be felt, and sometimes [for the acupuncturist], arrival of *qi* may feel like a bird flying. He/she may not understand why this happens.”

Suwen (chapter 54)¹⁹, however, describes *de qi* from the alternative perspective: “To treat a patient’s excess syndrome, the acupuncture needle should stay in until *yin qi* arrives, and [the patient] should feel coldness under the needle; to treat a patient’s deficient syndrome, the needle should stay in until *yang qi* arrives, and [the patient] should feel warmth under the needle.” As demonstrated, the question of who perceives *de qi* is left ambiguous in the *Neijing*. Furthermore, rather than specifying a standard sensation, the *Neijing* seems to suggest that the perception of *de qi* should vary according to a patient’s condition.

Somewhat surprisingly, and to the best of our knowledge, there have been few detailed accounts of *de qi* sensations (or how an acupuncturist or patient might experience *qi*’s presence other than those descriptions mentioned above) until relatively late in Chinese medical history. One important depiction of the acupuncturist’s perception of *de qi* comes from the *Biao You Fu (Ode to Clear Obscurity)* recorded in *Great Compendium of Acupuncture and Moxibustion (Zhen Jiu Da Cheng)*,¹⁸ which was originally written in the Yuan Dynasty (1271–1368). This text states, “The acupuncturist may feel as though the needle is being firmly grabbed and moving roughly when *qi* arrives, but only loosely grasped and moving smoothly if *qi* does not arrive. *Qi* arrival feels like a fish biting a hook and bobbing in the water; if *qi* does not arrive, the acupuncturist feels as though the needle is in a quiet empty house.” (Many subsequent textbooks have since quoted this metaphor of a “fish biting the hook”). Another way to judge the arrival of the *qi* is explained by Li Yan in *Medial Abecedarium (Yi Xue Ru Men)*,²⁰ which was composed during the Ming Dynasty (1368–1644). Here it is

written: “When the acupuncturist feels the needles getting heavy and full, there is *de qi*. . . . When the acupuncturist feels the needles getting hollow and loose, there is the absence of *de qi*.” These texts describe the experience of *de qi* from the perspective of the acupuncturist and depict the sensations as tense, heavy, tight, and full.

De qi from the patient’s perspective shares some similarities with those experienced by the acupuncturist, and these too, to the best of our knowledge, were only described clearly long after the *Neijing* period. According to *Zhong Guo Zhen Jiu Xue Shi (History of Chinese Acupuncture)*²¹ Jiang Shang Wai Shi wrote a clear depiction of *de qi*, as perceived by the patient, during the Republican period (*Ming-guo* period, 1912–1949). The causes and symptoms of illness, as well as the patient’s perception of acupuncture treatment are described in this Republican era text: “The patient whose illness is caused by wind may feel pain, the patient whose illness is caused by coldness may feel soreness, the patient whose illness is caused by dampness may feel swelling, and the patient whose illness is caused by both wind and cold may feel both soreness and numbness. To treat these disorders, the acupuncturist calmly inserts the needle, and the patient should feel soreness, numbness, and pain, or sensations similar to soreness, numbness, and pain. If the patient cannot tolerate the sensations, the acupuncture treatment should stop.”

The most influential interpretation of the patient’s perception of *de qi* in modern Chinese acupuncture practice can also be traced to the Republican era. In Cheng Dan An’s famous book, *Chinese Acupuncture Therapy (Zhong Guo Zhen Jiu Zhi Liao Xue)*,²² it is stated: “While you are twisting the needle, you should ask the patient whether he or she feels soreness and the heaviness. If he or she only feels hurting or nothing at all, you can insert the needle deeper or lift the needle a little and twist it again. You should keep trying until the patient feels soreness or heaviness.”

Around the same time, Zeng Tian Zhi linked *de qi* with the nervous system for the first time in a writing that attempted to reconcile Chinese and western medical notions. His book, *Scientific Acupuncture Therapy (Ke Xue Zhen Jiu Zhi Liao Xue)*, stated, “Nerve stimulation can produce sensations of pain, numbness, and soreness. . . . Thus, there is no doubt that acupuncture stimulates nerves.”²³ According to these Republican era texts, *de qi* is perceived by the patients as soreness, distention, numbness, heaviness, and possibly pain.

Building on the work of Jiang Shang Wai Shi and Cheng Dan An, post-1949 Chinese texts have expanded this emphasis on the patient’s experience by describing patient needling sensations that do not remain localized. Contemporary texts frequently depict patient sensations that manifest or propagate along channels, sometimes migrating to the physical location of the disease. Modern sources also mention patients who display externally visible responses to

acupuncture treatment (i.e., skin redness, gooseflesh, or localized red or white lines along the meridians of the body surface). All of these phenomena are thought to represent physical signs of *de qi*.²⁴

Understandably, present-day texts have not resolved the contradictory perspectives on *de qi*, and definitions of the term still conflict in several well-regarded Chinese language textbooks. Some sources continue to assert that *de qi* refers to sensations of both the acupuncturist and the patient. For example, the authors of *Acupuncture (Zhen Jiu Xue)*, written in 2004⁴ state: “When obtaining *qi*, the acupuncturist may feel the needle as slow and harmonious, or intense and heavy. At the same time, the patient may feel sensations of soreness, numbness, distention, heaviness, etc. around the needle, and this sensation can spread in certain directions to other location of the human body.” Other present-day sources continue to assert that *de qi* refers only to the sensations perceived by the patients. Accordingly, *Acupuncture and Moxibustion Administration Method (Ci Fa Jiu Fa Xue)*,³ published in 2003, states: “*De qi* is the subjective sensation of the subjects. It mainly includes soreness, numbness, distention, heaviness, coldness, warmth, electrical shock, throbbing, ant-climbing, air-flowing, water-flowing, involuntary limb movement, and pain in certain circumstances. The nature of the sensation is related to physical characteristics, disorder properties, and the location of acupuncture.”

In summary, *de qi* is a complicated concept that has nevertheless remained crucial to acupuncture therapy since the inception of the practice. However, because detailed descriptions of *de qi* manifestations and the issue of who perceives them were not fully developed until late in Chinese medical history, it is often difficult to judge whether these phenomena correspond with those mentioned in the *Neijing*. Under what circumstances the earliest practitioners of acupuncture believed *de qi* should be felt by the practitioner, patient, or both remains unclear.

In the following section, we will briefly review recent research on the quantification of acupuncture sensations and how it relates to therapeutic effects of acupuncture. We will then propose a way to measure *de qi* from the patient’s perspective. Although we recognize that *de qi* may have been traditionally intended to designate both the acupuncturist’s and patient’s perceptions, most researchers, including us, have chosen to attend only to the latter. We speculate that this decision owes partly to the fact that Cheng Dan An’s interpretation of patient sensations is generally considered normative in modern China. It may also reflect recognition that acupuncturists rarely perceive *de qi* with new modes of acupuncture, such as electro- and laser acupuncture. This decision may also be in response to the notion that the feelings of the acupuncturist are more subject to biased preconceptions of “what one ought to feel” than the patient’s, and thus hold greater likelihood of subjective report bias.

CURRENT CLINICAL PERSPECTIVE ON INVESTIGATION OF THE RELATIONSHIP BETWEEN *DE QI* AND ACUPUNCTURE THERAPEUTIC EFFECT

As shown above, many historical and contemporary sources posit that *de qi* is important or even necessary for attaining the salubrious effects of acupuncture. The importance of *de qi* sensations were further enhanced by the clinical and mechanistic studies of acupuncture anesthesia and analgesia conducted in the 1950–1980s in China. (In these studies also, the term *zhen gan* (acupuncture needling sensations) was introduced and widely used. Among these works, it is generally believed that *de qi* is essential for producing acupuncture analgesia and anesthesia. For instance, a study by Chiang and colleagues¹⁴ showed correlations between analgesia and *de qi* sensations of numbness, fullness, and sometimes soreness. Furthermore, this study demonstrated that both *de qi* sensations and analgesia could be blocked by intramuscular procaine injections, but not subcutaneous injections, at stimulated acupuncture points (LI 4, LI 10). These results suggest that *de qi* is an indispensable component of acupuncture analgesia.

However, other than acupuncture analgesia and anesthesia to acute pain, systematic testing of the biomedical basis of *de qi* and its relationship with therapeutic effect has been rare. Solid evidence linking *de qi* and other therapeutic effects of acupuncture is still lacking. In recent years, clinical trials of acupuncture have paid increasing attention to the evocation of *de qi*, but few investigators have made explicit efforts to examine the relationship between *de qi* and therapeutic effect.

In an earlier study by Takeda and colleagues,¹⁵ researchers investigated the effect of real and sham acupuncture on osteoarthritis (OA) and found that the experience of *de qi* can be used as a predictor for significant improvement. However, the sample size of this study is not large enough to make a solid conclusion based on these results. Larger and more recent trials of OA and acupuncture have also paid some attention to *de qi* sensations. Of three such OA studies designed to evoke *de qi* in real acupuncture treatment, but not sham (minimal depth needling) groups,^{25–27} two^{25,27} showed real acupuncture to produce significantly better therapeutic effects than sham acupuncture. The other²⁶ showed no significant difference between real and sham acupuncture treatments, and further concluded that “*de qi* sensation[s] do not result in marked effect,” which calls into question “whether deep needling with stimulation and *de qi* sensation is superior to shallow needling.”

Although some of the above results suggested that *de qi* may be important for therapeutic effect, none of these studies quantitatively measured *de qi* and assessed its relationship to therapeutic efficacy. We believe an unquantified measure of *de qi* is typical of most clinical studies. This factor may partly result from lack of a simple tool that can mea-

sure *de qi* and be easily and widely applied in clinics. In addition, the fact of *de qi* currently remaining (as explained earlier) a diffuse phenomenon may also contribute to the paucity of research on this topic. We believe that the creation and use of a standardized, quantitative *de qi* scale would make *de qi* a more accessible concept. More importantly, a reliable rubric would enable and encourage research on the therapeutic implications of *de qi*.

QUANTITATIVELY MEASURING SENSATIONS DERIVED FROM ACUPUNCTURE NEEDLE STIMULATION: DEVELOPMENT OF SCALES TO MEASURE ACUPUNCTURE NEEDLE SENSATION

Though few studies have attempted to correlate *de qi* and the therapeutic efficacy of acupuncture, investigators have begun to qualify and quantify sensations of *de qi*. Such work was started a couple of decades ago by Vincent and colleagues.⁶ This research group asked 125 patients to use the McGill Pain Questionnaire (MPQ) to rate the sensations experienced during acupuncture administration. A principal component analysis identified 7 components: dull-heavy, general intensity dimension, spreading, stinging, hot, sharp, and electric sensations.

Years later, Park and colleagues performed a similar experiment in 38 healthy, female and acupuncture-naïve Koreans.⁷ These subjects first completed the MPQ based on their expectations of acupuncture; then underwent a 30-second treatment at LI 4, involving needle insertion, stimulation, and removal; and finally completed the MPQ again, this time reporting their actual experience of needling. The results indicated that subjects expected to feel hurting, penetrating, sharpness, tingling, pricking, and stinging, but that they actually experienced aching, spreading, radiating, pricking, and stinging more than 60% of the time. Later, Park and colleagues⁸ performed another study investigating the difference between acupuncture-experienced and acupuncture-naïve subjects. They found that that 36 acupuncture-experienced Koreans expected to feel penetrating, aching, tingling, pricking, and throbbing more than 60% of the time, but experienced sharp, intense, radiating, and heavy sensations just as frequently. Furthermore, these subjects' expectations of hurting, tingling, pricking, stinging, burning, and pulsing exceeded their experience, while their experience of heaviness was greater than anticipated. With the exception of acupuncture-experienced subjects expecting less pricking and stinging, and experiencing less hurting and stinging than acupuncture-naïve subjects, there is no significant difference between the 2 groups. The results indicate that previous experience does not significantly influence expectation of *de qi* and the *de qi* experience of the subjects.

More recently, to determine appropriate descriptors of *de qi*, MacPherson and colleagues¹⁰ provided 29 international acupuncture experts a list of 25 sensations relating to acupuncture. Experts categorized the sensations as associated with either *de qi* or acute pain at the needling site. The 7 sensations in the cluster associated with *de qi* included aching, dull, heavy, numb, radiating, spreading, and tingling. In another study, Leung and colleagues¹⁰ investigated the electrical conductance of LI 4 and a non-acupoint, as well as the *de qi* sensations evoked by various acupuncture treatments applied at these locations. The results indicated "tingling" as the predominant *de qi* sensation deriving from electrical stimulation, and "aching" as the predominant *de qi* sensation deriving from manual acupuncture.

To address the complexity involved in accurately assessing *de qi*, our laboratory created a scale entitled "Subjective Acupuncture Sensation Scale (SASS)" when launching a pilot study on acupuncture analgesia in 2000. This scale allowed us to measure sensations evoked by acupuncture stimulation. Subjects were explicitly told when filling out the form that *de qi* does not refer to the sensation of the needle being inserted or withdrawn. We chose not to use MPQ to measure *de qi* for our investigation,⁶ because we felt it was inappropriate: MPQ measures pain, and acupuncturists usually try to avoid inducing sharp pain in their subjects, at least for the acupuncture points we were using (LI 4, SP 6, and ST 36). (This opinion has recently been supported by the survey article on *de qi* sensations¹⁰). While desiring a more appropriate scale for acupuncture research, we also wanted to generate a rubric that could test the relationship between sensations evoked by acupuncture stimulation and acupuncture-induced analgesia (the therapeutic effect of our treatments). To avoid problems wrought by using the indefinite term *de qi*, we entitled our assessment, "Subjective Acupuncture Sensation Scale." (The most accurate term for our scale might have been *zhen gan*, denoting acupuncture needling sensations specifically, a term, mentioned above, which is gaining popularity especially among Chinese investigators who study the mechanism of acupuncture.)

In brief, we listed 9 sensations on our scale: stabbing, throbbing, tingling, burning, heaviness, fullness, numbness, soreness, and aching. Selection of these descriptors was mainly based on *de qi* sensations found in the traditional literature sources mentioned above and contemporary textbooks.^{6,16,28,29} Since *de qi* involves complex feelings and because it is nearly impossible to list all related sensations, one supplementary row at the end of the 9 descriptors was left blank for subjects to describe perceptions in their own words. Each of the 10 elements on the SASS (9 descriptors, 1 blank row) was presented on a 10-cm bar with the anchor words "none," "mild," "moderate," and "severe" spaced evenly on the continuum.

This scale was first used in our pilot study investigating analgesia produced by different modes of acupuncture.⁹ In summary, this study investigated analgesia to experimental

heat pain produced by 3 modes of acupuncture treatment: manual acupuncture, electroacupuncture, and placebo electroacupuncture. Acupuncture was performed simultaneously at each of 3 points: Large Intestine 4 (LI 4), Stomach 36 (ST 36), and Spleen 6 (SP 6) on the right side of the body. Below we outline basic methodological procedures, but please see our published paper for further details of this work.¹⁹

Manual acupuncture needle manipulation was performed using a balanced tonifying and reducing technique at the 3 acupoints on the right side of the body in 3, 7-minute blocks each separated by a 2-minute rest period. During the 7-minute stimulation period, the acupuncturist manually stimulated 1 point for 30 seconds followed by a 15-second break before moving to the next acupoint.

For the electroacupuncture, after the 3 acupuncture needles were inserted and the *de qi* sensation was evoked, a surface ground electrode was placed 2 inches from each acupoint. The electrical stimulation (OMS Medical Supplies IC-1107) was then applied. During each 7-minute stimulation block, the current was simultaneously passed through the 3 acupoints and electrodes, with the frequency alternating between 2 Hz and 15 Hz every 30 seconds.

The procedure for the placebo mode was identical to that for the electroacupuncture except that (1) specially designed sham acupuncture needles^{19,30–34} were used, and (2) no current was passed through the electrodes. The SASS scale was administered after each acupuncture session.

Before and after treatments, identical calibrated thermal heat pain stimuli (Medoc Advanced Medical Systems, Rimat Yishai, Israel) were applied on the 4 limbs. The analgesic effect of each of the 3 modes of acupuncture was determined by comparing the subjective ratings (sensory and affective) to identical noxious stimuli applied before and after acupuncture administration.

Table 1 presents the mode and acupoint rating summaries for each of the 9 descriptors on the SASS. To investigate the relationship between analgesia and SASS, we performed an exploratory correlation analysis between the analgesic effect (difference in sensory pain ratings between post- and pretreatment pain epochs) and each of the 9 sensations quantified on the SASS.

Results revealed significant correlations between the 2 scales for numbness sensation ratings ($p < 0.0009$) and soreness sensation ratings ($p < 0.002$). The same results were noted when the analysis was performed for each mode separately. This result is consistent with an earlier Chinese study¹⁴ reporting correlations between numbness and acupuncture analgesia, and occasionally between soreness and acupuncture analgesia. The pilot results indicate that SASS is a reasonable means to measure sensations evoked by acupuncture stimulation. Most importantly, our pilot study suggests that sensation measurements are valuable in acupuncture research and have the potential to act as a predictive markers of treatment effects.

From SASS to MASS

Although our group has used SASS for several years,^{9,35} after deliberating with other acupuncture research groups from the Martinos Center for Biomedical Imaging at Massachusetts General Hospital (MGH), we have decided to modify the scale with the intent of making it useful to a wider range of research projects. Since this adapted version derived from a collaborative effort among all associated acupuncture researchers at the MGH Martinos Center, we have renamed the new scale the “MGH Acupuncture Sensation Scale” (MASS).

The MASS scale includes 13 descriptors: soreness, aching, deep pressure, heaviness, fullness/distension, tingling, numbness, sharp pain, dull pain, warmth, cold, throbbing, and one supplementary row at the end for subjects to describe perceptions in their own words (Fig. 1). The list of descriptors expands and modifies those 10 used in SASS to form a more comprehensive set of sensations.

“Stabbing” and “burning,” for instance, were removed from the previous scale and replaced by “sharp pain.” Although sharp pain is not commonly regarded as a *de qi* sensation,¹⁰ we have included it on the MASS because it can occur during acupuncture under certain conditions. The records will also be useful for future comparisons of *de qi* and pain. Furthermore, a recent functional magnetic resonance imaging and acupuncture study³⁶ demonstrated that

TABLE 1. SASS SENSATIONS EVOKED BY 3 MODES OF ACUPUNCTURE STIMULATION AND 3 ACUPUNCTURE POINTS (MEAN \pm SE)

Treatment	Point	Soreness	Heaviness	Fullness	Numbness	Tingling	Aching	Burning	Throbbing	Stabbing
Manual acupuncture	LI4	4.7 \pm 0.7	1.4 \pm 0.7	1.9 \pm 0.8	2.8 \pm 0.7	3.3 \pm 0.9	3.3 \pm 0.7	0.8 \pm 0.5	3.0 \pm 0.9	2.3 \pm 0.9
	SP6	2.8 \pm 0.8	2.2 \pm 0.8	1.9 \pm 0.7	2.7 \pm 0.7	4.9 \pm 0.6	2.0 \pm 0.7	0.7 \pm 0.5	2.3 \pm 0.7	2.3 \pm 0.8
	ST36	3.2 \pm 0.9	2.1 \pm 0.8	1.5 \pm 0.8	1.9 \pm 0.8	3.0 \pm 0.8	3.3 \pm 0.9	0.7 \pm 0.4	2.3 \pm 0.8	2.2 \pm 0.8
Electroacupuncture	LI4	4.7 \pm 0.5	2.2 \pm 0.9	1.5 \pm 0.7	3.1 \pm 1.0	3.2 \pm 0.9	3.9 \pm 0.8	0.1 \pm 0.1	1.2 \pm 0.8	1.3 \pm 0.6
	SP6	3.1 \pm 0.8	1.2 \pm 0.5	1.0 \pm 0.5	2.4 \pm 0.7	3.3 \pm 0.7	2.9 \pm 0.9	0.9 \pm 0.8	2.1 \pm 0.9	2.4 \pm 0.9
	ST36	3.4 \pm 0.6	1.5 \pm 0.5	1.1 \pm 0.5	2.5 \pm 1.0	3.4 \pm 0.8	3.2 \pm 0.8	0.3 \pm 0.2	1.0 \pm 0.5	1.2 \pm 0.5
Placebo acupuncture	LI4	1.8 \pm 0.6	1.9 \pm 0.8	1.8 \pm 0.8	1.7 \pm 0.6	1.6 \pm 0.6	1.6 \pm 0.6	0.5 \pm 0.3	1.5 \pm 0.6	0.9 \pm 0.6
	SP6	1.8 \pm 0.6	1.4 \pm 0.6	1.2 \pm 0.6	1.4 \pm 0.5	1.8 \pm 0.7	1.3 \pm 0.6	0.5 \pm 0.3	1.0 \pm 0.6	1.1 \pm 0.6
	ST36	1.6 \pm 0.5	1.0 \pm 0.4	0.8 \pm 0.5	1.2 \pm 0.5	1.4 \pm 0.5	1.4 \pm 0.5	0.5 \pm 0.3	0.9 \pm 0.5	1.3 \pm 0.5

SASS, Subjective Acupuncture Sensation Scale.

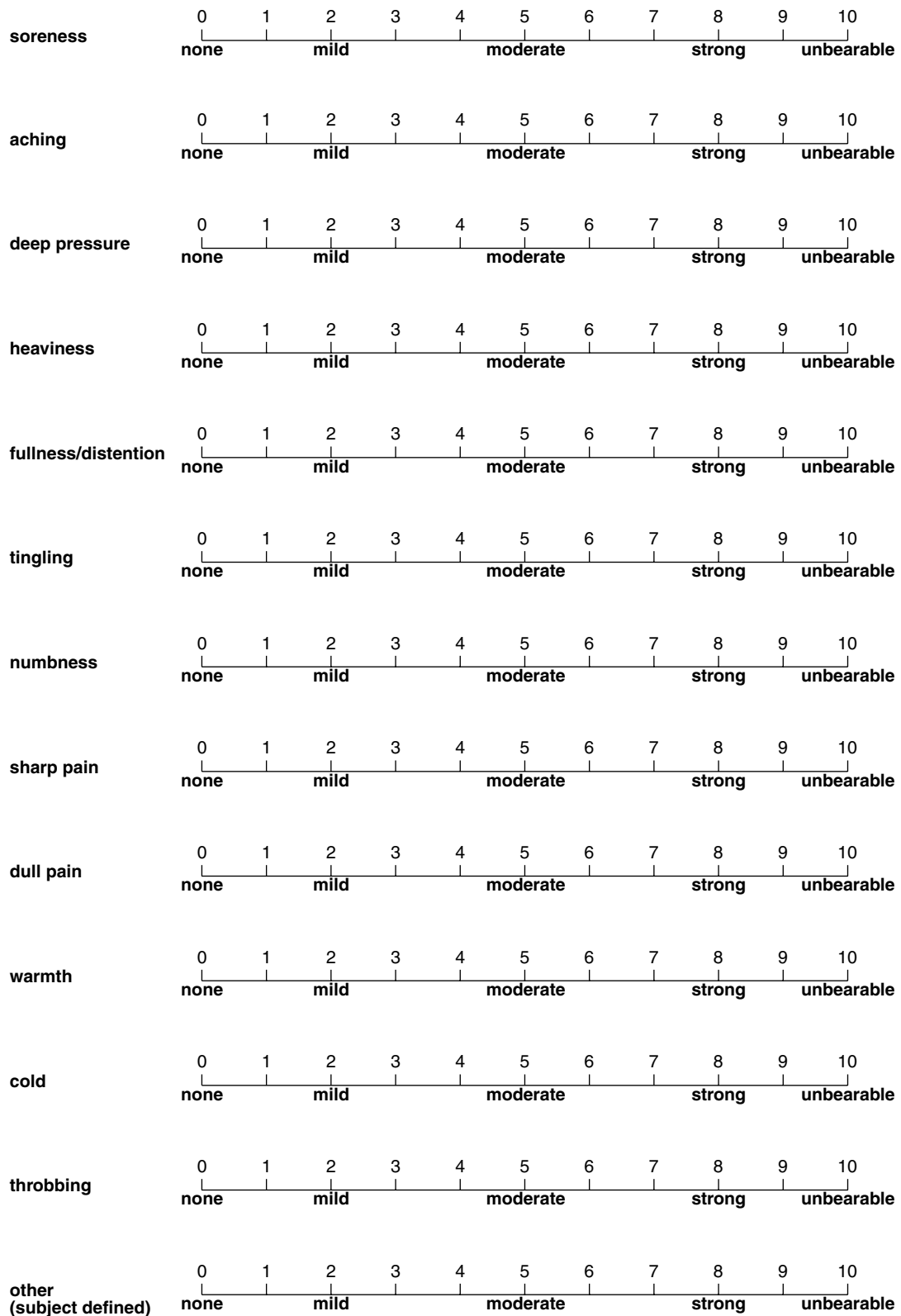


FIG. 1. The Massachusetts General Hospital acupuncture sensation scales (MASS). The scale includes 13 descriptors: soreness, aching, deep pressure, heaviness, fullness/distention, tingling, numbness, sharp pain, dull pain, warmth, cold, throbbing, and a subject defined “other.”

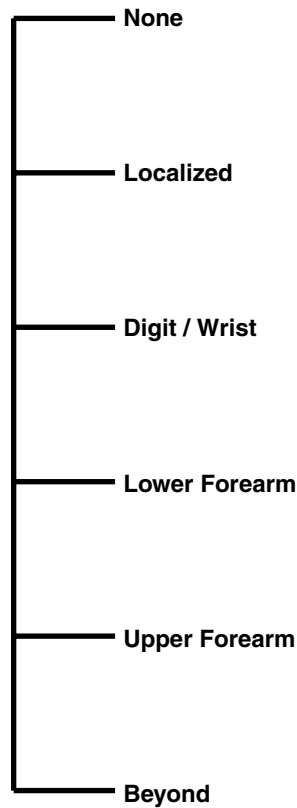


FIG. 2. The supplementary MASS scale entitled “MGH Acupuncture Sensation Spreading Scale.” Subjects use this scale to rate the spreading/radiation *de qi* sensations along their applied acupuncture point. (Please note that the words shown in this figure are designed for acupuncture points located on the hands (LI 4); different words should be used for acupuncture points located on face regions or other parts of the body.)

de qi and sharp pain elicited different effects on the brain. The pain neuromatrix was activated by sharp pain, but deactivated in *de qi*. Thus, it would be helpful to know whether a given treatment induced sharp pain, even if the acupuncturist was actively trying to avoid it.

Also to our list of descriptors, we added sensations of “warmth” and “coolness” after noting their frequent mention in ancient literature (*Suwen*, chapter 54) and after hearing them reported by several subjects in our own studies.

Our last addition to the MASS descriptor list was “dull pain.” This modification has been recently supported by a study by MacPherson and colleagues¹⁰ reporting the terms most commonly associated with *de qi* to include aching, dull, heavy, numb, radiating, spreading, and tingling, while many pain sensations were categorized as noxious.

Considering MacPherson’s findings further, although we did not include “radiating” and “spreading” among our list of MASS descriptors, we did create a supplementary MASS scale called “Acupuncture Sensation Spreading Scale” (Fig. 2). Orienting marks on this separate continuum include “none,” “localized,” “digit/wrist,” “lower forearm,” “upper forearm,” and “beyond.” Subjects use this scale to rate the

localization or expansiveness of *de qi* sensations along their limbs. (Please note that the aforementioned words were designed for acupuncture points located on the hands (LI 4); different words may be used for acupuncture points located on face regions or other parts of the body.) The last modification of SASS is the addition of a second supplementary “Mood Scale” (Fig. 3), on which subjects rate pre-, during, and post-treatment anxiety on a 10.0-point continuum (ranging from -5 to 5), with evenly spaced terms “completely relaxed,” “neutral,” and “unbearably anxious.”

The procedures for MASS administration are introduced by a written script on “Acupuncture Sensations” that reads: “Acupuncture is often associated with a variety of specific sensations called *de qi* (*duh chee*) sensations. You may experience any number of *de qi* sensations when the needle is manipulated by the acupuncturist and when the needle is stationary. *De qi* does not refer to the sensation of the needle being inserted or withdrawn. Please notice any sensations you feel during acupuncture. We will ask you to recall them after your treatment. Now I will place the needles and begin the treatment. Just sit back and relax.”

After acupuncture treatment, but before being given the scale, subjects will additionally be briefed on “MASS Instructions.” This script reads: “Take a moment to recall any *de qi* sensations you experienced during acupuncture. Remember, *de qi* does not refer to the sensation of the needle being inserted or withdrawn. On the next form, there is a list of words often used to describe *de qi* sensations. Because the experience of *de qi* is different for different people, these words may or may not describe what you felt. If you felt something that is not listed, please write it on the blank marked “OTHER.” If you do not experience any sensations, you can mark “0” (no sensation) for all items, in-

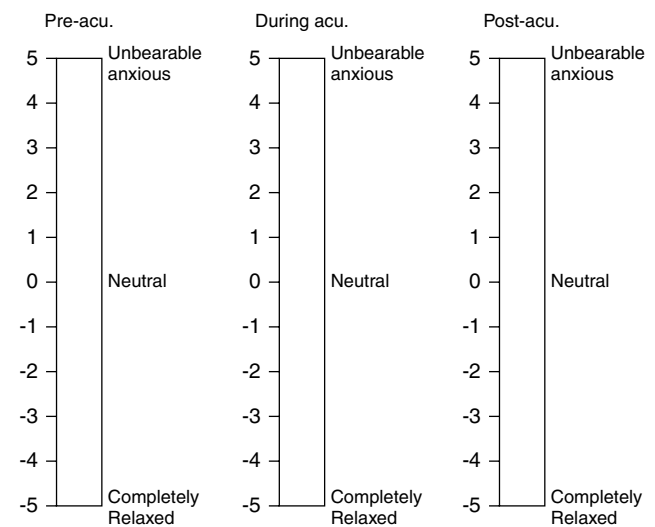


FIG. 3. The second supplementary “Mood Scale,” on which subjects rate pre-, during, and postacupuncture treatment anxiety on a 10.0-point continuum (ranging from -5 to 5), with evenly spaced terms “completely relaxed,” “neutral,” and “unbearably anxious.”

cluding “OTHER.” Now, please mark to what extent these words describe what you experienced during acupuncture.”

One challenge accompanying the use of MASS stems from the methods of how to analyze the data. Obviously, the method can vary depending on the investigators’ preferences and the aim of their studies. In the Appendix, we have provided several alternative methods, along with their limitations, for analyzing MASS. We hope these efforts will facilitate the application of MASS, allowing investigators to appropriately adapt them to their own studies, while retaining the coherence of the data collection across different sites.

FUTURE DIRECTIONS

As a central concept of traditional acupuncture, *de qi* and all of its implications (particularly its relationship to acupuncture therapeutic effect) remain to be verified. Basic scientific studies have begun to elucidate the neurobiologic basis of acupuncture needling sensations, however, including the sensory receptors and nerve fibers related to these sensations.

In one such study, researchers³⁷ have found that stimulation of blood vessels, nerves, muscles, tendons, and the periosteum can all evoke variable sensations, including soreness, aching, numbness, distention, and heaviness. Predominantly, stimulation of nerve branches produced numbness, stimulation of muscles produced soreness and distention, and stimulation of blood vessels produced pain. In another study, Wang and colleagues¹³ found the sensation of numbness to be predominantly associated with A β/γ fibers, distention and heaviness with A σ fibers, and soreness with C fibers. These studies indicated that alternative sensations may be linked with different tissues and nerve fibers, and may thus produce varying effects in the central nervous system and human body. Such research helps build the biomedical basis for linking different sensations with therapeutic effect.

Although some pilot studies have linked different *de qi* sensations with acupuncture, large clinical trials evaluating acupuncture efficacy are generally unequipped to do so. A standardized scale, such as MASS or something similar, could be used in clinical trials across multiple sites, and for different diseases. Such a scale could greatly benefit the field, making it possible to use specific sensations to predict the outcome of treatments for various disorders, and above all deepen our understanding of acupuncture mechanisms.

Before closing, it must be noted that while TCM and many other acupuncture styles intentionally elicit *de qi* sensations in patients and understand them as signs of treatment efficacy, this is not true for all forms of acupuncture. TCM is but one approach to acupuncture. Other styles, such as certain Japanese traditions, actively avoid inducing needling sensations in patients. For these forms of acupuncture, treat-

ment effect may be related only to the acupuncturist’s perception of *de qi*, or not related to *de qi* at all—measured entirely in terms of symptom relief.

CONCLUSIONS

De qi is a complex concept, and it is not known for certain whether it is the patient, practitioner, or both who experience the phenomenon during acupuncture treatment. Clear discussions of *de qi* developed much later in Chinese history than discussions of treatment, and it is difficult to judge whether sensations described in more recent literature correspond with the *de qi* originally mentioned in the *Nei-jing*. In this paper, we systematically reviewed the field and introduced a scale entitled “MASS” to measure the sensations evoked by acupuncture stimulation, as perceived by the patient alone. We hope our efforts will enhance the rigor of research on this topic.

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APPENDIX: HOW TO ANALYZE MASS

One challenge accompanying the use of MASS stems from the decision about how to analyze the data. While all the authors agree on using the MASS or a similar instrument to quantify acupuncture sensations, opinions vary on how best to analyze the data. The large variability in the data underscores the fact that acupuncture sensations are highly subjective, especially when studies are performed in acupuncture-naïve subjects. Sometimes, the subjects/patients may struggle to map the subtleties of the sensation of these artificial descriptor terms. The most common default approach to analyzing the results might be to take the mean of all ratings. In a previous study,⁹ however, we found that only soreness and numbness, but not other sensations listed on the SASS scale, were correlated with analgesia to experimental pain. Thus, it might be beneficial to select analytic methods that maintain the more subtle information of the data—by performing separate analyses for all sensations, for example. There are disadvantages to this method as well, however, because separate analyses tend to produce type I errors and require *p* value modifications. Below we propose two additional complementary methods for measuring MASS results.

Factor analysis

Factor analysis is a statistical data reduction technique used to explain the covariance relationships among variables in terms of a few underlying, but unobservable random quantities called “factors.” An assumption for this method is that all variables within a particular group are highly correlated among themselves but have relatively small correlations with variables in a different group.³⁸ The method originated in psychometrics, and is used in other fields such as behavioral science, social science, and marketing.

Factor analysis is appropriate for analyzing MASS results because it is sometimes difficult for subjects/patients to distinguish between sensations, and they may occasionally rate certain sensations together. Also, subjects within a cohort might be occasionally inconsistent in how they label sensations. Thus, it will help us to understand how individuals describe acupuncture sensation in terms of the several choices of sensation names.

In our previous study,⁹ we used this method to analyze the 9 sensations listed on the SASS scale. The results suggest 3 factors among the 9 sensations: factor 1 included stabbing, throbbing, tingling, and burning; factor 2 included heaviness, fullness, and numbness; and factor 3 included soreness and aching (Table 2). As we mentioned before, Vincent and colleagues⁶ also performed a principal component analysis on patients’ acupuncture sensation ratings with the MPQ, and reported 7 components including dull–heavy sensations, a general intensity dimension, spreading, stinging, hot, sharp, and electric sensations. (Please note here that factor analysis is an extension of principal component analysis³⁸). These studies suggest that factor analysis may be a useful method for analyzing acupuncture sensations under certain conditions.

One limitation of using factor analysis, as highlighted by our attempt to use the method in our prior study, was that we were unable to find any correlations between analgesia and averaged rating for any of the factors mentioned earlier. Thus, although useful in many regards, factor analysis may also miss some important information.

TABLE 2. RESULT OF FACTOR ANALYSIS ON SASS SENSATIONS ACROSS ALL 3 ACUPUNCTURE POINTS AND 3 TREATMENT MODES

<i>Items</i>	<i>Factors</i>		
	<i>Stabbing</i>	<i>Heaviness</i>	<i>Soreness</i>
Factor 1			
Stabbing	0.80		
Throbbing	0.74	0.15	0.30
Tingling	0.58	0.13	0.19
Burning	0.70		0.23
Factor 2			
Heaviness		0.98	0.16
Fullness	0.20	0.78	
Numbness	0.14	0.13	0.36
Factor 3			
Soreness	0.14		0.89
Aching	0.38		0.61

SASS, Subjective Acupuncture Sensation Scale.

MASS INDEX

To perform comparisons between different experimental conditions or between different groups of subjects with MASS, it would be convenient to devise a single value that could summarize the full multivariate breadth and depth of acupuncture sensations. This index, expressed as a single value, should summarize both the multivariate breadth and the intensity depth of experienced sensations.

Here we propose one potential index, the MASS Index, for a weighted average based on formulas related to exponential smoothing, to quantify the intensity of *de qi* experienced by a particular subject, without regard to the particular words that a subject would use to describe the sensation. Exponential smoothing was originally used for forecasting with the underlying principle that exponentially decreasing weights are assigned to early observations and recent observations are given relatively more weight.³⁹ For the MASS Index, ratings are weighted based on their comparative intensity versus other sensations.

For such an analysis, a subject's individual MASS ratings scales would first be ordered from highest to lowest, and then the MASS Index would be calculated according to the following equation. We suggest using only the 11 descriptors, not including sharp pain because it is not a commonly regarded as a *de qi* sensation (but this decision is optional). Investigators might also want to include data from the "other" blank if subjects supplied their own descriptive term.

$$\text{MASS Index} = \frac{\sum_{i=1}^n (1/2)^i R_i}{1 - (1/2)^n}$$

Here R indicates the ratings for different sensations from highest to lowest; n represents the number of *de qi* sensations on the MASS questionnaire. The weights in this equation were chosen to balance between 2 scenarios: (1) subjective responses where only a single sensation is rated with a high intensity (e.g., an aching intensity of 8, and low intensity for others); and (2) where many sensations are moderately rated (e.g., 5 for aching, 4 for numbness, 5 for tingling, etc.). The Index can produce an alternative way to summarize MASS ratings to a unit for each of the datasets.

One limitation of this approach is that different sensations may play unique roles in various disorders. Furthermore, investigators disagree on what constitutes *de qi* and on which acupuncture sensations induce the greatest therapeutic effect. In this case, for instance, the importance of a sensation may depend more on how important a sensation is to *de qi* and less upon its score. Thus, emphasizing the weight of the highest ratings may not be suitable. Also, exponential weighting may not be an appropriate weighting method for multiple acupuncture sensations, and investigators should adjust their methods accordingly. Nevertheless, we believe this equation may at least help spark further original thought in the field.

JIAN KONG

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