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Effects on muscles in the body through listening to music and emotional responses.

Abstract

This work arose form my research to find people's personal frequencies and to improve the effectiveness of therapy with music by tuning prominent notes in the music to match these frequencies.

These are early results and must be considered tentative, until confirmed with more subjects and under better controlled conditions.

In my work in *Attune to Health*, applying music in a high tech way for therapy, I originally used the methods of Applied Kinesiology to assess relative muscle tone, in response to music to assess whether the music seemed to be suitable therapeutically. Then almost accidentally. and to my surprise I found that, muscle tone was very strong at certain narrowly defined frequencies, and conversely very weak at slightly off these frequencies. In fact the frequency had to be correct to within 0.1% which corresponds to about 1/60 th of a semitone. This tiny difference of pitch cannot be heard – it would need to be about 10 times that to be easily discernable under ordinary conditions – and yet certain muscles in the body have this large response.

I then found there is not just one frequency for a person but at least 11 and that these are spaced in a regular geometric pattern which is not related in any way to (at least Western) musical intervals.

Some very different pieces of music appear to show the same frequencies for a person, however, when correctly "tuned in" the relative strength of other muscles, e.g. individual fingers, appear to vary with the emotional affect of the music

There is also a time dependent effect. If one applies a slightly "wrong" frequency, $1/60^{th}$ of a semitone too low, for say 2 minutes, the relevant muscle shows weak and it remains weak for perhaps 20 seconds after the "correct" frequency is applied. However if one instead of applying the 'correct' frequency, one applies one $1/60^{th}$ of a semitone too high, the muscle goes strong within about 2 seconds; Naturally one must not leave this "wrong frequency" on for more than 10 seconds or so because it would cause the muscles to go weak.

Introduction

This work arose form my research to enhance therapy with music. My earlier work had been concerned with enabling the music to be felt through the whole body through a structured vibroacoustic system which incorporated a new design of transducers [1]. I believed that while useful, this was not enough and it could be enhanced further if a way could be found o find people's personal frequencies. It would then be relatively simple to tune prominent notes in the music to match these frequencies.

The belief in people's personal frequencies is widespread. Checking in 8 languages there are sayings such as "He and I are on the same wavelength", "I am tuning into her", "I am finding his notes", " I am resonating with her." (Remember that frequency = k/wavelength). Most of us have had experiences of being in close proximity to a person we don't know and having a feeling of either being comfortable of uncomfortable. I have had a personal experiences of the great health benefits of music, which, without my

knowledge and in fact only discovered many years later, was tuned to my own frequencies. It was because of these benefits that I was motivated to find a way of helping others in this way.

It is universally accepted that one has to use the "right" music for the client and the occasion. The "right" music is not generally the clients favourite music but it has to be something which they like and which greatly moves them emotionally [2]. Without an appropriate choice any of the above attempts to enhance the therapeutic effect would be as naught.

Some year ago I trained as a practitioner of Applied Kinesiology and I believed I could use this to help select the appropriate music to use.

Applied Kinesiology

At the point its necessary to explain a little of the practice of Applied Kinesiology. The part of the practice which is diagnostic makes extensive use of testing specific muscles according to procedures to determine whether the muscle can resist a force applied in a specific way. The basis being that, for example, a substance to which the body is sensitive or allergic will make certain muscles go 'weak', while certain vitamins or other substances which the body needs will make specific muscles go 'strong'. The terms 'strong' and weak' and are a little misleading and are simply shorthand for ability to resist a specifically applied force. For more information see [3].

For the results to be valid, one has to first carry out some neurological tests and if necessary adjustment.

> Unfortunately some unscrupulous salespeople are using what they call kinesiology so show clients that they should buy the products, without such tests, often with invalid procedures and sometimes the inappropriate muscles. Such demonstrations give the subject a bad name.

The purpose of this article is not to justify Applied Kinesiology and I ask you to believe, that despite being a subjective method. when properly carried out the results are reliable

I investigated whether I could apply these methods to find whether the music being used was 'right', and found that I that could. Initially the muscles which I tested were the pectoralis major clavicular (which is linked to the stomach meridian) and the lattisimus dorsii (which is liked to the spleen meridian). Both of these are of course connected with emotions. Sometimes it was found to be appropriate to use a procedure in kinesiology known as the *relevance test*.

Of course kinesiology can only help to find the appropriate piece; one can only test with what one has, in this case the available music, in my case a selection of CDs which are believe to be therapeutic. Hence a wise selection of possible pieces is important, as clearly one cannot be testing too many in a therapy session.. If the client has an idea if which pieces are therapeutic for them, I strongly advice the client to bring these pieces with them.

An accidental discovery –application to finding personal frequencies.

While carrying out the above work ie to assess relative muscle tone, to determine whether the music seemed to be suitable therapeutically, ie noticed that on some pieces the muscle tone was extremely high whiles another recording of the same piece it was not [4] This might of course have been due to different musical interpretation and different instrumentation or voices, some of which might be disagreeable to the listener, but I also was alert to the possibility that it might sometimes be due to different tuning.

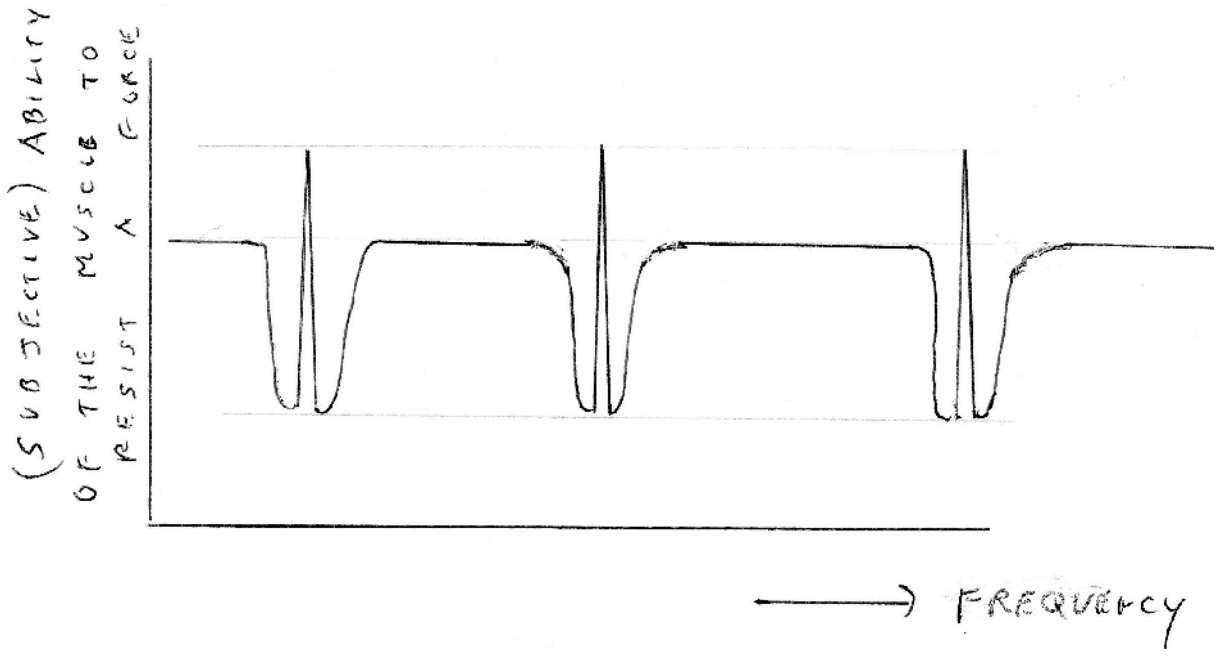
Investigated further by using pieces which were piano only, and which seems to have a similar tempo and interpretation. The same result was obtained, greatly strengthening the likelihood of it being connected with the frequency of tuning.

Investigating using 'variable pitch' playback

I began by using a variable pitch tape recoding deck which I had available. I used recording of piano pieces which had been found therapeutic and played them back at various pitches.

> While it is generally called 'variable pitch' it is in fact variable frequency. Pitch is a subjective measurement while frequency is absolute and the play back is absolute in term of the variation in the % change in Hz from that at which it was recorded. EG if it was recorded with the tuning for 'A' of 438 Hz and the 'pitch' wheel is set to -1.0% than it would play back as if it had been recorded at A = 433.62

This quickly showed that the frequency of tuning hypothesis seemed valid: at certain spot setting of the pitch adjustment control the muscles would go extremely strong while just a factional movement of the control knob would cause then to go extremely weak while further away from the spot frequency they were normal. This is shown diagrammatically below.



The adjustment to find the spot was very fine – a 'hairs breadth on the pitch adjustment knob, and being an analogue system, never designed for such a precise purpose, the position would not be reproducible hour to hour, or capable of being calibrated absolutely to a sufficient precision. Nevertheless it well served it purpose in finding that there were spot frequencies (I thought two) at which the muscles would exhibit this extremely sharp 'tuning' effect.

Further, and most important, I was able to show that it was not just an effect on the muscles. Some musical people found the music so disagreeable to listen to when it was jut slight off a "correct" setting for them, that they asked for it to be switched off.

Funding was obtained to buy a digital system based system, based on a 'Tascam MD-CD1'. This allowed the frequency to be varied by + or – 16% to a precision of 0.1%.which correspond to about 1/60 of a semitone. (A semitone difference in frequency is about 6%)

To my surprise the fineness of setting required to exhibit the muscle effect was even greater than I had thought, corresponding to about the maximum resolution to which the machine can be set, ie about 1/60 of a semitone.
Indeed it would be desirable to have a machine with double the precision of setting because occasionally it seems the best setting is between two adjacent settings.

It seems likely that the reason why this phenomena has not been found before, is that unless one was looking for it one would not find it, doe to the extreme narrowness of the frequency setting – within 1/60 of a semitone.

A number of personal frequencies – and their strange spacing.

Using this equipment, it became apparent that a person has considerable more personal frequencies than I first thought. With the range of the equipment there are 11 spot frequencies and typically they are spaced as below around which ever central frequency is strong. Actual figures depend on the individual person and the piece of music but the pattern is always similar. (The figures of 0.05% come from estimating between two settings of the frequency setting control.)

Frequency settings for client: Self

	PIECE	Mozart	Piano	Conc.	Num	21	Movemt	Slow				
Freq	L5	L4	L3	L2	L1		F0	H1	H2	H3	H4	H5
% devi	-14.7	-7.5	-4.4	-2.4	-1.4		0.0	1.5	2.6	4.9	7.9	14.7

Frequency settings for client: Self

	PIECE	Mozart	Piano	Conc.	Num	23	Movemt	Slow				
Freq	L5	L4	L3	L2	L1		F0	H1	H2	H3	H4	H5
% devi	-14.3	-7.5	-4.6	-2.6	-1.5		0.0	1.5	2.6	4.7	7.6	14.3

Now this is a very strange pattern – what can it mean?
Its is nearly symmetrical, whereas if it corresponded to some (at least Western) musical scale the spacing would be logarithmic.

The fact that these frequency intervals do not correspond musical intervals can be seen more clearly from the table below.

This table below shows typical frequency deviation settings as a percentage, and the ratio between each, and the intervals in cents.
(The 0.05 comes from interpolation between to settings of the frequency setting control)

Title: **Typical frequencies**

	Comment	L5	L4	L3	L2	L1	F0	H1	H2	H3	H4	H5
% deviat		**-14.70**	**-7.65**	**-4.75**	**-2.65**	**-1.65**	**0.00**	**1.65**	**2.64**	**4.75**	**7.65**	**14.70**
+ 100		85.30	92.35	95.25	97.35	98.35	100.00	101.65	102.64	104.75	107.65	114.70
Ratio		0.85	0.92	0.95	0.97	0.98	1.00	1.02	1.03	1.05	1.08	1.15
log		-0.07	-0.03	-0.02	-0.01	-0.01	0.00	0.01	0.01	0.02	0.03	0.06
	Cents from F0	-275.26	-137.78	-84.25	-46.60	-28.80	0.00	28.33	45.11	80.34	127.62	237.44

		Ratio toF0	Log	cents
	400.00			
5% up	420.00	1.05	0.02	84.47
5%down	380.00	0.95	-0.02	-88.80

Compare with intervals in music.

Equally tempered	Cents
semitone	100.0
tone	200.0

In just intonation,	Cents
Larger tone (e.g. C to Din key of C)	203.9
Smaller tone (e.g. D to E in key of C)	182.4
C to Db in key of C	111.7
C to C# in key of C	92.2
D to D# in key of C	70.7
D to Eb in key of C	90.2

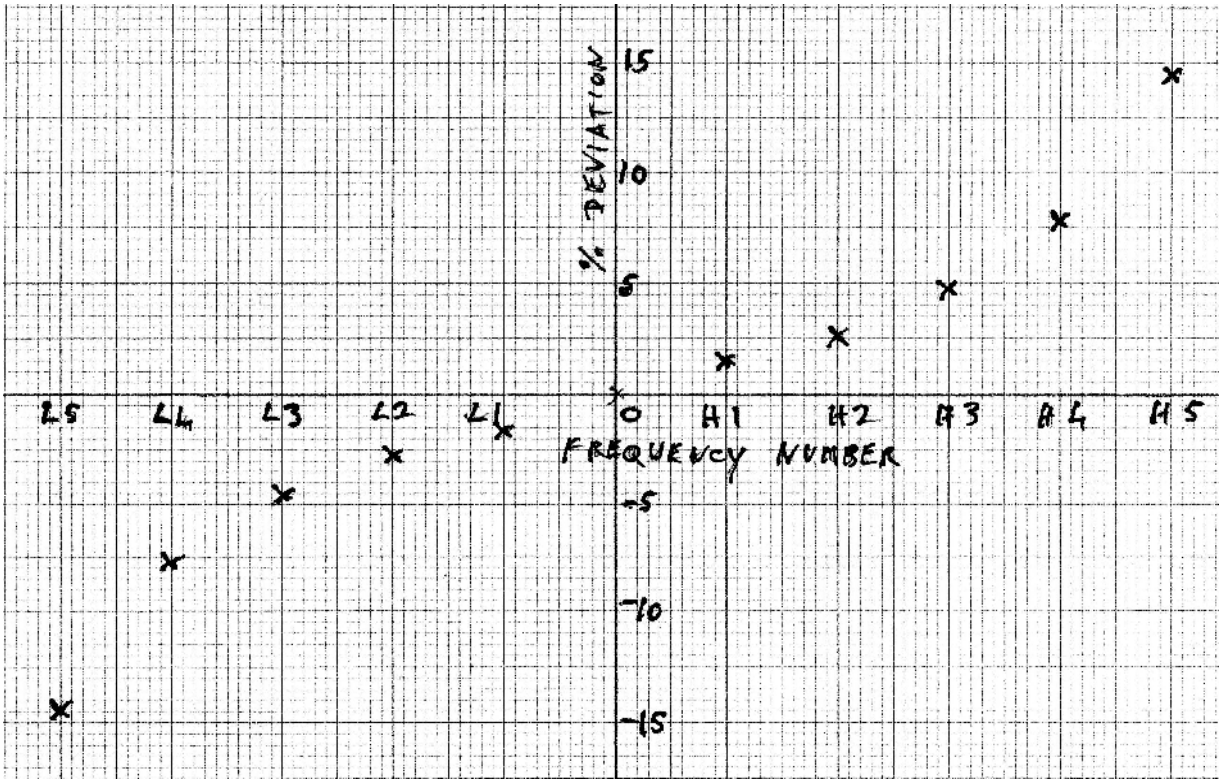
The following table is another way of showing that these spacings of these spot frequencies do not correspond to (at least Western) musical scales.

Scale Type

Note	Just Intonation (decm)	Pythagoras (decm)	Equal Temp (decm)	Just Intonation (Cents)	Pythagoras (Cents)	Equal Temp (Cents)
C	1.000	1.000	1.000	0.00	0.00	0.00
C#	1.055	1.068	1.059	92.18	113.69	100.00
Db	1.067	1.053	1.059	111.73	90.22	100.00
D	1.125	1.125	1.122	203.91	203.91	200.00
D#	1.172	1.201	1.189	274.58	317.60	300.00
Eb	1.185	1.185	1.189	294.13	294.13	300.00
E	1.250	1.266	1.260	386.31	407.82	400.00
F	1.333	1.333	1.335	498.04	498.04	500.00
F#	1.406	1.424	1.414	590.22	611.73	600.00
Gb	1.422	1.405	1.414	609.78	588.27	600.00
G	1.500	1.500	1.498	701.95	701.95	700.00
G#	1.563	1.602	1.587	772.63	815.64	800.00
Ab	1.580	1.580	1.587	792.18	792.18	800.00
A	1.667	1.688	1.682	884.36	905.86	900.00

A#	1.758	1.802	1.782	976.54	1019.55	1000.00
Bb	1.778	1.778	1.782	996.09	996.09	1000.00
B	1.875	1.898	1.888	1088.27	1109.77	1100.00
C'	2.000	2.000	2.000	1200.00	1200.00	1200.00

Having seen that the spot frequencies do not correspond to a scale we can graph then as below so see if we can recognise any pattern.



My research work continues to find the explanation for this pattern and also for the extremely sharply tuned muscle response.

Variations between people and the phenomena of entrainment

Some people have frequencies so similar that one wonders whether they are indeed “on the same wavelength”. Remember that wavelength = k / frequency

Freq for client: BA

	PIECE	Mozart	Piano	Conc.	Num	21	Movemt	Slow				
Freq	L5	L4	L3	L2	L1		F0	H1	H2	H3	H4	H5
% devi	-14.3	-7.6	-4.5	-2.4	-1.3		0.0	1.5	2.6	4.8	7.8	14.5

Initially I was finding that many of my friends and acquaintances were on very similar frequencies to me and I thought that meant that “they were on the same wavelength”. But there were too many similar for this to be a

sufficient explanation, and it became even more obvious that this must be rang when I began to measure the frequencies of clients who were ill. The explanation was entrainment.

Entrainment: This is well know and understood phenomena in physics. For example if a number of pendulums, with approximately the same period are swinging in a room, they will soon all come into synchronicity.
If there are two pendulums and one is much heavier then the other which is swing with a slightly longer period, the lighter will speed up to a period almost the period of the heavier, while the heavier will slowdown very slightly (imperceptibly if it is much heavier) to the common period**.**

It was found that if a person approached me, usually within 3 feet our frequencies would change, with the ill person's frequencies being pulled towards mine. For friends and acquaintances, it could go either way. Some people did not affect me at all, a few did as far away as 5 feet. In almost all cases touching the person produced no further frequency shift. A few people coming within 3 feet of me had no proximity effect but then when they touched me, a similar shift took place.

The above information may be valuable in the field of investigating unspoken communication.

There is a procedure in kinesiology involving holding what are known as the ESR point on the head, which can minimise or possibly remove such interactions, but whether that remove it completely in this case I don't know.

I have been able to investigate the interaction between people to some extent by this means and also by using 3 way testing.

Time dependant effects

There is also a time dependent effect, and one needs to be aware of it and allow for it in this work. If one applies a slightly "wrong" frequency, $1/60^{th}$ of a semitone too low, for say 2 minutes, the relevant muscle shows weak and it remains weak for perhaps 20 seconds after the "correct" frequency is applied. However if one instead of applying the 'correct' frequency, one applies one $1/60^{th}$ of a semitone too high, the muscle goes strong within about 2 seconds; Naturally one must not leave this "wrong frequency" on for more than 10 seconds or so because it would cause the muscles to go weak.

The need for an objective method of measurement and one which does not require being close to the subject

Because of this interaction between people, I feel it is very important to obtain an objective method of measuring the muscles without coming into proximity with the subject. Further this reason is, I believe, even more important than the objection that the technique of measurement is subjective, because with a person trained in kinesiology I believe the results are reliable. I have seen suitable equipment at Teesside University hospital but the cost was prohibitive for this work at about £20,000.

Further refinement on assessing the emotional effect on the muscles of the music

This work is at an early stage and needs to be confirmed.

To investigate this one first needs to be exactly on the person's frequency. I noticed that the pectoralis major clavicular (which is linked to the stomach meridian) and the lattisimus dorsii (which is liked to the spleen meridian)often gave slightly different answers and I hypothesises that this was due to different emotional effects.
It seems that the best muscle to use for this purpose of setting the frequency is the pirifomis. Having set the frequency precisely one can look at the secondary effects on these two muscles due to emotions.

I have also been assessing the relative strengths oft the fingers on the left hand, again once the frequency is set precisely. For example, in Handel's 'Messiah', the index finger is stronger in the 3 people I have tested in the 'Halleluiah Chorus' and the little finger stronger in the 'Amen'. In these 3 the effect is strong , and reproducible.

Why not use simple sounds (e.g. sine waves) instead of music for therapy?

A vary fair question. There are many types of sound therapy, including using Tibetan singing bowls, crystal bowls, large tuning forks, and the use of the human voice to make specific sounds. I am not considering these here: only the method using simple computer generated sounds in which I have been trained. I don't practice this therapy because of the inadequate results I have obtained. It true that some practitioners obtain good results but this may be down to them as individuals with special qualities, or because they combine it with other factors.

I think the reason is that the brain quickly tires of listening to a simple sound and pays little attention after a short time, whereas music is a highly complex stimulus.

Nevertheless I think it would be a good idea to add specific sounds to the music and I intend to pursue this, probably using low bass notes. If necessary, they could be tuned slightly differently from the existing bass notes and perhaps an octave lower, the ear-brain probably would not notice the slight mistuning (because pitch discrimination is much poorer with low pitch notes and because beat frequencies would be outside the audible range.)

Note

These are early results and must be considered tentative, until confirmed with more subjects and under better controlled conditions. These results are based on tests with only 31 people and these are far from a cross section of the population, being friends, acquaintances and clients.
Two people have independently verified some of my results without my involvement but using my equipment, so it is not entirely independent.

References

[1] G. Dalgarno . "A vibroacoustic couch to improve perception of music by deaf people and for general therapeutic use." 6th International Conference on Music Perception and Cognition. Keele University, ISBN 0-9539909-0-7 UK. 2000

[2] G. Dalgarno "A Scientific Approach, including the use of Voice Measurements, to Sound and Music Therapy." Positive Health, Sept 2005

[3] See www.kinesiology.com and www.kinesiologyuk.com

[4] G. Dalgarno. "Enhancing Therapy with Music." TRAHMA conference held at Cumbria University, July 08

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