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Research Article

Alpha Brain-Wave Neurofeedback: Social and Economic Impact on Community, Propagation of Benefits Beyond Those Trained

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Abstract

The purpose of this retrospective survey study was to assess the effectiveness of alpha brain wave training in making positive social and economic differences in the trainees' community. Trainees and their circle of contacts (family, friends and co-workers) were solicited to respond to an online survey that asked the respondents to rate and provide comments about the trainees' changes in financial, physical, emotional and psychological and lifestyle factors. Results indicated that the trainees improved in significant areas of their lives, both at home and at work, and their self-observations were corroborated by their family, friends and co-workers. Furthermore, some of the trainees' family, friends and co-workers reported that they made changes in their own behaviour as a result of the changes they observed in the trainee. The conclusion from this study is that alpha brain wave training has positive impact on the social and economic well-being of the trainees as well as the social and economic fabric of the community.

Keywords: *Neurofeedback; Alpha Brain Wave Training; Economic and Social Benefits*

Introduction

Providing effective ways for people to improve their social and economic situations in their communities benefits the individuals, their families, their communities and societies at large. In general, feedback changes any system to which it is added. In this retrospective survey study, we report on how training individuals with brain neurofeedback positively impacts not only their own lives but the lives of those around them. In the novel approach used and reported in this study, participants receive auditory feedback in response to their brainwaves, and are provided with tools and coaching that allows them to learn to change their own brainwaves. The two broad questions that guide this training program and that we aimed to answer in the survey of the participants of the training program were: At the individual trainee level, what happens when the trainees learn to change their brainwaves, in terms of their psychological, emotional, social, and economic situations? And at the broader societal level, what happens to the members of the trainees' social and familial networks? Our results show that the alpha brain-wave neurofeedback training enhances the trainees' psychological and emotional well-being [1], their economic and social situations, and most importantly, the positive impact spreads into the communities where the trainees live, leading to wide-ranging positive impacts with considerable positive societal implication.

Negative Impact of Psychological Stress

Stressful events are common in most societies and contribute to major depressive disorder as well as to depressive symptoms [2-4], and the numbers are staggering. For example, Mazure [3] showed that 50% to 80% of depressed persons experienced a major life event during the 3 to 6 months preceding the onset of depression, compared with only 20% to 30% of non-depressed persons evaluated during the same period. Estimates from a more recent study showed that approximately 20% to 25% of persons who experienced major stress-

ful events developed depression [5]. Levels of depression and anxiety increased in 9% and 20%, respectively, of previously symptom-free first-year university students in the UK, and financial difficulties were associated with increased depression while relationship difficulties were associated with increased anxiety [6].

Furthermore, over the past 25 or more years, many studies have been published that link anxiety and depression to medical disorders and diseases. Depression is co-morbid with many medical conditions in Canada and the United States, accounting for nearly 10% of all medical disabilities [7]. Stressful events contribute to the development of physical disease by causing negative affective states (e.g., feelings of anxiety and depression) which in turn directly affect biological processes as well as behavioural patterns that increase disease risk [8]. Exposure to chronic stress is even more toxic as it is believed to result in long-term or even permanent changes in the emotional, physiological, and behavioural responses, and these in turn make increase susceptibility to and negatively impact the course of disease [8,9].

Studies have shown that psychological stress has cumulative pathophysiological consequences and has been linked to not only clinical depression but also cardiovascular disease, human immunodeficiency virus (HIV/AIDS), and at least some forms of cancer [10]. Chronic stimulation of the sympathetic nervous system from persistent emotional stress raises blood pressure and increases heart rate, increases the secretion of catecholamines, leading to elevated levels of epinephrine and norepinephrine, and this in turn leads to hippocampal stressors [11]. Chronic unpredictable stress is known to stimulate the release of corticosterone and decreases the neurogenesis of the hippocampus [12]. Authors of a large-scale, international study of 29,972 patients from 52 countries [13,14] assessed the impacts of risk factors for developing an acute myocardial infarction, and concluded that anxiety, anger, depression and other psychological stressors were higher risk factors than were hypertension, abdominal obesity, diabetes and several other traditional risk factors. This small sample of the many studies in the literature is intended to demonstrate the link between negative emotions (brought about by emotional stress) and physical diseases (viz. coronary heart disease) via repeated sympathetic nervous system and hypothalamic-pituitary-adrenocortical axis activation, inflammation and immune dysregulation.

The long-term benefit of any treatment is commonly at the forefront of prognosis of both the health care professional and the recipient of the treatment. In psychiatry and psychology, treatments of depression consist mostly of prescription medications and psychotherapy. For example, in the United States, antidepressants are now the second most commonly prescribed drugs, and used by 1 in 10 Americans over the age of 12, with an effectiveness that is sometimes no more effective than placebo [15]. Other effective treatment modalities, particularly ones that are not dependent on medications such as the neurofeedback technique discussed here, are desirable.

Positive Effects of Neurofeedback

Neurofeedback, and more generally biofeedback, is based on the idea that the brain's electrical or the body's physiological (e.g., heart rate, blood pressure) responses can be recorded and "fed" back to the person so that with training and time the person will learn to voluntarily control those responses [16]. Behavioural cognitive training and neurofeedback have been shown to enhance executive cognitive functions such as task-switching, memory updating and dual task performance [17] as well as other performance skills likely by mechanisms that reduce anxiety (e.g., musical performance, Williamson [16]).

Since the 1970s and the advent of the electroencephalogram (EEG), neurofeedback, specifically alpha brain wave, training has been gaining attention as a method to enhancing a wide range of clinical and cognitive functions. For example, early studies have shown that learned self-regulation of EEG activity, specifically alpha activity, reduces anxiety [18-20]. More recently, Hardt [1] showed that alpha activity also reduces depression, and increases IQ, creativity, and improves relationships [1,21]. Neurofeedback has also been found to improve clinical symptoms in uncontrolled epilepsy [22], ADD/ADHD [23,24], head injuries, and learning disabilities.

The clinical benefits of neurofeedback as treatment of clinical depression and anxiety have begun to be demonstrated. The literature reviewed by Hammond [21] strongly suggests that neurofeedback can be more effective than medication or placebo in treating of certain

psychological conditions, notably anxiety disorders (generalized, phobic, obsessive-compulsive, and post-traumatic stress disorders) and depression. Hammond also noted that most of the neurofeedback studies on anxiety in the literature used very short training sessions (3.2 hours, on average) but even so, the results with the neurofeedback were positive in 7 or the 8 studies reviewed. One early set of experiments that examined the effects of alpha-training on reducing test anxiety, using random assignment, alternative treatment and wait control groups (Garrett and Silver, 1976), showed that the alpha trained groups produced between 33% and 78% more alpha post-training with a concomitant reduction in test anxiety compared with the untreated control and alternate treatment (relaxation) groups who showed no changes in their test anxiety.

Neurofeedback has also been shown to have positive impacts on people's lives in general. For example, using neurofeedback with participants of the Dine' (Navajo) People, Kelly [25] has shown that neurofeedback had led to decreased impact of drinking in 81% of participants and overall improvement in life-skill functioning. This author attributed the benefits to a combination of a range of influences that neurofeedback can exert, including: "(a) induction of the relaxation response; (b) induction of a beneficial neurologically-based altered state of consciousness which produces both chemical balance and emotional satisfaction; (c) the benefits of both Hawthorne and placebo responses combined with the other essential psychological values of faith, expectation, belief, and hope; (d) the new experience of physiological and psychological self-control in a situation where the client had previously felt helpless; (e) the apparent experience of what the participants commonly describe as a significant spiritual insight" [25].

Description of the Alpha Brain Wave Training Program and Current Study

Based on the earlier success of neurofeedback with clinical and non-clinical groups, we developed an Alpha Brian Wave Training Program. In this neurofeedback training program, individuals receive extensive information about their brain activity in real time. In the first phase of alpha brain wave training, Alpha One Training, the trainees receive 200 updates per second (50 updates per second on each of four EEG channels) that facilitates accelerated learning of the trainee's voluntary control of his or her brain activity. The feedback is provided in the form of an audio stream based on the naturally occurring frequencies of the brain. Retention of the learning is enhanced by "over-learning": this is achieved by using a 7-consecutive day intensive format (10 - 12 hours per day of training and coaching). More information about the training program is available at www.biocybernaut.com.

In a previous study published in this journal [1], this alpha brain-wave neurofeedback training program significantly decreased anxiety, depression, hypochondriasis, hysteria, masculinity/femininity psychaesthenia, schizophrenia and social introversion. Our belief is that by aiding the trainees in reducing these psychopathologies, we are also helping them by reducing their risk of other conditions discussed above (e.g., cardiovascular disease). In the study reported here, we are taking this a step further, to demonstrate positive social and economic impacts of alpha brain-wave neurofeedback in the trainees and their families and communities where the trainees live. Assessment of the impacts of neurofeedback beyond the trainees themselves is a new area of research. It is related to the ideas of social contagion studied by social psychologists, who have studied this and related phenomena ranging from, for example, the influences of political mobilization messages on voting behaviour of millions of people [26] to the spread of happiness [27]. It is also based on the 360-degree survey process used, for example, to provide physicians with team-based feedback to improve their relationships with patients and co-workers [28]. We hypothesize that the impacts of the neurofeedback training will spread beyond the trainees themselves and have positive impacts on the trainees' immediate social network.

Methods

Participants

A total of 117 potential study participants/trainees were sent a request to consult with their friends, family, and coworkers to answer a survey about them in respect to their alpha brain wave training. The key survey respondents were Biocybernaut trainees who had attended brain wave training programs from January 2010 to November 2012.

The contact with the potential survey participants included obtaining their informed consent prior to their inclusion in the study and they were asked to provide the contact details for family, friends and coworkers who agreed to be surveyed. The survey participants were informed that their responses, though not anonymous, would be kept strictly confidential, and that their responses would only be shared and published in aggregated form without attributing their names to any specific responses.

Some of the trainees could not be reached because their contact information was no longer active or valid email addresses were not available and some declined to participate for personal reasons (e.g. no time to be involved). The final distribution and response rates for the three groups are shown in Table 1.

	Trainees		Family and Friends		Co-workers	
Invitations Sent	96		116		25	
Responded	58	60.4%	70	60.3%	21	84%
Opted out	1	1%	2	1.7%	1	4%
Bounced	1	1%	1	.9%	0	0%
No Response	37	38.5%	45	38.8%	3	12%

Table 1: *Survey Distribution and Response Rates.*

Procedure

Trainees and their friends, family members, and coworkers who agreed to participate in the survey were invited to complete the online survey (Survey Monkey 2012). They were given one week to respond initially, followed by a reminder with a 5-day extension. The respondents were paid $25 to complete the survey and were entered into a draw to win one of two iPad 2 tablets (the survey took place in 2012). The trainees were in one drawing and the members of their circle were in another drawing.

Measures

Ten sets of outcome measures (a total of 77 items that required a numerical rating using checkboxes where people responded on a rating scale of 11 points with 0 being no change and -1 to -5 the scale of less and +1 to +5 of more. One question of financial behaviour had a rating scale of 3 measures: no change, increase and decrease and a second question on financial behaviour had a rating scale of yes or no. The results collected were:

- **Personality traits (10 factors):** Being judgmental, negative thinking, tolerance, patients, self-honesty, honesty with others, integrity, respectfulness, peacefulness and engaged indifference);
- **Communication abilities (6 items):** Ability to listen, effectively express yourself, openness to others, others' openness to you, ability to speak about feelings, and ability to be understood;
- **Personal interactions (9 items):** Willingness to engage with others, attentive to needs of others, trusting other people, others trusting you, trusting yourself, deep discussion, giving compliments, hugging/touching, and personal warmth;
- **Positive emotional expressions (6 items):** Feeling/being kind, happy, loving, surprised, joyful, and hopeful;
- **Negative emotional expressions (9 items):** Feeling fear/being afraid, feeling/being anxious, angry, upset, mean, disgusted, sad/depressed, sluggish/tired, and apathetic;

- **Positive attitudes and behaviour changes (7 items):** Positive attitude towards life, optimism, confidence, joking, story-telling, laughter/playfulness, and personal appearance;
- **Negative attitudes and behaviour changes (5 items):** Physical fighting/shoving, moodiness, being resentful, swearing, and sarcasm;
- **Family roles (8 items):** Being a good family member, a good spouse, a good friend, a good son/daughter, a good grandparent, a good aunt/uncle, and good brother/sister;
- **Cultural and spiritual development (7 items):** Attending/participating in ceremonies/feasts, volunteering, contributing to community, contributing to workplace, education (taking courses/classes), spiritual development, and cultural development; and
- **Work environment (10 items):** Being a "team player", being a good colleague, reliability, punctuality, participating in meetings, meeting deadlines, remembering important dates, being a perfectionist, creativity, and problem-solving.

The trainees were also asked an additional set of five questions about their incomes, savings and financial behaviours. (See also Table 2 below. The complete list of survey questions is available from the authors on request).

Construct (Number of Items)	Trainees (N = 58)	Family and Friends (N = 70)	Co-Workers (N = 21)
Personality Traits (10)	$F(1,57) = 27.330$, $p<.0001$ partial $\eta^2 = .327$	$F(1,69) = 34.965$, $p < .0001$ partial $\eta^2 = .336$	$F(1,20) = 9.385$, $p = .0061$ partial $\eta^2 = .319$
Communication Abilities (6)	$F(1,57) = 83.649$, $p<.0001$ partial $\eta^2 = .595$	$F(1,69) = 218.100$, $p < .0001$ partial $\eta^2 = .760$	$F(1,20) = 74.493$, $p<.0001$ partial $\eta^2 = .788$
Personal Interactions (9)	$F(1,57) = 92.863$, $p<.0001$ partial $\eta^2 = .620$	$F(1,69) = 184.942$, $p < .0001$ partial $\eta^2 = .728$	$F(1,20) = 48.842$, $p<.0001$ partial $\eta^2 = .709$
Emotional Traits (15)	$F(1,57) = 18.680$, $p<.0001$ partial $\eta^2 = .247$	$F(1,69) = 5.997$, $p = .0169$ partial $\eta^2 = .080$	$F(1,20) = 0.098$, $p = .7577$ ns (partial $\eta^2 = .005$)
Emotional Expressions (9)	$F(1,57) = 72.187$, $p<.0001$ partial $\eta^2 = .559$	$F(1,69) = 78.702$, $p < .0001$ partial $\eta^2 = .533$	$F(1,20) = 27.296$, $p<.0001$ partial $\eta^2 = .577$
Attitudes & Behaviours (12)	$F(1,57) = 59.719$, $p<.0001$ partial $\eta^2 = .512$	$F(1,69) = 143.759$, $p < .0001$ partial $\eta^2 = .676$	$F(1,20) = 34.851$, $p<.0001$ partial $\eta^2 = .635$
Cognitive Traits & Characteristics (11)	$F(1,57) = 62.064$, $p<.0001$ partial $\eta^2 = .521$	$F(1,69) = 143.214$, $p < .0001$ partial $\eta^2 = .675$	N/A
Work Environment (15)	$F(1,57) = 64.698$, $p<.0001$ partial $\eta^2 = .532$	N/A	$F(1,20) = 36.592$, $p<.0001$ partial $\eta^2 = .647$
Activities & Pursuits (15)	$F(1,57) = 76.608$, $p<.0001$ partial $\eta^2 = .573$	$F(1,69) = 133.997$, $p < .0001$ partial $\eta^2 = .660$	N/A
Use of Time (11)	$F(1,57) = 54.328$, $p<.0001$ partial $\eta^2 = .488$	$F(1,69) = 73.466$, $p < .0001$ partial $\eta^2 = .516$	N/A
Use of Time 2 (9)	$F(1,57) = 24.644$, $p<.0001$ partial $\eta^2 = .302$	N/A	N/A
Family Roles (8)	$F(1,57) = 94.383$, $p<.0001$ partial $\eta^2 = .623$	$F(1,69) = 139.977$, $p < .0001$ partial $\eta^2 = .670$	N/A
Spending Patterns (17)	$F(1,57) = 25.870$, $p<.0001$ partial $\eta^2 = .320$	N/A	N/A
Entertainment & Social Spending (7)	$F(1,57) = 14.875$, $p<.0003$ partial $\eta^2 = .207$	N/A	N/A
Health & Well-Being (10)	$F(1,57) = 5.091$, $p = .0279$ partial $\eta^2 = .082$	N/A	N/A
Diet (9)	$F(1,57) = 0.945$, $p = .3352$ non-significant (partial $\eta^2 = .016$)	N/A	N/A
Financial Behaviour (11)	$F(1,57) = 3941.972$, $p<.0001$ partial $\eta^2 = .986$	N/A	N/A

Table 2: *Multivariate Tests for Retrospective Survey Results.*

Survey Design and Data Analyses Conducted

For the main part of the post-training/retrospective survey, three versions of the survey were created, one for each group of respondents: (1) trainees, (2) trainees' family members and friends, and (3) trainees' coworkers.

Respondents were asked to rate each item with regard to the change they experienced (or perceived in themselves) when considering how they were prior to their alpha training and after. The response scale ranged from -5 ("much less") through 0 ("no change") to +5

("much more"). For each set of outcome measures, the analyses were done in the following order. First, a multivariate analysis was conducted to test the null hypothesis that the set of items for each construct (together) did not differ from zero (no change). The advantage of doing a multivariate analysis first is that the probability of making a Type I error (i.e., of incorrectly rejecting a true null hypothesis) is controlled at a small level (typically .05 is chosen). Following the multivariate analyses, t-tests were conducted on the individual items, to identify on which of the individual items the trainees perceived a change in themselves, and on which their family, friends and co-workers noticed a difference.

The information collected in the surveys included quantitative and qualitative data. The qualitative responses were analyzed for themes. The quantitative responses were analyzed using SPSS (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.) examining the pre- to post-training difference scores. Each set of outcome measures were analyzed in two steps, for each group of survey respondents. First, a multivariate analysis was conducted on the set of items, to assess overall per-post differences, controlling for Type I error. If the multivariate analysis was statistically significant, this was followed by univariate analyses (pre-post t-tests, chi-square or sign tests, as appropriate) on each item.

The written comments were analyzed using conventional content analysis, to identify the most common themes that appeared in the texts.

Results

All multivariate analyses were statistically significant, with all p-values of less than or equal to .006 (see Table 2). Table 2 shows that the trainees and their family and friends, and on some of the constructs though not all the co-workers as well, perceived a difference in the trainees' traits and behaviours. The more detailed and interesting results from the subsequent univariate analyses that show the pre- to post-training changes in ratings on each item by respondent group, are shown in Figures 1 through 10 and are discussed below. (The results of the univariate pre-post t-tests are not shown here, but all were statistically significant with the vast majority of p-values < 0.0001 and many Cohen's d estimates were greater than 0.8 indicating large pre-post mean differences).

Personality Traits

Figure 1 shows that the trainees improved by about 2 points, on average, on each of the 10 personality traits assessed (note that the first two, being judgmental and negative thinking, are negative traits and therefore improvement is when their scores on the post-test are smaller than on the pre-test). Note that friends in particular noticed an improvement in the trainees' self-honesty, honesty with others, and peacefulness. Family members noticed higher levels of tolerance and patience. The co-workers, though overall lower mean differences, nonetheless concurred with the trainees and family and friends that improvement in the trainee could be seen on each of these 10 personality traits.

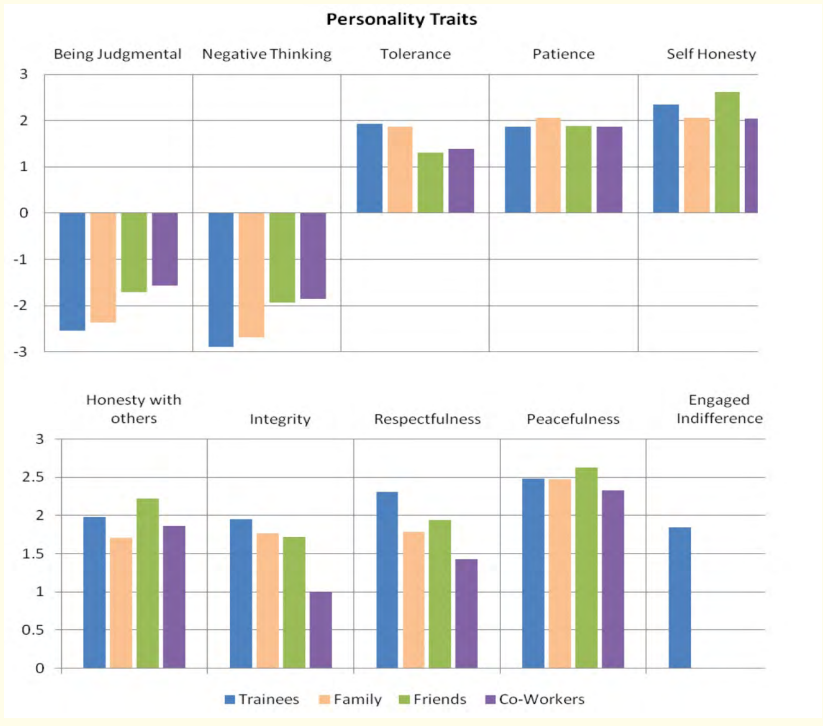

Figure 1: *Average pre-post training differences reported by trainees, family, friends and co-workers on the 10 items assessing PERSONALITY TRAITS.*

Communication Abilities

The trainees' changes in communication abilities are shown in Figure 2. Again, improvements, by at least 2 points on average, were reported on each of these abilities. In these cases, the trainees' friends and family often reported even bigger changes than the trainees themselves, for example, their openness to others and their abilities to speak about feelings and to be understood.

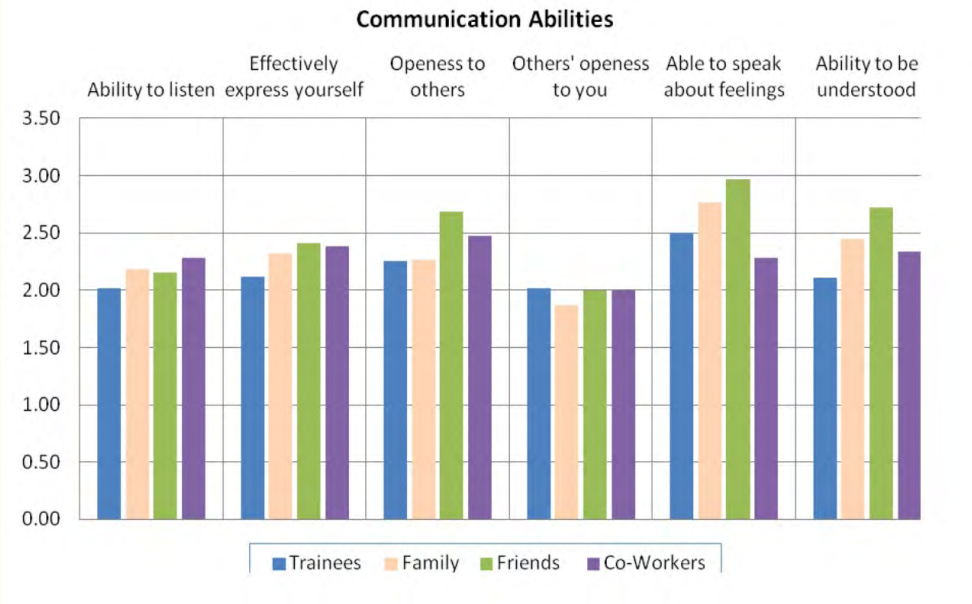

Figure 2: *Average pre-post training differences reported by trainees, family, friends and co-workers on the items assessing COMMUNICATION ABILITIES.*

Personal Interactions

With regard to personal interactions, the pre-post changes are shown in Figure 3.

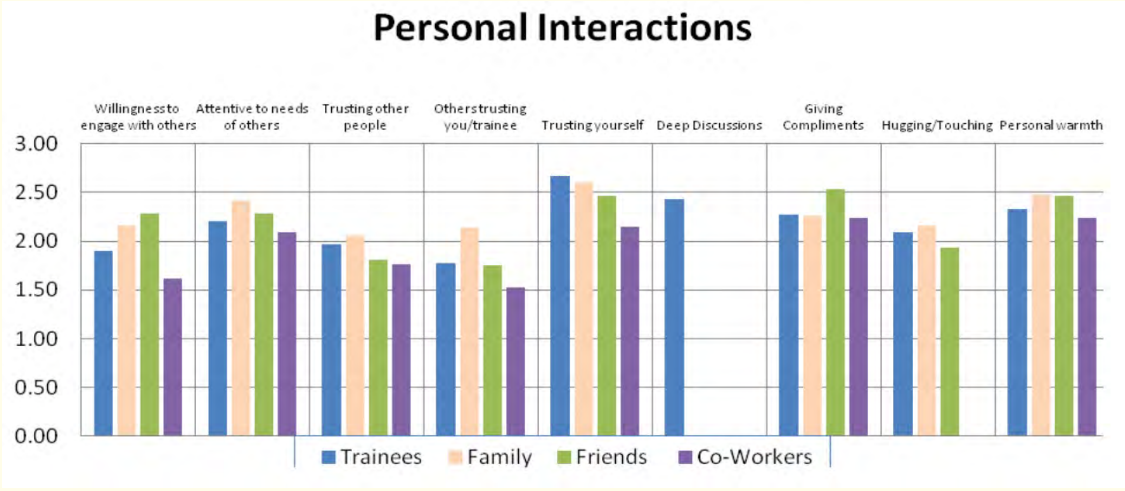

Figure 3: *Average pre-post training differences reported by trainees, family, friends and co-workers on the items assessing PERSONAL INTERACTIONS.*

Positive and Negative Emotions

Ratings on the six positive emotions were all improved by the training, as reported by all four groups; see Figure 4. Again, the co-workers were slightly lower across the emotions, but all were in the positive direction. With regard to the negative emotions, Figure 5 shows that the trainees decreased on each of the nine, as reported by each group of respondents.

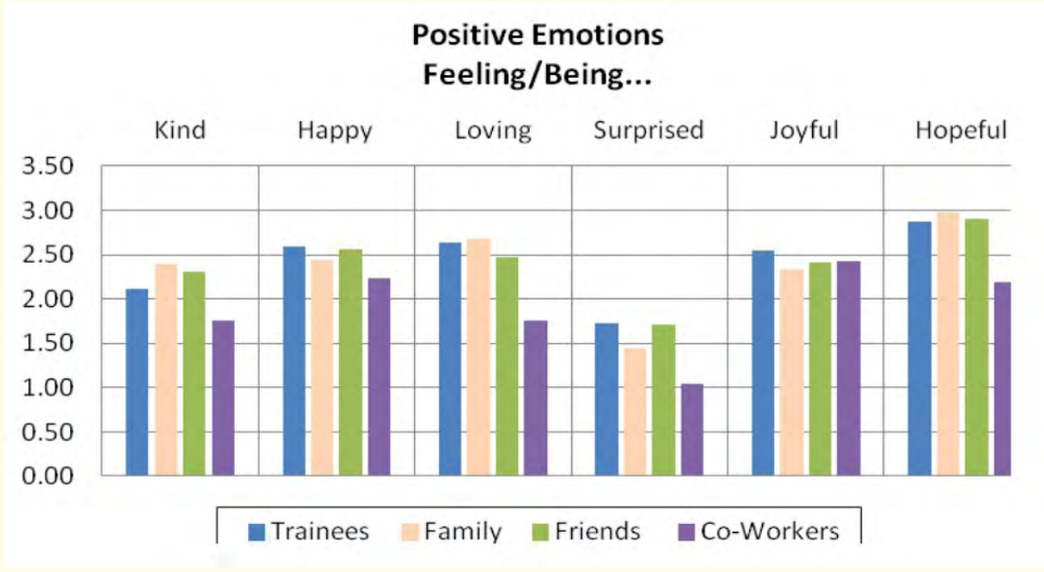

Figure 4: *Average pre-post training differences reported by trainees, family, friends and co-workers on the items assessing POSITIVE EMOTIONS.*

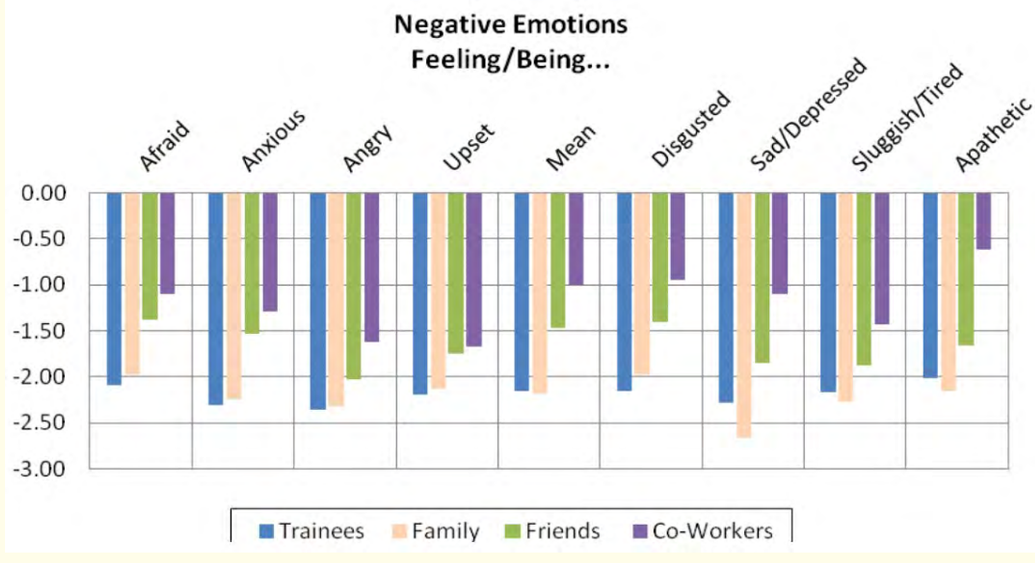

Figure 5: *Average pre-post training differences reported by trainees, family, friends and co-workers on the items assessing NEGATIVE EMOTIONALEXPRESSIONS.*

Positive and Negative Attitudes

Similar to the emotions, the trainees' positive attitudes improved (Figure 6) and negative attitudes became less negative (Figure 7). With regard to the negative attitudes especially, it is interesting to note that the coworkers noticed less moodiness, resentfulness and swearing in the trainees post-training, while the family members also agreed and also noticed less physical fighting/shoving and less sarcasm.

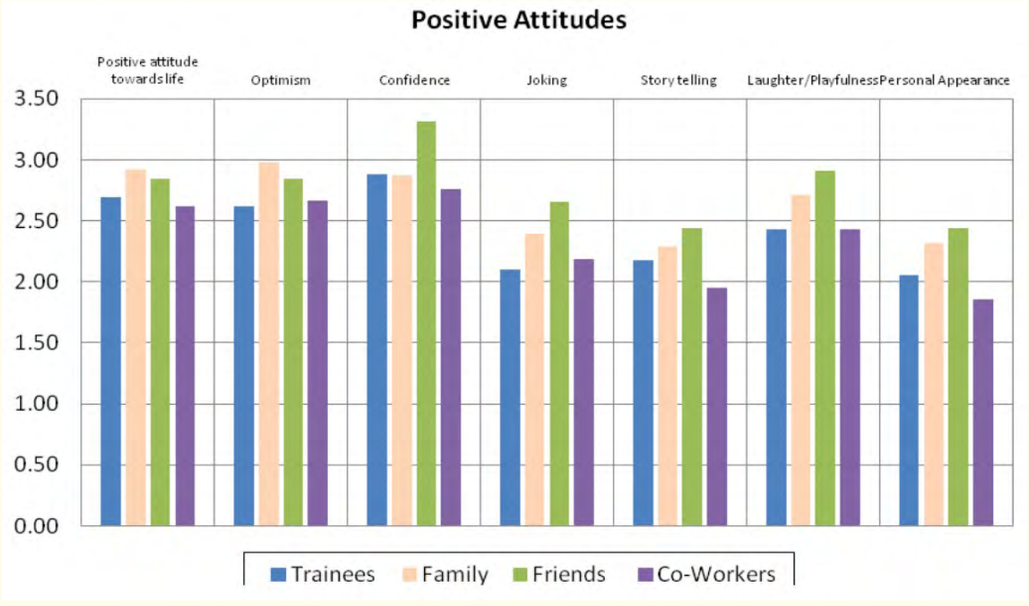

Figure 6: *Average pre-post training differences reported by trainees, family, friends and co-workers on the items assessing POSITIVE ATTITUDES.*

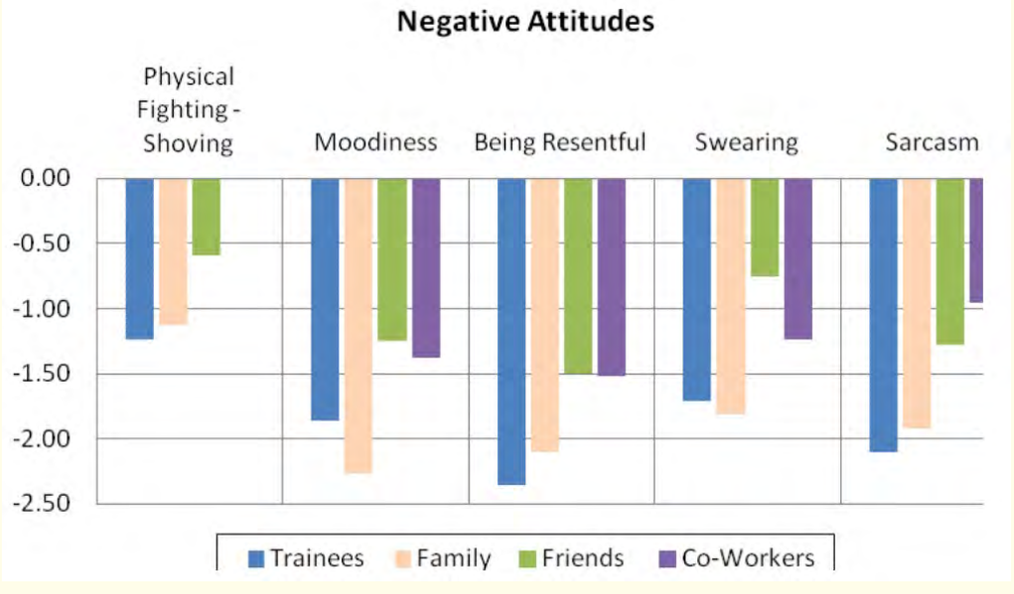

Figure 7: *Average pre-post training differences reported by trainees, family, friends and co-workers on the items assessing NEGATIVE ATTITUDES.*

Family Roles

Only the trainees, family and friends were asked about changes in the trainees with regard to their family roles. In this set of questions, see Figure 8, the family members saw even bigger changes in the trainees than the trainees self-reported themselves. On the "being a better friend", the trainees' friends also reported larger differences in the trainees than the trainees themselves.

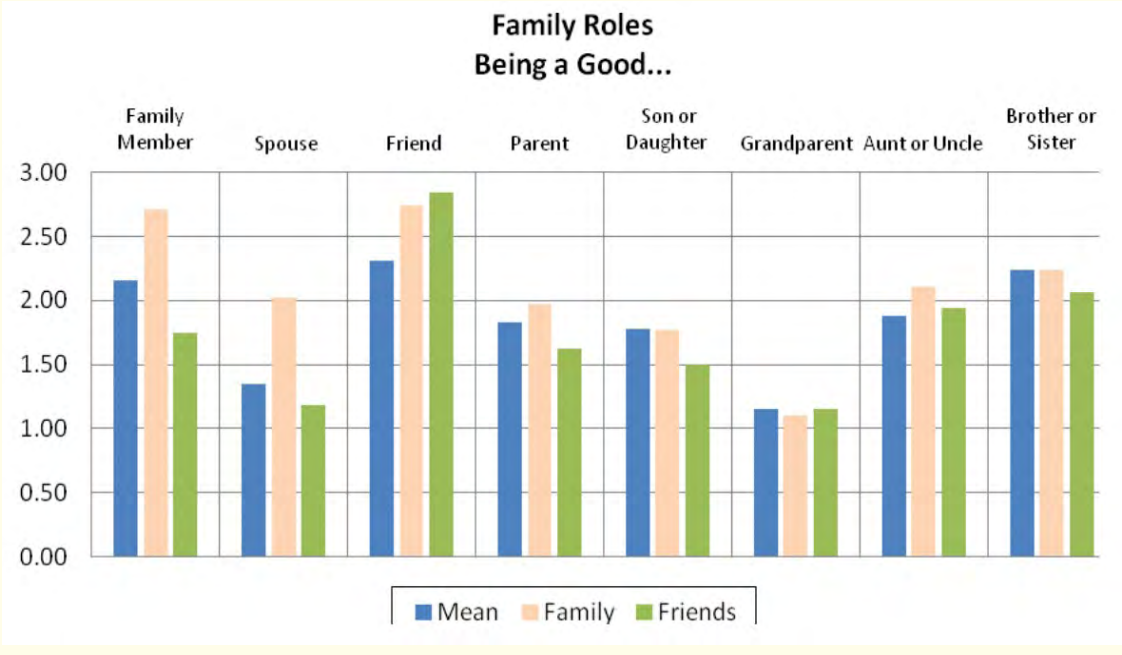

Figure 8: *Average pre-post training differences reported by trainees, family and friends on the items assessing FAMILY ROLES.*

Activities and Pursuits

The training also improved the trainees' participation in various social and cultural pursuits. These changes were overall slightly smaller than for the other constructs, but still consistently positive and statistically significant.

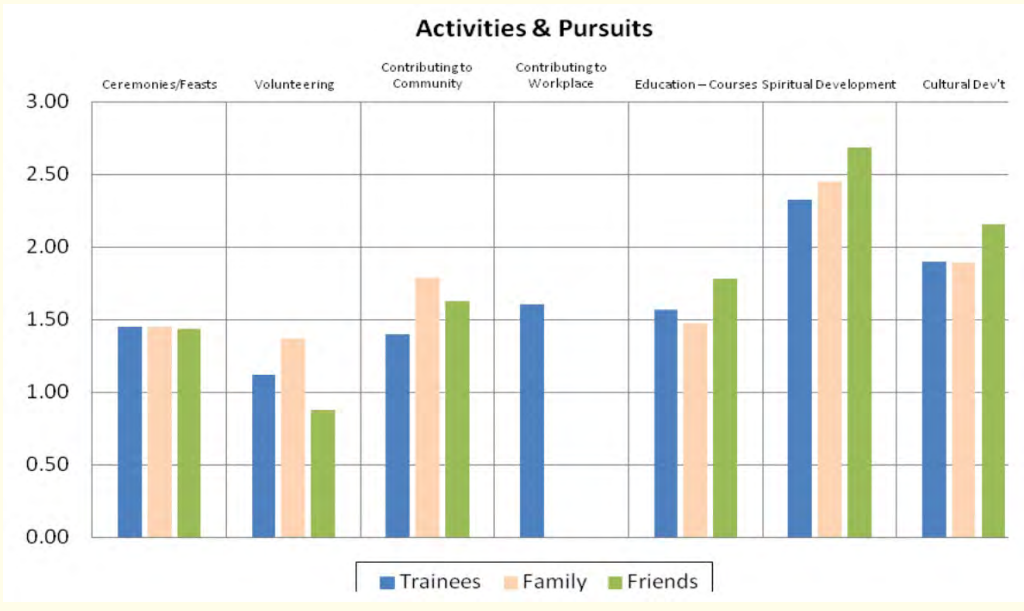

Figure 9: *Average pre-post training differences reported by trainees, family, friends and co-workers on the items assessing NEGATIVE ATTITUDES.*

Work Environment

The trainees and their co-workers were asked about changes in the work environment, and the reported changes are shown in Figure 10. It is interesting that the co-workers again perceived slightly larger improvements on these dimensions than the trainees themselves, on average, particularly with regard to being a team player and being a good colleague. Only one item in this set, the trainees' self-rating about being a perfectionist, saw a slight drop.

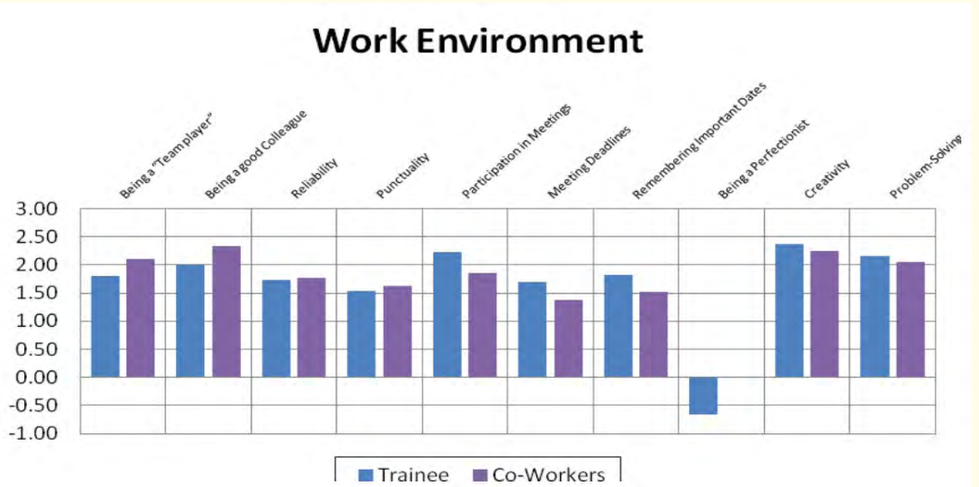

Figure 10: *Average pre-post training differences reported by trainees, family, friends and co-workers on the items assessing WORK ENVIRONMENT.*

Income, Savings and Financial Behaviour

Five overall items were asked about the trainees' income and savings before and after their Alpha training. The distributions of the 58 survey respondents across the three response options – decrease, no change or increase – are shown in Figure 11. Analyses found significantly significant changes on four of the five variables ($p < 0.01$ on sign tests), the one exception being income ($p = 0.1686$). Although the majority (50.0% to 65.5%) of the trainee respondents indicated no change, those who did report a difference due to the Alpha Training, the difference was in the positive direction. Specifically, higher proportions of trainees reported an increase in their income (29.3%), number of sources of income (34.5%), saving amounts (37.9%) and value of investments (31.0%), and a significantly high percentage of trainees reported a decrease in their debt levels (43.1%).

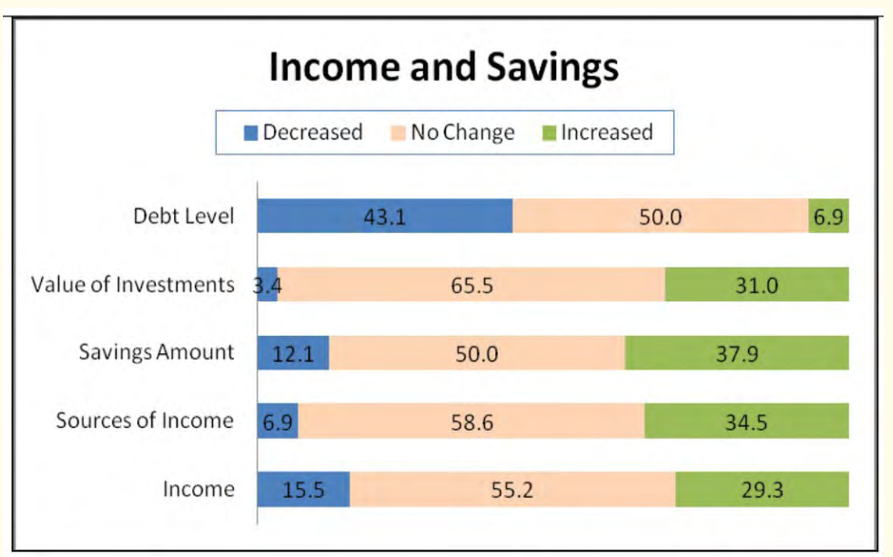

Figure 11: *Pre- to post-Alpha Training changes in trainees' income and savings.*

The trainees' financial behaviours, assessed on six items (see Figure 12) show that 72% of the survey respondents got a job or got a new job and 71% started or expanded their own business. Furthermore, 10 – 19% had bought or were in the process of buying real estate/property (10%), a major appliance (16%), or a car (19%). These findings are statistically significant. (Two versions of the Binomial test were conducted: (1) In a test of the null hypothesis that survey participants were responding yes/no "randomly" (50 - 50%), $p < 0.0022$ for all six financial behaviours; and (2) In a test of the null hypothesis that everyone would respond "no" (i.e., no pre- to post- Alpha Training changes), all $p < 0.0057$).

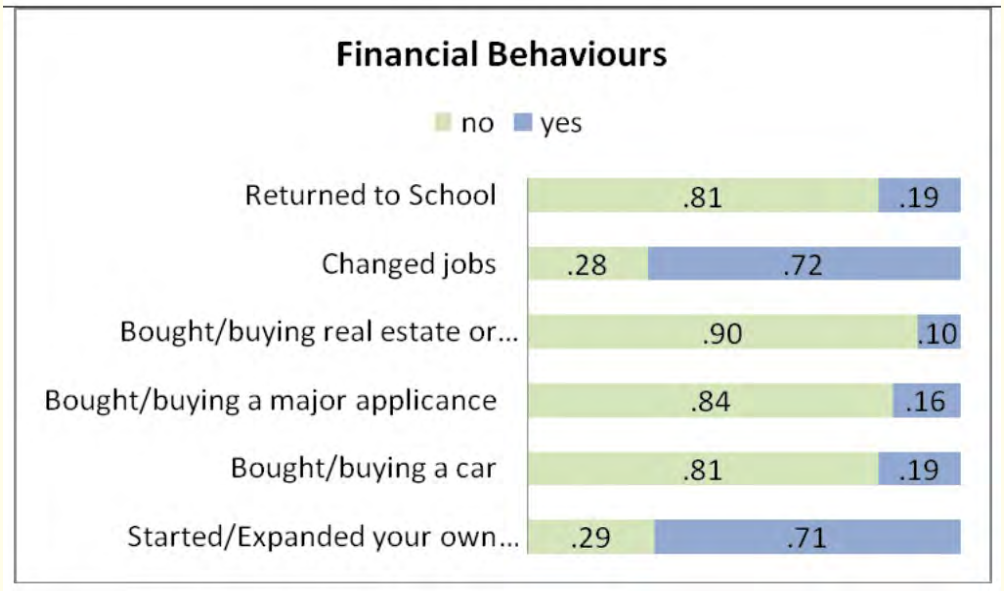

Figure 12: *Proportions of trainees who reported changes in their financial behaviour following their Alpha Training.*

Content Analyses of Written Comments

An important component of the survey data was in the comments made by the Trainees and their circle of contacts: family, friends and coworkers. A conventional content analysis was performed on the comments.

The following list presents most frequently occurring descriptive phrases made by friends and family to describe the changes in the trainees following the training: more at ease, more self-aware, more open, more happy, more optimistic, more relaxed, more tolerant, more confident. The observations made of the trainees indicate that, for the most part, the trainees are much easier to be around, have a lightness of being, and are more assertive without being confrontational or expressing anger. Furthermore, the trainees have a greater "zest for life," are more joyful, open and loving, with new energy, and are more grounded with a better understanding of their feelings and emotions and are better able to express them.

The trainees were also credited with having a positive impact on their friends and families. Some observations offered by the trainees' circle were:

- "I can be more tolerant";
- "[she] inspires me to be better and more engaged in life";
- "[I] have learned new things from her"; and
- "I want to spend more time with [X]".

In this context, there seems to be a "ripple effect" that the trainee has on their circle of family, friends and coworkers. Several comments refer to the significant breakthroughs that have occurred in the trainees towards greater personal authenticity. This produced a desire in others to seek them out for counsel or just to spend more time with them.

This was echoed by the commentary made by the coworkers.

As for the trainees themselves, it was observed that the more training individuals have, the more articulate they become about themselves and their own 'self-worth' statements increase in their intensity. Nearly all of the trainees focus on the changes they have experienced in their relationships with their families, and these were reported as overwhelmingly positive. Their comments indicated increased levels of self-esteem that represent self-confidence as well as an empathic response towards others. Trainees indicated spending less time on solitary and isolating activities (computer games, etc.), which is also about increased connection to others.

Economic elements, even for laid-off workers indicated a wider openness to seeking work in alternative fields. Again, this may reflect a new improved self-assessment of one's abilities and one's inherent self-worth.

Evaluations by co-workers were limited but irrespective of the client's background or occupation, the co-worker assessments reflected a nearly constant thematic refrain: increasing calmness; increased ability to focus; and better listening abilities. These are interpreted by others as indicating that the trainee has heretofore untapped mentorship abilities. They want to be like them, be around them, and they are admired.

Trainees were seen by their co-workers as: more aware of the issues that need to be dealt with; having more patience working with others employees whose abilities are not as strong; not always taking things as personally as before; being more in tune with himself/herself; calmer; more self-confident; able to handle stress and anxiety in a very positive way which in turn affects others around the individual for the positive; able to manage negative emotions better; able to see a bigger picture; more open and personable; fitting in better with the team.

Discussion

The findings for the Biocybernaut Alpha trainees show that the trainees themselves perceived significant and substantial benefits of the Alpha training on all of the outcome measures. The largest impact was felt by the trainees on their financial behaviour. Personal interactions, family roles and communication abilities also all showed overall very strong beneficial effects.

The trainees' personal development and social relations, as assessed in this study from the perspectives of the trainees and their family, friends and coworkers, showed that the trainees perceived positive changes that are good indicators of economic productivity gains. The length of time since the training and this retrospective survey may not have been sufficiently long to show the full impact of the benefits, so even stronger effects may emerge later. We are particularly interested in topical areas where there was strong agreement between the trainees and the people in their networks. There are many areas of strong agreement between the trainees and the people in their networks on the nature and magnitude of the benefits that the trainees gained from their Alpha training. This is a remarkable degree of support for the belief in the accuracy of the trainees' self-reported benefits. The areas where agreement between trainees and their family, friends and coworkers was particularly strong and significant were:

- Personality traits of Peacefulness, Honesty and a Reduction of Negative Thinking;
- Communication abilities of Openness to Others, Self-Expression and the Ability to Speak About Feelings;
- Personal interactions of Attentiveness to Other's Needs, Giving Compliments and Expressing Personal Warmth;
- General reduction of negative emotional traits;
- Increased states of being Happy, Joyful and Hopeful;
- Attitudes and behaviour changes yielding a more Positive Attitude Toward Life, more Optimism, more Confidence and a sense of Playfulness and increased Laughter with a decrease in Moodiness and Resentfulness;

- General improvement in family relations across kinship categories; and
- Increased spiritual and cultural development.

With regard to relationships in the workplace (where we considered responses from trainees and coworkers), the coworkers indicated a positive shift in the trainees' strengths in a number of areas that were also reflected in the trainees' personal self-descriptions. Specifically, the changes witnessed in the trainees included being seen as Better Colleagues and Team Players, showing more Initiative, Accepting More Responsibility and having increased Problem-Solving Ability.

The trainees reported very substantial improvements in financial behaviors in the pre- to post Alpha training time frame. While it is difficult to directly attribute these effects of the Alpha training per se (a randomized design with a control group would need to be conducted), these results clearly show that, particularly with regard to key life changes – changing jobs and starting/expanding their own business – the Alpha training beneficially impacted the lives of a large majority (over 71%) of the trainees.

The results of this retrospective survey showed that the trainees' personality, emotional states and social skill and abilities, were beneficially impacted by the Alpha training. This suggests that the Alpha training influences the trainees' overall level of confidence and their ability to actively take their own lives into their hands and make positive changes. This was further reflected in the trainees' written comments. The positive self-evaluation in terms of self-esteem and self-confidence may, in turn, underlie the large amount of commentary around the theme of 'optimism'. People who previously had quite a grim view of the universe – not just society – have altered their views on their lives to the point where they feel like they are in a dialectical relationship to the world around them: both influencing it, and being influenced by it. Even more importantly, they feel connected, and it is this sense of connection, rather than disengagement, that is very powerfully and beneficially transformational. In addition, this new-found connectedness to life is confirmed by all of the positive comments from family, friends and co-workers.

The study has a number of limitations that need to be considered. First, this was a retrospective study where two types of respondents were asked to comment on and to rate any changes they observed in the behaviour of the Biocybernaut Alpha trainees. One group of respondents were the Alpha trainees themselves, and second were the family members, the friends and the co-workers of the Alpha trainees. Any self-selection bias of the first group is counteracted by inclusion of the family, friends and co-workers of the Alpha trainees.

We found that the respondents sometimes used the "no change" response alternative, which could be due to the insufficient elapsed time from the training to the time of the survey; a longer follow-up period would allow for the realization of the impacts and/or for respondents to adequately note any changes. In this regard, a prospective longitudinal pre-post study would further augment the present findings and provide assessments of the sustainability of the changes made. From 1979-1982, Hardt conducted a double-blind Alpha feedback training study at the University of California at San Francisco funded by National Institute of Mental Health (RO1). The study had two pre-test batteries of personality tests one week apart before the training, and the same batteries administered immediately after the training. In a 6-month follow-up of the research participant with the test batteries showed beneficial personality changes well beyond the benefits seen immediately after the training. Additional follow-ups at 12 months after the Alpha training showed further improvements in the personality test measures. The study showed that even one year after the Biocybernaut Alpha training, new benefits are continuing to show up for the trainees. Long term outcome studies on the Alpha training are continuing. Biocybernaut Institute of Canada is currently conducting a longitudinal study with school children 12 - 15 years old, in a small community in Saskatchewan, Canada. One parent does the Alpha training with each child.

The findings from this study also have much broader implications. This study replicated and expanded our previous findings that Alpha training has strong positive effects on the lives of the trainees [1]. But it goes much further. The findings in the present study show that after their Alpha training, when the individuals go back to their "regular" lives in their respective communities, their newly learned

positivity and improved mental and emotional states that they bring back to their homes and workplaces then spreads through their networks, similarly to the social influences demonstrated in other areas of social science research, such as the social influences of contact among close members of social networks [26] and the spread of happiness [27]. Our findings clearly show that family members noticed positive changes in the trainees in many areas (i.e., positive emotions, relationships, family roles). It is just a small additional step to infer that these positive changes in the trainees then also bring positive changes in the trainees' family and social networks. Furthermore, some family members offered comments that they wanted to become better themselves and the family members also made positive changes and credited the Alpha training of their family members for being able to make beneficial changes themselves. Thus, the improvements in the trainees were "contagious" or "protagious"; when the family members saw the improvements in the trainees, they felt inspired to want the same for themselves. Comments made by the family members, friends and co-workers of the trainees are so powerfully indicative of the contagious or protagious effects of the Alpha training, that we quote a sample of the comments made:

Three Family Members of three different Alpha trainees

A. "I have undergone some large changes in the time that I have known him. He has really helped me process certain difficult things in my own life based off of the journey he has been on with Biocybernaut".

B. "Being around her after training compared to before, I feel a lot more positive and look forward to spending time with her to have her help me with 'me'"!

C. "Seeing how she has changed her outlook on life - focusing on being more positive and optimistic; has given me an opportunity to focus on the same in my life".

Two Friends of two different Alpha trainees

A. "I have been more willing to step up and get involved in community initiatives as a result of seeing the example they have put forth".

B. "She inspired me to do some deep emotional and physical work. I have been working on my own career and cultivating my own passions as a direct response to her example".

Two Co-Workers of two different Alpha trainees

A) Proactively seek out her opinion more often. See her as a very valuable mentor who is wise and offers very good advice. I have become more confident in my role, as she and I have improved our working relationships. I feel lucky to be able to work with her, and learn from her strengths and experiences".

B) "I look deeper for the source of my "problems" or "concerns". When I feel stuck, she has taught me to ask questions, lots and lots of questions. I believe I accept myself more for who I am".

In the realm of the workplace, the tools and coaching provided by the Alpha training increased the trainees' sense of security and feeling good about themselves and their work skills. Positive perceptions of work and productivity are the basis for entrepreneurial development of a society. This is why we were so pleased to see that 71% of the trainees had important positive economic changes, including starting or expanding their own home businesses. The findings in this study from the trainees' co-workers also point to the contagious (protagious) nature of the positive changes created by the Alpha training tools and coaching.

All economic activities are predominantly a form of exchanges. Participation in economic activity is deeply rooted in networks and affiliations and so, to the degree that trainees feel a better sense of connection to those around them, and an openness to trying new things, large positive economic results will be stimulated, as our results so clearly show. At the level of the individual, economic activity is not

solely motivated by personal gain. Many other motivators play a role in whether and how an individual will engage in economic activities; for example, sense of fulfillment, contributing to society, and assisting others. Moreover, other activities, such as traveling, learning, leisure and sporting activities, are also economic and contribute to the overall economic and social well-being of individuals and of communities. All of these activities are based on social connectedness, which the Alpha training appears to enhance. And when the individual with enhanced social connectedness returns to their community, the associated social and economic enhancements are likely to spread rapidly through the community. This is another example of contagion (protagion). Future research into this idea of "contagious or protagious positive consciousness" is warranted and planned.

In summary, the results show that, particularly with regard to key life changes – changing jobs and starting/expanding their own businesses – the Alpha training changed the economic lives of a large majority (over 71%) of the trainees. This is powerful and very important. The results of this retrospective survey on the trainees' personality, emotional, social and economic traits and abilities, were beneficially impacted by the Alpha training. This suggests that the Alpha training profoundly impacts the trainees' overall level of confidence and their ability to actively take their own lives into their hands and make positive changes. And the findings from the trainees' family, friends and coworkers both corroborate the trainees' self-reported improvements, and raise the intriguing notion of these positive impacts being contagious or protagious, at the individual and even the societal levels.

One way to begin to imagine the beneficial impacts that this Alpha training could have on humans individually and in human society, is to quote from one of Hardt's [29] papers:

- Feedback changes any system to which it is added. From engineering, we know that adding feedback to a mechanical or electronic system endows the system with new and often surprising properties. … When individuals receive Brain Activity Feedback, they can change in ways which give them greater objectivity, increased self-honesty, greater self-responsibility, more choices, and a degree of freedom from cultural conditioning, all of which changes can have surprising beneficial consequences. With appropriate Brain Activity Training, individuals can improve their skills and their abilities, and they can learn both how to have new desirable experiences [Happiness, Joy, Vigor, Contentment, Love, Compassion] and how to stop having undesirable old experiences [like Anger, Hostility, Anxiety, Depression, Paranoia]. Indeed, people can learn how to change the core dimensions of their personality, by changing their brain activity, just as a computer's basic characteristics can be changed by loading a new operating system.

- By changing their brain activity, people can change their behavioral characteristics and they can learn how to regulate almost any process in their minds and their bodies. An individual with such a range of capabilities is far outside the range of the cultural norms. The appearance of such individuals, even in small numbers, will have an enormous impact on established cultural values and cultural institutions, and will rapidly redefine our cultural beliefs about what is possible and desirable, and what is normal. A culture of consciously self-regulating individuals will bear little resemblance to any culture as we know it, and it is beyond our current abilities to fully imagine [29].

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