NeuroLeadership

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What's different about the brain of a transactional, transformational or visionary leader? Can the particular characteristics of leadership be defined and the brain mapped to show specific patterns? And if so, might we then be able to change our own brain, through training, to make it function more like the brain of an outstanding leader? Those are the questions and theory behind an emerging niche of neuroscience research being driven largely by business management experts and the military who are seeking new ways to assess and foster leadership skills. Myself, Dr. Pierre Balthazard and Dr. David Waldman from Arizona State University W.P. Carey School of Business and Dr. Sean T. Hannah from West Point United States Military Academy, are among a path-breaking few who are trying to harness the brain's inherent plasticity to build better leaders. The idea is to map the patterns and intensities of electrical activity across and within brain regions to see what stands out in leaders and then to develop neurofeedback training programs targeted at those areas.

So far we have measured EEG in over 150 people, and have analyzed the first 44. We are just beginning to piece together surface EEG and LORETA images of the brain of a leader. "Visionary" or inspirational leadership attributes are identified in an extensive psychological assessment for the evaluation of different forms of leadership: 1- Transformational, 2- Transactional, 3- Visionary and, 4- Laissez-faire. The psychometric test is called the Multifactor Leadership Questionnaire (MLQ) described in detail by Bass and Avolio (1990). The survey, its scales, and outcomes associated with its constructs have been studied in detail by Avolio, Bass & Jung (1999); Lowe, Kroeck & Sivasubramaniam (1996) and Judge, Erez, Bono & Thoresen and Piccolo (2004).

Leadership Psychometric Tests

The basic idea of the MLQ is to assess a full range of inactive versus active forms of leadership. Laissez-faire at one end of the continuum represents inactive leadership or the absence thereof. Such leaders avoid making decisions and they are absent when needed (e.g., needed to help subordinates or provide direction). Laissez-faire tends to correlate negatively with leader effectiveness measures.

Transactional leadership is a more active form of leadership that emphasizes maintaining the status quo in one of two ways. First, transactional leaders may manage-by-exception whereby they take action to correct deviations from expected performance (e.g., correcting an employee who has made a mistake). Second, they can employ contingent reinforcement whereby it is made clear to employees as to the types of

behaviors and actions that will be rewarded. In total, transactional leadership has shown modest relationships with leader effectiveness.

Transformational leadership represents the most active form of leadership, and it has been most strongly related to leader effectiveness (i.e., more strongly than transactional leadership). Measures of leader effectiveness have been associated with transformational leadership at the individual, group, and organizational levels. In other words, such leadership helps individuals, groups, and organizations to develop, change, and perform. Transformational leadership is composed of three sub-constructs and a total of four sub-scales. The three sub-constructs include: (1) individualized consideration, (2) intellectual stimulation, and (3) charisma. Individualized consideration involves getting to know followers as individuals with unique motivations and developmental needs. Intellectual stimulation involves solving, and helping others to solve, old problems in new ways. Intellectually stimulating leaders get at the heart of complex problems. To use an old adage, they help people to think outside of the box. Charisma is composed of two highly related sub-scales: (a) idealized influence, and (b) inspirational motivation. Together, these two sub-scales deal with things like a strong sense of values, showing a lot of optimism, presenting a compelling vision, and demonstrating a collectively-oriented purpose as opposed to be self-serving.

qEEG Discriminant Analyses of High, Intermediate and Low Leadership Subjects

A minimum of two minutes of eyes closed EEG was recorded from a total of 44 subjects that also had full Leadership psychometric scores. Principle factor analysis with a Varimax rotation was performed to determine the redundancy and dimensionality of the psychometric measures. The factor analysis produced six factors that accounted for approximately 88% of the variance. We identified the TLIM (Transformational Inspirational Motivation) and the TLIC (Transformational Individualized Consideration) as representing the highest loading variables on the first two factors and selected these measures to be used in a preliminary discriminant analysis of high vs. low performers on the leadership test.

Three groups of subjects were selected, a High group defined as the top 15 subjects based on their scores on the TLIM and the TLIC; a Low group was defined as the lowest 15 subjects based on their scores and an intermediate Group of 14 subjects that were neither high nor low on their scores. The Discriminant analysis of the TLIC ordered subjects used a total of 32 variables with an entry criteria of 0.15 and resulted in 100% classification accuracy. A Jacknifed leave-one-out replication was 93% accurate as shown in Table I. The Discriminant analysis of the TLIM ordered subjects also used a total of 32 variables with an entry criteria of 0.15 and resulted in 100% classification accuracy. A Jacknifed leave-one-out replication was 100% accurate as shown in Table II.

Transformational Inspirational Motivation

Classification

GROUPs	HIGHER	LOWER	MIDDLE	%Correct
HIGHER	15	0	0	100
LOWER	0	15	0	100
MIDDLE	0	0	14	100
			Overall %	100

Jackknifed Classification

GROUPs	HIGHER	LOWER	MIDDLE	%Correct
HIGHER	15	0	0	100
LOWER	0	15	0	100
MIDDLE	0	0	14	100
			Overall %	100

Table I – Initial discriminant and jackknife cross-validation accuracy of the EEG in high, middle and low performers on the TLIM psychomctric test.

Transformational Individualized Consideration

Classification

GROUPs	HIGHER	LOWER	MIDDLE	%Correct
HIGHER	15	0	0	100
LOWER	0	15	0	100
MIDDLE	0	0	14	100
			Overall %	100

Jackknifed Classification

GROUPs	HIGHER	LOWER	MIDDLE	%Correct
HIGHER	15	0	0	100
LOWER	0	13	2	87
MIDDLE	0	1	13	93
			Overall %	93

Table II – Initial discriminant and jackknife cross-validation accuracy of the EEG in high, middle and low performers on the TLIC psychomctric test.

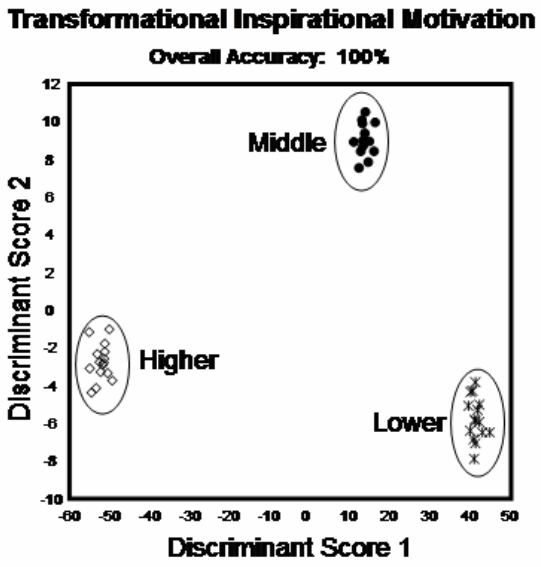

Fig. 1 – Two dimensional plot of the discriminant analyses for the Transformational Inspirational Motivation leadership profile. The y-axis are discriminant scores for discriminant function 1 and the x-axis are discriminant scores for discriminant factor 2. The discriminant accuracy values are shown in Table I.

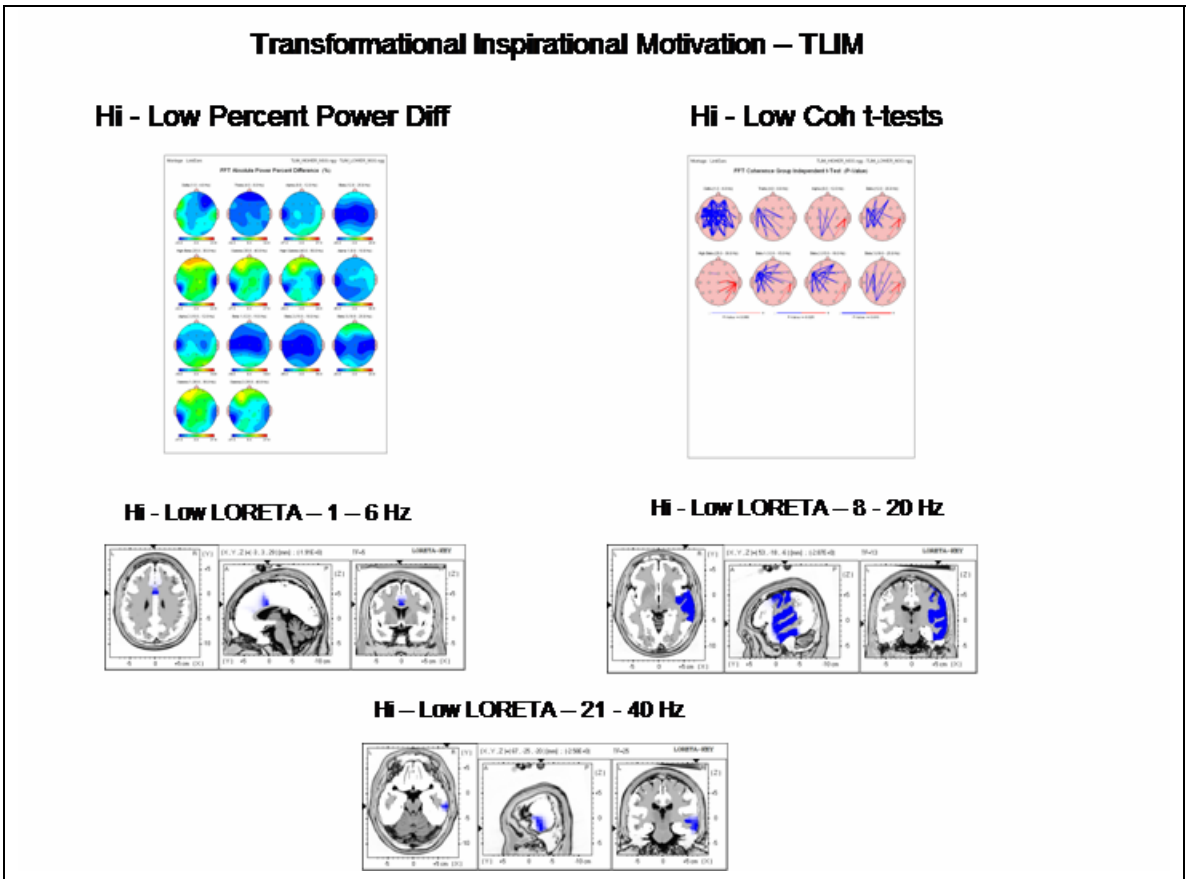

Fig. 2 – Percent differences between individuals that score high vs low on Transformational Inspirational Motivation (TLIM) psychometric profile. Top are differences in absolute power and coherence. Bottom are differences in current sources using LORETA.

Transformational Inspirational Motivation leaders as measured by TLIM (a high loading factor) have reduced power and devote less metabolic energy in the right temporal lobes and cingulate gyrus as parts of the "default" brain systems (Fig. 2 bottom). It is hypothesized that this gives them greater flexibility and greater resource to allocate to tasks. Elevated power in the left frontal regions indicates greater activity in support of executive functions, speech articulation and sequential planning. The coherence measures show greater cerebral complexity in high Transformational Inspirational Motivation leaders in comparison to low Transformational Inspirational Motivation leaders, especially in the frontal lobes and greater integration in the right hemisphere. Elevated coherence in the right temporal lobe indicates greater connectivity and integration involved in social skills and awareness of the environment (Fig. 2 Top). The LORETA analyses are consistent with the surface EEG power and show

right temporal lobe and cingulate gyrus reduced “default” activity which indicates better regulation or greater homeostasis of the default system in high Transformational Inspirational Motivation leaders and thereby greater ability to allocate attention resources.

Figures 3 and 4 show the results of analyses of the Transformational Individualized Consideration (TLIC) comparisons. Transformational Individualized Consideration (TLIC) leaders have reduced power and devote less metabolic energy in the temporal lobes, cingulate gyrus and the precuneus which are parts of the “Default” brain systems, especially in the right temporal lobe which gives them greater flexibility and greater capacity to allocate resources to tasks. Elevated power in the left temporal regions indicates greater activity in support of language functions and short-term memory. The coherence measures show greater cerebral complexity in high Transactional Transformational Individualized Consideration leaders in comparison to low Transformational Individualized Consideration leaders, especially in the frontal lobes and greater integration in the right hemisphere. Elevated coherence in the left temporal lobe is consistent with the elevated power in the same region and indicates greater connectivity and integration involved in receptive language and short-term memory. The LORETA analyses are consistent with the surface EEG power and show temporal lobe, posterior cingulate gyrus and precuneus reduced “default” activity which indicates better regulation or greater homeostasis of the default network in high Transformational Individualized Consideration leaders.

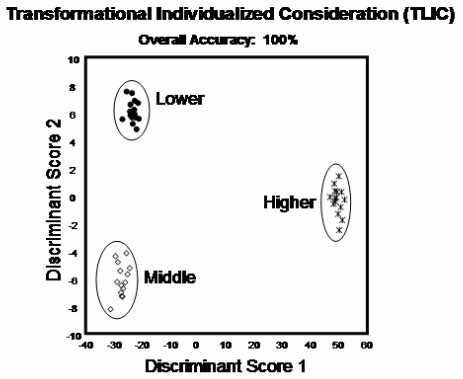

Fig. 3 – Two dimensional plot of the discriminant analyses for Transformational Individualized Consideration (TLIC). The y-axis are discriminant scores for discriminant function 1 and the x-axis are discriminant scores for discriminant factor 2. Discriminant accuracy is shown in Table II.

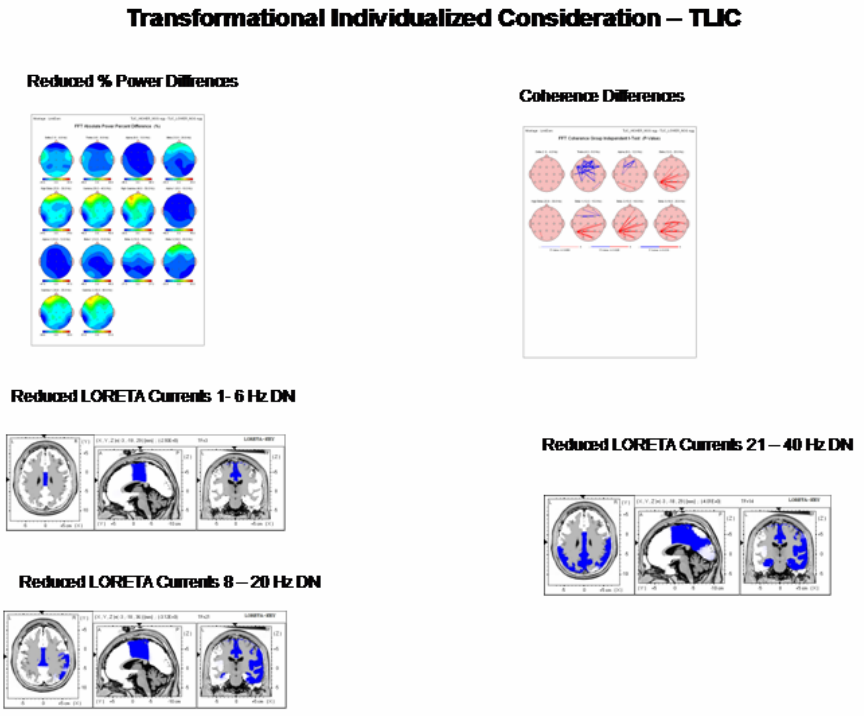

Fig. 4 – Percent differences between individuals that score high vs low on Transformational Individualized Consideration (TLIC) psychometric profile. Top are differences in absolute power and coherence. Bottom are differences in current sources using LORETA.

leaders seem to have “a more highly developed right hemisphere” and better-coordinated neuron firing among subregions in the right hemisphere, which suggests more efficient neural processing.

Hundreds more EEG recordings will be needed to extend and validate the early findings; we have most recently scanned West Point cadets to investigate whether a military leader is unique in any way. At the same time, Dr. Balthazard, Dr. Waldman and myself are forging ahead with plans to create training programs to help people attain a more “leader-like” brain through a combination of traditional leadership training programs and new applications of EEG biofeedback training modeled after those used in therapeutic regimens. In addition to the studies previously cited, below are references to some of the work by Drs. Balthazard, Waldman, Hanna and Peterson that has already been published or is scheduled to be published in the future.

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