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# Moral development, executive functioning, peak experiences and brain patterns in professional and amateur classical musicians: Interpreted in light of a Unified Theory of Performance

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ABSTRACT

This study compared professional and amateur classical musicians matched for age, gender, and education on reaction times during the Stroop color-word test, brainwaves during an auditory ERP task and during paired reaction-time tasks, responses on the Gibbs Sociomoral Reflection questionnaire, and self-reported frequencies of peak experiences. Professional musicians were characterized by: (1) lower color-word interference effects (Stroop task), (2) faster categorization of rare expected stimuli (P3b), and a trend for faster processing of rare unexpected stimuli (P3a), (3) higher scores on the Sociomoral Reflection questionnaire, and (4) more frequent peak experiences during rest, tasks, and sleep. Both groups had high values on the Brain Integration Scale. These findings are interpreted in light of a Unified Theory of Performance, which posits that effectiveness in any area is influenced by one's level of mind-brain development—emotional, cognitive, moral, ego and cortical development—with higher mind-brain development supporting greater effectiveness in any domain.



## 1. Introduction

Success in any field is determined by natural inborn talent shaped by ongoing experience. Levitin and colleagues report that accomplished musicians practice longer hours than musicians who are not at the top; the best conservatory students practice up to twice as much as those who were not judged as accomplished; and musicians, who achieve the highest performance ratings over time, practiced the most, irrespective of how much "talent" they possessed (Levitin, 2006).

The relation of practice to top performance is consistent with what is known with how the brain learns. The term *neuroplasticity* is used to describe the brain's ability to adapt and change as a result of training and experience over the course of a person's life. Through repeated experience we create neural circuits that support smooth, automatic flow of behavior. Neuroplasticity includes both increasing the number of connections and increasing the myelin sheath around each axon, which speeds up information flow (Fields & Stevens-Graham, 2002; Stevens, Porta, Haak, Gallo, & Fields, 2002). For instance, experience of music and language enhance brainstem representation of sound, supporting improved perceptual abilities to distinguish a signal from back ground noise (Song, Skoe, Banai, & Kraus, in press). Playing an instrument in an ensemble primes the brain to choose what is relevant in a complex situation that involves reading or remembering a score, timing issues and coordination with other musicians (Kraus & Chandrasekaran, 2010). Voxel-by-voxel comparison of gray matter (structural MRI) in professional keyboard players and matched amateur musicians revealed differences in motor as well

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as auditory and visuospatial brain regions, with greater structural differences in musicians who began learning music at a younger age (Elbert, Pantev, Wienbruch, Rockstroh, & Taub, 1995; Schlaug, Norton, Overy, & Winner, 2005), and who practiced with greater intensity (Gaser & Schlaug, 2003; Hutchinson, Lee, Gaab, & Schlaug, 2003; Schneider et al., 2005).

In addition, sensorimotor functioning is enhanced in musicians. Music training can strengthen connections between auditory and motor regions while activating multimodal integration regions. Training of this neural network may produce cross-modal effects on other behavioral or cognitive operations that draw on this network (Wan & Schlaug, 2010). Compared to non-musicians, musicians possess better control of finger movements (Kincaid, Duncan, & Scott, 2002) and detect changes in the pitch of sound faster and more accurately than non-musicians. The amplitude of event-related potentials (ERP), a brain measure of speed of processing, is reported larger in musicians 200 ms after the stimulus (N200), which indexes stimulus evaluation, and 300 ms after the stimulus (P300), which indexes categorization of stimuli (Nikjeh, Lister, & Frisch, 2009; Tervaniemi, Just, Koelsch, Widmann, & Schroger, 2005).

While most research has investigated specific effects of music practice, studies have also reported differences between professional and amateur musicians in overall brain functioning. Frontal brain areas—involved in planning, guiding mental and behavioral sequences, and controlling responses—are more extensively activated during performance in professional musicians compared to non-musicians (Munte, Nager, Beiss, Schroeder, & Altenmuller, 2003). Functional MRI studies revealed reduced brain activation during motor tasks in piano players compared to control subjects in the primary, premotor, and supplementary motor cortex (Hund-Georgiadis & von Cramon, 1999; Jancke, Shah, & Peters, 2000; Krings et al., 2000; Meister et al., 2005). This was explained in terms of more efficient wiring leading to lower neural activation (Bangert et al., 2006; Jancke et al., 2000; Krings et al., 2000).

Overall brain functioning has been conceptualized in a Unified Theory of Performance as "mind-brain development" (Harung, Alexander, & Heaton, 1995). During the first three decades of life, mind-brain development is affected by natural brain maturation interacting with ongoing experience. After age 30 years, experience is the major factor in changing brain structure and functioning (Toga, Thompson, & Sowell, 2006). Continuous brain development is considered to underlie cognitive, emotional, moral and ego development (Harung, 1999; Travis & Brown, 2011).

One marker of mind-brain development is brain integration. Higher brain integration provides a coherent framework for the brain to integrate localized processing modules into a larger picture (Palva & Palva, 2007). Brain integration has been operationalized by three EEG-derived measures recorded during challenging tasks: broad band frontal coherence, relative global alpha power, and brain preparatory response during challenging tasks (Travis, Tecce, Arenander, & Wallace, 2002). These three brain measures have been combined into a Brain Integration Scale. Higher scores on the Brain Integration Scale are associated with higher activity in the frontal–parietal default mode network of the brain (Travis et al., 2010), which is reported to underlie general intelligence (Glascher et al., 2010). Higher scores on the Brain Integration Scale correlate positively with higher emotional stability, higher moral reasoning, and more openness to experience; and correlates negatively with anxiety (Travis, Arenander, & DuBois, 2004).

Another marker of mind-brain development is moral reasoning. Higher moral reasoning requires a larger context for making moral decisions, for instance the impact of actions on others, society, and environment, rather than merely on one's own individual needs. Higher moral reasoning is associated with higher levels of cognitive and self-development (Gibbs et al., 1990) and, as just noted, with higher scores on the Brain Integration Scale (Travis et al., 2004). In terms of business, companies based on healthy human values and sound ethics are reported in the long run to outperform solely profit-driven organizations in terms of rise of share value (Collins & Porras, 2002).

A third marker of mind-brain development is frequency of peak experiences. Peak experiences are experiences of ego transcendence, glimpses of higher consciousness lying beyond ordinary daily experience (Alexander et al., 1990; Harung, 1999). Research with 22 world-class performers from many countries in a wide range of professions reported, "an association between world-class performance and more frequent experiences of an expanded, alert, and settled state of consciousness, even while engaged in dynamic activity" (Harung et al., 1995). Peak experiences bring with them such qualities as inner silence and deep relaxation amidst dynamic activity, ease of functioning and effortless action, playfulness, inner happiness, broad awareness combined with sharp focus, frequent luck or fortunate coincidences, reliable intuition, and sustainable performance on a high level (Alsgaard, 2008; Maslow, 1968). More frequent peak experiences have been reported by business leaders compared to non-leading controls (Thornton, Privette, & Bunderick, 1999).

Research on world-class athletes supports the relation of these three proposed markers of mind-brain development with greater effectiveness in sports. Compared to age-, gender- and type-of-sport matched average-performing athletes, 33 Norwegian world-class athletes reported (1) higher levels of self-development, (2) higher levels of moral reasoning, (3) faster electrodermal habituation to loud tones (an objective measure of the ability to ignore distractions), and (4) higher scores on the Brain Integration Scale (Harung et al., 2011). The world-class athletes in this study finished among the top ten in Olympic Games, World Championships, or similar competitions for at least three seasons.

Comparison of top-level managers and skilled knowledge workers—matched for age, gender, education, and type of organization (public or private)—reported a similar pattern of higher Brain Integration Scale scores, higher levels of moral reasoning, and more frequent peak experiences in the top-level managers. This study is now in review.

The current cross sectional study investigated whether levels of mind-brain development would differentiate professional and amateur classical musicians. Being a cross sectional study, this research cannot test causal relationships. However, it further investigates the relation of these measures in high performing populations as the basis for later longitudinal studies.