

Neuroscience and Multiple Intelligences

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The purpose of investigating the neuroscience underpinnings of the multiple intelligences after nearly 30 years is to determine its validity and viability as a scientific concept. We are fortunate today to have many neuroscientists investigating essential skills and abilities associated with each intelligence. It is important to first describe several key ideas pertaining to MI in order to frame our discussions. This will help us to avoid a number of common misunderstandings about MI theory.

Several years ago a neuroscientist friend warned me about the tendency of people in the educational community to immediately jump from "synapses to intelligences" based on too little scientific information. This can lead to educational "fads" that are short-lived and counter productive. I take his advice seriously as I do MI as a scientific theory and proposed this symposium as a means to reflect on and review 20 years of neuroscience evidence and its relationship to MI theory-- both pro and con.

There are six main points that I hope you'll keep in mind as we review neuroscience data.

1. **First**, Dr. Gardner uses a unique definition of intelligence as the basis for the formulation of MI theory.
2. **Second**, there are eight criteria from a wide array of disciplines that a capacity should (for the most part) meet in order to be included in the list of intelligences.
3. **Third**, research to date supports the contention that there are eight distinct forms of intelligence and there is limited support for the inclusion of a ninth intelligence.
4. **Fourth**, MI theory does not preclude the existence of "g" or general intelligence as measured by I.Q. tests.
5. **Fifth**, when scientists observe and interpret data they do so through the lenses of personal, professional and cultural assumptions as well as explicit theories regarding the nature of intelligence. This is important to keep in mind as we review work in the neurosciences.
6. **Sixth**, of the eight criteria used to formulate MI theory one of them is based on neuroscience and this is the focus of today's presenters. The data that Howard Gardner reviewed were originally sketched out in 1983 and are in need of further explication based on 20 additional years of research.

I will now briefly elaborate on these 6 points.

1. A Unique Definition of Intelligence

The definition that Howard Gardner uses to base MI theory is:

"Intelligence is a bio-psychological potential to process information in certain ways, in order to solve problems or fashion products that are valued in a culture or community."

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There are three points to this deceptively simple yet profound definition that are worth noting.

1- Intelligence is the ability to solve problems. That is the core feature involved in IQ tests-- problem-solving and coming up with the one right answer.

2- Intelligence is not limited to logical problem-solving and convergent thinking, but also includes the ability to create products and to provide valuable services. This expands our understanding of intelligence to include creative thinking and interpersonal activities.

3- Intelligence isn't something that only happens "in your head" but it also includes the materials and the values of the situation where and how the thinking occurs. This is sometimes called "situated or distributed intelligence" or "contextual thinking".

In order to understand the multiple intelligences you need think beyond these eight labels and go deeper into the specific aspects of each intelligence and also wider to understand how they function in the culture. Within each intelligence are clusters of skill sets (e.g., for Linguistic; reading, writing, and speaking) that form *domains* (prose, poetry, rhetoric) that get expressed and recognized in cultural fields (contemporary poetry, novel writing, presidential debates, etc.). When speaking of a person's intelligence then it is not enough to make general statements that a person is high or low in, say, the Linguistic intelligence. It is necessary to describe how well developed he or she is in specific skills or domains ("Her persuasive speaking skills are exemplary in word choice and expression but her writing requires improvement in sentence structure and logical organization").

2. Eight Criteria for the Intelligences

Unlike traditional unitary concepts of intelligence, MI is not based on the statistical analyses of a few sets of specifically selected tests (typically, linguistic, mathematical problem-solving and logical reasoning). Instead, to qualify as an intelligence each set of abilities has to fare reasonably well in meeting 8 criteria that come from a diverse array of scholarly disciplines.

The eight criteria used to identify the intelligences are:

- 1- identifiable cerebral systems
- 2- evolutionary history and plausibility
- 3- identifiable core operation or set of operations
- 4- meaning that can be encoded in a symbol system
- 5- a distinct developmental history & mastery or “expert” levels
- 6- existence of savants, prodigies and exceptional people
- 7- evidence from experimental psychological tasks
- 8- psychometric findings

Another important factor not explicitly included as one of the criteria is "cross-cultural evidence".

3. Research to Date Identifies Eight Intelligences

The eight intelligences identified by MI theory are Linguistic, Logical-mathematical, Visual-spatial, Kinesthetic, Musical, Naturalist, Interpersonal and Intrapersonal. Each intelligence is thought to have its own semi-autonomous memory system with cerebral structures dedicated to processing its specific contents (Gardner, 1993).

Linguistic and Logical-mathematical intelligences are most often associated with academic accomplishment. The core features of Linguistic intelligence include the ability to use words effectively for reading, writing and speaking. Linguistic skill is important for providing explanations, descriptions and expressiveness. Gardner describes the poet as the epitome of Linguistic ability. Other career fields requiring skill in this area include teaching, journalism, and psychology. Convergent aspects of Linguistic intelligence assessed by standard intelligence tests include vocabulary and reading comprehension. Activities requiring divergent thinking include story telling, persuasive speech, and creative writing.

Logical-mathematical intelligence involves skill in calculations as well as logical reasoning and problem-solving. People strong in this intelligence are usually the ones who are described as being “smart” (e.g., mathematicians, philosophers, logicians). Logical-mathematical intelligence is required for multi-step, complex problem-solving and mental math. Most IQ tests assess a person’s ability to reason and problem-solve quickly but do not examine divergent and reflective aspects of Logical-mathematical intelligence, such as the identification of novel problems or the generation of new and worthy questions.

Musical intelligence includes sensitivity to pitch, rhythm, and timbre and the emotional aspects of sound as pertaining to the functional areas of musical appreciation, singing, and playing an instrument. A composer requires significant skill in many aspects of this intelligence—especially involving creative musical thinking. On the other hand, musical careers (e.g., instrumentalist, vocalist) generally require more circumscribed abilities that emphasize technical skill rather than creative output.

The Kinesthetic intelligence highlights the ability to use one's body in differentiated ways for both expressive (e.g., dance, acting) and goal-directed activities (e.g., athletics, working with one's hands). Well-developed kinesthetic ability for

innovative movement is required for success in professions such as choreography, acting, and directing movies or plays. Precision, control, and agility are the hallmarks of athletes such as karate masters, professional soccer players, and gymnasts.

Spatial intelligence includes the ability to perceive the visual world accurately and to perform transformations and modifications upon one's own initial perceptions via mental imagery. Functional aspects of Spatial intelligence include artistic design, map reading, and working with objects. Visual artists and interior designers exemplify creative spatial thinking, and a successful architect will need both the creative abilities as well as technical accomplishment. An automobile mechanic or engineer, on the other hand, does not need creative and artistic abilities to find the solution to a malfunctioning engine.

A person strong in the Naturalist intelligence displays empathy, recognition, and understanding for living and natural things (e.g., plants, animals, geology). Careers requiring strong Naturalist skills include farmer, scientist, and animal behaviorist. Skilled scientists use pattern recognition to identify an individual's species classification, create taxonomies, and understand ecological systems. Empathic understanding is a related ability that allows people to care for and manage the behavior of living entities.

Unique contributions of the MI model to educational theory are the personal intelligences. The Intrapersonal and Interpersonal intelligences are presented as separate yet related functions of the human brain (especially the frontal lobes). They are described as two sides of the same coin, where Intrapersonal emphasizes self-knowledge and Interpersonal involves understanding other people.

Vital functions of Intrapersonal intelligence include accurate self-appraisal, goal setting, self-monitoring/correction, and emotional self-management. Results of research have highlighted the importance of metacognition for learning in the basic academic skills of reading and mathematics (Forrest-Pressley & Waller, 1984; Mevarech, 1999). Intrapersonal intelligence is not the same as self-esteem, but it may be a strong factor in promoting self-confidence and effective stress management. Well-developed Intrapersonal intelligence may well be essential to an individual's sense of satisfaction and success. A core function of this intelligence is guiding a person's life-course decisions. Careers that require skills in Intrapersonal self-management include pilots, police officers, writers, and teachers.

Interpersonal intelligence also plays a vital function in a person's sense of well being. It promotes success in managing relationships with other people. Its two central skills, the ability to notice and make distinctions among other individuals and the ability to recognize the emotions, moods, perspectives, and motivations of people, are known to be critical factors in successful employment. The ability to manage groups of people is required for managerial or leadership positions. Good teachers, counselors, and psychologists need to be adept at understanding a specific individual and then managing that relationship.

Dr. Gardner has considered adding Existential intelligence to the list but has not because it does not yet meet the criteria sufficiently. He has clearly distinguished this capacity from spiritual awareness. He defines core existential abilities as being

"...the capacity to locate oneself with respect to the furthest reaches of the cosmos--the infinite and the infinitesimal--and the related capacity to locate oneself with respect to such existential features of the human condition as the significance of life, the

meaning of death, the ultimate fate of the physical and psychological worlds, and such profound experiences as love of another person or total immersion in a work of art." p. 60, Intelligence Reframed.

4. Does MI theory deny the existence of “g” or general intelligence?

When posed this question in 1993 (Multiple Intelligences: Theory and Practice) Howard Gardner responded in this way.

“I do not deny that g exists; instead, I question its explanatory importance outside the relatively narrow environment of formal schooling. For example, evidence for g is provided almost entirely by tests of linguistic or logical intelligence. Since these tests measure skills that are valuable in the performance of school-related tasks, they provide reliable prediction of success or failure in school. So, for that matter, do last year’s grades. The tests are not nearly as reliable in predicting success outside of school tasks.” p. 39.

5. Scientists interpret data through personal and profession theoretical frameworks that may be explicit or implicit.

When we are viewing the actions of the brain it is important to ask, “*What are the assumptions about the behaviors associated with these cerebral activities?*” Is the scientist assuming that intelligence is only associated with the traditional tasks of logical problem-solving, convergent thinking, and linguistic skills?

6. What is the Neuroscientific Basis for Each of the Intelligences?

In response the question, “Does brain research continue to support your theory?” Howard Gardner responded in this way in 1999:

“The accumulating neurological evidence is amazingly supportive of the general thrust of MI theory. Research supports the particular intelligences that I have described and provides elegant evidence of the fine structure of such capacities as linguistic, mathematical, and musical processing. At the same time, this research calls into some question an effort to localize each intelligence at a specific point in the brain. It makes more sense now to speak of several brain areas involved in any complex intellectual activity, and to highlight the extent to which different individuals may carry out a certain function using different portions of their respective brains.

It is sometimes argued that MI theory is questionable because the brain is a very flexible organ subject to the events of early experience. This remark is not pertinent, since “neural plasticity” is independent of the issue of different intelligences. MI theory demands that linguistic processing, for example, occur via a different set of neural mechanisms than does spatial processing. The fact that the processing may occur in somewhat different regions of the brain for different people, because of their early experiences, is interesting but irrelevant to the identification of intelligences per se. p. 99, Intelligence Reframed.

The question also arises how closely linked are the intelligences to specific neural structures.

While there are specific neural structures that are closely and undeniably linked to the core components of each intelligence, it is better to think of the brain as having sets of “cerebral systems” that are primarily responsible for processing the specific contents associated with each intelligence. It is a goal of this session and future endeavors to explore these links in greater detail and to provide a general neurological framework for better interpreting neuroscientific data and understanding the multiple intelligences.

Here is a brief list first cited by Gardner in 1983 that makes few of these links:

Kinesthetic:

- cerebral motor strip
- thalamus
- basal ganglia
- cerebellum

Musical:

- right anterior temporal
- frontal lobes

Spatial:

- right hemisphere, parietal
- posterior
- occipital lobe

Logical-mathematical:

- left parietal lobes & adjacent temporal & occipital association areas
- left hemisphere for verbal naming
- right hemisphere for spatial organization
- frontal system for planning and goal-setting

Linguistic:

- left hemisphere, temporal & frontal lobes

Intra and Interpersonal:

- frontal lobes as integrating station between internal and external states

Naturalist:

- left parietal lobe and more

Existential:

- specific regions in the temporal lobe?