27 The Theory of Multiple Intelligences

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Introduction

The theory of multiple intelligences (MI) was established in 1983 by Howard Gardner, then a research psychologist at the Boston Veterans Administration Medical Center and co-director of Project Zero, a research and development group at the Harvard Graduate School of Education (Gardner, 1983). Under MI theory, an intelligence is "a biopsychological potential to process information" (Gardner, 2009, p. 5). Further, all individuals have several, relatively autonomous intelligences, which they use in varying combinations to solve problems or create products that are valued in one or more cultures. Together, the intelligences underlie the range of adult endstates – occupations, social roles, and practitioners within domains of organized knowledge and skill – found across cultures (Gardner, 1983, 1993, 1999a, 2009). MI thus diverges from theories rooted at the start of the twentieth century that argue general intelligence, *g*, is central to all human problem-solving (Spearman, 1904). It also stands as a challenge to classical stage theory (Piaget, 1983) and, more generally, to measuring intelligence through psychometric methods.

In this chapter, I first consider the origins of MI. Following that, I present the evidence and criteria used to develop the theory, provide clarifications of the theory, examine critiques of the theory, consider its educational implementations, and briefly look to its future.

Origins of Multiple Intelligences (MI)

Since the early 1970s, Gardner had conducted numerous studies both of children's cognitive development and of adults' neuropsychological impairments (Gardner, 1983, 1999a). This research generated numerous contradictions to the conception of intelligence as a single, general intelligence. For example, Gardner and his colleagues found that children's developmental trajectories differed with different symbol systems – for example, for those entailing language, music, and gesture (e.g., Gardner & Wolf, 1983). However, if all problem-solving were governed by one underlying mental capacity, then the developmental trajectory across different symbols should proceed at the same pace. The unevenness of development across symbol systems also ran counter to the work of Jean Piaget (Gardner, 1983), who held that stages of children's cognitive development from sensorimotor to formal operations, in realms such as number, causality, and volume, occurred in a well-coordinated, if not entirely lockstep, manner (Piaget, 1983).

In neuropsychological investigations, Gardner and his colleagues documented patients who had lost communicative skills in language but who could learn to communicate through visual symbols (Gardner et al., 1976). He documented patients with language impairment, who varied with regard to their comprehension of humorous cartoons (Gardner et al., 1975), and the case of an artist whose brain damage spared his language abilities, while leaving him unable to recognize or identify objects presented visually (Wapner, Judd, & Gardner, 1978). Such disjunctions run counter to the notion of *g* and related psychometric conceptions under which all problem-solving abilities are positively correlated (e.g., Carroll, 1993; Spearman, 1904) and can be arrayed in a positive manifold (Spearman, 1904).

The contradictions to mainstream theory about intelligence were further catalyzed by Gardner's involvement in the Project on Human Potential at the Harvard Graduate School of Education. Gardner's charge by the project's funder, the Bernard Van Leer Foundation, was to synthesize what was then known about human cognition in the biological and behavioral sciences. Thus, Gardner undertook a detailed exploration of what was known about the development of cognition in normal and gifted children and the breakdown of cognitive capacities among adults (Gardner, 1983, 2011a). The product of his synthesis, MI theory, took issue "with the assumption inherent in *g* that an individual who has a high *g* could be equally accomplished in any intellectual area. MI theory is an extended argument against this all-purpose view of intellect" (Gardner, 2006a, p. 69). That said, MI is not intended to eradicate *g*-based views but, rather, to question their "province and explanatory power" (Gardner, 2006a, p. 69). In essence, Gardner argues that *g*'s role is likely more limited than its proponents have asserted and that other cognitive capacities contribute markedly to human problem-solving.

Evidence and Criteria for the Intelligences

Psychometric conceptions of intelligence are frequently used to explain and predict a range of measurable outcomes but particularly those closely associated with school: grades, achievement tests, other intelligence tests, and occupational status (e.g., Jensen, 1998; Sorjonen et al., 2013). Such findings are enabled partly by test instruments that rely on discrete items and decontextualized, standardized conditions from which *g* and its descendants have commonly been derived and which they also purportedly explain. In contrast, MI seeks to identify the intellectual capacities that enable human beings to assume the range of adult endstates that are valued within and across cultures. Therefore, the theory might contribute to understanding not only the traditionally measured cognitive capacities that are the hallmarks of scientists and lawyers but also the cognitive capacities of artists, entrepreneurs, musicians, animal trainers, peace makers, athletes, or pilots.

To identify the intelligences that might explain the range of adult endstates, Gardner reviewed diverse bodies of research literature. These included psychometric studies as well as studies in anthropology, neuroscience, developmental psychology, and evolutionary biology and studies of special populations including savants and prodigies. During this investigation, Gardner also formulated a set of eight criteria against which candidate intelligences could be screened. The criteria included characteristic developmental trajectory and selective sparing or breakdown among brain-damaged individuals. In addition, an intelligence should be distinguishable by its neural structures and functions, core information processing, experimental tasks, characteristic forms of symbolic representation, and evolutionary biology. Gardner stipulated that a candidate intelligence should meet all, or nearly all, of the criteria (see Table 27.1).

These criteria can be illustrated by considering two potential intelligences: linguistic and bodily-kinesthetic. The former is clearly manifested in psychometric testing. Its typical developmental trajectory, from incipient expression to proficient usage, is rapid and distinct from that of mathematics or music. In addition, linguistic intelligence is selectively lost or spared among stroke victims. Linguistic intelligence is also distinguished by neural structures associated with it (e.g., Broca's and Wernicke's areas) and entails core information processes for syntax and phonology. Evidence for this intelligence is found in experimental tasks; for example, neonates respond differently to speech versus nonspeech sounds with similar temporal and spectral qualities

Table 27.1 *Criteria for the identification of an intelligence (after Davis et al., 2011; Gardner, 1983; Kornhaber et al., 2004).*

- It should be seen in relative isolation in prodigies, autistic savants, stroke victims, or other exceptional populations. In other words, certain individuals should demonstrate particularly high or low levels of a particular capacity in contrast to other capacities.
- It should have a distinct neural representation – that is, its neural structure and functioning should be distinguishable from that of other major human faculties.
- It should have a distinct developmental trajectory – that is, different intelligences should develop at different rates and along paths that are distinctive.
- It should have some basis in evolutionary biology. In other words, an intelligence ought to have a previous instantiation in primate or other species and putative survival value.
- It should be susceptible to capture in symbol systems, of the sort used in formal or informal education.
- It should be supported by evidence from psychometric tests of intelligence.
- It should be distinguishable from other intelligences through experimental psychological tasks.
- It should demonstrate a core, information-processing system – that is, there should be identifiable mental processes that handle information related to each intelligence.

(Vouloumanos & Werker, 2007). The criterion of evolutionary biology is met in the form of gesturing among apes and their use of specific rumblings to indicate the presence of dangerous animals. Linguistic intelligence is also captured in varied symbol systems, from cuneiform to sign language to Morse code.

In contrast, bodily-kinesthetic capacities are not measured within psychometric models. However, evidence for bodily-kinesthetic intelligence exists in a developmental trajectory from infancy to mature use that is more variable than that of language, with some uses (e.g., neurosurgery) taking many years of practice. Bodily-kinesthetic intelligence is selectively lost among brain-damaged individuals suffering apraxias, even as such individuals may retain speech comprehension or compose music. Bodily-kinesthetic intelligence has distinct neural structures – for example, the motor strip, which supports the execution of coordinated movement. Evidence from evolutionary biology can be seen in the form of tool use by primates. It is captured in various symbol systems – for example, choreography diagrams and play sheets used in American football.

By applying these criteria to wide-ranging research literature, Gardner initially identified seven intelligences: linguistic, logical-mathematical, spatial, musical, bodily-kinesthetic, interpersonal, and intrapersonal. In 1995, he identified an additional intelligence, naturalist: “the ability to make consequential distinctions among organisms and entities in the natural world” (Gardner, 2011a, p. xiv; see Table 27.2). Gardner has considered other potential intelligences, among these, existential,

Table 27.2 *Gardner’s eight intelligences (Davis et al., 2011; Gardner, 1983, 1999a).*

Intelligence	Description
Linguistic	An ability to analyze information and create products involving oral and written language such as speeches, books, and memos.
Logical-Mathematical	An ability to develop equations and proofs, make calculations, and solve abstract problems.
Spatial	An ability to recognize and manipulate large-scale and fine-grained spatial information
Musical	An ability to produce, remember, and make meaning of different patterns of sound.
Naturalist	An ability to identify and distinguish among different types of plants, animals, and weather formations that are found in the natural world.
Bodily-Kinesthetic	An ability to use one’s own body to create products or solve problems.
Interpersonal	An ability to recognize and understand other people’s moods, desires, motivations, and intentions.
Intrapersonal	An ability to recognize and understand one’s own moods, desires, motivations, and intentions.

pedagogical, and moral, though none has adequately met the criteria for inclusion in the theory (Gardner, 1999a).

Certainly, other psychologists have argued that intelligence is not unitary. However, unlike Gardner, their theories rested largely on psychometric data. Among contemporary theorists, Robert Sternberg has posited a triarchic theory of intelligence, comprised initially of componential, experiential, and contextual subtheories, the evidence for which came from tests as well as analyses of questionnaire data (Sternberg, 1985). Later versions posited analytical, practical, and creative intelligences, each supported by evidence from a test developed for the theory (e.g., Sternberg et al., 2001). The roots of a multifaceted versus general intelligence can be found in Binet and Simon (1916/1973), who stated, "One [child] succeeds best in test 'A' and fails in test 'B'; another, of the same age, fails in 'A' and on the other hand succeeds in 'B.' . . . intelligence is therefore not made nor can it be made as one measures height" (p. 243). Thurstone (1938) posited seven primary mental abilities; Guilford (1967) argued that intelligence was comprised of 120 and, later, 150, and, then, 180 factors arrayed in three categories. In contrast to Thurstone and Guilford, researchers using factor analysis have typically arrived at structures of intelligence that place *g* atop narrower factors or abilities (e.g., Carroll, 1993), a structure that has gained broad acceptance (e.g., Demetriou & Spanoudis, 2017; Willingham, 2004).

However structured, it is not clear what *g* and the group or narrower factors presented in hierarchical models actually represent: Is *g,* per Spearman, a single "mental energy" (Spearman, 1923, p. 5) or are *g* and group factors primarily syntheses of the test data and correlates of school and test performance? Are they based in neurobiology and, if so, how? Does *g* capture processing speed or flexibility? Does it reflect motivation to perform in, or familiarity with, decontextualized tasks, a willingness to follow instructions, or persistence (Gardner, 2006b)? Given that psychometric models have drawn data from atypical problem-solving contexts (e.g., test settings or labs that lack resources, collaborators, and time to reflect and revise), it may be that these models represent contrived forms of cognition (Davis et al., 2011a; Gardner, 2006b). In contrast, MI attends to the development of intelligences within and toward culturally valued domains.

Clarifications and Caveats

The intelligences Gardner posited in MI theory have sometimes been conflated with other concepts or have been misunderstood. These misunderstandings are addressed and clarified in this section.

First, an intelligence is not dependent on a given sensory system. For example, spatial intelligence is not dependent on the visual system, though such conflation is captured in mislabelings, such as visual-spatial intelligence. In fact, spatial problem-solving is often keenly developed among the blind, as is evident from their ability to navigate without sight. Even musical intelligence can be manifested among those with severe hearing loss (Kolb, 2017). Gardner differentiates conceptually between sensory systems, which allow for perceptual input from the world, and intelligences, which are biopsychological computational capacities that operate on information that can be conveyed from various sensory systems.

Second, given that intelligences are computational capacities, they are not synonymous with domains, though an intelligence and a domain may have similar monikers – for example, musical intelligence and music. A domain consists of a body of knowledge and skills that exists within one or more societies and for which there are practitioners who vary from novice to expert (Gardner, 2006a).

Third, while the intelligences can be isolated using the criteria Gardner has stipulated, they are rarely applied in isolation to real-world problem-solving. For example, a mathematician will clearly draw on logical-mathematical intelligence. However, she also likely draws on linguistic intelligence to read papers written by other mathematicians as well as on interpersonal intelligence in collaborating with others to tackle complex problems. A clinical psychologist depends on interpersonal intelligence but also relies on linguistic intelligence to interpret clients' speech and likely uses bodily-kinesthetic intelligence in interpreting clients' body language. Indeed, only in brain-damaged patients or individuals who present with symptoms like autism can one observe intelligences spared or destroyed in isolation.

Fourth, MI theory has been mistakenly conflated with ideas about learning styles (Gardner, 2013). In contrast to MI, the evidence and criteria for positing different learning styles theories rest largely on psychometric test batteries. In addition, learning styles theories often include constructs pertaining to both cognition and personality. Unlike MI, learning styles theorists often hold that individuals tend to employ a consistent style in their problem-solving, taking, for example, a visual approach to whatever cognitive task lies before them (see Zhang, 2011). There is no assumption under MI that individuals rely on any individual intelligence or cluster of intelligences across the range of real-world problem-solving.

Fifth, while the intelligences are universally present among the neurologically intact, individuals vary with regard to their "profiles of intelligence." Gardner further claims that no two individuals, not even identical twins, will have exactly the same profile. That is, one individual may be relatively strong in spatial intelligence and linguistic intelligence, less strong in naturalist, mathematical, interpersonal, and intrapersonal intelligences, and weak in musical intelligence. Another individual may have roughly the opposite profile. Such heterogeneity stands in contrast to the positive manifold arising from test data found by Spearman (1904) and later proponents of *g*.

Sixth, although individuals will manifest relative strengths among the intelligences, this does not indicate that all individuals are gifted in one or more of the intelligences. In the same vein, relative weaknesses do not indicate that each person suffers from at least one intellectual deficit. These are romantic views, which lack a factual basis.

Seventh, intelligences are modifiable. Environmental opportunities and supports will influence the development and expression of intelligences and the profiles of intelligences.

Eighth, profiles of intelligence or a given strength or weakness among the intelligences should not be associated with claims of innate racial or ethnic characteristics or differences. Gardner has taken particular care to undermine such assertions and has described such claims as “offensive” (Gardner, 2011a).

Further Developments of the Theory

The set of intelligences Gardner has identified has been stable since 1995. However, Gardner does not claim that the intelligences identified thus far are the definitive set. His primary claim is that human intelligence is not singular or general but rather multifaceted. Additional intelligences may occur as new data and evidence arise. At the time the theory was first proposed, it was grounded in notions of domain performance and the set of intellectual abilities that would explain endstates valued across cultures. Should some valued roles emerge that cannot be understood in terms of the intelligences, it may be that further investigation of such roles will prompt reconsideration.

Further, MI theory was not grounded in neuroimaging studies, technology for which was being advanced and made more accessible during the 1980s when the theory was first published. Such studies are now possible. Their preliminary findings support the existence of distinguishable neural structures for each of the intelligences (Shearer, 2018). Yet it could also be the case that additional neuroimaging may find different patterns and a reconsideration of the distinctions among intelligences would be justified.

Critiques of the Theory

MI theory has been criticized on varied fronts. Critics have argued that the theory suffers from conceptual murkiness, that it is not grounded in evidence or scientific, and that its claim of relative autonomy across the intelligences is incorrect (see Schaler, 2006).

Critics of the theory argued that the use of the term intelligences undermined theoretical clarity about the construct of intelligence (e.g., Barnett, Ceci, & Williams, 2006) and that “it is not at all clear what we gain by referring to such skills, competences, and abilities as ‘intelligences’” (Kanazawa, 2010, p. 281). It is common for these critics to hold that the term intelligence ought to refer to abstract reasoning, planning, and the ability to grasp complex ideas readily that might be applicable in broad contexts but especially valued in school, as well as be predictive of occupational status and assessed by intelligence tests or tests of processing speed (Brody, 2006; Gottfredson, 1997). Gardner asserts such boundaries and tests partly reflect a narrow Western stance on what intelligence is and does not account for cross-cultural research that has repeatedly found low-scoring individuals functioning at high levels in their own societies (Gardner, 2006b). The construct of intelligence has yet to secure an agreed-on definition, even among psychologists investigating it (e.g., Hauser, 2010; Neisser et al., 1996; Sternberg & Detterman, 1986).

White (2006) has taken issue with the claim that the set of intelligences enables problem-solving that is valued across cultures. He states it is not possible to know all the types of problem-solving that have been valued. This issue does not undermine the theory. The theory speaks to the set of cognitive capacities that, together, can tackle problems or fashion products that are known to be valued. Should a domain arise for which the current set of intelligences is insufficient to explain, then the theory may be modified. Indeed, such a conundrum helped give rise to the naturalist intelligence (Gardner, 2006a). In addition, White (2006) argues that some intelligences may not have been equally valued across cultures. To wit, not all cultures equally value expressions of music. However, Gardner did not stipulate that all the intelligences must be equally valued across cultures. He does stipulate that individuals across cultures will possess the full set of intelligences. The contribution of the environment to the development of the intelligences will vary depending in part on what a culture values.

Critics have also asserted that the intelligences cannot be relatively autonomous, since psychometric studies continually find positive correlations among aptitudes (Visser, Ashton, & Vernon, 2006; Waterhouse, 2006a; Willingham, 2004). As noted, Gardner has responded that such correlations arise in part from the atypical tasks and settings psychometric studies feature. In any event, the existence of a positive manifold does not in itself invalidate the utility of positing and assessing intellectual capacities that may have considerable autonomy.

Critics have argued that MI is not based on evidence. Yet, as already noted, Gardner drew on evidence from a variety of disciplines. More central to this critique is the claim that MI ignores or misinterprets psychometric evidence (Brody, 2006; van der Ploeg, 2016; Willingham, 2004). The theory clearly does not ignore psychometrics, since evidence from psychometrics is one of the criteria for evaluating a candidate intelligence.

Relatedly, the theory has been criticized as unscientific, particularly because studies that might test the theory's validity or overthrow it via experimental methods are absent or inadequate (Jensen, 2008; van der Ploeg, 2016; Waterhouse, 2006a, 2006b). This critique holds that psychometric data are central to such tests of the theory. Per Jensen (2008), "Because Gardner's theory of mental abilities remains aloof from research based on measurement and analysis in the tradition of the natural sciences, it has no means for proving itself to be more correct than the model of intelligence that has emerged from the London School" (p. 97). Gardner has responded in varied ways to critiques that the theory is untestable. He notes that, while he does not think the theory is subject to an up or down testing regime, psychometric evidence could be brought to bear on the theory (Gardner, 2011a). Some studies (e.g., Visser, Ashton, & Vernon, 2006) using factor analysis of tasks reflecting Project Spectrum (detailed in the section "Efforts to Assess Individuals' Multiple Intelligences") find that the intelligences are not relatively autonomous and instead can be explained by *g*. Other factor analytic studies using similar data find support for relatively autonomous intelligences (Plucker, Callahan, & Tomchin, 1996). Still others take a middling position, finding that the intelligences are neither as distinct from *g* as Gardner claims nor wholly explainable by *g* (Almeida et al., 2009; Castejón, Perez, & Gilar, 2010). Such divergent results are unsurprising given decades of debate among psychometric researchers about the structure of intelligence or intelligences.

While psychometric tests of MI are likely to be inconclusive, Gardner (2011a) has noted that evidence from neuroscientific research might disconfirm or modify the theory. For example, if such studies find a particular configuration of neural structures provide for equally strong performance across the intelligences, this would support *g* and undermine MI. In contrast, if distinct profiles are associated with characteristic neural structures, then this would provide support for the theory at the expense of *g* (Davis et al., 2011). Though this point is debated (see Gardner & Moran, 2006; Waterhouse, 2006a, 2006b), there is increasing, not decreasing, evidence from neuroscience to support distinctions in the neural processing of capacities identified by MI (Gardner, 2011a; Gardner & Moran, 2006). For example, Shearer (2018) has examined more than 500 studies (primarily fMRI experiments) and concludes that the core processing skills are well supported by neuroscientific evidence. In a separate investigation of more than 420 studies, he found that neural activation of regions associated with the different intelligences varied among individuals who were impaired, typical, or skilled. The theory could be supported or refuted by analogous research into the genetics of intelligence (Gardner, 2011a): Should some pattern of genes support equally high functioning across intelligences, then the argument for *g* over MI would be supported. If patterns of genes were associated with particular intelligences or profiles of intelligence, then the evidence for MI, rather than *g*, would be strengthened.

Even as Gardner has illustrated how empirical studies could test MI, he has also stated,

> I've never felt that MI theory was one that could be subjected to an "up and down" kind of test, or even series of tests. Rather, it is and has always been fundamentally a work of synthesis; and its overall fate will be determined by the comprehensiveness of the synthesis, on the one hand, and its utility to both scholars and practitioners, on the other. (Gardner, 2011a, pp. xix–xx)

Gardner's stance and that of MI's critics regarding how the theory might be undermined or sustained reflect philosophical differences in epistemology and conceptions of science. MI was not constructed through formal hypothesis testing and experimental design (Sternberg, 2012). Instead, it is what Einstein called a *constructive theory*, one that offers a reasonable model for understanding a given phenomenon (e.g., variation in human intelligence as manifested in domains across cultures) versus a *principle theory*, which is built on confirmed, empirical generalizations (Howard, 2017). For MI, the latter is becoming possible via neuroscience (Gardner, 2011a; Shearer, 2018) and potentially through new research in genetics.

Efforts to Assess Individuals' Multiple Intelligences

Gardner argues that psychometric methods and laboratory tasks are not adequate for examining multiple intelligences. Psychometric tests require individuals to channel their intelligences via media (words, numbers, pictures) or tools (keyboards, pencils, speech) that are inadequate or narrow. Moreover, they can be deceptive. For example, musical intelligence enables individuals to hear and analyze a chord progression. However, individuals who have little by way of musical intelligence or training might learn to analyze a written chord progression without being able to recognize or perform the sounds or to appreciate how a given chord progression might evoke responses. Analogous challenges exist for most of the other intelligences that are not typically tested and even for spatial intelligence, which frequently is via items requiring the spatial rotation of two-dimensional figures. A two-dimensional rotation item also cannot evaluate whether individuals can interpret or create images intended to represent concepts or to navigate among locations when digital maps are unavailable.

Gardner does not believe testing of the intelligences is necessary in most cases – a view not unlike Binet, who said that intelligence testing should be limited to those individuals who struggle within typical classrooms (Binet & Simon, 1916/1973). To the extent that it is important to assess intelligences, Gardner argues that such assessments need to be "intelligence-fair." That is, they should allow for the direct expression of the intelligence, using appropriate resources (e.g., musical instruments, other people, objects that can be taken apart and reassembled), and take place in environmental settings that are familiar (vs. isolated, test-administrator–controlled settings). Such assessments are both intelligence-fair and authentic – they mirror the kinds of problem-solving that are valued in the world beyond the test or school (Gardner, 1995).

Via Project Spectrum, a research endeavor within Project Zero, Gardner and colleagues developed a more intelligence-fair approach to assessing young children's "profiles of intelligence." Spectrum assessment tasks were embedded in the regular classroom and available for students to explore and interact with on a regular basis. Thus, they broke down the barrier between assessment and ongoing curricular and classroom activities. This approach is in line with Spectrum's emphasis on both identifying children's profiles of intelligences and drawing on that knowledge to foster individualized learning opportunities. Spectrum relied on hands-on, engaging activities in language, mathematics, visual arts, music, science, movement, and social understanding.

For example, in the assessment of social understanding, students made use of a scale model of their own classroom and the students within it, whose photographic likenesses were affixed to movable wooden pegs. Spectrum researchers, who spent time in the classroom with the students and instructors, could then interact with students using the model to assess students' understanding of social relationships within the class. An example of a mathematics activity was the bus game, in which a model bus was moved about several bus stops at which passengers got on or off (Chen, Krechevsky, & Viens, 1998; Krechevsky, 1998). Spectrum tasks demonstrate reliability (Chen, 1998; Chen, Krechevsky, & Viens, 1998). Spectrum researchers also found that young children exhibited distinctive profiles of intelligences and that the intelligences were relatively autonomous (Gardner & Hatch, 1989). Hatch (1997) reported that profiles exhibited in a small group of Spectrum kindergarteners manifested similarities and differences six years later. Hatch (1997) held that some change in observed profiles of intelligences should be expected, given that intelligences are demonstrated in activities and social contexts and that these will undergo change in the six years following kindergarten. Such change also reflects the role of context in the development and expression of intelligences.

Project Spectrum was the only assessment of intelligences in which Gardner was directly involved but many other assessments have been developed outside of Project Zero. Many have no credible basis whatsoever or consist of brief paper-and-pencil tests, which are at odds with intelligence-fair, authentic, or ecologically valid approaches.

One assessment that does incorporate these approaches is Web-Observation (Nicolini, 2011). "Web-Ob" is an online platform that facilitates teachers' daily observations of students during ordinary classroom activities. Web-Ob enables teachers to organize, manage, store, and retrieve records of observations, as well as to generate reports related to frequency and about examples of children's manifestation of the different intelligences within the classroom and report profiles of intelligence manifested at different points in time (Nicolini, 2011; Nicolini, Alessandri, & Bilancioni, 2010). Web-Ob is accompanied by ongoing professional development of teachers about MI and about producing descriptive observations of their students' activities (Nicolini, 2011; Nicolini, Alessandri, & Bilancioni, 2010).

The most well-known assessment developed outside of Project Zero is the Multiple Intelligences Developmental Assessment Scale (MIDAS). The MIDAS provides a structured self-report in which individuals can use both quantitative and qualitative descriptions of their skills and abilities (Shearer, 2012). It has been translated into several languages, administered worldwide, and used in a variety of research projects (Shearer, 2007). Self-reports are not necessarily accurate appraisals of one's own cognitive abilities. However, Shearer has undertaken research to compare individuals' self-reports with reports by informants who are knowledgeable about the individual. He found the inter-reliability between individuals' self-reports and reports by knowledgeable informants to be fairly strong. Of 742 paired comparisons of assessments of strengths of individuals' multiple intelligences on the MIDAS, 46 percent of comparisons generated exactly the same rating on a five-point scale and 92 percent of ratings were within one scale point (Shearer, 2012).

Educational Influence of the Theory of Multiple Intelligences

Within a few years of the publication of Gardner's (1983) book *Frames of Mind: The Theory of Multiple Intelligences*, educators in the United States began drawing on MI (Armstrong, 2017; Campbell, Campbell, & Dickinson, 2003; Hoerr, 2000; Kunkel, 2009). By the mid-1990s, the theory was being widely used across US schools and in colleges, museums, and other settings. The theory has been used with diverse learners, including those with special needs (Hearne & Stone, 1995; Takahashi, 2013), gifted students (Callahan et al., 1995; Hernández-Torrano et al., 2014; Maker, 2005), and adults (Kallenbach & Viens, 2002). It has spread to educators in diverse parts of the world (e.g., Chen, Moran, & Gardner, 2009; Nicolini, 2011; Pienaar, Nieman, & Kamper, 2011). A science theme park in Denmark drew on MI to communicate about science and to enable visitors to explore their intelligences (Sahl-Madsen & Kyed, 2009). More recently, game designers have investigated MI's utility for adapting learning games for different players (Sajjadi, Vlieghe, & De Troyer, 2017).

Over time, and given MI's broad implementation, Gardner elaborated on the theory's educational implications, which were only briefly sketched in *Frames of mind*. Two main implications are *individuation* and *pluralization*. The former entails knowing each student well and using knowledge of their profiles of intelligence to provide varied ways for each to learn and demonstrate their understanding (Gardner, 1999a). Pluralization entails conveying what it is that is important for students to learn and understand in a variety of ways. Each may be enabled by digital resources as well as other means (Gardner, 2015). In addition, pluralization may be fostered via curricula and instruction that engage different "entry points" (Gardner, 1991, 1999b). Gardner (1991, 1999b) developed the entry points framework as a way of bridging the richness of disciplines and the complexity of individuals' profiles of intelligence. He has argued that worthwhile curricular topics can be approached through each entry point and thereby made accessible to all learners (Table 27.3). In addition, Gardner stated that the theory should not be an end in and of itself but rather serve as a means to pursue and achieve valued educational ends established by the cultures surrounding schools (Gardner, 1999a).

One powerful end for which MI could provide a useful means is disciplinary understanding. This entails the acquisition of knowledge and skills and forms of analyses pertinent to science, math, history, psychology, and other domains, as well as the application of skills and knowledge to new material and questions (Gardner, 1999a, 2006a).

Research over the course of ten years has surfaced five explanations about why educators adopt MI. First, the theory resonates with educators' everyday experiences and observations that students manifest different capacities and sets of capacities. Put otherwise, MI serves as a *constructive theory* for representing variation among students. Second, it provides a vocabulary for educators to think more systematically about differences, strengths, and needs among their students. Third, MI enables richer communications with colleagues and students' families about learners' strengths and needs, especially relative to the communications enabled by test results (e.g., "proficient," "at the 40th percentile," "two standard deviations about the mean"). Fourth, the theory provides a framework for educators to reflect on their own practice – a kind of mental closet organizer for the many different activities, materials, and instructional strategies educators employ. Finally, educators' reflection via MI fosters their efforts to develop learning environments that support the varied learners with whom they work (Kornhaber, 2004; Kornhaber & Krechevsky, 1995).

There is little doubt that implementations of the theory are widely variable. There are no permissions needed to adopt the theory and no clearing house for reporting

Table 27.3 *The entry points framework and an illustration of application to the topic of evolution (Gardner 1991, 1999b; Kornhaber et al., 2004).*

Narrative	The narrative entry point deals with the story or stories that are central to a topic. Typically, a rich or "generative" topic will offer several possible narrative entry points, some of which may be recounted or performed as dramatic narratives. For instance, for the topic of evolution, there is the narrative involving Darwin's own life, his voyage to the Galapagos Islands, or even various traditional folk stories about how different animals and plants came to have their unique form.
Logical-Quantitative	The logical-quantitative entry point focuses on numerical aspects of a topic and/or on deductive, logical reasoning, of the sort that can often be captured by if-then syllogisms. A more quantitative entry point for the topic of evolution might entail looking at Darwin's effort to map the distribution of different species across different islands. A logic-focused entry point might pose syllogisms for the students to explore: If there were no variation within a species, then what might happen when its environment changed?
Aesthetic	The aesthetic entry point engages artistic aspects of, or representations of, a topic. An aesthetic entry point for evolution might be to examine different drawings Darwin made of finches or other species he studied on the Galapagos and to describe how their shapes/morphologies differ.
Experiential ("Hands-on")	This entry point provides students opportunities to do work involving the physical "stuff" of the topic. For example, for the topic of evolution, students might breed fruit flies, or do virtual simulations of evolutionary processes, and document what they observe.
Interpersonal	The interpersonal entry point involves working with others to learn about a topic. One way to incorporate the interpersonal entry point in the topic of evolution is to form research teams to carry out real or simulated experiments in breeding fruit flies.
Existential/Foundational	This entry point deals with fundamental, philosophical questions about the nature of the topic, why it exists, and/or what is its meaning or purpose. For the topic of evolution, this entry point might explore questions such as "Why are new species created and others die out?" and "What is the purpose of variation within species?"

how the theory is implemented. This raises questions about whether the theory can be associated with any particular practices among teachers or with any changes among students. These issues have been most extensively investigated during the Schools Using MI Theory (SUMIT) study (Kornhaber, Fierros, & Veenema, 2004). As part of

Table 27.4 *SUMIT's Compass point practices (Kornhaber et al., 2004).*

Readiness	Educators took time to study the theory and explore how it might be applied. On average, it took about eighteen months of such study to build readiness to implement MI in classrooms.
Culture	The culture of the school was marked by beliefs in students' strengths and potential, advocacy of care and respect among all members of the school community, a sense of excitement about learning, and by persistence, dedication, and hard work by educators.
MI as Means to High-Quality Work	Educators use MI as a means to help learners acquire knowledge and skills in the disciplines.
Collaboration	Educators came to see variations in strengths, knowledge, and skills among their colleagues as resources for improving curricula and teaching. This supported ongoing informal and formal collaboration among teachers.
Meaningful Choice	Students were given meaningful curricular and assessment options. Such options provided routes for students to draw on their profiles of intelligences to produce high-quality work and demonstrate their understanding.
Arts	The arts played a vital role, both in formal studies of arts disciplines and as a means of fostering students' understanding of the range of other disciplines.

SUMIT, researchers conducted qualitative interviews among an intentional sample of forty-one public schools with diverse populations in eighteen US states and one Canadian province that used MI for three or more years. Of these schools, 49 percent associated improved test scores with MI; 54 percent associated improvements in student discipline with MI; 60 percent reported improvement in parent participation associated with MI; 78 percent associated the theory with improvements for students with learning disabilities; and 2 percent reported improvements for that population not associated with MI (Kornhaber, Fierros, & Veenema, 2004).

SUMIT researchers also conducted school case studies, including classroom observations, interviews with teachers, and documentation of student work. This, together with the interviews from forty-one schools, enabled them to identify five "compass point practices" that were common to schools using MI (see Table 27.4).

The SUMIT study has been critiqued for not reporting statistical significance, using control groups, offering causal claims, or accounting for changes that might be due to other factors (van der Ploeg, 2016; Willingham, 2004), though the latter were clearly reported (see Kornhaber, Fierros, & Veenema, 2004, pp. 13–16). These critiques evince a limited understanding of qualitative research, which typically does not seek to generate causal explanations via control groups, and the goals of the SUMIT research in particular, which focused on identifying the practices educators used to implement MI and the changes they associated with the implementation of MI.

There are studies of MI whose designs meet calls for the theory's educational utility to be demonstrated via a randomized control design. For example, Nguyen (2000) investigated learning outcomes in one school that participated in a pilot site visit for the SUMIT study. That school randomly assigned students to clusters of faculty that were or were not implementing MI. Because Nguyen found no difference in average achievement scores between the two groups, Van der Ploeg (2016) claimed the study showed MI makes no difference. Yet there were substantial differences in the spread of scores, with much less variance around the mean among students in the MI treatment (Nguyen, 2000). One reasonable inference from this finding is that, when MI is used thoughtfully, it can help foster more equitable achievement.

Certainly, additional quantitative and qualitative studies could be valuable in examining how MI is used and the variations in implementations that are most beneficial and whether any may have downsides. However, it is not the case that only randomized controlled trials can answer such questions. Indeed, demands that research on educational interventions must employ such designs carry problems of their own (see, e.g., Erickson & Gutierrez, 2002; Ginsburg & Smith, 2016).

It is also useful to consider MI against educational practices prompted by *g*-based conceptions of intelligence. Allowing that IQ testing may help identify and then also provide enriched educational opportunities to students who may have learning disabilities – a practice Binet and Simon (1916/1973) said should be the primary reason for intelligence testing – the track record of *g*-based interventions is problematic. For much of the twentieth century, IQ testing fostered markedly different learning opportunities along socioeconomic and racial lines (Callahan, 1962; Oakes, 1985). It also promoted the view that intelligence was unmodifiable – a belief shown to undermine student learning (Blackwell, Trzesniewski, & Dweck, 2007) – while frequently reinforcing harmful stereotypes of intellectual inferiority among students from historically disadvantaged groups (Herrnstein & Murry, 1994; Jensen, 1969; Terman, 1916).

The Future of MI in Education and Psychology

While MI was posited and first implemented in the United States, in the last few decades government policies requiring schools to raise math and English language test scores have often narrowed curricula and pedagogy in ways that undermine educators' use of the theory (Kornhaber, 2009). Yet the theory is still being used by US educators and is continuing to be adopted around the world. In 2017 and 2018, an interactive online MI course launched from the Harvard Graduate School of Education enrolled teams of pre-K through professional school educators from five continents and some twenty nations, among them Cypress, Vietnam, Lithuania, China, Indonesia, Peru, Turkey, and India as well as the United States. Thus, it appears that MI continues to be a constructive theory for educators.

Within psychology, MI has stood as a provocation to normative psychometric conceptions of intelligence. The theory's foundations are empirical, though not restricted to psychometric evidence. Gardner himself has largely moved on from the theory to other research (e.g., Gardner, 2011b, 2018; Gardner & Davis, 2013). Others have tested the theory's claims by using psychometric methods and have come to disparate conclusions regarding the relative autonomy of the intelligences (Almeida et al., 2009; Castejón, Perez, & Gilar, 2010; Visser, Ashton, & Vernon, 2006; Plucker, Callahan, & Tomchin, 1996; Waterhouse, 2006a; Willingham, 2004). New research involving neuroscience has begun to test such claims. Research involving genetics could also be brought to bear. Through such research, MI may be refuted. Or it may allow the theory to come to rest as both a constructive and a principle theory of intelligence.

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