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Shunned and Admired: Montessori, Self-Determination, and a Case for Radical School Reform

Angeline S. Lillard[1]

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Abstract

School reform is an important national and international concern. The Montessori alternative school system is unique in that it is well-aligned with the science of healthy development and learning, has strong social–emotional *and* academic outcomes, is virtually unchanged in over a century, can be applied across all the school years, and still attracts considerable attention and allegiance—yet it remains "on the margins" (Whitescarver and Cossentino *Teachers College Record, 110*, 2571–2600, 2008) of the bulwark educational system, as often shunned as admired. Why does Montessori persist (and increasingly in the public sector) and why does it elicit such sharply contrasting reactions? This article reviews several reasons why it is admired, such as evidence of Montessori's effectiveness, its alignment with educational psychology research, and its broad scope. The points of research alignment are presented as natural corollaries of Montessori's central premise: independence, or self-determination. After discussing these extrinsic and intrinsic reasons why Montessori is admired, the article concludes with speculation as to why it is also shunned—namely its incommensurability with conventional education culture and what might be a consequence: frequent poor implementation. The incommensurability of evidence-based alternatives with the conventional system is also posed as a reason for radical school reform.

Keywords Education · Alternative schooling · Human development · Self-determination

> My vision of the future is no longer of people taking exams and proceeding from [one level of school to the next], but of individuals passing from one stage of independence to a higher [one], by means of their own activity [and…] will, which constitutes the inner evolution of the individual. (Montessori 1948a, p. xv)

✉ Angeline S. Lillard
Lillard@virginia.edu

[1] Department of Psychology, University of Virginia, P.O. Box 400400, Charlottesville, VA 22904-4400, USA

Ted Dintersmith, recipient of the National Education Association's 2018 "Friend of Education" award, recently spent a year observing classrooms across the country, and while for the most part he saw standard conventional teaching (e.g., a teacher tells students what they need to know then tests them to see if they learned it), he also saw some excellent teaching in which children learned with a sense of purpose and agency, acquiring essential skills and cultivating knowledge that he believed was deep, useful, and retained. He said these learning principles "abound in preschools, kindergartens, and Montessori schools—places where children love school, learn deeply and joyously, and master essential skills […—but are lacking in] most schools" (Dintersmith 2018, p. xvi). Montessori does not appear in Dintersmith's text again, but his examples of excellent innovative teaching reflect elements that are routine in Montessori education (for example, hands-on activities, abundant free choice, no grades or tests; see Marshall 2017). This exemplifies the Montessori quandary: recognized as excellent, yet often left out of conversations on school reform (Chertoff 2012, December; Walsh and Petty 2007).

Although instigated contemporaneously with the factory system of schooling, initially with children who were atypically developing and then with children of low-income parents, Montessori education is today undergoing a surge, proliferating into public schools and charters, high schools, and day cares the world over (Debs 2019; Whitescarver and Cossentino 2008). Bookstores typically still stock Montessori's writings, and scholarship about Montessori is on the rise (for example, Google Scholar citations for the term have increased eightfold over the last 25 years; see Fig. 1 for comparison with other education systems). The system Montessori developed also remains virtually unchanged, in contrast to conventional education which has undergone several adjustments since its origins in the one-room schoolhouse (age-graded classrooms, grades, chalkboards, bells, the 50-min hour, Carnegie units or credits, multiple choice tests, and sometimes back again) in attempt to improve it (Tyack and Cuban 1995). When so many other school reforms have come and gone, it seems remarkable that this marginal Montessori system persists. In the first part of this article, I discuss three sets of reasons for this. The first is extrinsic reasons: child outcomes, teacher satisfaction, and what parents want. The second set of reasons is intrinsic to Montessori—its match to human psychology, as is indicated by a wealth of research, and its tremendous breadth. I end with speculation as to why, despite these attributes, Montessori is still marginalized in discussions of education reform, and I argue that radical school reform, such as Montessori, is what is needed to really improve schools.

Montessori is a system of education aimed at children from birth to 18. It is rooted in observations made by an Italian physician between 1890 and 1952 in response to children's behaviors in evolving prepared environments. Montessori's overarching goal was "to supply the needs of every stage from the beginning" (Montessori 1961/2007, p. 53). "Education should no longer be mostly imparting of knowledge, but must take a new path, seeking the release of human potentialities" (Montessori 1946/1963, p. 2). The system that resulted by the end of her life (e.g., Montessori 2012) involves 3-year age groupings (0–3, 3–6, and so on) wherein a specific, carefully developed apparatus appropriate for all the children in the age group is supplied, with a teacher whose role is not to impart information, but instead to connect children to the environment where self-guided learning occurs. The apparatus contains a network of teaching materials interconnected across all curriculum areas (language, math, geometry, science, geography, music, art, and even practical life skills) and age levels, with which children can freely choose to work in constructive ways to further their development. The teacher's responsibility is to ensure constructive activities, in part by presenting individual children lessons that meet their successive developmental needs. A central premise is that children are

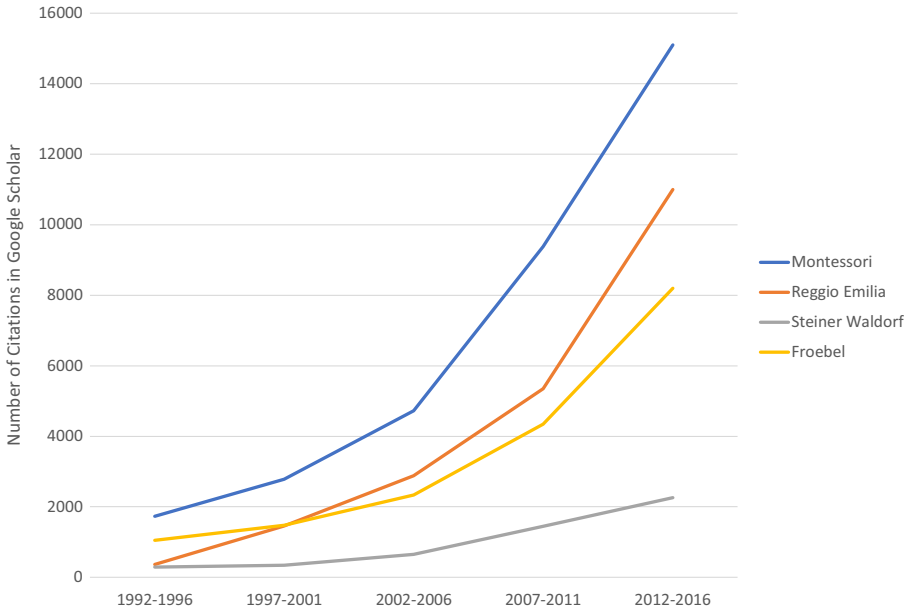

Fig. 1 Google scholar references to alternative school type name and the terms "child" and "education" from 1991 to 2016. Froebel kindergartens began in the late 1700s, Montessori in 1907, Waldorf (for elementary school ages) in 1919, and Reggio Emilia (for pre-K-kindergarten) around 1945. Using references as a measure of interest, Montessori garners by far the most interest, although interest in each method has increased since the early 1990s

active learners with intrinsic motivation and innate knowledge of how to develop themselves under two conditions: when adults do not interfere, and when they can deeply concentrate on meaningful work in natural social environments. Further description can be found in Montessori's books (e.g., Montessori 1948b; Montessori 1967/1995). Although Montessori was developed many decades ago, its orientation to basic human psychological needs might render it still relevant for children today, much as the basic tenets of Buddhist psychology still are true at 2500 years old (Walsh and Shapiro 2006).

Extrinsic Reasons for Montessori's Persisting

Empirical Evidence on Montessori Outcomes

Although Montessori implementation ranges in quality, evidence suggests that properly implemented Montessori education (Lillard and McHugh 2019a, b) is very effective (Lillard 2018). The highest standard for intervention research, pure random assignment, is not always feasible for testing schoolwide models[1]; two recent studies used the next most stringent design: lottery waitlisted controls. Lotteries rarely exist at private schools, but there are over 500 public Montessori schools in the USA (National Center for Montessori in the Public Sector 2014) and some admit by random lottery following parent application. Lillard and Else-Quest (2006) sampled 5- and 12-year-olds who had gained admission by random lottery as 3 year olds to a

[1] True random assignment was done for Head Start programs over 40 years ago, but the Montessori implementation was poor (see Marshall 2017).

high-quality (as evidenced by its being recognized by the Association Montessori Internationale or AMI[2]) public Montessori school in Milwaukee, or were assigned to a waitlist. Children in Montessori performed better or the same on every measure, never worse. To wit, at age 5, they performed better than waitlisted controls on the Woodcock-Johnson Letter-Word, Word Attack, and Applied Problems subtests, and on tests of executive function, social problem-solving, and social cognition. On the playground, they were significantly more likely to be involved in positive peer play and less likely to be involved in ambiguous rough play. Twelve-year-old children in Montessori wrote more creative stories using more sophisticated sentence structures. They also used more constructive strategies in solving social problems and reported feeling a greater sense of community at school.

The second study was longitudinal and followed across preschool children who by random lottery were admitted to one of two AMI-recognized public Montessori magnet schools in one of America's poorest cities (Hartford, CT) or were waitlisted (Lillard et al. 2017). Although equal on all measures and demographics (income, parent education, age, race, gender) at the outset, by the end of kindergarten, the Montessori children performed better in academic achievement and social cognition. They also persisted more on a challenging task and expressed greater liking of academic tasks relative to recreational tasks, and at the end of PK4, they had significantly stronger executive function. Of particular interest, children in the lower income half of the sample who were in Montessori significantly closed the achievement gap with higher income children by the end of the study. The income–achievement correlation in Montessori was half what it was in business-as-usual schools, and even less than half what it was in the 16 other public magnet schools in the study. Effect sizes in both these lottery studies were strong for school interventions (see Dweck 2019), ranging from a third to over three quarters of a standard deviation.

Other studies have found positive outcomes of Montessori using matched samples (for reviews, see Lillard 2017, chapter 11; Marshall 2017). With such designs, parent effects can masquerade as school effects, if particular types of parents that are expected to have better child outcomes (say, authoritative ones) also prefer Montessori schools. But matched samples are sometimes the best designs available, and while the results should be viewed with some caution, they should not be ignored, especially given the outcomes from lottery studies. One study found that children who had gone to public AMI-recognized Montessori schools through 5th grade performed better in math and science than their age-, gender-, and economically matched high school classmates (Dohrmann et al. 2007). Two studies found better social–emotional outcomes (including feelings of "flow" while doing schoolwork and social support at school) among AMI Montessori middle schoolers than matched private school controls (Rathunde and Csikszentmihalyi 2005a, b). A recent study of 3rd grade test scores in South Carolina found significantly higher standardized test scores for over 7000 children in 45 public Montessori schools (with varying quality of implementation) versus controls (Culclasure et al. 2018). Other recent studies also show that Montessori—especially

[2] AMI is the organization founded by Maria Montessori to carry on her work. It has very intensive requirements for the people who train teachers; after their own training and at least 5 years of teaching, the trainers undergo at least 5 more years of apprenticeship to three different teacher-trainers. Exams for new teachers are overseen by a central AMI committee, keeping standards high. AMI-recognized schools have AMI-trained teachers, a full set of approved Montessori materials, classrooms with specific age divisions (3–6, 6–9, and so on), a 3-h work period in the morning and 2–3 h in the afternoon, and just one trained teacher with 24–35 children per class. An AMI-trained consultant visits at least once every 3 years. See https://amiusa.org.

when it is implemented with high fidelity, but sometimes even when it is not—has strong outcomes in social emotional and academic realms (e.g., Ansari and Winsler 2014; Bhatia et al. 2015; Brown and Steele 2015; Franc and Subotic 2015; İman et al. 2017; Kayılı 2018; Kayılı and Arı 2016; Mix et al. 2017; Pate et al. 2014; Peng and Md-Yunus 2014; Stewart et al. 2007). Montessori also fares better than other schools in terms of racial equality. Over half of children in public Montessori schools in the USA today are students of color, and such students have better academic outcomes and a reduced racial disproportionality of disciplinary events in Montessori schools (Brown and Lewis 2017; Brown and Steele 2015; Debs 2016; Debs and Brown 2017).

Several studies that do not find better academic outcomes (e.g., Laski et al. 2016; Lopata et al. 2005; Ruijs 2017) failed to address implementation quality, which might explain the differences. In the only studies thus far to directly compare implementations, children in Montessori classrooms that used only Montessori materials advanced more than children in classrooms that used other materials as well (Lillard 2012; Lillard and Heise 2016). The later study was experimental: Children in classrooms in which the non-Montessori materials were removed advanced more in reading and executive function across a semester than children in a classroom that retained its non-Montessori materials. In another experimental study supporting the importance of Montessori materials, adding some Montessori exercises to conventional preschool classrooms improved fine motor ability relative to classrooms in which the exercises were not inserted (Rule and Stewart 2002). In sum, although there is significant variation in how Montessori is implemented (Daoust 2004), at this point, better outcomes on the wide range of outcomes studied appear to be reliable in well-implemented Montessori.

The generally positive results of outcome studies are an extrinsic reason for Montessori's persistence. Still more evidence is needed. The vast majority of Montessori schools are private and require tuition. While most of the studies just cited used well-matched control groups, not all did; even those that did could be masquerading parent effects as school effects, with two exceptions: those using lotteries. Yet the lottery studies compared Montessori to "business-as-usual," and of course schools in the USA are very diverse (see Dintersmith 2018). Further research is needed comparing Montessori to other specific models (as in Ansari and Winsler (2014) which compared specifically to HighScope). In addition, it is unclear whether the results of lottery studies would apply to children whose parents do not enter them in lotteries for special school programs. Further, most research has concerned children ages 3 to 6; only a handful of studies examine outcomes of older children in Montessori, and research on children younger than 3 in Montessori infant and toddler programs is practically nonexistent. There is also little research on the impact of variation in Montessori implementation, which definitely exists (Daoust 2004), particularly when one goes outside of the stricter AMI-recognized implementation (by definition since AMI schools have particular implementation standards). Marshall (2017) notes other problems, like the dearth of longitudinal studies (but see Lillard 2012; Lillard et al. 2017; Phillips-Silver & Daza 2018; Stewart et al. 2007) and studies examining dosage and critical period effects. A different concern regarding Montessori research is that teachers have not been randomly assigned to take Montessori training, nor have they been studied for pre-existing differences; although the experimental implementation study above suggests otherwise, better outcomes in Montessori students, when seen, might result from teacher differences that would have led to better outcomes regardless of what educational system those teachers implemented. Pertinent to this is teacher satisfaction—another possible extrinsic reason for Montessori's longevity.

Teacher Satisfaction

Montessori would not exist if there were no teachers willing to use it, and Montessori teachers express being very "at home" with the approach (Malm 2004). In a recent study of public South Carolina teachers, those teaching Montessori expressed greater job satisfaction: 98% reported either loving or liking their job versus 89% of South Carolina public teachers altogether (Culclasure et al. 2018); this 89% is similar to the 90% satisfaction level of public school teachers across the USA in 2011–2012 (U.S. Department of Education 2016). South Carolina public Montessori teachers overwhelmingly liked their job despite indicating they were asked to compromise the Montessori program and often lacked the full set of Montessori materials, suggesting a lack of administrative support; in the national survey just cited, teacher satisfaction among unsupported public school teachers was 65%. Teacher job satisfaction is especially dependent on working with students and witnessing their development, as well as being in a positive school climate (Cockburn and Haydn 2003). Why Montessori teachers experience greater job satisfaction is an empirical question (addressed to a degree by Malm 2004). Research (cited above) indicates that Montessori schools have a more positive social climate, and teachers work with each child for 3 years, and both factors are associated with higher teacher job satisfaction. In addition, in-depth Montessori teacher training intentionally prepares teachers psychologically for their task, cultivating attitudes to children and aligned values (Whitescarver and Cossentino 2007). One of the attitudes is allowing children the space to develop themselves, to be independent. Montessori teachers report giving children significantly more independence than conventional teachers (Caldwell et al. 1981), and teachers might be more satisfied in school environments that are higher in student self-determination. The teacher training could thus lead to better and more satisfying teaching. On the other hand, the higher job satisfaction might be due to selection bias. Although the implementation studies cited above suggest other factors are at play, it is possible that people who were already predisposed to enjoy teaching more (regardless of type of teaching) might self-select to teach in the Montessori way.

Parent Endorsement

A third possible reason for Montessori's longevity is parents. Some parents are at liberty to choose a neighborhood they know has good schools, but others have no choice; in contrast, if a child is at a Montessori school, it was *intentionally chosen* by parents; unlike conventional programs, alternative programs are rarely if ever the only option. The surge in public Montessori today is surely led by parent demand. Recent studies of why parents today choose Montessori reveal that middle class parents are attracted to Montessori principles like self-determination and Montessori's respect for children (Debs 2019; Hiles 2018). Many parents also are also attracted to the classroom environment and materials, and believe Montessori will help their child to have better outcomes, including academic success, while also sustaining intrinsic motivation and joy in learning. On the other hand, parents can also be a reason for why there is not more Montessori. In Debs' (2019) qualitative study of public Montessori, parents, especially low-income parents, expressed concerns (contrary to the evidence described earlier) that Montessori itself is not academically rigorous.

In sum, the outcomes of Montessori, the high degree of Montessori teacher satisfaction, and parent endorsement are three extrinsic possible reasons for this educational system's longevity.

However, more high-quality research is needed on the system's outcomes, including the degree to which better outcomes result from the system itself or from the teachers who chose to implement it—and who implement it in particular (high-fidelity) ways.

Intrinsic Reasons for Montessori Persisting

Besides these extrinsic reasons, I consider two intrinsic reasons why this century-old system is still relatively prevalent and unchanged: alignment with findings from developmental and educational psychology, and breadth.

Montessori's Convergence with Developmental Science: Self-Determination and Its Corollaries

Montessori was based in observations of children, which might explain why it dovetails very well with the accumulated evidence from developmental and educational psychology (Lillard 2017; Marshall 2017). Highlighting her intent to develop a system suited to human psychology, Montessori called her education system "Psycho-Pedagogy" (Montessori 1955/1989, p. 16), and the Italian title of her first book, *The Montessori Method*, was, literally translated, *A Scientific Method of Pedagogy as Applied to Child Education in the Children's Houses* (Montessori 2012, p. 7). The generality and perpetuity of Montessori's observations might stem from the variety of children and cultures in which she observed. Initially, Montessori observed atypically developing children, then children with extreme economic disadvantage, and eventually children on four continents from all social classes (Montessori 1962/1967). This variety of children could help render ideas that could apply to all children, even a century later. The central premise Montessori arrived at is that school should be "Help given in order that the human personality may achieve its independence" (Montessori 1955/1989, p. 6). After presenting evidential support for this central premise, evidence is presented on several features that can be viewed as natural corollaries to it. Many of these features are discussed at length in Lillard (2017).

Self-Determination Independence means self-determination. Abundant theory and empirical evidence suggest the benefits of self-determination to the human psyche (Ryan and Deci 2000). Ryan and Deci claim that humans have three basic innate psychological needs: competence, autonomy, and relatedness. By setting children free in a natural social environment (meaning a place where they can freely interact with their peers) and providing conditions that cultivate sufficient social skills, relatedness is naturally achieved in Montessori settings (see "Peers" section below). By giving children opportunities to do many activities which children choose, and at the right level (difficult but not too challenging), a sense of competence arises (Cyvas 2010). And self-determination is of course at the very root of autonomy. Thus, the Montessori system is set up to satisfy basic human needs according to the self-determination theory.

Self-determination has several natural prerequisites and consequences, shown in Fig. 2 and detailed in the subsequent sections. To preview, self-determination requires that children choose their own activities. For free choice in school to lead to constructive learning, the activities must be interesting. Embodied and interconnected activities/knowledge engender more interest than purely abstract and disconnected ones. When deeply interested, we focus our attention, developing executive function. Extrinsic rewards undermine the sense of self-

determination, so rewards must be intrinsic. A tightly ordered and organized environment and curriculum also facilitate self-determined learning. Self-determination allows for and, in fact, requires positive and caring teacher–child relationships, if teachers are going to have any influence. Finally, when children can determine their social groupings, they gravitate to arrangements that are satisfying for their age levels, and natural peer tutoring and collaboration can result. The evidence for each of these points is discussed below.

Free Choice Montessori practice aligns with research in educational psychology by giving children considerable choice, which clearly confers a sense of self-determination. "The essential condition [for psychological health] is freedom to act in a prepared environment where the child can be intelligently active" (Montessori 1948a, p. 24). A great deal of evidence supports the benefits of free choice to well-being, learning, and development.

In one study, a group of children were asked to choose a category of anagrams to solve (Iyengar and Lepper 1999), whereas others were told their (yoked) category had been chosen for them. Students in the first group solved the most anagrams and were most likely to choose to take more anagrams home to solve on their own. In a second experiment, they found that even choosing the elements and names of objects in a computer game improved performance and task interest. In another study, babies who could move their own mobile by kicking their foot showed more positive affect, and later transferred their mobile-control knowledge to a new mobile; babies who could not control the initial mobile did not figure out that they could have controlled the subsequent one (Watson 1971). These and many other studies (for a review, see Lillard 2017, chapter 3) show that more self-determination, and the intrinsic sense or locus of control that goes with it, leads to more learning and higher well-being, across ages and settings, including school classrooms (Ames 1992; De Charms 1976). Findings are particularly strong when activities are interesting (Patall 2013), a Montessori feature discussed more below.

In Montessori classrooms, "children have free choice all day long. Life is based on choice, so they learn to make their own decisions. They must decide and choose for themselves all the time … They cannot learn through obedience to the commands of another" (Montessori 1989, p. 26). Montessori gained this insight from a simple incident in the first classroom in Rome (Montessori 1962/1967). The teacher had arrived late, to find that the children had asked the janitor to let them into school. At the time, the Montessori materials were kept locked in a cabinet until distributed to children by the teacher. Yet on that day, the children had taken the materials out themselves and were using them when the teacher arrived. Montessori was

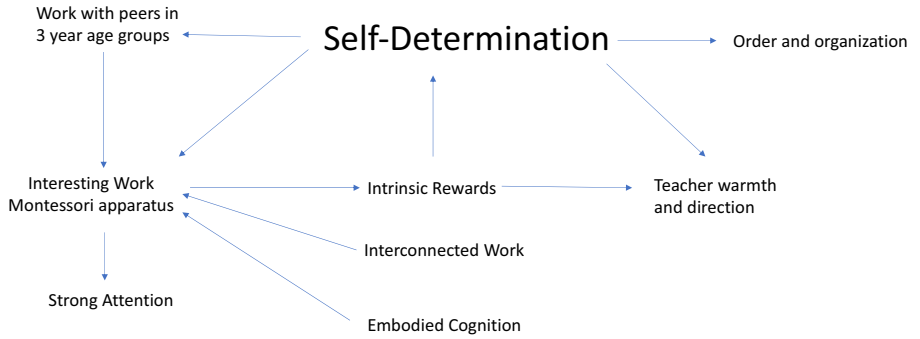

Fig. 2 Some evidence-based elements of the Montessori system

fascinated, and from that day, the materials were placed on low shelves and children chose their own activities.

Montessori noted that, "Children must develop themselves by their own exercises" (Montessori 2013, p. 22). She believed that intrinsic impulses cue the development sequence, and therefore, children's development is self-driven (rather than adult-driven). She inferred that children have an internal drive to independence from watching babies learn to nurse, reach and grasp objects, sit, crawl, walk, and finally talk, essentially on their own, with no formal lessons from adults in these skills (Montessori 1967/1995). Until the late 1800s, this is how learning almost always occurred; only a tiny minority of the world's children had formal schooling (Rogoff et al. 2001). Natural or informal learning "is nondidactic; is embedded in meaningful activity; builds on the learner's initiative, interest, or choice (rather than resulting from external demands or requirements); and does not involve assessment external to the activity" (Rogoff et al. 2016, p. 358). In informal learning situations (versus in conventional school settings), children pay very close attention to the source of information; for example, a Mayan child learning to weave carefully studies the adult weaver (Rogoff 2004). In so doing, children act independently, taking control of their own learning by directing their attention. Montessori education is consistent with informal learning, and children learn in part by watching their peers (discussed later) and teacher demonstrations.

Montessori's beliefs that (1) children have internal drives toward self-development, and (2) when unimpeded, development is healthy and normal, together imply that children are naturally driven to surmount challenges and to learn (see also Simon 2001; Vygotsky 1978), and will do so if given the right stimuli (for example, child-directed human speech) or tools (for example, objects to handle or climb on) and freedom to choose what stimuli to interact with, when, and how much. This is consistent with much educational theory (for further discussion, see Rathunde 2009) and evidence ("The Goldilocks Effect," Kidd et al. 2012, 2014): Young children choose to attend to what is just above their current level—essentially in their "zone of proximal development" (Vygotsky 1978)—tailoring the input to facilitate their own development. Setting children free in an environment prepared to serve their developmental needs allows children to select stimuli from the environment to fill their proximate needs.

An analogy is found in the nutrition literature. In a classic study, 15 children were given a choice of 30 healthy foods each day from weaning until age 6, and their self-selected diets were nutritionally sound over long time scales (Davis 1928, 1939). More recent studies support this principle: At liberty among healthy choices, organisms select diets that meet their nutritional needs (Frankel et al. 2012; Johnson et al. 1991; Rovee-Collier et al. 1996). Montessori aims to provide an array of healthy choices for intellectual and socioemotional growth from which children can select what is needed for their current moment in development. In Montessori theory, two impediments to healthy self-development are (1) adults' interfering with children's choices, typically by providing extrinsic rewards or punishments, discussed later, or (2) adults failing to provide appropriate stimulators, leaving children bored.

Interesting Curricular Materials and Activities Given free choice, children would only work with the materials and follow up on lessons on their own if doing so was interesting. Interest can be situational, as when most anyone would agree something is interesting, or individual, where a child has a particular intense interest (Renninger and Bachrach 2015). Regardless of which source interest has, research in educational psychology has made clear that learning

improves when interest is aroused (Harackiewicz et al. 2016; Renninger and Hidi 2011). For example, children score more highly on reading comprehension items for topics they had previously noted were more interesting (Estes and Vaughan 1973; Renninger 1992). Adolescents' advances on skills at which they had been identified as especially talented are predicted by how deeply interested the adolescents were at younger ages when engaging those skills, measured by experience sampling (Rathunde and Csikszentmihalyi 1993). And interest in reading is a strong predictor of later literacy (Whitehurst and Lonigan 1998).

Children in Montessori classrooms can choose activities and work on reports on topics that are personally interesting to them, giving a strong sense of self-determination. A child who loves frogs can make frogs the subject of art, math, biology, geography, and language endeavors. But self-determination is also helped by engendering situational interest. "The secret of success is found to lie in the right use of imagination in awakening interest, and the stimulation of seeds of interest already sown" (Montessori 1948a). Montessori materials and lessons were designed by trial and error to captivate children's attention, and teachers are also trained to engender situational interest. "Whatever is presented to [a child] must be made beautiful and clear, striking the imagination" (Montessori 1948a, p. 17). Two supports to interest in Montessori are the work being embodied and interconnected.

Embodied Cognition Montessori work is arguably interesting in part because it is embodied (Rathunde 2009); doing things tends to be more interesting than sitting still. Embodied or "grounded" (Barsalou 2008, 2010) cognition refers to the idea that thought is not composed purely of abstract, amodal symbols, but rather, is supported by the body (Wilson 2002), and in some cases even offloaded to the body and the external world (Byrge et al. 2014; Clark 2013; Pouw et al. 2014a, b). It includes the idea that metaphors reflect how our bodies are constructed and function (Lakoff and Johnson 1999) and systems perspectives in which organisms develop in dynamic interplay with their environment (Smith and Thelen 2003).

Abundant evidence supports that learning and development are helped when they are embodied (but see Pouw et al. 2014a, b). As evidence, consider that infants who manually explore objects have more advanced visual perception regarding objects (Needham 2000). Handling objects also predicts understanding others' reaching behavior to be goal-directed, and infants who are given early experience handling objects (by giving pregrasping infants "sticky" Velcro mittens that attach to cloth toys) appreciate others' goals earlier (Sommerville et al. 2005). With older children, movement has been shown to enhance memory, literacy, and physics understanding. For example, motioning one's hands as if to pour enables better prediction of the angle at which water would pour (Schwartz and Black 1999) and walking in various positions on a carousel allows children to understand that all parts of an object move at the same speed better than does watching the carousel (Levin et al. 1990). Children who trace letters while making the associated sounds learn sound–letter relations better than children who look at letters while making sounds (Bara et al. 2007), and the act of writing enhances reading skills (James 2017). Many more studies support embodied cognition, explaining its current prominence in discussions of schooling (de Silva Joyce and Feez 2018).

Piaget, who took Montessori's training course and was president of the Swiss Montessori Society (Baumann 1999), noted Montessori's prescient recognition that cognition is embodied: "Generalizing her discoveries with unparalleled mastery, Mme Montessori . . . immediately applied to normal children what she had learned from backward ones: during its earliest stages the child learns more by action than through thought [, leading her to develop] a general method whose repercussions throughout the entire world have been incalculable" (Piaget

1970, pp. 147–148). Montessori's books are replete with quotations expressing the connection she saw between movement and cognition, for example: "Watching a child makes it obvious that the development of his mind comes about through his movements… Mind and movement are parts of the same entity" (Montessori 1967/1995, p. 142). Montessori is deeply concerned with educating children's movements, and it uses movement to teach (Rathunde 2009).

Feez (2018) provided an example from geometry. The youngest children in a Montessori primary (3 to 6) classroom are taught to fold cloths they will use as napkins or for cleaning. Lines are sewn in the cloths to show children where to fold them, resulting in squares, rectangles, and triangles. Children learn the names of these shapes, and later come to apply them to other material, including a language material called the metal insets, a set of 10 geometric shapes which children trace and eventually use to make Spirograph-like artistic designs (see Montessori 1934/2011). When children trace the metal insets, they learn names like *pentagon* and *ellipsoid*, which they will apply in later geometry work and elsewhere. By tracing the metal insets with pencils, children also receive indirect preparation for writing. They also trace many more additional shapes in a geometry cabinet; here they trace the shapes with their fingers while saying the name, continuing preparation for writing. A puzzle-like game in which the wooden pieces are placed on cards showing the shapes' outlines ensues, and is a step in a movement toward abstraction, as the cards become symbols, as do the words, and children eventually leave behind the tracing and can simply use the word to denote the concept. Some of the geometric shapes resurface as children learn parts of speech, with a black equilateral triangle representing the noun family and a red circle representing the verb. Children place these symbols (and others representing other parts of speech) next to words as they diagram sentences. "By combining objects and movement with language in multi-modal ensembles of learning resources, Montessori designed sign complexes in which sensory and intellectual meanings are unified. These ensembles isolate and give prominence to the critical variables and contrasts from which educational knowledge emerges" (Feez 2018, p. 45).

Also related to embodiment, Montessori is well known for its encouragement of fine motor skills; even in conventional kindergartens, Montessori exercises significantly strengthened such skills over 6 months (Rule and Stewart 2002). Control of one's hands is related to intelligence more generally (Deary et al. 2004; Melnick et al. 2013), and children's fine motor skills strongly predict later school success (Cameron et al. 2012; Grissmer et al. 2010).

Interconnection People also tend to be more interested in material that connects with other material they already know in part, but not thoroughly (Berlyne 1960; Hidi and Renninger 2006; Tobias 1994). Hence, an excellent study strategy is "bridging": thinking about how new material connects to other materials one already knows (Miyatsu et al. 2018). "Advance organizers" like outlines also serve this function by giving people concepts on which to anchor new information (Mayer 2008). The Montessori system capitalizes on bridging. "It is well-known that … [one must link] all new knowledge to the old, 'going from the known to the unknown,' because what is absolutely new can awake no interest" (Montessori 1917/1965, p. 45). Throughout the Montessori curriculum, from birth to high school, there is a great deal of interconnection; the napkin-folding-to-grammar symbol sequence just described is one of many. At the elementary (6 to 12) level, interconnection is explicit in the title: Cosmic Education: Children are presented with the universe as an interconnected entity. "All animals and vegetables [even] insects have a cosmic task. All are agents, maintainers and conservers of this order in the environment" (Montessori 2012, p. 89).

Self-determination requires that activities be interesting, and embodiment and interconnection are two ways to make them be. A consequence of engaging in activities in which one is very interested is that attention becomes fixed and deeply concentrated. This is another way that Montessori is aligned with educational psychology research, which could account for its persistence.

Concentrated Attention When one is deeply interested in one's task, one concentrates deeply, engaging full attention (Csikszentmihalyi 1990). The ability to control attention is a highly laudable goal for education (James 1890, p. 424). Attention is a pillar of the executive system (Petersen and Posner 2012), which has been tied to school and life success (Blair and Raver 2015). For example, self-regulation at ages 3 to 6 predicted age 32 health, wealth, and criminality outcomes in a sample of over 1000 people born in 1972–1973 in Dunedin, New Zealand (Moffitt et al. 2011).

Deep-focused attention is central to Montessori education. "The task of education is to fix the wandering mind of the child" (Montessori 1994, p. 105). Once children began to concentrate on self-determined work, Montessori said, "The child's whole personality changed, and the first sign of this was an assertion of independence. It was as though [the child] were saying: 'I want to do everything myself'" (Montessori 1967/1995, p. 130). Thus, concentration appeared to enable self-determination. In addition, several other positive characteristics were said to emerge once children began to concentrate on work: they became joyful, empathetic, kind, and respectful of others, began to make good choices, became more compliant, perseverant and so on (e.g., Montessori 1962/1967, 1966, 1967/1995). Research does indicate that Montessori particularly develops executive function (Diamond and Lee 2011; Kayılı 2018; Lillard 2012; Lillard and Else-Quest 2006; Lillard et al. 2017). The characteristics Montessori noted also resemble the "autotelic" personality associated with regularly achieving "flow" states through deep concentration on work (Csikszentmihalyi 1997) and characteristics of a self-regulated learner (Blair and Raver 2015). Such effects of concentration have even been observed in monkeys: Nonhuman primates raised in captivity, natural models for attention deficit hyperactivity disorder (ADHD), improve in their behavior following training on how to use a joystick, a task requiring their sustained attention (Rumbaugh and Washburn 1996).

In sum, self-determination requires interesting activities, which lead to deep attention, promoting executive function—another way in which Montessori education is aligned with research findings. And executive function in turn supports healthy choices in a context of self-determination. Self-determination also requires that one avoids extrinsic rewards, like gold stars, grades, and "reading for pizza" programs, because research shows that such rewards negate a sense of self-determination (Deci et al. 2001).

All Rewards Are Intrinsic Besides requiring interesting activities, environments marked by self-determination lack extrinsic rewards, praise, and overt evaluation that can be taken as means of extrinsic control—an "overjustification effect" (Lepper and Henderlong 2000). Consistent with its goal of self-determination, Montessori also lacks these elements. There are no grades, and teachers are counseled not to praise or openly evaluate children (except if a child clearly seeks praise, see Montessori 1967/1995). The materials are self-correcting, and children learn to find their own errors using control materials. Montessori believed that children naturally want to fix their errors, in keeping with a natural tendency to virtuosity (Kubovy 1999), but that "All the crosses made by the teacher on the child's written work. .. only have a lowering effect on his energies and interests" (Montessori 1967/1995, p. 245).

There is considerable controversy about the long-held practice of extrinsic rewards in school, which Thorndike over 100 years ago urged on teachers– to reward correct associations with candy and pats on the head and to punish incorrect ones with "stern looks" (Jonich 1962), and extrinsic reewards are embedded in the conventional model. Although there are likely many reasons why children's intrinsic motivation to learn in conventional school declines every year they are in school, research suggests extrinsic rewards might be one. And intrinsic motivation is positively related to school performance, whereas extrinsic motivation is negatively related (Corpus and Wormington 2014; Lepper et al. 2005). An ample body of research has shown that if people are already motivated to engage in an activity (as perhaps young children are in school learning), using extrinsic rewards depletes motivation once the rewards are removed (Deci et al. 1999). Extrinsic rewards are detrimental in part because they create a sense that other people are responsible for one's outcomes—in other words, they undermine the sense of self-determination (Deci and Ryan 2011). Montessori's lack of grades and other extrinsic rewards is another way in which it is aligned with educational psychology research (see Lillard 2017, chapter 6).

Natural Peer Engagement Self-determination applies not only to activities, but also to social milieu: Children are free to choose their social arrangements in Montessori classrooms. This has led some to claim Montessori is asocial, because rather than all acting together as a single group, as they do when teachers lead whole-class activities, children (especially before age 6) often engage in different individual activities, although they might be working side by side (even on the same type of activity) and conversing. Another way children in Montessori classrooms commonly interact is peer tutoring, with older children helping younger ones (Montessori 1967/1995). At the elementary level (ages 6–12), children in Montessori classrooms almost constantly engage with others, collaborating on reports, deciding on the nature of their report, how to conduct the research, who will do what parts, how it will be presented to the class, and so on. Educational psychology research on peer and collaborative learning supports this natural Montessori sequencing of more individual work at younger ages transitioning to more group work with age (Hartup 1983). Research also supports the efficacy of peer tutoring and collaborative learning.

For example, low-SES children who were assigned to engage in a peer tutoring program significantly outperformed those who did not, not only in the topic tutored but in all other topics and even 2 years after the tutoring program had stopped; they also performed as well as a higher SES group (Greenwood et al. 1989). Collaborative learning programs like Brown's "Communities of Learners" and Jigsaw Classrooms are also very successful (Aronson and Patnoe 1997; Brown and Palincsar 1989; Rogoff et al. 2001). Yet children's skill and proclivity toward peer interaction increases with age (Hartup 1983), such that the benefits of collaborative learning manifest after age 6 (Azmitia 1996) except in special in laboratory situations where they have manifested at 5 but not earlier (Plötner et al. 2015). Typically, "Even 5-year-olds, competent problem solvers in many instances, have difficulty working together to solve any but the simplest and most familiar problems" (Siegler 1998, p. 277). In addition, as children get older, their desire to be with peers increases (Hartup 1983), and working with peers enhances interest (Renninger and Hidi 2011; Thoman et al. 2012). Self-determination in Montessori classrooms appears to allow children to gravitate toward the social arrangements that correspond to their developmental capabilities and proclivities (see Lillard 2017, chapter 7).

Warm and Supportive Teacher–Child Relationships For teachers to influence development when children are free to make their own choices, positive teacher–child relations are especially important (Davis 2003; Pianta 1997). Montessori presaged current research by

focusing on the importance of teacher–child relationships (Whitescarver and Cossentino 2007). She counseled teachers on exactly how to behave with children, in ways consistent with secure-attachment parenting (sensitively responsive) and authoritative parenting (adults provide guidance, but give children considerable autonomy within those strict boundaries; see Lillard 2017, chapter 9). For example, she said, "Young people must have enough freedom to allow them to act on individual initiative. But in order that individual action should be free and useful at the same time it must be restricted within certain limits and rules that give the necessary guidance" (Montessori 1948b, p. 113), and "A teacher [must be] ready to be there whenever she is called in order to attest to her love and confidence" (Montessori 1956, p. 76). Life outcomes are better when children are securely attached to warm and sensitive caregivers (Drake et al. 2014; Stams et al. 2002) who become authoritative as children grow up (Baumrind 1989). The importance of warm, sensitive, responsive teachers who can build positive relationships is clear; teacher–child relationship quality predicts child outcomes (Pakarinen et al. 2017; Pianta et al. 2002). Montessori was at the vanguard in seeing the importance of such relationships for human learning. Presaging Baumrind's (1989) description of the authoritative parent, she wrote, "It is true that the child develops in his environment through activity itself, but he needs material means, guidance and an indispensable understanding. It is the adult who provides these necessities… If [the adult] does less than is necessary, the child cannot act meaningfully, and if he does more than is necessary, he imposes himself upon the child, extinguishing [the child's] creative impulses" (Montessori 1956, p. 154). To the extent that Montessori's recommendation for how teachers relate to children holds true, this is another way in which Montessori adheres to research in developmental science.

Orderly, Organized Environments Another aid to the success of a self-determined learning environment is organization. Abundant research has shown that children thrive when conditions are orderly and predictable. In one such study, kindergartners received over 2 weeks six lessons in a nearby classroom; for three lessons, its walls were filled with decorations and information, as one often sees in classrooms (Bullard 2013); for the three other lessons, the walls were sparse, containing just a little information relevant to the lesson. Children's attention was coded during each science lesson, and their learning was tested after. The results suggested that children were distracted by the cluttered walls: They spent more time looking at them than the teacher, and they also learned significantly less. This experimental study is consistent with a naturalistic study in the UK of over 3500 children, ages 3 to 11, in 153 classrooms in 27 different schools (Barrett et al. 2015). Across the school year, children learned the most in classrooms in which walls provided an intermediate level of stimulation, "in balance with a degree of order, ideally without clutter" (p. 129). Other studies have examined household chaos and clutter: children who grow up in homes with more structure and order (temporal and spatial) fare better at all ages, even controlling for demographic third variables like SES (Evans 2006). Other studies have focused on routines, from bedtime to chores to holidays, and again, have found that children thrive on order (see Lillard 2017, chapter 10).

As described in Montessori's books, an authentic Montessori classroom is a modicum of order both at the macro level and micro levels, and in physical and temporal ways. For example, the classroom is prepared in an orderly fashion, with like materials together, so there is a math area, a language area, and so on. In addition, within and across sets of materials, factors like color are held constant. All the items on the "table washing" activity tray will be the same shade of blue, for example; and across all the decimal math materials, units are green,

tens are blue, and hundreds are red; this sequence repeats for the thousands. There are set sequences with which to use all the materials, and set ways to remove them from the shelves to which they are returned by the child after use, all in order. In addition, the object of many of the materials—the game so to speak—is to put things in order. One messes up then arranges the color tablets, for example, from lightest to darkest, or places all the like pairs together. The classrooms have auditory order as well, as children are taught to use calm voices like their teacher uses. "Pedagogically the work of the school is to organize the work of the child …The organizing of the child's work and offering this work to the child is a very exact work for us… It is the organization of the work which [leads to]… the establishment of mental order" (Montessori 1997, pp. 31–33).

Montessori's organized approach to sensorial education provides another example that is pertinent to developmental neuroscience. In the late 1800s, Wundt's laboratory in Leipzig was interested in the limits of human perception, while Montessori was interested in how to *aid* human perception. As noted earlier, the ability to make fine sensory discriminations is correlated with intelligence (Deary et al. 2004; Melnick et al. 2013). Brains are hierarchically organized, with lower levels feeding into higher ones (Merzenich 2001; Stiles et al. 2015). Montessori's theory was that by presenting children orderly, graded arrangements of sensorial impressions—light to dark shades, lower to higher notes, rough to smooth boards, and so on—the haphazard impressions of real world stimuli would have an organized neural system in which to be registered. Given that we know the sensory cortex is organized in this (tonotopic, etc.) fashion (Hari et al. 1993; Merzenich 2001; Romani et al. 1982), and that neuroplasticity is specific to the input (Lillard and Erisir 2011), Montessori's ideas make sense. Furthermore, given the hierarchical nature of neural organization, it is possible that organization at the lower sensory levels feed into organization at the higher levels (Lillard 2017).

Order might explain the discrepancy between poor outcomes from pure "discovery learning" approaches (Klahr and Nigam 2004; Mayer 2004) and better outcomes from "guided play" approaches (Alfieri et al. 2010; Verdine et al. 2017). In Montessori classrooms, children are not simply let loose with stuff to do as they please. They are given orderly lessons with how to use each material; everything is tightly organized with prescribed procedures of use. Sometimes lessons are given by peers rather than the teacher, and peer tutoring is most effective when procedures are tightly structured (Fantuzzo et al. 1992; Ginsburg-Block et al. 2006). Thus, the order of the Montessori environment also supports its guiding principle of self-determination.

Summary: Self-Determination, Its Corollaries, and Montessori's Alignment with Educational Psychology Research In sum, Montessori is well-aligned with educational psychology research. Its central premise of self-determination can be seen as the core from which several other alignments follow. Self-determination necessitates free choice, which is helped by not having extrinsic rewards that can be perceived as manipulative. If children are to have free choice in school and still learn, it requires that the learning activities be very interesting, so children will want to do them. Interestingness in Montessori work is helped by its being embodied and interconnected. The degree of interest also inspires deep attention, which develops executive function, that then assists self-determination. Self-determination also requires positive warm teacher relations, in order for teachers to have influence at times when children need their subtle guidance (subtle to retain the sense of self-determination). Free choice also allows children to adopt social arrangements corresponding to their levels of social development. Finally, constructive development in a self-determined environment is likely

helped by the environment being tightly organized. Montessori arrived at these principles through close observation of children, and education and psychology research today support the conclusions to which she came. This alignment with research could be one reason Montessori is so admired, and hence, continues to exist so long after its development.

Montessori's Broad Scope

Besides its good outcomes and its alignment with psychological research, another appeal of Montessori its broad scope, three facets of which are discussed here.

Age The basic tenet of Montessori—to set children free in a prepared environment, in which they will self-educate—applies at all ages. Children become increasingly independent of adults across the schooling years, but the basic Montessori method remains the same across them. Montessori noted that, "Other methods have not so wide a function" (Montessori 1955/1989, p. 5) in the ages served: Froebel's kindergarten and Reggio Emilia were designed for children under age 7; Pestalozzi and Steiner developed schools for children ages 7–12; the Dalton Plan was developed for high school; and so on. Montessori serves a broad age range, from birth to 18, which could be part of its appeal and longevity.

Global Reach Montessori education was intended not for children in a single particular culture but for a biological human being. Children everywhere adapt to their cultures; Montessori is designed to give children "a knowledge of the environment to which [they] need to adapt [themselves]" (Montessori 1955/1989, p. 11). Montessori schools are in at least 110 (Whitescarver and Cossentino 2008) of the world's 195 countries, from China to Argentina, Australia to Finland, Kenya to Malaysia, and even (as I have seen) in the tiny Himalayan Buddhist Kingdom of Bhutan. The differences in Montessori across countries lie in culturally specific symbol systems (sandpaper Chinese characters, for example), practical life exercises (making sand mandalas versus polishing shoes), whether materials are purchased or handmade (as they are in less affluent countries), and basic elements like classroom density (higher in densely populated cities like Mumbai). In other respects, Montessori classrooms enact the same basic curriculum with the same materials around the globe.

Intraindividual Development In addition to being broad in ages served and cultures in which it has integrated, Montessori education covers a broad range of areas of development (Montessori 2012). The Montessori system began with children ages 3 to 6. Children begin learning in this classroom in two areas: practical life and sensorial. The former educates children on how to take care of themselves and their worlds: how to get along with others (with "lessons of grace and courtesy"), and prepare meals, set the table, and clean dishes, arrange flowers, mop the floor, and so on. In these latter activities, the hand works in service of the mind, and many children have their first moments of deep concentration in the classroom while doing such work; others experience those moments in sensorial work (Montessori 2012). As noted earlier, sensorial activities systematically educate the senses by having children pair like objects (for example, musical bells of the same pitch) and arrange objects in order (lowest to highest pitch). The array of sensorial discriminations made includes colors, textures, temperatures, weights, sizes, shapes, smells, tastes, and so on. Stemming from the sensorial training, Montessori presents materials that lead children to discover how to write and then

read, as well as how to do mathematics and geometry. Children are also introduced to the continents and countries of the world (including their geology and biology) and given vocabulary to describe the universe and its contents. In sum, the curriculum in a Montessori primary classroom is intentionally broad, carefully constructed to assist the child's whole development, from social skills to mathematics.

A similar approach was taken in bringing the method down to infancy (Montessori 1967/1995). For example, infants are initially given mobiles with specific patterns to help to develop the visual cortex (black–white contrasts in the earliest mobiles, gradations of color in later ones). Later they are given interesting objects to interact with, often just outside of their reach, to inspire them to move toward the objects, purportedly to develop a sense of agency. Children are given limited choices initially, which increase as they become able to handle choices.

In elementary, for ages 6 to 12, the Montessori curriculum enlarges to embrace the entire cosmos (Montessori 1948b). Montessori found that this scope engages children from age 6 on; less scope, she said, kills interest. "If neglected during this period, or frustrated in its vital needs, the mind of the child becomes artificially dulled, henceforth resistant to imparted knowledge" (Montessori 1948a, p. 3). In middle and high school, children in Montessori become increasingly independent, increasingly moving into and interacting with the real world, while continuing to make interconnections and learn in collaboration with peers. Montessori's idea was that from 12 to 15, children engage in practical work using what they have already learned; they might live on a farm, take care of animals, build farm structures, and run several businesses associated with farm products, run a hotel, and so on. From 15 to 18, school becomes like university.

In sum, Montessori education is unique in its broad scope with regard to the ranges of ages and cultures served, topic areas covered, and aspects of development it aims to foster.

Summary

Montessori education exists basically unchanged over 100 years after its founding. I have reviewed three extrinsic (outcomes, teacher satisfaction, and alignment with parent goals) and two intrinsic aspects of Montessori education (alignment with developmental science and breadth) that might explain why. And yet Montessori also remains on the margins (Whitescarver and Cossentino 2008) and is often ignored in discussions of school reform (Dintersmith 2018). In the next section, I explore possible reasons why this is so.

Challenges: Montessori's Incommensurability with Common School Culture

Montessori education has remained on the margins, despite many of its elements being adopted into conventional systems (Whitescarver and Cossentino 2008). Some think this is because Montessori is too expensive, but when done the way Montessori described, it is actually not more expensive than conventional schooling (Kahn 1990). Other concerns are raised (like worry that it is not academically rigorous, Debs 2019), but I think the deeper reason for Montessori's odd position of being admired yet shunned is its incommensurability with the culture of conventional schooling. Montessori requires a paradigm shift in how one thinks about school (Cossentino 2005), given how deeply steeped we are in the conventional system.

The Conventional School Paradigm

The conventional school system has existed since the mid-1800s, with some minor adjustments. Two cornerstones support the edifice: the factory model (Callahan 1962) which Dintersmith (2018, p. 4) concluded is "still with us to this day," and the behaviorist model of the child (Resnick and Hall 1998; Thorndike 1913). These two models support our "grammar of schooling" (Tyack and Cuban 1995). This grammar includes the notions that students are "graded" into levels: 1st grade, 2nd grade, and so on, and that within levels, they might be further "graded" into gifted, regular, or "slow" groups. Teachers deliver information. Desks often face a teacher's desk behind which hangs a blackboard. A bell marks the beginning and end of prescribed learning periods, often 50 min. Textbooks supplement and/or reinforce what the teacher delivers. These texts divide subject areas, and children learn discretely their math, English, and so on; information across subjects typically does not connect. Tests are given periodically, and students get marks on those tests, which determine when the child changes grades. Children learn and are tested individually. And so on. The conventional system is deeply engrained in most people, and fundamentally, "little has changed" (Tyack and Cuban 1995, p. 85) over the years.

However, because it is not entirely satisfactory, this system has been "tinkered" with repeatedly (for example, by removing marks, combining ages, using more hands-on materials, putting desks in clusters, collaborative learning, and so on), and some argue that school reform will always consist merely of "tinkering" with this basic system because the grammar is so deeply held. Montessori education violates almost every aspect of this grammar and, thus, requires massive translation. Even though research supports basic elements of Montessori, as reviewed above, the Montessori system is in many ways incommensurable with conventional schooling.

This incommensurability is apparent in responses to findings that children in authentic Montessori classrooms fare better than children in business-as-usual schools (reviewed earlier). Specifically, in response to these findings, people often ask what elements of Montessori make the difference (Marshall 2017)—for example, is it the teacher, the free choice, the peer learning, or the embodied materials? In the context of conventional schooling, this question seems sensible: One tries different things, inserting and deleting elements, trying to improve it, *Tinkering Toward Utopia* (Tyack and Cuban 1995). This is how minor changes have been made to conventional education. But which elements make the difference is a wrong question, because Montessori—and I would argue conventional school as well—is all the elements in an interconnected, self-reinforcing whole (Fig. 2 shows some of the elements).

Cross-Cultural and Cultural Psychology: an Analogy

An analogous situation previously existed for cross-cultural psychology and cultural psychology. Cross-cultural psychology, or the study of how people in different cultures are psychologically different, emerged in the early 1900s from a foundation of logical positivism, which undergirds modern science. Logical positivism is the view that truth requires sensory evidence, and a key tenet is that entities can be broken into parts that can be systematically examined. Much of science today proceeds from that assumption, and it was the guiding assumption of the field of cross-cultural psychology, comparing people from different cultures (Shweder 1999). Taking this approach, one might ask what elements of American culture make Americans individualistic, and what elements of an Asian culture make Asians collectivistic:

childhood sleeping or transportation arrangements, how the "I" is ensconced in one's language, and so on. A corollary is that if one transferred the right element(s) of Asian culture to America, Americans would become more collectivistic. The conventional schooling system emerged in America around 1900 coincident with logical positivist behaviorism, and so it makes sense that conventional schooling is viewed as a collection of independent parts.

Cultural psychology, which gained traction in the 1990s, has a different concept of the person and world than has cross-cultural psychology. Specifically, cultural psychology views the person and culture dialectically, such that culture and mind make each other up (Kim and Sasaki 2014; Shweder 1999). A person cannot be separated from culture; a person's mind develops in and with the culture that surrounds it. Likewise, cultures are made up of the minds that embody their values, practices, artifacts, and so on. Hence, for cultural psychologists, it does not make sense to think of pulling out elements of a culture to see which aspects of culture influence which aspects of people. Although one examines aspects of each, one does so with respect to the fact that there is a whole with which those aspects are inextricably entwined.

Cultural Psychology as a Framework for Understanding School

All schooling, including Montessori schooling, is more profitably viewed in this cultural psychology frame, in two ways. First, any school culture creates minds, ways of thinking about school and the world. A mind that was formed in Montessori schooling is made up differently than a mind formed in the culture of conventional schooling. For example, children in Montessori schools engage in learning for learning's sake because there are no grades. This might create selves that are more mastery oriented, and less performance oriented, and there is some evidence that this is the case for children in Montessori (Haimovitz and Dweck 2017; Lillard et al. 2017). In addition, a survey of 230 former Montessori students (about half of whom were in Montessori through 6th grade) showed that 72% strongly agreed and virtually none disagreed with the statement that they felt capable and confident in their abilities while in Montessori; numbers were similar for "While in Montessori, I was happy to be at school" (Cyvas 2010). I would argue that Montessori created this sense, supported by the lottery study finding that it created stronger mastery orientations (Lillard et al. 2017). Most students do not feel capable, confident, and happy in (conventional) schools, resulting in a plethora of "positive psychology" interventions that try to help (Waters 2011).

Second, school systems are cultures in that they have myriad practices and artifacts that reinforce each other, making the whole greater than the sum of its parts. In fact, difficulties with really improving our conventional system might be due to the failure to see it as a cultural whole, rather than as a collection of parts. People try differentiated instruction (Tomlinson and Kalbfleisch 1998), for example, but because it is challenging to fit a psychologically valid principle like respecting that children differ into the behaviorist-factory edifice of conventional school grammar (Santangelo and Tomlinson 2012) that assumes children are uniform "raw products" (Cubberly 1916/1929, p. 512), the reform might not get traction.

A reason Montessori is shunned might be its incommensurability with this conventional school culture. When Montessori wrote, "I am talking about a revolution" (Montessori 2017) with regard to schooling, she meant *revolution*. Revolutions bring in entirely new cultural systems—the American revolution with its Constitution, Bill of Rights, and Common Law; the Maoist revolution with its collective farms and communist doctrine. Perhaps most exemplary here is scientific revolution (Kuhn 1962). In changing from the Ptolemic (earth-centered) to the

heliocentric view of the universe, people's entire world view was disrupted. The Great Chain of Being, with the human as the center and ultimate end, with the authority to name all creatures, gradually ceded to Darwinian evolution, where unintentional processes guide phylogeny, with the fittest surviving, rather than those ordained to survive by a distant interested being. A new set of concepts arrived with this scientific revolution, bringing with it new ontological distinctions.

The shift from conventional schooling to Montessori is a revolution in this sense. The goals and approaches, vocabulary, and grammar that undergird these different ways of schooling are radically different; Montessori is conceptualized as an "aid to life," a cultural system to help children develop into optimally healthy adults.

Incommensurability and Weak Implementation

It stands to reason that if people do not understand something well, particularly something complex and very different from what they know, they might well fail to implement it properly. Perhaps a corollary to cultural incommensurability that is another reason for its being shunned is that Montessori is all too often not properly implemented (Debs 2019). There is no trademark on the term (Whitescarver and Cossentino 2008), and although most Montessori classrooms in many ways function similarly the world over, implementations do vary (Daoust 2004)—I have seen desks in rows with computers and no materials, and timers limiting children's work time, and children filling out worksheets instead of using Montessori materials, all in classrooms that call themselves Montessori—but these are clear violations of core principles. Implementation problems are especially likely when principals or teachers have no Montessori training, as too often happens. Even within Montessori training, there is variation, from in-depth year-long courses taught by highly trained teacher-trainers who adhere tightly to Montessori's system (AMI courses) to superficial courses taught by people without deep knowledge who urge creatively changing it (Debs 2019). The deeper difficulty from which these variations in implementation emerge is cultural incommensurability: Montessori is very different from school as we know it, understanding Montessori requires deep and sustained study, and when people change it they typically make it more like our cultural concept of school, which is anathema. People see poorly run classrooms that call themselves Montessori and decide based on poor exemplars that Montessori is ineffective. (For more on implementation, see Lillard and McHugh 2019a, b).

Summary

In sum, Montessori is very different from, even incommensurable with the conventional school system most people know very well. Discomfort with this difference may be the deep reason it is shunned—beyond more superficial reasons like (incorrectly) thinking it costs too much. The incommensurability also underlies poor implementation that can also be a reason for dismissing Montessori. Understanding a very different alternative system requires adopting a different cultural lens and forging a deep shift in one's concepts and theories. Because of resistance or inability, people who implement Montessori—school administrators and teachers, sometimes with no training—sometimes do so with poor fidelity. Others see these poorly implemented programs that do not function well, and fail to realize it is actually pseudo-Montessori that they disdain.

Conclusion

Unlike many other unconventional educational systems, Montessori education has not faded away, but is increasingly implemented in the public sector and around the world. And unlike the conventional system, Montessori is virtually unchanged since the first half of the 1900s. Yet even the conventional system has not radically changed, because it is an entrenched cultural system that we try to improve by treating it as a logical positivist collection of parts. Real school reform may require radical change.

Montessori is also a cultural system and it has lasted as such because of its admirable outcomes (although more research is needed), alignment with educational psychology research, and breadth. At the same time, Montessori is often shunned and is oddly left out of discussions of school reform. I pose that this is because of its incommensurability with the culture of schooling, which can lead to poor implementation. Since the term is not trademarked, examples of poor Montessori or even Montessori-in-name-only abound. Yet the positive elements of this system, and its compatibility with current findings in psychological research, suggest that it warrants a closer look and more research to determine whether it could be a useful alternative model for schooling in the twenty-first century.

> Education is the help we must give to life so that it may develop in the greatness of its powers. To help those great forces which bring the child, inert at birth, unintelligent and unsympathetic, to the greatness of the adult being—this should be the plan of education—to see what help we can give. Before we help, we must understand; we must follow the path from childhood to adulthood. If we can understand, we can help, and this help must be the plan of education: to help develop not humans' defects, but their greatness. (Montessori 2012, p. 6)

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