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What Belongs in a Montessori Primary Classroom?

Results from a Survey of AMI and AMS Teacher Trainers

Angeline S. Lillard
University of Virginia

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What Belongs in a Montessori Primary Classroom?
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Lillard and Else-Quest (2006) studied children who by lottery at age 2 were or were not admitted to a Milwaukee public Montessori school, and found that children in their last year of Montessori Primary outperformed those who had lost the lottery and were in other types of Kindergarten programs on social skills and behavior, executive function, early math, and early reading. The public Montessori classrooms offerings' were largely limited to classic Montessori materials[1], and yet many Montessori schools offer a variety of materials not described by Dr. Montessori. To investigate the impact of offering supplementary materials, I went on to study children in what I termed Classic versus Supplemented Montessori primary classrooms (Lillard, submitted). Classrooms were identified according to the percentage of children engaged with Montessori materials during periodic visits to the classrooms; Classic Classrooms had over 95% engagement on average, whereas Supplemented Classrooms averaged around 50% engagement. In terms of school-year gains, those in the Classic classrooms outperformed those in the Supplemented ones on a variety of academic and social measures. They also outperformed those in excellent conventional classrooms serving demographically similar families.

The "classic" materials used to distinguish classrooms were selected mainly with reference to Montessori's books. However, teachers have sometimes responded that they are not sure about what the classic materials are. To examine whether there is an agreed upon set of materials, and to clarify what materials elicit divergent views, American teacher trainers were asked to fill out a questionnaire listing 140 materials or activities that the author had seen in Montessori Primary classrooms; Montessori materials catalogs and the AMS School Accreditation Handbook's list were also used in constructing the list. Three Montessori primary teachers, trained at different centers, looked over the list to ensure that no important materials were left out and that names used for the materials should clearly designate specific materials to teacher trainers. For each material or activity, people were asked to designate if it was Necessary, Desirable, Acceptable, or Better Not Used in a Montessori Primary classroom, and to make any remarks they might have about it. Two additional questions at the end of the survey were aimed at 1) Whether Practical Life activities need always be real activities in the culture; and 2) Whether duplicate materials beyond Moveable Alphabets, Stamps Games, and Equation Cards are ever okay.

Montessori Primary teacher trainers were asked to fill out these forms on the rationale that they should be the best living "voice" for what the materials should be. There are two major types of Montessori teacher training in the US: AMI-USA (The American Branch of the Association Montessori Internationale, which was founded by Dr. Montessori to carry on her work) and AMS (Association Montessori Society, founded by Nancy Rambusch to represent Montessori in America). A problem for a study involving these two groups is representation: Primary training is offered at 10 AMI

[1] The term "material" is used here to refer broadly to materials and activities, from the Pink Tower to Table Washing to Walking on the Line.

training centers in the US, whereas it is offered at about 100 AMS training centers. Ten is a very small sample size, but one also does not want highly skewed representation for a study. Some skew, however, is in keeping with the actual skew in the population. Thus questionnaires were sent to all AMI Primary training centers, and a subset of 20 AMS Primary training centers geographically proximate to the existing AMI centers. Seven months later 29 forms had been returned, 17 from trainers at AMS centers; 11 from people presently or recently training at AMI centers; and 1 from an AMI affiliate in training. This last survey was used in the full pool but not the AMI pool since the individual was not yet a certified AMI trainer (but could have trained at other types of center). Although many AMS trainers are AMI-trained themselves, in this sample all respondents happened to be trained at the same type of center (AMI or AMS) at which they now trained with the exception of 3 AMS trainers with NMCE and/or IAPM training.

The results of this survey are presented here. For materials that elicited considerably divergent views, I try to shed light on the material by examining Montessori's writing and lectures. The source most often used in these discussions is the 2-volume *The Creative Development in the Child*, which consists of Montessori's lectures to the training course in Madras, India, in 1939, translated into English by Mario Montessori. These lectures were given 32 years after the opening of the first Montessori classroom in San Lorenzo, hence the system and Montessori's philosophy were well-developed; Mario's translation also renders these lectures particularly authentic. Other books are also used where they seemed helpful. In addition research in developmental psychology is discussed for issues on which it bears relevance.

In discussing Montessori's ideas of what the Primary materials are one faces a task that is perhaps not unlike those of justices attempting to interpret the Constitution: the world is different today, and we do not know what modern tools she would have used in the classroom (Whiteboards? Tape recorders?). We can only surmise based on reasoning about materials that did exist. Second, in going back to her books, one is asserting that her voice is primary. This might well be contested. At AMI, the Pedagogical Committee periodically reviews materials and has made changes. AMS was founded on the claim that, "American Montessori education needed to be as diverse and pluralistic as America itself" (Rambusch, 1992, p. 11). The study previously mentioned suggests that supplemented classrooms do not have better outcomes, but that does not mean that some changes would not be improvements. Yet without empirical evidence we cannot know. In some cases there is empirical evidence bearing on the issue. This paper aims to promote deep discussion by reviewing Montessori's writings and, where relevant, current research.

As a preview, there are many materials about which there is high agreement among trainers: they belong in a classroom, or they don't (workbooks were the one item trainers agreed did not belong). When there are disagreements, they appear to stem from one of two issues: the material is not developmentally appropriate but might be useful at another time—in these cases it either aims too low for most 3-year-olds or aims too high for a child in the first plane of development; or second, the material has no clear or at least agreed-on educational purpose at any age.

Results and Discussion

Materials discussions below are arranged by topic or area. Within each, first I list materials that all trainers agree are important to a Montessori Primary Classroom, before discussing materials that elicited divergent opinions across or even within trainings. Not every trainer responded regarding every material, in some cases because they could not identify the material and perhaps in others because they are unsure. Sometimes comments made it clear that they had an opinion but they did not mark a category. For example, if a comment was “For Elementary only” I assumed the trainer meant it should not be in a Primary classroom. Percentages were calculated concerning the group that did respond or for whom a response could be clearly inferred from a comment.

Materials are discussed according to their basic groupings (Sensorial, Practical Life, and so on). For the materials in the initial table under each area below—materials agreed to be necessary--at least 85%, and in most cases 97%, of all respondents said the material was necessary to a Primary Montessori classroom. The reason no material elicited 100% agreement was that one trainer designated all the manufactured Montessori materials as desirable but not necessary; this trainer wrote, “One can be a Montessori teacher with anything at hand. I would hate to limit true Montessori to those who can afford all the materials.” It is not clear that Montessori would agree, given the depth of her discussions about each material and statements like, “The importance of the material lies in the fact that through the activity, the mind of the child is called to that key which is presented by the material” which “should always [be] present[ed] in the usual prescribed fashion so that the special quality for which the material has been designed stands out” (Montessori, 1989b, p. 196). If one lacked the special materials, one would lack the “keys” to the world that the Primary materials present. Montessori seems to think the specific materials she developed along with exercises of practical life (which differ by culture) were important to her system of education. That said, there are surely many classrooms around the world that lack many or even most of the Montessori materials, but that still offer free choice, independent activity, and much else that is of great value for children’s development. The study mentioned previously found that children’s outcomes were not as strong in classrooms that had all those features of Montessori but also included materials that were not developed by Montessori. Still, the value-added of the materials is itself an interesting issue for further study.

Under each table, I also note materials that at least 80% of respondents agreed were necessary or desirable, noting training differences where they were marked, and then I go on to discuss materials that elicited divergent opinions within or across trainings.

Sensorial Materials

Seventeen sensorial materials were agreed to be necessary to a Montessori Primary Classroom, and another 6 elicited very strong endorsement.

Sensorial: 85% or higher agreement as Necessary

Wooden Cylinders (4 Sets)	**Pink Tower**	**Brown Stair**
Red Rods	**Knobless Cylinders**	**Color Tablets**
Geometry Cabinet	**Sound Boxes/Cylinders**	**Rough & Smooth Boards**
Smelling Bottles	**Fabric Box**	**Mystery Bag**
Geometric Solids	**Sorting Exercises**	**Constructive Triangles**
Binomial Cube	**Trinomial Cube**	

More modest but still strong agreement was expressed for **Musical Bells, Thermic Bottles, Thermic Tablets, Baric Exercises,** and the **Circles, Squares, and Triangles Tray**. These materials were all necessary for AMI trainers, and either necessary or desirable for at least 80% of AMS trainers. The **Smelling Exercise** was 88% positive (necessary or desirable) overall although less so for AMI trainers, several of whom were unfamiliar with it. It has been described as a collection of smelly items (selected by the teacher or found on a walk) that children identify while wearing a blindfold (Seldin & Epstein, 2003).

There were also many Sensorial materials that elicited different views depending on training affiliation. The **Inscribed/Concentric Figures,** a series of geometric shapes that can be inlaid allowing the child to explore gradations of size and how one object can fit into another, were considered necessary/desirable by over 80% of AMS trainers, but elicited some divergence in AMI:

AMI Trainers:	Necessary	Desirable	Acceptable	Negative
Inscribed/Concentric Figures	75		13	13

No trainers made remarks about this material. It is described as an Elementary material in *The Advanced Montessori Method—II* (p. 290), but as a material derived from geometric inset materials and which underlies creation of decorative design, but in the Primary lectures in *The Creative Development of the Child-I* (p. 130) she mentions exploring concentricity as well, with insets. Perhaps the reason why a sizeable minority of trainers saw this material as just acceptable or even negative is that existing materials could convey the concepts well enough, and it thus represents just one more material to clutter a shelf. On the other hand, most trainers thought it a good material for the Primary classroom.

The post-Bells music materials elicited somewhat different views across training as well. AMI trainers had more strongly endorsed the Bells (above) but also strongly endorsed the **Musical Boards and Notes**, whereas AMS trainers were spread on views of the Musical Board's and Notes' importance.

AMS:	Necessary	Desirable	Acceptable	Negative
Musical boards and notes	17	53	29	

The Musical Boards and Notes are described in Montessori's books as being presented after and along with the Musical Bells to introduce the symbol system that leads to musical notation (Montessori, 1916/1965, 1967).

The **Tone Bars** are a material that AMI trainers said should not be in a Primary classroom but that 60% of AMS trainers said was desirable and 40% claimed was acceptable. Many AMI trainers commented that the Tone Bars are an Elementary Material.

Montessori discussed the Tone Bars as being a material with which one composes music after having learned musical notation from the Music Boards. The *Advanced Montessori Method II* specified that the first two materials are used in the Primary Classroom, and then moved on to discussing materials for teaching the full scales including the Tone Bars, but did not specify which classroom this material goes in. Consideration of the Planes of Development and how each of these materials addresses the needs in those planes might help to shed light on this issue. In the first plane, ages 0 to 6, the child is "receptive, absorbing impressions with ease" (Montessori, 1948/1967, p. 5). The Musical Bells suit this time, as they are about "training the ear to perceive differences between musical sounds" (Montessori, 1916/1965). The child moves on to learn the musical notes and corresponding names ("do, re, me") and then the symbol system as used on musical staffs, learning to write basic songs. In this way learning musical notation parallels learning linguistic and numerical notation in the Primary classroom. "All these exercises are based on sensory experience as the point of departure" (Montessori, 1916/1965, p. 332). By contrast, in the second plane, 6 to 12, the child is analytical, "wants to understand for himself" (Montessori, 1948/1967, p. 5) and acquires culture in an organized and systematic way. The Tone Bars are designed to convey the musical scales, allowing the child to discover the scales through experimentation and to develop understanding of melody. They are a much more complex and abstract material than the Bells. By allocating the Tone Bars to the Elementary classroom, AMI trainers seem to suggest that the activities they engender are suited to the second plane of development. Perhaps they are used in some Primary classrooms as a material to explore sound, similar to the Bells, and this explains the divergence. Alternatively, in a classroom where children were very advanced in their musical composition with the Bells, the Tone Bars might be used at the end of the Primary cycle in the ways Montessori describes.

AMS Trainers:	Necessary	Desirable	Acceptable	Negative
Tone Bars		60	40	
Pressure Cylinders	25	69	6	

In addition to the Tone Bars, AMI trainers contrasted with AMS ones in viewing the **Pressure Cylinders** as anathema to a Primary Classroom. These cylinders convey the feeling of varying degrees of pressure. They are attributed in the Nienhuis catalog to George Russell and were apparently developed in the 1980s. Montessori developed sensorial materials to abstract the qualities of color, temperature, texture, smell, tone, and so on, but did not herself develop a material for abstracting the quality of pressure. Whether that quality is important enough in our lives that it deserves a place on the Sensorial shelf is an issue for discussion.

In sum, there is wide agreement among trainers about most Sensorial materials. The Music materials that follow the Bells elicit some divergences across trainings, as do

the Pressure Cylinders. Most trainers also endorse the Inscribed/Concentric Circles, but a substantial minority of AMI trainers do not.

Language Materials

There were 10 language materials that were highly agreed to be necessary, and 4 that received high agreement as necessary or desirable.

Language: 85% or higher agreement as Necessary

Vocabulary Cards	**Sandpaper Letters**	**Moveable Alphabet**
Metal Insets	**Chalkboards for Writing**	**Phonetic/Phonogram Objects**
Phonetic Cards	**Phonogram Booklets & Cards**	**Puzzle Word Cards**
Realistic Books		

Writing on Lined and Unlined paper, The Farm, and the **Grammar Symbols** were considered necessary by AMI trainers, and either necessary or desirable by at least 80% of AMS trainers.

Three language materials elicited divergent opinions within both trainings. The criteria for this was that 80% or fewer of the respondents chose either necessary/desirable or acceptable/negative (combining) categories. By dividing the categories in this way we can tap into points of real divergence, as the first two are clearly supportive, and the last two lukewarm or negative.

Divergent Language Materials	Necessary	Desirable	Acceptable	Negative
Grammar boxes-AMI	20			80
Grammar boxes-AMS	18	24	29	29
Punctuation exercises-AMI	63		13	25
Punctuation exercises-AMS	13	31	38	20
Tape recorder-AMI		22	33	44
Tape recorder-AMS	19	31	44	6

For the **Grammar Boxes**, most AMI trainers thought the material negative in Primary classrooms, with some noting that it is an Elementary material, but 20% thought it necessary for Primary. Among AMS Trainers, 42% saw it as necessary or desirable, and close to 30% saw it as acceptable and the same amount as negative. This material seems to sit at the junction of the two planes of development in Montessori's books. She described in *The Creative Development in the Child II*, the lectures in which appear to constitute a Primary training course, but also in *The Advanced Montessori Method – II* –formerly entitled The Montessori Elementary Material. In the latter volume she notes that it is an activity of most interest to children from ages 5.5 to 7.5—the end of the first plane and the beginning of the second. Thus whether Grammar Boxes belong in a Primary classroom might depend on how far the children in that classroom come with their writing and reading, and whether the classroom has many children on the verge of the second plane of development.

The **Punctuation Exercises** also elicited divergent opinions, with 63% of AMI trainers considering them necessary, and 24% considering them negative; AMS trainers were more spread across the four categories but 43% considered them necessary or desirable and 38% simply cceptable. Montessori describes a series of more advanced Punctuation Exercises in *The Advanced Montessori Method II*. In keeping with this, one trainer explained that the basics of what certain marks mean for readers (a comma indicates a pause, for example) would be explained to a Primary advanced reader, but that more formal exploration of punctuation is for Elementary level children. Another trainer noted that a short introduction to punctuation would come after presenting verbs to children. The divergent opinions here therefore might rest on whether one is thinking of a basic introduction to punctuation, or a particular set of exercises aimed at Elementary children.

Tape Recorders are a fixture in many Montessori classrooms, typically with books on tape supplied that the child can listen to while looking at a book. 50% of AMS teachers thought tape recorders were necessary or desirable, and another 44% thought them acceptable. AMI teachers were less positive, with 44% against them, and 33% finding them just acceptable. Several trainers noted that they saw no purpose in such a material. A question that arises then is what purpose do they serve? Three possibilities that come to mind are: 1) the entertainment value of hearing a story; 2) the educational value that might stem from the content of the book-on-tape; and 3) as an assist to early reading.

Regarding the first issue, Montessori clearly did not include among the materials items that were of entertainment value only—she describes in several books having initially had toys in the classroom, but removing them because they were not used. The mark of Montessori materials is that they challenge the child. “Every item of culture that enters the syllabus must stimulate the child’s intellect…draw his attention and demand his concentration” (Montessori, 1989c). To the extent that books on tape can do this, it might be due to content. It is difficult to speak to the content issue since no specific content for books on tape was given in the questionnaire. What I typically see are common children’s storybooks along with a tape of the story being read.

Books on tape could also challenge the child by assisting with early reading. Research on using books on tape to assist reading is clear. Beginning readers are not helped by listening to books on tape while “reading” (Reitsma, 1988) although older readers (3^{rd}-4^{th} grade level) are sometimes helped (McKenna, 1998; Rasinski, 1990). Reitsma (1988) suggests that children using books on tape often do not attend to the written words, but merely listen and look at the pictures.

I wonder about the place of a book on tape in the Montessori language sequence. Do teachers present it with Sandpaper Letters, or is if for once the child is deep into the Moveable Alphabet, or later? In Montessori, reading emerges spontaneously from learning to write, so the phonetic mappings are well-learned during the beginning writing stage; once the child has the phonetic mappings, he or she has the tools to begin to. Books on tape in the classroom would seem to be aimed at helping the child with these mappings, but as I’ve just noted, research has shown that they do

not. In addition, supplying the tape recorder is supplying one more material to take the child away from the others, like the phonetic objects and cards that assist reading in a more direct way. Montessori was quite clear that the materials she developed comprised a complete set: "the experimental use by the children has determined the quality and quantity of the material" (Montessori, 1997, p. 13). For these reasons I think the Tape Recorder is questionable on theoretical grounds. There may of course be other considerations, and I hope this preliminary assessment will spur discussion about the use of tape recorders in Primary classrooms.

The only language material that AMS trainers strongly supported (over 85%) but which elicited divergent views among AMI trainers is the **Sand Tray**, a wooden tray filled with sand in which a child can practice writing letters. One trainer noted that the Sand Tray was "remedial work", but others did not comment.

AMI Trainers:	Necessary	Desirable	Acceptable	Negative
Sand Tray	18	27	36	18

The Sand Tray is not to my knowledge mentioned in Montessori's books; *The Montessori Method* as well as her later work (e.g., Montessori, 1989c) discussed only Metal Insets and the Sandpaper Letters as direct preparation for writing. Does the Sand Tray offer needed help beyond what is offered by the Sandpaper Letters? The child must produce the letter's shape in the sand, rather than simply trace it, but is there some advantage of producing it in sand over doing so with chalk or a pencil (both of which are mentioned in Montessori's books)? Although research on learning to write is clearly in support of Montessori's method of tracing letters while uttering phonemes, I don't know of research on showing particular benefits for any particular type of writing instrument.

There were two language materials that AMI trainers eschewed but about which AMS trainers differed: Whiteboards and Fantasy Books.

AMS Trainers:	Necessary	Desirable	Acceptable	Negative
Whiteboard with Marker	21	50	21	7
Fantasy books	44		25	31

Using a **Whiteboard with a Marker** to practice writing elicited a 70-30 split among AMS trainers, with the majority having a positive view. One trainer explained that one should have the material if possible because it is "certainly part of our culture these days." Whether their place in the culture warrants having them as a material in the classroom might be a matter of individual choice; certainly the place of video games and television in the culture does not mean they should be in classrooms. Some trainers eschew markers because they are not sensitive to pressure: the same amount of ink goes out regardless of whether the child presses hard or lightly. Montessori was clearly concerned with children learning to use a light touch, and having materials that give feedback on the degree of pressure (the Pressure Cylinders?) the child uses (see *The Creative Development of the Child*, Vol. 1, Chapter 37). Markers lack this feature. It would be interesting to examine how developing pensmanship is affected by use of a pencil versus chalk versus a marker.

Fantasy books also elicited divergent opinions. Montessori clearly took a negative view of introducing fantasy to children under 6 years of age; the Fairy Tales, she specified, should be introduced in Elementary, and normalized younger children she found had no interest in them (Montessori, 1989a, p. 44-6). In other places she suggests that adults presenting fantasy to children confuse the developing mind, which is trying to sort out reality (Montessori, 1997, pp. 40-5), and she noted that, "Often silly, funny stories or cartoons, in children's books, do not appeal to the child" (Montessori, 1989c, p. 224). She went on to describe the beautiful, realistic, factual books she recommended teachers make (because publishers at the time did not).

Current research does weigh in on the best types of books for children's learning. For example, we know that children do not learn words as well from cartoon-like illustrations as they do from straightforward photographs and realistic line drawings; fantasy books showing (for example) letters of the alphabet as animals fail to teach letters; children learn less from pop-up books than from books that have plain pages; and children who are told stories about trains with families and feelings later are more apt later to judge that trains really do have families and feeling (Ganea, Ma, & DeLoache, in press; Ganea, Pickard, & DeLoache, 2008; Ganea, Richert, Bean, & DeLoache, 2004; Tare, Chiong, Ganea, & DeLoache, in press). This evidence would suggest that simple realistic books are most appropriate to Primary classrooms. Given that both Montessori and the research literature lean against the use of fantasy books for young children, particularly deep consideration of their uses for children in the classroom would seem to be in order. It is not that children cannot tell the difference between reality and fantasy—researchers conclude that they typically do (Woolley, 1997)—but evidence thus far does not suggest that fantasy is useful for preschool education.

There were three language materials that AMI trainers agreed were necessary or desirable, but about which AMS trainers diverged.

AMS:	Necessary	Desirable	Acceptable	Negative
Reading analysis	18	24	29	29
Word study	18	41	29	12
Detective adjective game	12	53	24	12

Reading Analysis, introducing children to the foundations of grammar, is described in *Creative Development of the Child, Vol 2,* p. 281, followed by a presentation of the Grammar Boxes. **Word Study** begins with oral games (detecting sounds in words, described in *The Creative Development of the Child* Vol 2, p. 15) and extends to studying related nouns, compound words, contractions, and the like towards the end of Primary. The **Detective Adjective Game** was also among the presentations at the course in Madras (vol 2, p 218), with the teacher giving the child labels for different types of triangles (little, red, isoceles) for the child to choose. These are clearly more advanced reading materials, and so would only be needed in a class where children were more advanced in their reading. The same issues discussed with regard to the Grammar Boxes thus seem pertinent here, although all of these materials come before the Grammar Boxes in the sequence and so more clearly fall in Primary.

One language material that did not elicit much endorsement from either training was **Writing workbooks/sheets**. I found this interesting because I often see workbooks in Montessori classrooms. All the AMI trainers considered them negative and 65% of the AMS ones did, with most of the remaining AMS trainers viewing them as just acceptable. My own observations are that children find workbooks very attractive (they often like television and candy too), but just as Montessori early on had preprinted outlines of drawings for children to fill in which she later removed (see change from *The Montessori Method* to *The Discovery of the Child*), my guess is that she would not endorse today's worksheets and workbooks but rather would want 1) for the child primarily to interact with 3-dimensional materials and 2) when in two dimensions, to choose their own words rather than use preselected ones. Workbooks offer an entirely different form of education that theoretically does not seem to jibe well with Montessori, a judgment with which this group of trainers appears to concur.

In sum, there was agreement that 14 language materials belonged in the classroom, and a further set of materials appear to belong when readers in the classroom are more advanced. There was one language material, the Sand Tray, that was considered a remedial add-on by some but necessary by others. Tape Recorders and Fantasy Books are two materials and about which there was disagreement across trainings.

Math Materials

Fifteen math materials were agreed to be necessary to a Montessori Primary classroom, and another 3 elicited very high agreement.

Mathematics: 85% or higher agreement as Necessary

Number Rods & Cards	**Sandpaper Numbers**	**Spindle Boxes**
Cards & Counters	**Golden Beads (1 & 2)**	**Decimal Numeral Cards**
Teen Boards & Beads	**Ten Boards & Beads**	**Unit Division Board**
Strip Boards	**Linear Chains with Squaring Labels**	**Linear Chains with Cubing Labels**
Snake Game	**Multiplication Board**	**Multiplication with Beads**

The Stamp Game, Small Bead Frame, Fraction Insets were deemed Necessary by over 85% of AMI trainers, and either Necessary or Desirable by at least 80% of AMS trainers.

There was only one math material eliciting divergent views across the board.

	Necessary	Desirable	Acceptable	Better Not
Equation booklets-AMI	50			50
Equation booklets-AMS	53	18	24	6

Equation Booklets are squared paper booklets used with materials like strip boards and finger charts to assist memorization of basic math facts. One trainer commented that this material was acceptable if a child was ready for it. Among AMI trainers, only 8 answered this question; 2 others indicated they did not know what the

material was. Of those who answered half found the booklets necessary and half thought them negative. It is possible that some of the divergence concerning this material was around the issue of whether the equations are preprinted, thus like a workbook for a child to fill in, or are blank booklets for the child to write equations in. Montessori teachers sometimes discuss the importance of children making up their own problems, rather than being assigned problems by a teacher, thus giving the child more ownership of their work as opposed to the idea that the work is for the teacher. The divergence of opinions about this material might thus stem from lack of clarity in the questionnaire.

There were 5 math materials that AMI trainers considered necessary but about which AMS trainers were divergent.

	AMS: Necessary	Desirable	Acceptable	Negative
Dot game	47	12	18	24
Finger charts and equations	56	25	13	6
Large bead frame	25	19	31	25
Story problems	35	24	41	
Racks and tubes		14	29	57

The **Dot Game** is about "carrying" in addition, described in *Creative Development of the Child Vol. 2* (pp. 94-5) as a material presented after but used in parallel to the Stamp Game. Today it is offered either as a pencil-and-paper exercise with a preprinted form or with a whiteboard and water-based marker; Montessori describes it as involving a ground glass over a paper form. Whereas the Small Bead Frame is used for addition and subtraction, the **Large Bead Frame** supports multiplication. **Racks and Tubes** are used in Long Division. **Story Problems** (self-explanatory) are not something I have seen described in Montessori's books. These are all more advanced Montessori math materials, and while AMI trainers considered them necessary, AMS trainers were divergent. As with some of the language materials, their necessity in the classroom might hinge on how advanced the students in the classroom are. At schools where 5-year-olds tend to leave for public school, they might unfortunately not be necessary.

One math material considered negative among AMI trainers, but necessary/desirable for 94% of AMS trainers was **The Hundred Board**. This material was developed in Holland to assist counting from 1 to 100; it is not described in Montessori's books. Other Montessori materials for counting include actual objects which one counts (like the Golden Beads and the Long Bead Chains); the step to abstraction in Montessori's sequence is the Stamp Game, which uses the color coding for units, tens, hundreds, and thousands, and is used mathematical operations rather than simply counting. My guess is that the controversy surrounding this material stems from whether abstract counting with the Hundred Board has a place in the sequence of Primary math materials, or whether a child at the stage of counting should be using concrete representative materials. Although I find Montessori's sequence of math materials (rooted in the Sensorial objects) generally supported by the empirical math literature (e.g., Halberda, Mazzocco, & Feigenson, 2008), and long-term math/science

outcomes of children who were in Montessori are superior to those who were in other schools (Dohrmann, Nishida, Gartner, Lipsky, & Grimm, 2007), more specific studies of the Montessori math sequence remain to be done. Such studies could help shed light on whether introducing abstract counting with the Hundred Board is a useful addition to the original set of math materials.

Like writing workbooks and sheets, trainers were universally negative about **Math workbooks and sheets**.

In sum, there was wide agreement about a core set of math materials, but there were some materials that elicited divergent views across trainings. Specifically, there were 5 materials deemed necessary only by AMI trainers, and the Hundred Board was deemed necessary only by AMS ones.

Geography and Science

Four Geography materials were considered necessary by all trainers.

Sandpaper Globe	**Land & Water Forms**
Painted Globe	**Puzzle Maps**

Four additional materials, two geography and two science, elicited strong agreement. **Geography Cards and Folders/Boxes** and the **Botany Cabinet** were seen as necessary by over 85% of AMI trainers, and necessary or at least desirable by over 80% of AMS ones. **Botany and Animal Cards** were agreed to be necessary or desirable by 80% of all trainers. Over 80% of all trainers considered the set of **Flags** necessary or desirable, but a substantial minority of AMI trainers (18%) thought them just acceptable.

One science/geography material that AMS trainers considered necessary/desirable but about which AMI trainers were divergent was **Animals of the Continents**. This was described to me as placing plastic models of animals in their appropriate places on a map of the continents. A different iteration might be descriptions of animals placed in Geography Folders describing different countries, and this might be the reason for the divergence in AMI. I know of no discussions of this material in Montessori's writings. Whether it helps to direct interest to different areas of the globe for further research—in line with geography folders—would seem to be key. On the detracting side, one can imagine a temptation to animate the small animal figures. While I have nothing against pretend play, I have raised the issue of whether children derive the same benefits from materials when they play with them rather than use them as intended (Lillard, 2005, Chapter 5).

AMI Trainers:	Necessary	Desirable	Acceptable	Negative
Animals of the continents		44	44	11

Three other science materials were considered necessary or desirable by AMS trainers but negative among AMI ones.

AMS Trainers:	Necessary	Desirable	Acceptable	Negative
Sink and Float	94	6		
Magnets	94	6		
Botany and Animal Puzzles	63	31	6	

Sink and Float involves a basin of water and a set of objects that the child drops in to determine their flotation. This activity is not described in Montessori's books. One question is how useful it might be for Primary children to do: What do they learn from it? Research on pure discovery learning has clearly concluded that children rarely learn what adults think they might from interacting with a set of objects without quite specific guided instruction (Klahr & Nigam, 2004; Mayer, 2004). Thus although they might learn that the wood floats and the metal sinks (is this very useful to know?), children probably derive no deeper understanding of what makes one object sink and another float from this activity. One might consider it useful as a Sensorial material imparting the abstract quality of "flotility", but unless one lives by a large body of water that quality does not seem particularly important to abstract. The material also might be useful in introducing early systematic testing, although children don't tend to test systematically until they are much older. So, for what purpose do we have Sink and Float? It does evoke concentration, but might activities that evoke concentration and teach something useful be better?

Magnets are interesting. In Elementary a child might begin to explore the underlying mechanisms of magnetism, and using them in Primary could set a child up for this much as the Binomial Cube is first used as a Sensorial activity. Montessori however did not introduce science activities in this way, so it seems to be another interesting material for discussion.

The **Botany and Animal puzzles** are offered in the Nienhuis catalog, but they are not described by Montessori. They show the different features of different animal groups and types of plants. Perhaps the source of the divergence is whether it would be better for a real plant to be found outside and brought in to illustrate the feature. Another source of the difference might be that it is simply one more material, and one must choose whether and when to reserve the shelf space for other materials that Montessori did design. Whether children get a better introduction to biological systems in one manner or another is a topic for empirical research.

In sum, the area of science and geography had a small set of agreed upon materials, as well as a few materials that elicited different opinions. This is not an area that is much discussed in Montessori's books for Primary—but it is much discussed in her books with regard to Elementary. Perhaps less is more at this level: having fewer activities in this area would leave the child more time for using materials that give a basic foundation in number and language and sensory perception.

Practical Life Activities

Seventeen Practical Life activities were agreed to be necessary.

Walking on the Line	**Silence**	**Grace And Courtesy**
Dusting	**Table Washing**	**Sweeping**
Folding Clothes	**Pouring Liquid**	**Pouring Solid**
Polishing	**Scissors Exercises**	**Dressing Frames**
Arranging Flowers	**Dish Washing**	**Food Preparation**
Care Of Plants	**Washing Hands**	

Table Setting and **Cloth Washing** also elicited quite strong agreement as necessary or desirable.

Six Practical Life activities evoked disagreement within AMI, but were agreed by most AMS trainers to be necessary or desirable.

AMI Trainers:	Necessary	Desirable	Acceptable	Negative
Braiding	18	27	55	
Weaving	27	27	46	
Tools (hammer, screwdriver)	18	18	64	
Spooning beans	46		55	
Using a sponge	22	22	33	22
Opening/Closing Jars and Bottles	55		46	

Roughly half of AMI trainers thought **Braiding** and **Weaving** are desirable/necessary classroom activities, while the rest deemed them merely acceptable. Montessori's writings make it clear that her criteria for Practical Life was that the activity be of real value and be an activity of the culture (Montessori, 1989c, p. 11), so perhaps the difference in trainers centered on whether they are from communities where braiding and weaving are more common. The use of **Tools** also elicited disagreement, perhaps because it is unclear how one might use of a hammer, screwdriver, and so on in the Primary classroom for a real activity. No AMI trainer saw any of these three activities as negative.

Spooning Beans also elicited some disagreement among AMI trainers, but again with no negative views. Montessori discussed *pouring* dry materials (Montessori, 1989b, p. 57), and this was agreed on by all trainers as a necessary activity. But *spooning* beans (dry beans) is perhaps not something we do less—coffee beans? When trainers put notes by this item, they specified that it might be a preliminary activity. Preliminary activities isolate skills that are needed for other activities, and the trainers who endorsed two other Practical Life activities—**Opening Bottles and Jars** and **Using a Sponge**--tended to emphasize this as well: these activities might be there if there were children in the class who seemed to need them, but then they should be removed and replaced by more challenging activities as soon as possible. The child's interest, Montessori said, "may be destroyed in two ways—in finding things too difficult, or too easy" (Montessori, 1989c, p. 9). Thus choosing Practical Life activities with practical uses, and moving preliminary exercises out of the classroom once they were mastered by the children, would both seem to be important in the selection of activities of Practical Life.

Another 6 Practical Life Activities were thought to be negative among AMI trainers, but necessary/desirable or divergent among AMS Trainers.

AMS Trainers:	Necessary	Desirable	Acceptable	Negative
Dropper Activity	88	6	6	
Tonging Activity	88	6	6	
Shell scrubbing	63	31	6	
Grating soap	21	43	36	
Locks/lock box	75	25		

Peace table/stick	53	29	12	6

Dropper and **Tonging** activities involve moving liquids with a dropper or solids with tongs to move them from one container to another. Tonging is often done with cotton balls in Primary classrooms. **Shell Scrubbing** and **Grating Soap** are self-explanatory. Trainers sometimes asked in their comments on these activities, "For what purpose?" Extrapolating from Montessori's discussion of Practical Life, one would guess that in a culture where soap was routinely grated for use in washing, or shells were scrubbed so they could be used as dishes, such activities would make sense, if the child (or classroom) went on to use the grated soap or shells in the classroom. Dropper and tonging activities seem at the level of preliminary activities, like the pouring of dry materials.

A basket of **Locks or a Lock Box** was seen as merely acceptable by 82% of AMI trainers but as necessary by 18%, whereas it was viewed as necessary or desirable by all AMS trainers. I would guess the import of this activity would depend on the child's need to know how to use locks. The Dressing Frames isolate the actions a child needs to button, tie, and zip, because a child needs this knowledge for independence in dressing and the actions are difficult to do on one's own clothing. In some communities knowing how to use locks at a young age is very important.

Having a **Peace Table or Stick** was highly endorsed by AMS trainers but viewed as negative (67%) or just acceptable (22%) by AMI ones. Montessori did not mention the use of these in her books, which describe children who are normalized and seem to naturally find ways to work peacefully with each other. My guess is she would not find such a material necessary, and would ask in what ways the classroom was not serving children's needs so that peace was disrupted and a special material was needed to restore it. Another question about this material arises from its not being part of the larger culture. If a child gets into a dispute in a store, for example, where there is no peace table or stick, will that interfere with their ability to resolve the conflict? The material reminds one of the Talking Stick used in some native American council meetings, and its use would seem appropriate for children in such cultures. The material also has some similarity to the use of an "ear" for buddy reading in the Tools of the Mind program: one child holds a model of an ear and listens to another child who holds a model of a mouth and reads. When the roles switch, the children switch items. An external device can be a helpful reminder to a child with little self-control. In my research I have found that children in Montessori classrooms tend to have strong self-control (executive function), but early in the year in a class of young children some external aids might be helpful. The issue of whether the material is necessary and useful seem ripe for exploration.

Near the end of the survey, teacher trainers were asked, "For Practical Life, does it matter if the activity is something one would normally do in real life? For example, is hammering golf tees into Styrofoam for practice at hammering at least an acceptable activity?" Overall trainers were about evenly split on this question, with 12 saying yes and 15 saying no. There was a strong difference across trainings, with 11 AMS trainers affirming the golf tee activity and 5 having a negative view of it (one did not answer the

question), and 9 of the 10 AMI trainers who answered against it. Across both trainings, when the activity was endorsed it was often noted that it was okay as a preliminary activity and that real hammering of a real nail into wood should be moved to as soon as possible. Those who were negative, across both trainings, specified that practical life activities should be ones that are real and meaningful in the culture, and should have a real purpose. The use of the material then hinges on one's response to the Tools question discussed earlier, and whether there is a real activity in the classroom that requires using a hammer.

In sum, there was a large set of agreed on Practical Life activities, but there were also some divergences. These revolved mainly around two issues: one was whether an activity was aiming too low, in which case it might be useful as a preliminary activity in a young classroom but should be moved out early. The other was whether the activity was real and useful in the culture. In general, AMI trainers seemed to put more emphasis on whether an activity is really and truly done in the culture, whereas AMS ones seemed to see more value in providing preliminary and preparatory activities so that the child could later perform the real activity.

Art

Just two art materials elicited near-universal agreement among teacher-trainers: **Paints** and the **Easel**. **Pastels** and **Chalk** for drawing elicited fairly strong agreement as necessary or desirable among both trainings, but 27% of AMI trainers thought them only acceptable. From there, the opinions were diverse both between and within trainings. Montessori's own views regarding art appear to have evolved considerably over her lifetime. After an overview of the survey results, I discuss her writing/lectures on this issue.

Only one art material elicited divergent opinions within both trainings: **Crayons**.

Crayons for drawing-AMI	36	18	27	18
Crayons for drawing-AMS	56	6	31	6

Fifty-four percent of AMI and 62% of AMS trainers saw crayons as desirable or necessary; 18% of AMI trainers thought them negative as compared to 6% of AMS trainers. One trainer who said they were desirable specified that their use should be limited, rotating them with other art materials, and that they should be presented formally. Two trainers specified that crayons are a transition material for new children in the classroom; one said the goal was to work towards higher-quality materials like Oil Pastels. Another trainer held that crayons were acceptable only for special occasions and activities. Crayons were commercially available when Montessori was establishing her first schools, but I know of no mentions of them in her books. They are sensitive to pressure, unlike markers, but their tips easily lose sharpness making it difficult to draw precisely with them. Colored pencils with sharp points might be a better material for drawing than crayons, unless the crayons could be kept sharpened like pencils are.

Playdough and **Markers for Drawing** were viewed negatively by AMI trainers and divergently but mainly positively by AMS trainers. Some trainers noted that

PlayDough is too soft and clay is preferable. This would suggest that strengthening the hand might be an indirect benefit of working with clay, a material that is discussed momentarily. Markers fail to discriminate lightness of touch, as discussed elsewhere, and this might explain their being eschewed by some trainers; they are clearly however tools of the culture which some might consider a reason to include them in the classroom.

AMS Trainers:	Necessary	Desirable	Acceptable	Negative
Playdough	41	23	18	18
Markers for drawing	47	6	29	18

Three activities that were endorsed by AMS trainers elicited disagreement in AMI.

AMI Trainers:	Necessary	Desirable	Acceptable	Negative
Colored pencils for drawing	27	27	36	9
Crafts projects	27		36	36
Clay	36	27	27	9

The divergence regarding **Colored Pencils** might stem from whether they are being used for drawings from Insets or free drawing. Montessori clearly endorsed the former and not the latter (see below). **Crafts project**s were another point of disagreement, with the majority of AMI trainers finding them acceptable/negative but a few considering them necessary. I know of no discussions in Montessori's books on this topic, and suspect they were not considered part of school then. One trainer who did not make a category judgment commented that crafts projects should be used like any Montessori material, well-organized and thought out and presented in a lesson. Another said they were acceptable only for special occasions. Another objected to the "project" aspect, suggesting crafts are fine. **Clay** also elicited different opinions. In the *Montessori Method* the use of clay for "Free Plastic Work" is discussed (Montessori, 1912/1965, pp. 241-2) as analogous to free drawing with pencils. She noted that children often make small models of objects in their homes, and thus could provide teachers insight about the child; but she removed this from the later edition of the book, suggesting she had decided by then that it was not a good material to include.

Art materials are an interesting point of discussion with Montessori, particularly as her own views of them seemed to evolve quite a bit from the first edition of *The Montessori Method* in 1909 to her revision of it in 1948 as *The Discovery of the Child*. The art materials Montessori mentions in her later writings include colored pencils, particularly with reference to Metal Inset designs (Montessori, 1989b, p. 242), and paints and paintbrushes (Montessori, 1989b, p. 240). She has a section on Drawing and Representative Art in *The Discovery of the Child,* again specifying use of the metal insets, also noting watercolors and brushes (thus not the opaque tempura paints more common today), and colored paper for cutting and making designs. She mentions that children learn to use these items spontaneously, without teacher intervention, building on the foundation of hand control brought about by the Metal Insets. Montessori clearly put high value on precision in drawing, discussing the interesting designs and botanical

drawings children spontaneously made. On the other hand, she disparaged self-expressive young children's art as "nothing but monstrous expressions of intellectual lawlessness [which] show only that the eye of the child is uneducated, the hand inert, the mind insensible" (Montessori, 1916/1965, p. 308).

The basis for free drawing that children spontaneously did to decorate their work in Montessori's classrooms is the geometric shapes of the metal insets and the geometry cabinet (Montessori, 1989b, p. 133). But training of the hand and eye were primary, and at issue is the most compelling instruments for helping children with these tasks. Earlier, *The Montessori Method* referred to giving a child a pencil and blank sheet of paper for free drawing, as well as giving outlines of objects to color in (Montessori, 1912/1965, pp. 240-1), but this section was removed from *The Discovery of the Child*, replaced by, "The so-called free drawing has no place in my system" (Montessori, 1967, p, 280), and that by having started with geometrical Metal Inset designs to train the hand, children would later (still in Primary) adorn their work with lovely free drawings. She also mentions using pastels in this section. In her 1939 lectures in Madras, Montessori described painting leading to drawing as means of self-expression, and of the need for very careful selection of and training in the use of the implements for these tasks (Montessori, 1989b, pp. 218-221). In sum, it would seem that Montessori would not endorse having much in the way of art materials in the classroom, save a set of drawing implements and a set of painting implements with which to decorate one's work and make illustrations (like botanical drawings), and perhaps pastels and collage materials. Her contemporaries were interested in self-expressive art by children, but she was not, preferring instead to have them do art once they had the skills to produce beautiful and accurate pictures. Today art in schools is viewed as a valued activity by some and an expendable one by others, and interestingly there is a dearth of high quality research on the issue.

Toys and Games

Montessori's books note that she initially had toys in the classroom but removed them because children were more interested in work (Montessori, 1966, p. 122). Two Toy/Game Activities were thought to be negative among AMI trainers, but elicited divergent views among AMS Trainers.

AMS Trainers:	Necessary	Desirable	Acceptable	Negative
Commercial puzzles	29	18	53	0
Building blocks/Legos	12	18	59	12

Building blocks, Legos, and **Commercial Puzzles** (in contrast to the Puzzle Maps) were more acceptable to trainers in AMS than AMI centers, but several trainers from both trainings who gave them a negative evaluation also said that they were suited to transition or full-day programs. For transition (when starting a new class, or bringing many new children in), Montessori talked of having group activities, such as singing a song together, or walking carrying chairs together, and having this then turn into children pursuing individual practical life activities. She also mentioned that it is appropriate to give the child toys during the transition time (Montessori, 1989b, p. 183).

Hence she would concur with the views of the trainers who reserved these materials for transitioning classrooms. The materials themselves certainly convey some information of use to children (gravity in blocks, the visual-perception exercise of a puzzle), but the Montessori materials offer those things and more (Pink Tower, Puzzle Maps), and it is not clear to me why a teacher would opt for having children use ordinary blocks or a commercial puzzle instead of the Montessori materials which convey more important information for a child to ponder.

Duplicate Materials

The end of the survey asked trainers if duplicate materials were ever okay, beyond duplicates of the Stamp Game, Moveable Alphabet, and small Equation Cards. Just one trainer thought it was always okay to have duplicate materials, and then only when the age span of the class warranted. Eighteen trainers said sometimes, and of these 4 specified that it is okay when there are many young students or the age span is particularly large. (It is not clear to me why a large age span would render it okay, as developmental needs would be spread more across the set of materials). For young students, an extra table washing set was endorsed by two trainers and specifically advised against by one. The materials most often cited as okay for duplicating were the Bank Game/Decimal Beads, but several others were named, including Metal Inset Trays, Sandpaper Letters and Numerals, Number cards, Art/Craft activities, Cooking, and Sewing. Those who did not think a second copy of other materials was okay rarely gave reasons, but one stated that having just one copy eliminates competition, and another pointed to this passage from *The Child, Society, and the World*:

"The fundamental fact in the preparation of the environment is to have only one set of each type of material. In many schools the teachers that came from our courses thought it would be better and give greater scope to have two whole sets in the school…but it became evidence that the discipline of the school is hereby slackened; and if one lessens the number of sets the discipline returns" (p. 64).

In sum, Montessori seemed to speak against having additional materials, although trainers were more open to having duplicates of a small set of materials under certain conditions.

Conclusions

This survey points out what materials are highly agreed by trainers from both AMI and AMS training centers to be necessary and/or desirable in a Montessori Primary Classroom. There is a large set of agreed on materials across most areas, but little agreement for art and science/geography—two areas which Montessori herself allocated little attention in discussions of the first plane of development. For other areas, when there were divergences, they stemmed from two sources: materials appearing to aim to high or too low (some math and reading materials, for example, that are for more advanced children or some practical life materials that are preliminary to other skills), or they stem from divergent opinions as to whether the activity has a clear positive developmental purpose (the tape recorder or fantasy books, for example). I have tried to supply some preliminary discussion from research, Montessori's writings, and my own sensibilities, but those with much more training and classroom experience than will do better. I do know that teachers are not always certain about what materials

they should have in their classrooms, and hope that this will provide some foundation and elicit deeper consideration as well as fuller understandings within and across trainings.

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