Different Media, Different Languages

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Children Learn More Deeply When They Represent the Same Concept in Different Media.

Representational media such as drawings made with markers, paper constructions, clay sculpture, and wooden constructions are used in the Reggio Emilia schools to deepen the children's understanding of a theme or concept. Typically, a small group of children will work together in a team, each making a version of his or her idea in several media. In the "Field Project" at La Villetta, one of the schools in Reggio Emilia, the children first talked about a plot of ground outside in their yard, drew what they remembered, made wire and paper models of the ecosystem of spiders, birds, and crickets, and even made noise machines for the sound of rain and of the animals living in the field.

In the project called "The Amusement Park for Birds," a group of children at La Villetta discussed what they knew about water wheels, drew them, and made them in paper, clay, and finally wood and wire. At each passage, their questions about how water wheels work and where they are used deepened and broadened.

Each Medium Has Different Affordances.

Now I would like to take a more technical look at the physical properties of various media and how these properties influence thought. Consider the concept "love." How might this concept be represented in blocks or in string? The artist takes the physical properties of the medium into account before beginning to work. Blocks can be stacked, counterbalanced, and arranged in patterns. They fall down if not placed properly. How can these physical properties capture some aspect of love (Figure 1)?

Suppose our artist in residence leans two blocks together and calls the work "Love." The artist presumes that the viewer will interpret this arrangement to mean that "love is a mutually supportive relation." The viewer knows that each of these blocks would fall if not for the other, that these are separate elements each supporting the other. Thus the message of mutual support is both the symbol and the physical property of the medium.

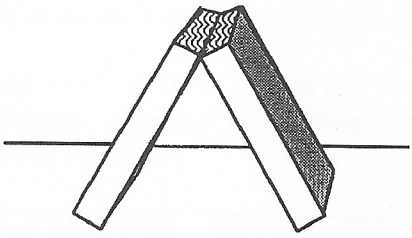


Figure 1. Two blocks give each other mutual support.

With string, again the artist inspects the medium. Strings are flexible, linear, easily curved and tied into knots. The artist decides to tie a small knot in the string and then loop the remaining string into a larger and looser knot that has not been pulled as tightly as the first. This creates a string that has a knot closing onto another knot. The artist labels this work "Love," and the viewer interprets this to mean that "love can even tie our knots into knots."

Each medium has its own set of physical properties, and those physical properties, when inspected by the artist, help to define the message to be expressed. Different media allow the artist to express some meanings more easily than other meanings. The string more easily than the blocks represents the looping of one action on another. The physical properties of the string afford looping. Stated slightly differently, the string possesses an "affordance" for representing the concept of looping.

Each medium has physical properties that make some concepts more easily represented than others. The ease of representation is determined by how easily the child can vary a physical property of a medium. Metal can represent a flowing river if it is heated, but I would not suggest that fluidity is an affordance of metal. The transformation of metal from less to more fluid is not easily created; therefore, fluidity is not an affordance for symbolization in this medium. A transformation in the medium that a child can easily produce is an affordance. Each affordance provides the child with a method to express an idea by transforming the medium. Clay is easily twisted; therefore, children can make meaning by using the twist as a symbol, such as showing the anguish in a mouth or the strain of effort in a run. An affordance is the relationship between the transformable properties of a medium and the child's desire to use that property to make symbols.

Each Affordance Provokes a Special Orientation toward the Problem to be Solved.

Given that only certain properties of any medium can be varied, children using that medium quickly develop a biased perspective to their work. That is, the medium itself orients children to certain classes of meaning. The medium is not technically the message, but it biases what messages can be easily expressed. Round blocks of wood orient children to dynamic relations, flat blocks to stationary relations, bumpy textures to patterns of light, and so forth (Figure 2).

These biases can be considered strengths. This is particularly true if the medium biases children to view the world from an unusual perspective. Take the activity called "The Mime of the Feet," as reported in the Reggio Emilia exhibition *The Hundred Languages of Children*. Here the children decided to act out a story about three people by photographing their feet as the characters.

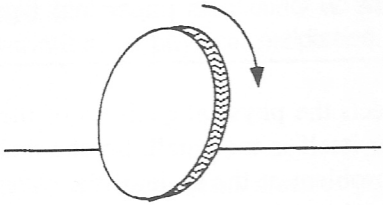


Figure 2. Round blocks contain dynamic relations.

The children then laid out about sixteen photographs of their feet in various positions to tell the story of a man and woman who are apart at first, get married, dance, are robbed by another character (pair of feet), fight, and then separate because, in the children's words, "When a person fights, it's better to split up, because what's the point of staying on just to fight." I would maintain that the story line was more creative because it derived from the actions that feet afford for symbolization, such as coming together, kicking, and moving apart. The story would have been more conventional had the children used hand puppets. The feet as a medium caused the children to think about a whole different set of relations.

Children Learn to Make Compromises with What the Medium Does Not Easily Afford.

Representation also involves an element of compromise between the affordances of the medium and the meaning the child wishes to express. Suppose a child wants to express her concept of elephant, but has only

a single sheet of white paper. The paper does not afford her the opportunity to express the attributes of elephant most salient to her. Nevertheless she persists. She tears the paper into the biggest oval that the sheet will allow (Figure 3).

Granted, this symbol is completely flat and white, but it has at least captured the largeness and roundness of the child's concept of elephant. Even the symbol for largeness, on some absolute scale, is not large. But since it is the largest oval she can make with this medium—the sheet of paper—the child is satisfied that the oval can represent the largest land animal she knows.

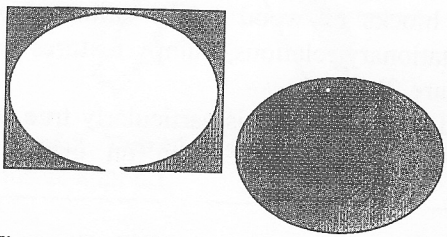


Figure 3. Child cuts paper into biggest oval possible.

The child thinks about the referent *elephant* and inspects the physical qualities of the sheet of paper and decides that the paper itself is too small. So she makes the compromise of dealing with the problem at the scale of the sheet of paper rather than at the scale of the real elephant. Thus she makes the largest oval she can, given the constraints of the medium. The child's purpose and use of the medium define its affordances and constraints. The difference between an affordance and a constraint is not physical. A transformable property can be an affordance if it works to carry meaning, but this same property can be a constraint to some other meaning that it does not afford.

The constraints of a medium make it difficult to symbolize certain meanings. The paper used to symbolize elephant has no easy way to capture heaviness or the lumbering walk or the trumpeting roar. But we need to help children do two things: one, find the best medium for expressing an idea and, two, make creative compromises with the medium at hand. These compromises often yield totally new perspectives on the theme or concept being represented. Furthermore, as I will discuss in a moment, children should learn to traffic between a variety of media. The traffic across media will help children produce new representations informed by old ones, and to revisit and revise these old representations as well.

Other Aspects of Media Affect Representational Bias.

Granted, paper can be used to capture the color of the referent by using colored markers, and the human voice can be used to capture the elephant's trumpeting roar. Some media are better suited for chromatic

information because they are chromatic; other media are better suited for acoustic information because they are acoustic. The consequences of these media properties are fairly obvious.

For example, a pencil set may or may not vary in color. Take a pencil set with only shades of gray. Such a pencil set would place great constraints on representing the autumn season. But is this affordance interesting or trivial? Granted, if a child could invent a way to portray the four seasons by using only shades of gray, the child's performance would be interesting. But does the contrast between chromatic and achromatic pencils cause us to ask any interesting questions about media? Perhaps not.

Media influence representation in ways other than their affordance to changes in color, size, or shape. Media also differ in their modularity, their persistence across time, and the amount of physical feedback they provide. These aspects of media may have more profound effects on representational bias than do their variations in physical properties.

Modularity

Give children a thousand chips of colored paper versus a set of colored pencils. Both media are chromatic, but one is modular and the other, the set of pencils, has no preformed shapes. The pencil medium requires the children to construct the elements by drawing well-defined shapes. Variations in the modularity of a medium place different cognitive demands on the artist, and these differences create different representational biases (Figure 4).

In the above example, a thousand chips of colored paper could create a bias to represent the densely packed colors of fallen leaves. When a medium is modular, that is, when the elements are given, children's attention shifts to the arrangement of those elements. But when the elements are not given, as in a blank piece of paper, the children are biased to representing shapes because this is the first step in making symbols with markers. Indeed, when drawing, children often refuse to overlap their drawn shapes, as if this were a

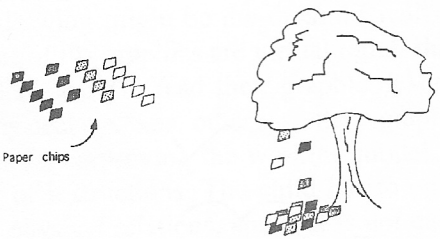


Figure 4. Chips of paper create their own representational bias.

violation of a graphic rule. Every shape has it own encompassing line. To overlap shapes, children would have to violate this rule.

I remember the project called "The Crowd," completed at Diana School in Reggio Emilia. The children were trying to decide why their drawings did not seem to capture the essence of this concept, a crowd. When they drew people in a crowd, each figure drawn was influenced by the previous figure drawn, and the resulting crowd looked too organized and the people too separated. Too many people were moving in the same direction, and every drawn figure had its own right-to-left space. But when the children represented the crowd by using paper doll cutouts of their drawings, they began to experiment with overlapping and with reorienting the passage of people, some facing to the right, some to the left. The affordances of the paper cutouts created a bias to consider the direction of movement and planes in space as couriers of meaning. This was possible because the direction of movement and occlusion for the cutouts was easily transformed.

Persistence across Time

Now let's compare media elements that persist in time versus those that do not. A musical note, once played, is gone. A mark, once made, persists across time. The cognitive demands of making symbols from musical notes places on the child's memory a certain load not encountered with a drawing. In composing music on an instrument, the previous pattern must be remembered. In making a graphic design, the marks persist and are available for repeated review. Given these differences, children will be biased in different ways for each medium. If a child is trying to represent the flight of a bird by using a xylophone, the child is more likely to consider the entire flight path—the swoops, rises, dips, and turns (Figure 5).

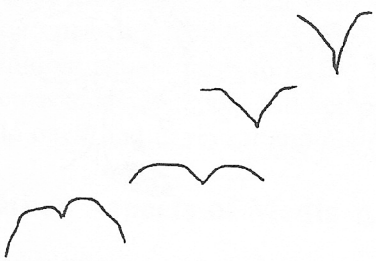


Figure 5. Markers let the child study successive positions at once.

A child who is trying to represent the flight of a bird by using markers is more likely to think about the position of the wings at one moment, then a second moment, and so on. The marks afford this study of successive actions frozen in time, but the xylophone does not. The xylophone is more capable of capturing the changes rather than the positions themselves.

Media That React to Changes

Some media allow children to make more mistakes, and other media are more self-corrective. For example, with paper one can draw an impossible block structure, but with the real blocks one can build only those arrangements that do not fall over (Figure 6).

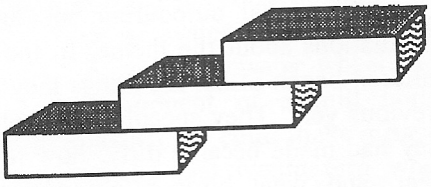


Figure 6. A drawing allows one to visualize impossible structures.

Media differ in the amount of feedback they provide to children. Thus some media can serve to test an idea, and others can serve to design an idea. I will say more about this difference between design and test later.

The distinction between reactive media such as blocks and nonreactive media such as drawing needs further comment. Media such as drawing and painting serve design purposes well because they have more degrees of freedom. With drawing, one can make more complicated shapes and impossible arrangements than one can with reactive media like blocks, which conform to the laws of gravity and friction. However, media such as drawing that best serve the role for design also make the most cognitive demands on children. This greater range of symbolic expression has several effects. First, the child has to invent the shapes and lines because they are not "contained" in the medium. Second, the child has to read these marks as equivalencies to real objects that conform to physical laws. Drawing a round shape that looks precariously balanced requires more graphic literacy than physically trying to balance an oval piece of wood. Thus we have a cognitive dilemma. Drawing as a medium might be best for making a design because it is so open-ended, yet drawing might be the most difficult to read because the physical dynamics of the graphics are virtual rather than real. It behooves us to help children learn to read their graphic designs as virtual embodiments of real physical systems, otherwise their graphic designs will carry no implications for improving the working model. A picture is not automatically a set of instructions. The child has to enter the picture as a virtual system of physical relations, and that is not easy.

Sequences across Media Will Affect the Child's Success

Let us grant that various media, which differ in their affordances, create different representational biases. In what sequence or combinations should

we present these media to children? Should children progress through a prescribed cycle of media as they try to understand something? Perhaps it does not matter whether the children draw their ideas first or whether they build them from wood and wire. But with a thoughtful analysis of the affordances of different media, we might decide that different sequences can have very different effects.

Typically, projects in Reggio Emilia begin with what I have termed a type of verbal outpouring, an outpouring of memories, ideas, and speculations about the theme. In the "Amusement Park for Birds," the children began to list the things they remembered seeing in the yard the previous year. They speculated on why birds need houses, why the lake they had made became dirty, how to make a new lake that would stay clear, and what birds might enjoy if the children were to design amusements for the birds.

The verbal medium allows children easy access to their memories. So many of our memories are retrieved through a remembered word, a phrase, and conversation. The spoken language also affords fantasy as well as reality. Under fantasy, I would include all those wonderful theories that children have about how something works, intuitive theories that may never work in the physical world, but that nevertheless have a logic and reasonableness within the confines of their own frame of thought. It is important to begin a quest for understanding by using a medium that allows free rein to thought. Language can be the playground of ideas without being bridled by the universal laws of nature. It is during the verbal outpouring that many of the hypotheses emerge about what could or should be implemented during the project.

As is often the case, during the verbal outpouring, children reach a point where they need to communicate an idea more clearly, either to themselves or to others. They draw their thoughts on paper and then discuss their drawings with their peers. Sometimes the children draw what they know; sometimes through drawing they discover gaps in their knowledge, and often they repair their theories first by changing their drawing and then by adding an oral explanation. Drawing and speaking work together to help the children deepen their understanding.

These drawings can then serve as a plan for making something else. In the "Amusement Park" project, children made drawings of water wheels, then made them in paper while looking at their drawings. The representation of water wheels in words, or we might say the revisiting of one's memories via words, keeps the water wheel concept deeply immersed in a personal and meaningful context. This is the water wheel that saved the fish; this is the water wheel that grinds the flour; this is the water wheel on the mill that I saw with my grandfather.

The power of words keeps the objects contextualized and connected to other meaningful experiences. Given that the water wheel has not been disembodied from these contexts, the children can retrieve these memories later when they try to solve the more technical problems of how a water wheel works (Figure 7).

For example, one child told his friends that the water wheel was connected to the side of the mill house. Consider how this context of a water wheel on a mill house must have affected his construction of the paper water wheel. Mentally framing the water wheel as a component of a mill house helped the child make a paper model that would turn when held vertically. Additionally, he also set a flat wheel as his objective, otherwise it could not interface properly with the wall of the mill house. The point here is that the constructed object is always less than the context that generates the object, yet this context gives the final object its rationale. Thus it is extremely important to help young children contextualize their constructions so that the richness of this context can inform the construction. The talking about water wheels, where they are found, what they are used for—these memories are brought forward into the drawing, and yet again from the drawing to the paper model.

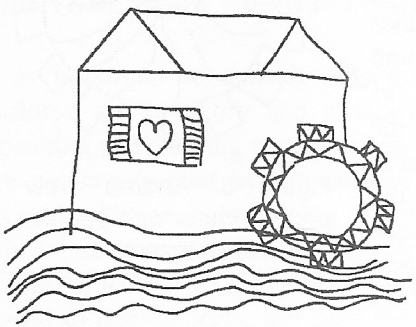


Figure 7. The water wheel on a mill adds helpful context.

Children Should Be Encouraged to Revise Earlier Representations because of Later Ones.

At this point in the passage from medium to medium, the children working on the water wheels took a more technical stance to their work. How does the water make the wheel go around? Does the water push the wheel or does the wheel push the water? How are the paddles positioned to either push or be pushed by the water?

Andrea had drawn a paddle wheel with the paddles in frontal profile. His cardboard model also had the paddles in this orientation. Children will often draw an object and show two different frontal perspectives.

The most common case occurs when children draw a house. They draw both the full face of the front and the full face of the side. Andrea had done this in his water wheel drawing (Figure 8).

Since Andrea used his drawing as a guide for his paper model, this orientation was brought forward into his cardboard model. Then he set about making his clay model. Clay has an affordance different from that of cardboard. The child can read clay as an object with changeable parts. This affordance sometimes causes children to play with changes even when these changes are not motivated by a particular symbolic intent. They just fool around with the clay. This affordance of changeability is not present in the cardboard. Once the cardboard object is constructed with staples and glue, the components are set. Could it have been the malleability of the clay that caused Andrea to change the orientation of the paddle, perhaps in a playful manner at first, but then as a reflective follow-up? Once the paddle before him was changed, he was provoked to think about the reasonableness of this new orientation. Serendipity plays a big role in problem solving.

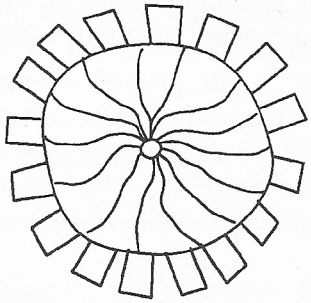


Figure 8. Andrea drew a paddle wheel with paddles in a frontal perspective.

Alternatively, it could have been that the clay version was more carefully read as an object upon which water can splash. Once the object-like affordances of the clay were read in this manner, Andrea might have considered, for the first time, the interface between water and paddle. When this image occurred to him, the paddle did not seem right. The interface of water and paddle was not read from the paper model and the drawing because the affordances of these media create a bias toward other aspects—the shape of the whole wheel, the story about the fish in the water, the radial symmetry of the spokes coming from the hub of the wheel. But the clay water wheel can be hefted and moved into a stream of water. Therefore, images of the water hitting the paddle blades were more easily provoked by this affordance of the medium.

The interesting part of the episode of Andrea's creativity was his desire to return to his paper model and change the orientation of the paper paddle blade. One could expect that this redressing of previous representation could have great benefits. The ultimate benefit would be for Andrea to revisit his pencil drawing of the water wheel and discover that the full view of the paddles was a mistake. This discovery could

have even greater impact on his general understanding of drawing. He could learn how to draw a side perspective of the paddles and, in this discovery, begin to consider in his future drawings whether he had violated rules of good perspective. The intent here is not to teach children how to draw, but to teach them how to read their drawing. It's in reading the drawing that the children can use their drawing to solve problems. Reading the drawing as a guide for action may have little to do with the technical skills of drawing.

Some Media Are Better Suited for Theory Construction and Others for Theory Testing.

It is important to consider the differences between media that help children test a theory and media that allow them to build a theory. Speaking and drawing certainly help children build theories. These media are not constrained by the laws of nature and allow children to play around with ideas until some reasonable hypothesis emerges. Clay and wire and three-dimensional materials have their own spontaneous reactions to the laws of nature (friction, gravity, momentum) and are useful to help children test their theories through simulations.

These media, generally called construction materials, cause the children to place their image into a functional context. Thus a water wheel made from wood and wire will be eyed according to how well it works. Ordinarily a drawing will be eyed according to how well it looks. But hopefully, if a child is drawing in order to build, then the drawing will also be eyed according to how well it represents a working model. It is rather unusual for young children to eye a drawing in order to ask whether it would work if built with construction materials. Such a stance toward a drawing is a case of using a symbol as a guide for action. More commonly, children eye a drawing simply to identify its intended referent, as in, "This is a water wheel on a mill house." The point in using a variety of media is to encourage the children to depart from their usual stance toward a medium. As they traffic back and forth between medium types, the stances toward one should transfer to the other.

We Need to Consider the Child's Level of Media Literacy.

To continue this logic, not only would the drawing be eyed as a set of instructions for building a model, but likewise the constructed model could be eyed as the embodiment of a drawing. Once the children learn to traffic in both directions, they become more adept at cycling through the phases of design, test, and design again. Each representation has

implications for the other. Both are symbols and referents at various points in this cycle.

We must be careful not to classify media independently of how the medium is used. Certainly drawings can be used to test a theory, at least in the hands of someone who is literate in graphic conventions and who can mentally navigate the implications of a technical drawing (Figure 9).

In fact, the U.S. Department of Patents does not require a working model to establish the value of an invention. A drawing is sufficient. However, for young children, we should not assume this level of literacy. It serves us better to recommend construction materials for theory testing and drawings for generating the relevant questions to be tested.

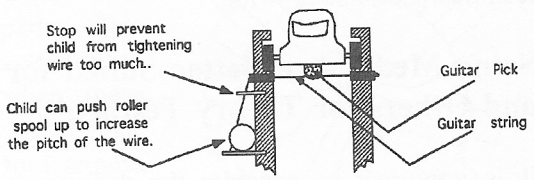


Figure 9. U.S. patents rely on drawings, even without physical models.

We Need to Accept the Partial Theory as if It Were Complete.

A special digression is needed here to qualify what I mean by "working model" or "simulation." I do not advise that we encourage children to build a working model of a water wheel or an elevator for birds, at least not in any completed form. I have seen too many cases where children are asked to build an apparatus that really works or that meets adult standards for strength and safety. Once we ask children to enter this world of the adult standard for functionality and safety, we will lose the enterprise for the children. Thus, in the "Amusement Park for Birds," it was not important that the elevator door did not open, or that the elevator could not stop during its ascent. The elevator was simply a feathered box on a pulley cord. Yet in their attempts to make a working model, the children were learning about inverse relations: pulling down makes something go up. And they were confronting what this simple machine did not have that a better elevator would have. The simulation may give answers to some subset of questions, but it also has value as a vehicle for generating new questions.

Summary

- Children learn more deeply when they represent the same concept in different media.
- Each medium has different affordances.
- Each affordance provokes a special orientation to the problem to be solved.
- Children learn to make compromises with what the medium does not easily afford.
- Other aspects of media, such as modularity, persistence across time, and amount of feedback affect representational bias.
- Sequences across media affect the child's success.
- Children should be encouraged to revise earlier representations because of discoveries made with more recent representation.
- Some media are better suited for theory construction and others for theory testing.
- We need to consider the child's level of media literacy.
- We need to accept the partial theory as if it were complete.