The Dance on Paper: Effect of Notation-Use on Learning and Development in Dance

Edward C. Warburton

Learning to dance is much like learning a foreign language. The best way to learn is to jump in with both feet. In more progressive schools, the instructor has her students speak the new language immediately, twisting their tongues around its words and listening to its unique sounds. Teachers reserve formal training for later. Second language learners need to be immersed in the new language before they learn how to put it down on paper, or so the reasoning goes.

Unlike instruction in verbal languages, however, it is generally the case that dance is never put to paper (Czompo 1974; Lloyd-Jones 1997; Van Zile 1985-86). Ask most dance educators and they will tell you dancers dance, period. The dance on paper, "movement notation," may sound like an oxymoron to them. Indeed, mention the word "notations" to dancers and in all likelihood they will look at you askance. They may have never used dance notations or considered the study of movement as much more than daily practice in a dance studio. The possibility that dance is a language on par with music and verbal languages may seem inconsequential. If I can speak dance, that is to say "dance dance," then why would I need to read and write dance? If my students use dance notation, what difference will that make to their learning?

There is long standing debate concerning the impact of literacy skills—reading and writing—on intellectual development (Goody 1987; Luria 1975; Ong 1982; Scribner and Cole 1981). While arguments over the general cognitive effects of literacy persist, investigators in domains such as language, music, and geography suggest that reading and writing result in specific, qualitative shifts in thinking (Liben and Downs 1989; Olson 1994; Scripp 1995). These researchers link notation-use to the development of patterns of thinking that contribute to knowledge acquisition and the formation of key domain-specific concepts.

For example, Olson and Astington (1990) suggest that language literacy, with its focus on precisely what was said, is related to an increased understanding of subjectivity, or precisely what was meant. People who do not learn to read and write at higher levels have difficulties distinguishing between what is said and what is meant and consequently have trouble understanding complex uses of language, such as certain forms of figurative speech (Astington et. al., 1988). In the domain of music, the availability of a visual notational system appears to support the understanding of complex and abstract forms, such as sonata form, and to enable the use of musical devices such as inversion and retrogression (Sloboda 1985). Finally, investigators in the geographic sciences find that understanding the symbolic codes of maps increases one's ability to recognize and arrive at specific locations. Maps reduce the complexity of navigation by organizing spatial information in systematic ways (Gregg and Leinhardt 1992).

As in the domains of language, music, and geography, it is possible that notation supports understanding in dance through the organization of key concepts in movement. Dancers who learn a notational system may be more able to use movement concepts in the recognition and execution of physical movements. Putting the dance on paper may help young children understand dance better when they see it.

Theory of Notation

Arguments about notation in the arts, and dance in particular, are highly controversial, reaching deep into the theory of language and knowledge. The human proclivity to symbolize our experience—to conceptualize and communicate worlds of meaning—is one of the special features of humankind. Very young children enter easily into these worlds of meaning. Contrary to the popular view that there is but one "natural" language, it is possible to view young children's emerging symbolic fluency as the development of multiple natural languages or symbol systems: systems that constitute how human beings make and express meaning. Just what these unique languages are made of, how they are constituted and come to embody the knowledge of a domain, is a question that finds a comprehensive, philosophical answer in Nelson Goodman's (1976) systematic investigation of symbols and symbol systems.

Goodman articulates a general theory of symbols and argues that all symbol systems can be divided into two camps: those that are notational languages, such as music and dance, and those that are non-notational systems like verbal language. In Goodman's terminology, "notational" is a technical term that should not be confused with the lay sense of notation. Goodman's theory of notation requires that, to be considered a notational system, symbol systems must meet certain syntactic and semantic requirements. In notational languages, scores—and the symbol systems that create scores—define a work. Consistent with the rigorous requirements of a notational system, it must be possible to go from the notation to the performed work and back again. In this way, notational languages define a body of knowledge (Gardner 1982).

Goodman's ideas have important implications for the study of human symbolization. The distinction between notational and non-notational symbol systems entails a set of criteria for comparing and examining them; it opens a way for asking whether different psychological processes are involved in dealing with symbol systems of varying degrees of notationality. For example, "semantic disjointness" is a requirement of notationality that rules out most ordinary (verbal) languages. Semantic disjointness is a technical term that describes symbol systems that do not have overlapping meanings creating ambiguities and redundancies in the system:

> The requirement of semantic disjointness rules out most ordinary languages, even if we suppose them freed of ambiguity. For see how much is prohibited. A notational system cannot contain any pair of semantically intersecting terms like 'doctor' and 'Englishman'; and if the system contains the term 'man,' for example, it cannot contain the more specific term 'Englishman' or the more general term 'animal.' The characters of a notational system are semantically segregated (Goodman 1976: 152).

In this light, the ambiguity and redundancy in ordinary language may have a deleterious effect on one's ability to create the meaningful distinctions necessary for categorizing objects and events in other domains. When the domain in question is dance, a domain with access to a unique notational language called "Labanotation" (Goodman 1976; Hutchinson 1961; Laban 1956), an emphasis on verbalization may actually impede perceptual and procedural development.

Consider the following anecdote as an example of how the ambiguity and redundancy in verbal language may interfere with understanding in a non-verbal domain. Many years ago, a very traditional ballet mistress and I had a discussion about how to perform a glissade. She told me that, in ballet terminology, a "glissade" means "to glide." I performed what I thought was a very good approximation of gliding. She said, "No, I want you to move across the floor from foot to foot, traveling not jumping to the side." She demonstrated.

Gliding is a word that suggests traveling above the floor in a kind of skimming leap. Gliding overlaps the meanings of "traveling" and "leaping." It incorporates movement ideas such as direction and relationship. These actions are physically and visually represented as different categories of movements. The actions do not have overlapping meanings: they are semantically disjoint. Moreover, to tell a dancer to perform a floor-leaping-action-that-skims-across-the-floor permits a variety of interpretations: interpretations that can not be easily defined by more semantically intersecting terms like destination or motion, but may be clarified with a visual, notational system.

I tried another glissade. She said no. I wanted an explanation: Was I traveling too much or too little? Do I start traveling then leap, or do I leap up and then travel to the side? The ballet mistress replied, "Just do it and I'll tell you if it's right." I did it again and again. Finally, she said it was right. But I never knew just what was right about it. In fact, as any trained dancer will attest, a good glissade is often difficult to master. In general, dancers must master such steps with years of training, of practicing glissades, with little recourse as to how one might conceptualize the component actions that make up a glissade. In retrospect, when that ballet teacher told me to stop talking and start dancing, she was sharing an intuitive knowledge about the domain. Namely, "I can not explain to you what is an inherently bodily experience." Only, maybe the problem was not one of explanation but of the best "notational" means to do so.

It is possible that, as a visual device for organizing the domain, movement notation is a good tool for thinking in dance and is a superior means for the instructional goal of communicating important ideas in movement. Taking a page from music psychology, one might call this method for organizing the experience of dance "conceptualization" (Reimer 1989; Torff and Gardner 1999). In the world of dance, it is generally accepted that in order to achieve expertise there needs to be an increased ability to use dance concepts. Just as music students must learn about melody and harmony, dancers must learn to conceptualize movement in particular ways. It is especially important that dancers internalize concepts that relate to the content of movement, such as "traveling" or "leaping," in addition to more qualitative aspects of dance-making, such as muscular effort and use of space. Notation-use may be an important device for this kind of internalization.

Purpose

The theory of notation suggests that when dancers learn the language of dance there are conceptual and cognitive implications. The purpose of this paper is to consider Goodman's ideas seriously and report the results of an examination into the impact of so-called "second-order" symbolization on learning and development in dance. If a child reads dance notation, as she would read a musical score, in what ways does her thinking in and about dance change, if at all?

This topic is important for the world of dance and for the study of human symbolization. Many in the psychological community accord symbolic activity a specific organizing function (Gardner 1982, 1991; Gardner and Wolf 1983; Vygotsky 1978; Werner and Kaplan 1963). The study of the development of children's competence with symbol systems across various domains of knowledge continues to flourish (Bialystok 1992). This study contributes to these traditions by testing the theory of notation and by examining how different symbol systems interact. If a notational system acts as a conceptual device for organizing an area of knowledge, then the use, misuse, or disuse of such a system may have consequences for learning and development. In dance instruction, the substitution of a verbal literacy for a literacy of movement may contribute to the loss of visuokinesthetic engrams needed for building up representations of key movement ideas (Jeannerod 1997). It may be part of the reason why some dancers never learn to perform a good glissade. Such findings can help dance educators avoid obstacles to learning and development in young dancers.

To place this study in context, I begin with a targeted review of notation-use in dance. I propose two research questions and argue that, as a device for conceptualization, notation-use is key for knowledge acquisition and cognitive development in dance. I present the plan for testing my hypotheses and outline my approach. The methods section details the research program and is followed by findings and a discussion of results. I conclude this paper with a review of the main findings and implications for the fields of psychology, dance, and education.

Notation-use in Dance

My experience as a dance instructor suggests that exposure to simple movement notations alters how dancers view dance and how they move when dancing:

> Today, we gave students lots of time to create their own dances. One particular student, Jonathan L, built the most complex dance to date. Prior to this period

> we had covered single movement ideas, such as a spring, and occasionally two-movement combinations, such as a turning jump. Using the symbols, Jonathan increased the complexity of his dance by combining three different movement ideas: a series of springing turns that traveled on a circular path (not easy!). When asked if he could show what he was considering, he paused, put his finger to his lip, and then accurately performed his movement idea to the amazement of his teachers (Tina Curran 1998: personal communication).

A review of notation-use in dance reveals that most of the literature relies on anecdotal evidence like the first-person account above. It describes how notation aids teaching and learning but lacks empirical research about the effects of notation on cognition and development (Warburton 1999). These articles include the use of notation as practical aid in instruction (Babitz 1940; Davis 1995; Lasky 1972), notation as compositional aid for students (Benesh 1960; Hutchinson 1956a/b; Lohmiller 1977), and notation as vehicle for learning and performing dance (Bichan 1978; Cohen 1960; Hutchinson Guest 1984; Lloyd-Jones 1997). Many of these authors claim that symbolic representation—second-order symbolization of movement in detailed notational systems like Labanotation—advances dance cognition by establishing a conceptual framework for understanding the principles of movement (Debenham 1997; Van Zile 1985-86; Youngerman 1984). Only one study attempts to substantiate this claim (Moses 1980).

Moses's study is inadequate to address the issue at hand because of theoretical and methodological flaws. She employs an obscure and seldom-used pictorial system that is limited to ballet dancing and which does not meet theoretical requirements for a notational system (Goodman 1976; Sutton 1978a,b). It would have been preferable to use Labanotation, the most widely used and detailed system of movement notation that has many of the same features as notational languages in other domains (Dyke 1939; Goodman 1976; Nadel 1970; Youngerman 1984). Moreover, her research methods do not account for the possible effects of task complexity, which can adversely affect measurement, increasing measurement error and distorting results and subsequent conclusions (Fischer et al. 1993a; Light et al. 1990).

Research Questions and Hypotheses

This study asks, what are the effects on learning and development in dance if a child is exposed to notation-based approaches versus approaches that are, technically speaking, not notational? These questions focus on the effect of notation-use on dance cognition; that is, the ability to recognize discrete, action-related units in movement. This aspect of dance cognition concerns the content of movement as opposed to the effort/shape, space/harmony, or syntactic dimensions of dance which contribute to more qualitative aspects of dance-making. These 14 "prime actions" are the raw material of movement, the so-called movement alphabet (Hutchinson Guest 1983).

I hypothesise that notation-use will help young children learn how to recognize and understand dance when they see it. The dance allows us to experience a world we do not normally move in. It transports us psychologically to a place we can encounter through visual and physical forms of representation. (In the cognitive neuroscience of action, this is sometimes called "visuokinesthetic representation"). The meaning secured through dance has its own special content; it performs specific, epistemic functions only if we are able to read what is written (Eisner 1994). I argue that reading from a score will help young children recognize important movement ideas. It will help recognition by engendering a particular (i.e., domain-specific) kind of concept-rich symbol processing that will lead to improved knowledge acquisition and continuity in developmental trajectory. On the other hand, if a non-notational system—such as ordinary verbal language—is used in lieu of a visual notational system during instruction, then one will find deficits in learning and discontinuities in development.

Method

Participants

A stratified random sampling of 96 participants was drawn from a target population of 210 third grade students ages 8-9 who attended public elementary school in rural Northern California, USA. These students participated in the study as part of a free performing arts program. Students with prior experience in dance were excluded from the sample. In general, participants were of European descent in families with low to lower-middle levels of socio-economic status. The age range between 8-10 years is an optimal time period for exposure to dance and notation. It avoids specific cognitive constraints in symbol processing (Tolchinsky Landsmann and Karmiloff-Smith 1992), as well as certain affective barriers to participation in dance that older children, especially boys, appear to experience (Baum et al. 1996).

Design

The method for investigation was a primary analysis of data collected in pre- and post-tests organised around an 8-week instructional period. The participants were divided equally into three groups: 1) treatment-plus (verbal description of movement concepts plus symbolic notations), 2) treatment-minus (verbal description of movement concepts), and 3) control (movement instruction that labels movement but does not include notations or detailed verbal description of movement concepts). Each grouping had 32 students with roughly equal distributions of boys and girls. The three group design ensured that notation-use—and not the dance concepts associated with notations—was the subject of the study.

Data was collected on five dependent and four independent variables related to recognition in dance. The dependent variables included the ability to 1) distinguish between movement types (differentiation), 2) group movement types (classification), 3) perform individual movements or a series of movements (production), 4) name movements (identification), and 5) state the meaning of movements (expression). The two primary independent variables were test (i.e., pre- and post-test responses) and group membership. To disentangle the effects of the substantive predictors from the effects of less important, background characteristics, data was also collected on two covariates, gender and academic achievement. Academic achievement was measured by the Stanford Achievement Test Series, 9th Edition, which includes reading, math, and written language scores.

Measurement Instrument

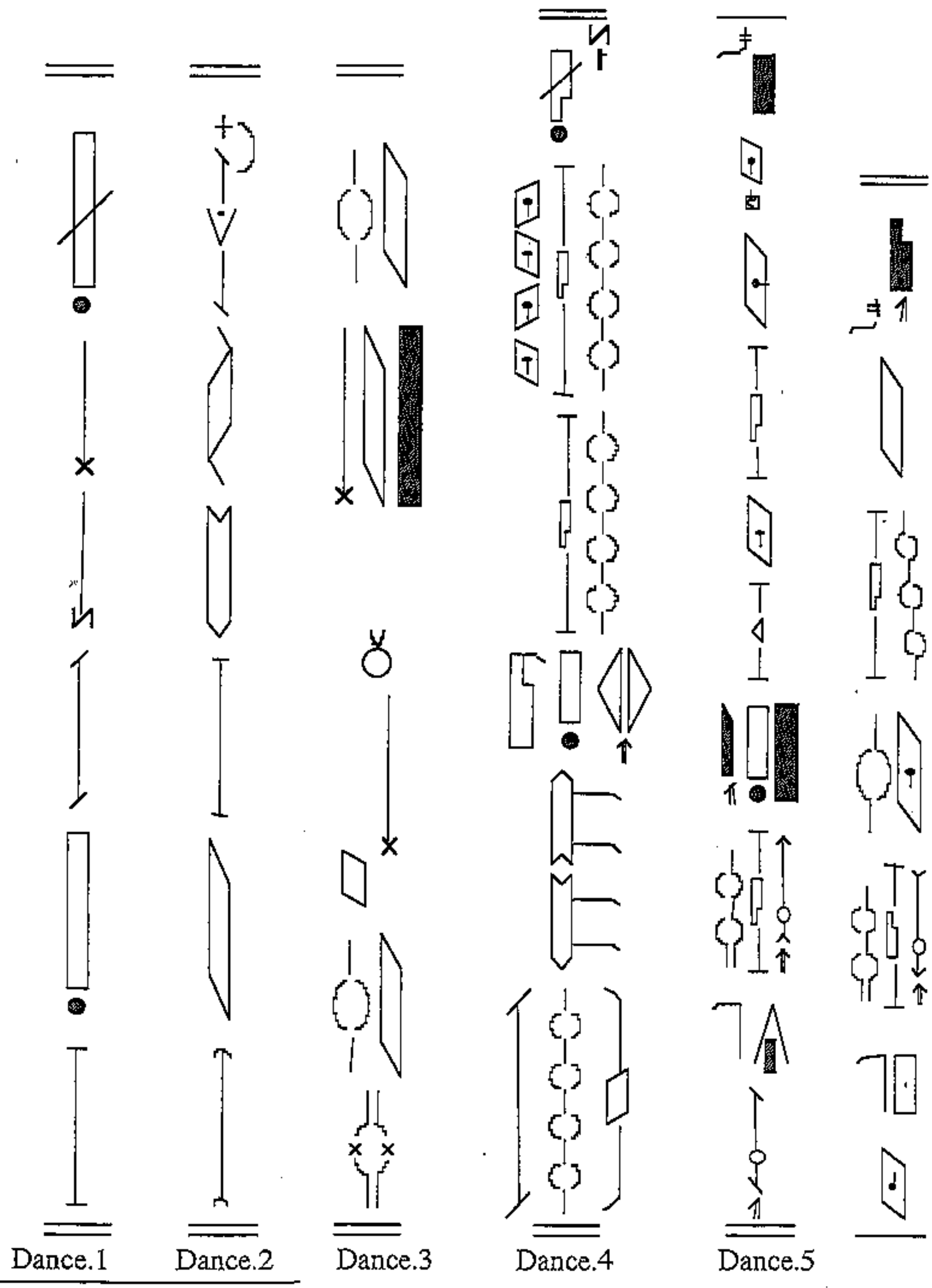
The Assessment of Prime Actions in Creative Movement (APACM) was devised in collaboration with members of the Division of Dance at Southern Methodist University, Dallas, Texas, USA, and the Department of Dance at Texas Woman's University, Denton, Texas, USA. The APACM includes a video-taped dance stimulus and two test-sets. In pilot-testing, it proved to be a reliable, valid, and precise tool for assessing recognition-related understandings in dance (Warburton 2000).

Dance Stimulus

The dance stimulus has five video-taped movement phrases that were filmed in a dance studio with a professional dancer. As represented in motif writing in Figure 1, these movement phrases were designed to follow a 7-step developmental sequence. This sequence increases in complexity and predicts development between approximately 2 and 15 years of age (Fischer 1980; Fischer et al. 1993b).

For instance, Movement Phrase One corresponds to Steps 1 and 2. Step 1 describes single representations as the ability to recognize at least one action fitting a category for expressing a movement idea, such as traveling. Step 2 involves a shift of focus between single representations: i.e., recognizing traveling followed by a balance. Movement Phrase Two corresponds to Steps 3 and 4, representational mappings. Step 3 requires at least two transformations of a single movement idea, such as traveling on straight or meandering paths. Step 4 involves a shift of focus to include more movement ideas: traveling on straight/curving paths followed by rotations that pivot and somersault. Movement Phrase Three corresponds to Step 5, representational systems, which involves an integration of movement ideas, such as a "traveling turn." Movement Phrase Four corresponds to Step 7, which adds more components, e.g., "a traveling, springing turn." Finally, Movement Phrase Five corresponds to Step 8, which describes the realm of abstraction and the skill to recognize actions that integrate transformations of movement ideas, such as the physical manifestation of an existential crisis. Imagine a Woody Allen character walking agitatedly down a street (straight path), twisting and turning his body to look around (two kinds of rotation) while his hands gesture wildly in the air (meandering path). Together the movement systems co-ordinate to produce a single abstract movement idea: crisis.

Figure 1: Notated Score for Movement Phrases[1]



[1] Notated using *The Language of Dance*, (Hutchinson Guest 1995).

Testing and Analysis

For this study, respondents viewed the dance sequences in two test-sets—a standard and extended form—in which they differentiated, classified, produced, identified, and expressed the meaning of the movements represented. Participants' responses were videotaped and recorded onto the notated score sheet. An independent rater and the author coded and scored these performances. Interrater reliability was very good, with 90% reliability on all tasks.

The purpose of the standard test-set is to ascertain basic recognition abilities in large numbers of people. It focuses on differentiation and classification tasks and is designed to provide a relatively quick assessment (10 minutes) so as to maximize the amount and quality of data and to work around the constraints of a public school schedule. The extended test-set applies the full range of recognition tasks, from differentiation to expression prompts. The purpose of the extended test-set is to gain a more thorough profile of students' understanding and developmental skill level. It lasts approximately 25 minutes.

The standard test-set assigns an item-response score for each movement phrase. As participants respond to the videotaped stimulus, their responses are tallied as pass/fail. Because the movement phrases increase in complexity and therefore in number of movement elements, scores are calculated as proportions to transform them to a uniform scale. Thus, participants have possible scores of 0-100 points on each of the 5 movement phrases. Data from the standard test-set is analyzed using descriptive and inferential statistics, such as Repeated Measures Analysis of Variance (ANOVA) and linear and logistic regression techniques.

The extended test-set goes beyond a simple item response score to calculate a "step" score. Step scores derive from dynamic structural analysis and describe a profile of participants' developmental progression (Fischer and Bidell 1998). For example, on Movement Phrase One, a participant may correctly differentiate one kind of movement from another kind (pass) and incorrectly group two movements as the same kind (fail). He may be unable to perform the selected movement accurately (fail), but be able to name the movement (pass) plus give a good idea of the expression it conveys (pass). His score would add up to a 3 out of a possible 5 points. In this way, participants develop profiles of understanding based on the distribution of their responses to each of the five movement phrases.

For the extended test-set, a Guttman-type ruler is used to uncover sources of variation in step scores. A graphical representation is used to display this variation. For example, the ruler in Table I and the representation in Figure 2 predict a hypothetical "normal" 9 year old child's profile of understanding and the concomitant shape of development. Table I shows the pass/fail responses to recognition tasks. Figure 2 describes this profile as a pathway for the developing competency to recognize or "read" dance. Reading from top to bottom, this predicted pathway shows a non-linear developmental trajectory that begins with the skill to differentiate between movements and then develops into the almost simultaneous ability to classify and produce movements accurately. These skills extend into the ability to identify (or name) the movement and eventually into the ability to express a reasonable, verbal idea of what that movement means.

Figure 2. *Reading dance.* Predicted developmental pathway for recognizing the prime actions of dance.

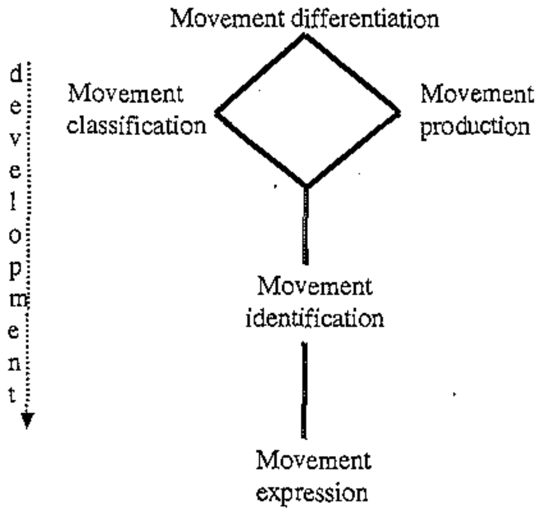


Table I. *Guttman-type ruler.* Task profiles for predicted developmental sequence in recognizing key content-related aspects of dance.

Step	Movement Differentiation	Movement Classification	Movement Production	Movement Identification	Movement Expression
0	-	-	-	-	-
1	+	-	-	-	-
2a	+	+	-	-	-
2b	+	-	+	-	-
3	+	+	+	-	-
4	+	+	+	+	-
5	+	+	+	+	+

Note: Pass = "+"; fail = "-"

Procedure

Two times during the study, once before and after an 8-week instructional period, the APACM was administered to students individually. It began with the examiner explaining the study and requesting participation. In the standard test-set, participants started with the warm-up sequence and ended with Movement Phrase Five, viewing the entire videotape twice. On the first showing, they differentiated movement ideas; on the second round, they classified movement ideas. In the extended test-set, participants viewed the videotape three times. The first two showings ran participants through differentiation and classification tasks as described above. On the third showing, participants watched one sequence at a time, responding every time to a production task ("Can you do this with your body?"), an identification task ("What kind of movement is this?"), and an expression task ("What does this movement mean?"). The session ended after participants responded to all five dance sequences.

Intervention

The instructional part of the study was based on the *Language of Dance* (LOD): an instructional approach designed for young children that incorporates creative movement exploration with symbolic notation based on Labanotation (Hutchinson Guest 1995). This program integrated dance into the regular academic day and focused on teaching the fundamentals of creative dance through movement exploration and composition (Green Gilbert, 1992). The 8-week instructional unit integrated dance into the language arts and science curriculum through the story of John Henry (Lester 1994). The curriculum encompassed eight lessons, beginning with a general introduction to dance and ended with student choreographed productions. All lessons included introductory activities (e.g., warm-up), community building games (e.g., rhythm clapping), introduction of movement ideas with exploration, and composition.

For purposes of research, I modified the instructional approach just enough to control for notation-use and concept-use. Each group participated in creative movement exercises; each group composed dances. Thus, groups differed in terms of instructional medium but not in content or context. This slight modification insured that all students in all groups felt that they were working at something new.

Results and Discussion

In what follows, the notation-use data sets are organized thematically, with findings discussed at the end of each section. The first section examines results from the notation-use and learning data set (n=96). The second section analyses findings from the notation-use and development data set, which uses a stratified random sampling of 27 out of the 96 students.

Question I: Notation-use and Learning

Do young children who have access to movement notation score higher on differentiation and classification tasks than those children who either learn the concepts without notations or who gain identical movement experience without concepts or notations?

At first glance, the univariate statistics in Table II suggest—*for all groups across both test occasions*—that there is a good chance of correctly differentiating and classifying movement phrases and that with instruction in dance the probability of scoring well increased. With the exception of scores on 4 out of 30 variables (less than 15% of scores), students in all groups improve their recognition abilities across pre- to post-test occasions. The average Differentiation scores increase from 1 to 9 points and Classification scores increase from 9 to 20 points.

A closer look at this table, however, foreshadows a differential based on group membership: all students in all groups do not seem to do equally well. Gains in test scores seemed to be related not only to test occasion but also to group membership. On the post-test, the treatment-plus group appears to have had higher average differentiation and classification scores.

Table II: *Examining groups' univariate statistics.* Mean scores (M) and standard deviations (SD) for Students' Differentiation and Classification scores for Movement (Mvt.) Phrases 1-5, by Test and Group (n=96).

Variable	PRETEST Control (n=32) M / SD	PRETEST Treatment - (n=32) M / SD	PRETEST Treatment + (n=32) M / SD	POSTTEST Control (n=32) M / SD	POSTTEST Treatment - (n=32) M / SD	POSTTEST Treatment + (n=32) M / SD
Mvt. Phrase 1						
Differentiation	81 /12.4	84 /17.2	81 /18.2	86 /14.0	88 /15.0	97 /9.9
Classification	84 /23.6	91 /23.6	78 /31.0	94 /16.8	95 /19.5	98 /8.8
Mvt. Phrase 2						
Differentiation	88 /12.1	90 /11.1	88 /14.3	90 /12.6	95 /10.7	97 /8.8
Classification	55 /31.4	58 /32.9	47 /32.8	68 /31.8	65 /32.7	82 /28.0
Mvt. Phrase 3						
Differentiation	73 /13.8	80 /12.4	75 /16.3	72 /16.1	77 /13.7	83 /5.9
Classification	44 /23.8	41 /25.1	45 /23.3	41 /21.6	44 /21.1	70 /28.7
Mvt. Phrase 4						
Differentiation	83 /6.9	83 /9.6	82 /13.3	84 /8.8	85 /5.8	84 /9.0
Classification	54 /33.7	48 /32.8	46 /40.4	52 /29.4	56 /31.2	76 /30.8
Mvt. Phrase 5						
Differentiation	58 /16.5	64 /14.7	62 /19.5	65 /14.7	67 12.3	77 /15.3
Classification	3 /17.7	6 /24.6	13 /33.6	9 /29.6	9 /29.6	31 /47.1

Results from Repeated Measures ANOVA confirm these patterns, indicating that instruction in dance has a generally positive influence on all students' recognition abilities. On the Classification task, there is a consistent difference between pre- and post-test scores across all movement phrases: Movement Phrase One, (*F* statistic = 20.11, $p < .001$); Phrase Two, (*F* statistic = 24.27, $p < .001$); Phrase Three, (*F* statistic = 6.64, $p < .05$); Phrase Four, (*F* statistic = 9.38, $p < .01$); and Phrase Five, (*F* statistic = 4.43, $p < .05$). In all groups, there is also a strong main effect of Test for Differentiation scores on Movement Phrase One (*F* statistic = 18.93, $p < .001$), Phrase Two (*F* statistic = 15.08, $p < .001$), and Phrase Five (*F* statistic = 21.76, $p < .001$). Two exceptions to this positive pattern are Differentiation scores for control and treatment-minus groups on Movement Phrases Three & Four.

ANOVA results also reveal that the type of dance instruction has a significant impact on student understanding. On average, students in the treatment-plus group have higher recognition scores than either control or treatment-minus groups. While there is no appreciable difference between groups on the less complicated Movement Phrases One & Two, one expects this result because instruction of any kind should help children develop basic understandings in dance. As movement phrases increase in complexity, however, group membership makes a difference. The treatment-plus group shows significantly higher average Differentiation scores on Movement Phrase Three (*F* statistic = 3 .09, $p < .05$) and Phrase Five (*F* statistic = 3.06, $p < .05$) than control or treatment-minus groups respectively. Likewise, average Classification scores show improvement for the treatment-plus group on Movement Phrase Three (*F* statistic = 7.56, $p < .001$) and Phrase Five (*F* statistic = 4.50, $p < .05$). The exception is found on Movement Phrase Four, where group membership does not appear to make a difference in average scores.

Table III. *The fitted multiple regression models.* Examining the final, fitted multiple regression models, Differentiation, Movement Phrase Three (M1) and Movement Phrase Five (M2) and Classification Movement Phrase Three (M3), in which Students' mean Differentiation and Classification scores are predicted by the main effects of question predictor Group and control predictors Gender & Academic Achievement (n=96).

Model	**Intercept**	**Question Predictor**		**Control Predictors**				**R^2**	**ER df**
		Main Effects		Main Effects					
		Group		Gender	Academic Achievement				
		d1	d2		Read	Math	Lang		
M1	69.96*	6.46	13.97**	-0.69	-0.08	-0.09~	0.22*	0.2020	58
M2	70.28~	3.47	14.86**	-3.18	-0.12	0.12	-0.01	0.2003	58
M3	77.73	4.05	38.91***	-2.72	-0.23~	-0.20	0.35*	0.4200	58

~$p < .10$ *$p < .05$ **$p < .01$ *** $p < .001$

Results from linear regression also provide strong evidence for the group differential. Regression tests the difference between groups in the presence of background effects: that is, does the differential persist or differ depending upon a students' gender and academic achievement? The results shown in Table III support the hypothesis that, controlling for the effects of gender and academic achievement, average recognition scores for the treatment-plus group are significantly different than either control or treatment-minus groups. In contrast, there is no significant difference between treatment-minus and control groups.

In Table III, Models 1-3 show that students in the treatment-plus group have average Differentiation scores from 13-40 percentage points higher than the other two groups. In Models 1 & 2, one finds up to 20% of the variation in scores associated with group membership (R^2 statistics = .20). Model 1 estimates a 13.97 percentage point difference in scores between treatment-plus and control groups, a 7.51 percentage point difference for treatment-plus and treatment-minus groups, and a 6.46 percentage point difference between treatment-minus and control groups. Model 2 estimates a 14.86 percentage point difference in scores between treatment-plus and control groups, an 11.39 percentage point difference between treatment-plus and treatment-minus groups, and a 3.47 percentage point difference between treatment-minus and control groups. Model 3 shows the treatment-plus group has average scores almost 40 percentage points higher on Classification tasks, with 42% of the variation in scores associated with group membership (R^2 statistic = .42). The regression equation estimated a 38.91 percentage point difference in scores between treatment-plus and control groups, a 34.86 percentage point difference between treatment-plus and treatment-minus groups, and a 4.05 percentage point difference between treatment-minus and control groups.

Results from the Classification task on Movement Phrase Five are not shown in Table III because they violate the assumptions of linear regression and therefore require *logistic* regression techniques. The fitted logistic regression model estimates the probability that students will have a perfect score on the Classification task, Movement Phrase Five: 1 / 1+e -(-1.37 D1 + 3.04 D2 + 1.48 Gender - 0.03 Reading score - 0.006 Math score + 0.03 Language score). This model indicates that the odds of higher classification scores is 2.42 times greater for students in the treatment-plus than those in control or treatment-minus groups (α statistic = 2.42). Since the difference between the full model ($\Delta\chi^2$ statistic = 15.04) and reduced model ($\Delta\chi^2$ statistic = 3.680) is larger than the critical value at the .05 level, one can argue that group membership has a statistically significant impact on recognition scores. The fitted logistic regression model predicts the distribution of observed data correctly in 75% of cases.

Discussion

Generally speaking, the results from the notation-use and learning data sets fit the original hypotheses. All children learned how to observe movement correctly when given dance instruction that emphasizes movement exploration and composition. But young children who were exposed to movement notation improved more. They learned how to look at and understand dance better than those children who either learned the concepts without notations or who gained identical movement experience without clearly articulated concepts or notations. Neither a child's gender nor his/her academic abilities had an impact on this group differential.

While these findings suggested a broad group differential, there was one caveat: a consistent pattern of discontinuity in Movement Phrases Three & Four. This discontinuity foreshadowed patterns of response that continued to emerge throughout ANOVA and regression analyses. Because the measurement instrument was designed to develop on a continuum from simple to complex, this finding requires special consideration.

There are a number of possible explanations. One possibility is that the APACM does not measure what it purports to. In other words, the progression of movement phrases may have been miscalculated. This is possible but unlikely given the record of pilot study and revision that was undertaken to insure reliability and validity of the instrument. Another possibility is that—for this fine-grained challenge—some students may be *more accurate* recognizers of dance. This is not the case. Examination of a main effect of Test or Group on students' *accuracy* when differentiating or grouping movements shows insignificant differences between groups.

An alternative possibility is that this discontinuity uncovers a "ceiling effect" in recognizing dance. Instruction and/or notation-use may affect a general recognition ability but not fine-grained discriminations. Once young children acquire the notion of a representational system in dance, they may not be able to distinguish more subtle differences between a movement phrase that shows actions that integrate at least two movement ideas (Step 5), and actions that integrate two or more movement ideas (Step 6). In the end, it may be that children ages 8-9 reach a point where greater understanding awaits further cognitive development—perhaps a shift to "formal operations" (Piaget, 1955)—and a metaphorical raising of the cognitive ceiling to new heights.

Question II: Notation-use and Development

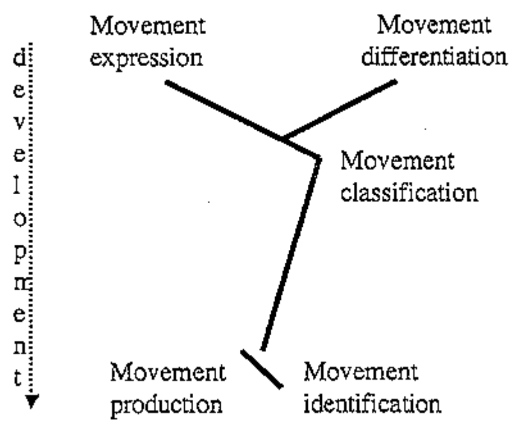
Do young children who have access to movement notation show different developmental pathways for reading dance than those students who either learn the concepts without notations or who gain identical movement experience without concepts or notations?

In this section, graphical representations of students' step scores summarize the developmental profiles according to group membership. The graphs develop from top to bottom, showing lines as pathways or "constructive webs" that represent the skills needed for recognizing movement accurately. The connections between web strands delineate relations among skills; the differing directions of the strands indicate variations in developmental pathways. These graphical representations are compilations of individual patterns as group patterns.

As shown in Figures 3-5, all children in all groups demonstrate early skill in differentiating between and expressing the meaning of movement ideas. The initial "fork" in the pathways implies that these two skills develop simultaneously and independently. This finding suggests that 1) the ability to differentiate does not depend upon an understanding of expressive content—and visa versa, and 2) these skills are key to early ability in reading dance. As recognition skills develop, however, the groups show varying trajectories.

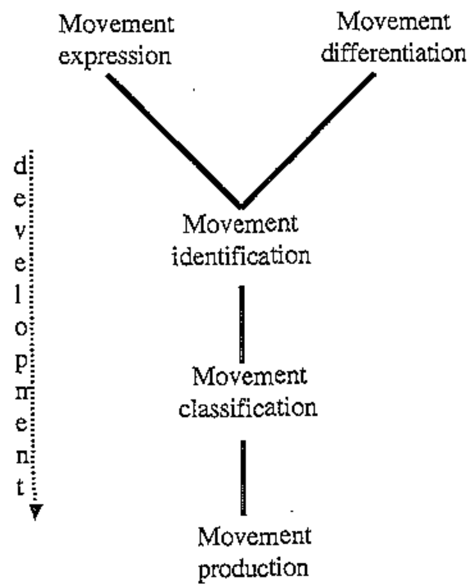
Figure 3 displays the developmental profile of the control group. Here, one sees children beginning to integrate their recognition abilities, combining the skills of differentiation and expression with the skill to classify movements. These skills never integrate fully with other skills needed for good recognition at the highest levels of development. When production and identification skills appear, they develop in an independent, unintegrated fashion. That is, about half of the students in the control group follow a developmental pathway that integrates expression, differentiation, classification, and production skills; the other half shows a pathway that integrates expression, differentiation, classification skills, and identification skills. Overall, the control group displays an unintegrated and incomplete profile of development for reading dance.

Figure 3. *Reading dance.* **Control** Group's prototypical developmental pathway for recognizing the prime actions of dance.



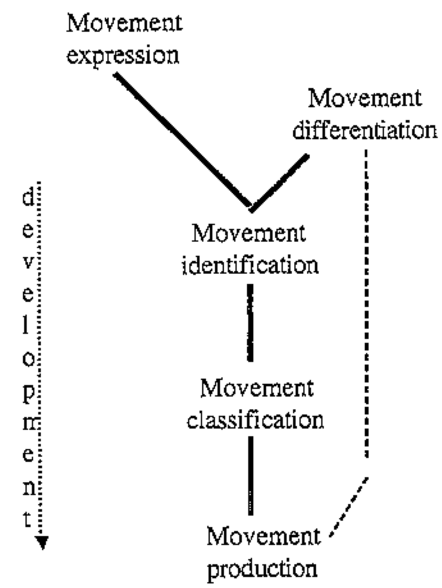
On the other hand, the prototypical developmental pathway for the treatment-minus group shows good integration of the skills needed for recognizing dance (Figure 4). The main difference between students in the control and treatment-minus groups is seen at the highest levels, where students must combine their skills to recognize increasingly complicated movement phrases. For the treatment-minus group, this proves to be relatively straightforward. By this point, the expression and differentiation skills have integrated smoothly with the abilities to identify, classify, and produce the prime actions in movement.

Figure 4. *Reading dance*. **Treatment-** Group's prototypical developmental pathway for recognizing the prime actions of dance.



As shown in Figure 5, the treatment-plus group exhibits many of the same branches and patterns of integration as the control and treatment-minus groups. One finds independence of expression and differentiation skills in early stages of development with increasing integration of the abilities to identify, classify, and produce the prime actions in movement. The main variation in this pathway is a discontinuity in ability, linking differentiation skills to production skills. This finding describes an early ability to perform accurate reproductions of movements. This singular achievement surfaces around the same time as the ability to differentiate movements, submerges as the skills of identification and classification emerge, and then resurfaces as the last, most developmentally difficult-to-achieve piece in the recognition skill set.

Figure 5. *Reading dance.* **Treatment+** Group's prototypical developmental pathway for recognizing the prime actions of dance.



Discussion

The findings from the notation-use and development data set fit the basic hypothesis about differences between groups, but do not fit specific hypotheses. As predicted, the control group evinced an overall unintegrated profile of development. Not one child in this group integrated all the skills necessary for accurate recognition at higher levels of development. In contrast, where one might have expected larger differences, students in both the treatment-plus and treatment-minus groups exhibited good integration of recognition skills. One plausible explanation for this finding is that a conceptual approach to movement—via the verbal and/or notational medium—helps young children maintain a steady developmental progression in reading dance.

Despite the similarity in overall developmental trajectory, children who had access to notations did demonstrate a singular discontinuity that set them apart from the other two groups. These students showed an early ability to perform accurate reproductions of movements, as revealed by significantly higher production scores. A review of the videotaped performances confirmed a qualitative difference, showing that these students rendered movements in more clear, articulated ways. This achievement appeared to surface early in development, disappear as other skills were integrated, and then resurface as the final piece in the set of recognition skills needed for reading dance.

Conclusion

Notation-use matters. This study provides convincing evidence that instruction based on creative movement exploration and Labanotation facilitates young children's acquisition of important concepts in dance and improves their abilities to look at and understand dance. Young children develop these skills through the use of notations that embody the language of dance: an embodiment that clearly marks the types and categories of action in movement. This approach presents a way of knowing dance that appears to be qualitatively different from that which is accessed by verbal description. At the same time, this study shows that verbal language is a necessary and valuable tool in dance instruction. Young children learn about dance if it is described to them and they are given a chance to do it. By itself, however, verbal instruction does not appear to be the most effective means for learning in dance.

The same conclusion holds for cognitive-symbolic development, with one caveat. Verbal instruction without reference to concepts does appear to have a deleterious effect on the integration of recognition skills needed for viewing dance. In contrast, conceptual explanations appear to promote well-integrated skill development. Though explaining dance concepts to children helps them stay on course, notation-use does seem to jump-start their abilities to produce movements accurately. The early sign of production skill is meaningful, even if the skill is a nascent one.

Implications

This study is important because it contributes to the study of human symbolic functioning by providing an empirical test of Goodman's theory of notation. The basic hypothesis, about the need to devise a symbol system that supports the key features of knowledge in a domain, is central to advances in cognitive science (Gardner, 1983, 1985, 1998). To use movement as an expressive symbol system, to dance, one must employ its unique language. This finding contradicts the view that verbal language/language literacy is the *sine qua non* of conceptualization.

The implications for dance educators are clear: if the goal of dance education is to help dancers increase their abilities to use dance concepts, to "read, write, and dance" dance, then notation-use is a good tool for doing so. This study demonstrates that teaching a child about dance, by simply labeling movements or making her "do it again," leaves out important information: information that is embedded within the symbol system and that can be accessed with notations. In contrast, a rich instructional environment—one that emphasizes dance concepts plus notation-use with lots of movement experience—appears to be an effective way to help young dancers avoid obstacles to learning and development.

The implications for future directions in research in dance are also clear. This study provides a systematic examination of dance in a realm that is relatively under-investigated. It provides an initial foray into the psychology of dance. However, the hard questions about cognitive functioning in dance include not only psychological issues concerning the mental structures and representations that subserve dance competence and that characterize putative stages of development, but also philosophical issues related to the effectiveness and limitations of a system like Labanotation to represent fully and accurately the essential features of the language of movement. To realize a more complete picture of cognition in dance, future work needs to consider the possible constraints as well as the benefits of such a system on the spectators and producers of dance.

References Cited

Afifi, Abdelmomem A. and Virginia Clark
1990. *Computer-Aided Multivariate Analysis*. New York: Chapman and Hall.

Astington, Janet W., Paul L. Harris and David R. Olson (Eds.)
1988. *Developing Theories of Mind*. Cambridge, England: Cambridge University Press.

Babitz, S.
1940. Dance Notation at U.S.L.A. *Dance Observer* 7: 143.

Baum, Susan M., S.V. Owen and B.A. Oreck
1996. Talent Beyond Words: Identification of Potential Talent in Dance and Music in Elementary Students. *Gifted Child Quarterly* 40(2): 93-101.

Benesh, Joan
1960. Dance Composition, Part 1-3. *The Dancing Times*. 50, Parts 1-3: 359, 361, 414-415, 585, 587.

Bialystok, Ellen
1992. The Emergence Of Symbolic Thought: Introduction. *Cognitive Development*, 7(3): 269-272.

Bichan, V.
1978. *Dance Takes a New Step: Children Learn to Read and Write Ballet*. Irvine, CA: The Movement Shorthand Society Press.

Cohen, Selma Jean
1960. Notation Anyone?: Dance Notation Bureau Celebrates Its 20th Anniversary. *Dance Magazine* 34: 44-45.

Czompo, Ann
1974. Dance: An Illiterate Art? *Journal of Health, Physical Education and Recreation*. February: 73-74.

Davis, J.
1995. Laban Movement Analysis: A Key to Individualizing Children's Dance. *The Journal of Physical Education, Recreation & Dance* 66(2): 31-34.

Debenham, Pat
1997. Motif Writing and its Relationship to Language Acquisition. *Movement News* Fall: 10.

Dyke, J.
1939. Dance Notation: A Comparative Analysis and Evaluation of Various Systems. Unpublished master's thesis: Wellesley College.

Eisner, Elliot W.
1994. *Cognition and Curriculum Reconsidered,* 2nd Edition. New York: Teachers College Press.

Fischer, Kurt W.
1980. A Theory of Cognitive Development: The Control and Construction of Hierarchies of Skills. *Psychological Review* 87: 477-531.

Fischer, Kurt W., D.H. Bullock, E.J. Rotenberg and P. Raya
1993a. The Dynamics of Competence: How Context Contributes Directly to Skill. In *Development In Context: Acting and Thinking in Specific Environments* (Eds. R.H. Wozniak and K.W. Fischer). Hillsdale, NJ: Lawrence Erlbaum Associates.

Fischer, Kurt W., C.C. Knight and M. Van Parys
1993b. Analyzing Diversity in Developmental Pathways: Methods and Concepts. In *The New Structuralism in Cognitive Development* (Eds. W. Edelstein and R. Case). *Contributions to Human Development, Vol* 23. Basel, NY: Karger.

Fischer, Kurt W., and T.R. Bidell
1998. Dynamic Development and Psychological Structures in Action and Thought. In *Theoretical Models of Human Development, Volume* 2. (Ed. R. Lerner). *Handbook of Child Psychology, 5th Edition.* (Ed. W. Damon). New York: Wiley.

Gardner, Howard
1982. *Art, Mind, and Brain: A Cognitive Approach to Creativity.* New York: Basic Books.
1983. *Frames of Mind.* New York: Basic Books.
1985. *The Mind's New Science.* New York: Basic Books.
1991. *The Unschooled Mind: How Children Think and How Schools Should Teach.* New York: Basic Books.
1998. Extraordinary Cognitive Achievements (ECA): A Symbol Systems Approach. In *Theoretical Models of Human Development, Volume* 2 (Ed. R. Lerner). *Handbook of Child Psychology, 5th edition.* (Ed. W. Damon), New York: Wiley.

Gardner, Howard, and Dennis Wolf
1983. Waves and Streams of Symbolization: Notes on the Development of Symbolic Capacities in Young Children. In *The Acquisition of Symbolic Skills.* (Eds. D.R. Rogers and J.A. Sloboda). London: Plenum.

Goodman, Nelson
1976. *Languages Of Art: An Approach to a Theory of Symbols.* Indianapolis: Hackett.

Goody, Jack
1987. *The Interface Between the Written and the Oral.* New York: Cambridge University Press.

Green Gilbert, Anne
1992. *Creative Dance For All Ages: A Conceptual Approach.* American Alliance for Health, Physical Education, Recreation.

Gregg, M. and G. Leinhardt
1992. Mapping Out Geography: An Example of Epistemology and Education. *Review of Educational Research:* 64(2): 311-361.

Hutchinson, Ann
1956a. Learning to Dance with Labanotation, Part I. *Ballet Today* January/February: 22-23.
1956b. Labanotation a Tool for the Exploration and Understanding of Movement. *Physical Education* 18: 144.
1961. *Labanotation*. Norfolk: New Directions.

Hutchinson Guest, Ann
1983. *Your Move: A New Approach to the Study of Movement and Dance*. New York: Gordon and Breach.

1984. *Dance Notation: The Process of Recording Movement on Paper*. New York: Dance Horizons.

Jeannerod, Marc
1997. *The Cognitive Neuroscience of Action*. Oxford: Blackwell.

Laban, Rudolf
1956. *Principles of Dance and Movement Notation*. London: MacDonald & Evans.

Lasky, G.
1972. A Teaching Breakthrough. *Dance Gazette* 2: 14-15, 40.

Lester, Julius
1994. *John Henry*. New York: Dial Books.

Liben, Lynn S. and Roger M. Downs
1989. Understanding Maps as Symbols: The Development of Map Concepts in Children. In *Advances in Child Development* (Ed. H. Reese). New York: Academic.

Light, Richard J., Judith D. Singer, and John B. Willett
1990. *By Design: Planning Research in Higher Education.* Cambridge, MA: Harvard University Press.

Lloyd-Jones, K.
1997. How to Rehearse on the Bus. *Dance Magazine* 71(1): 78-82.

Lohmiller, M.
1977. Motif Writing: A Creative Tool. *Journal of Physical Education and Recreation* 48: 60-62.

Luria, Alexander R.
1975. *Cognitive Development: Its Cultural and Social Foundations*. Cambridge, MA: Harvard University Press.

Moses, N.H.
1980. The Effects of Movement Notation on the Performance, Cognitions, and Attitudes of Beginning Ballet Students at the College Level. *Dissertation Abstracts International* 4: 3479. Doctoral dissertation: Boston University.

Nadel, Myron H.
1970. The Analysis and Preservation of Movement: Labanotation, Benesh Notation, Choreoscript. In *The Dance Experience*. (Ed. M. Nadel). New York: Praeger.

Olson, David R.
1994. *The World on Paper: The Conceptual and Cognitive Implications of Writing and Reading.* New York: Cambridge University Press.

Olson, David R. and Jane W. Astington
1990. Talking about Text: How Literacy Contributes to Thought. *Journal of Pragmatics* 14(5): 557-573.

Ong, Walter
1982. *Orality and Literacy: The Technologizing of the Word.* London: Methuen.

Piaget, Jean
1955. *The Language and Thought of the Child.* New York: New World.

Reimer, Bennett
1989. *A Philosophy of Music Education.* Englewood Cliffs, NJ: Prentice-Hall.

Scribner, Sylvia and M. Cole
1981. *The Psychology of Literacy.* Cambridge, MA: Harvard University Press.

Scripp, Lawrence
1992. The Development of Skill in Reading Music. Unpublished doctoral dissertation, Cambridge: Harvard University,.

Sloboda, John A.
1985. *The Musical Mind: The Cognitive Psychology of Music.* Oxford: Clarendon Press.

Sutton, Valerie
1978a. *Sutton Movement Shorthand Dance Writing.* Cambridge, MA: The Movement Shorthand Society Press.
1978b. *Sutton Movement Shorthand: Writing Tool for the Dance.* Irvine, CA: The Movement Shorthand Society Press.

Tolchinsky Landsmann, Liliana and Annette Karmiloff-Smith
1992. Children's Understanding of Notations as Domains of Knowledge Versus Referential-Communicative Tools. *Cognitive Development* 7(3): 287-300.

Torff, Bruce and Howard Gardner
1999. Conceptual and Experiential Cognition in Music. *Journal of Aesthetic Education* 33(4): 67-88.

Van Zile, Judy
1985-86. What is the Dance?: Implications for Dance Notation. *Dance Research Journal* 17(2), 18(1): 41-47.

Vygotsky, Levy S.
1978. *Mind in Society: The Development of Higher Psychological Processes.* Cambridge, MA: Harvard University Press.

Warburton, Edward C.
1999. The Effects of Notation-Use on Learning and Development: A Measurement Pilot. Qualifying Paper, Harvard University: Harvard Graduate School of Education.
2000. The Dance On Paper. Thesis Paper, Harvard University: Harvard Graduate School of Education.

Werner, Heinz and Bernard Kaplan
1963. *Symbol Formation.* New York: Wiley.

Youngerman, Suzanne
1984. Movement Notation Systems as Conceptual Frameworks: The Laban System. In *Illuminating Dance: Philosophical Explorations* (Ed. M. Sheets-Johnstone). London: Associated University Presses.