How a Creative "System" Learns: The Distributed Activity of Choreography

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Abstract: Although the arts, and dance in particular, are underrepresented in studies of cognition, they provide rich opportunities to enlarge our understandings of how people learn, think, and accomplish tasks, individually and collectively. In an ethnographic study of professional choreographers and dancers composing in their studios, I sought to understand choreography as a case of distributed cognition, embodied knowledge, and creative work. In this paper, I present a model of the interactions between choreographer and dancers as a system of activity. I explain the specific contributions of each of these roles to the function of the system, and how both individual and joint cognitive activity help to move a composition from initial conception to final performance. I argue that the creative relationship between choreographer and dancers represents a unique model of collective learning, one that is not addressed in current research on cognition in practice.

Introduction

What we know about cognition is constantly being expanded by studies of thinking and knowing in new contexts. Research on cognition has, for the most part, not paid much attention to the arts as a way of thinking and knowing. Yet choreography possesses multiple features that make it unique as a cognitive activity and therefore rich with potential for enlarging understandings of cognition.

The notion of cognition as distributed derives in large part from socio-historical approaches to the study of mind. In this perspective, frameworks for thinking are developed through problem-solving activities and social structures grounded in specific historical and cultural contexts. By examining different kinds of activity, different uses of mediating tools or environmental features, social roles and divisions of labor, etc., we gain a broader understanding of cognition as it is distributed within specific cultural practices (Cole & Engestrom, 1993). Researchers from anthropology and sociology have expanded notions of cognition by looking at people "knowing" in a range of everyday settings and activities: engaged in daily tasks (Lave, 1988), at work (Goodwin, 1993; Harper, 1987; Hutchins, 1995; Scribner, 1997; Stevens, 1999), practicing a craft (Keller & Keller, 1996). Central to these studies is the notion of cognition as a *system of activity*: inquiry is aimed at understanding how social and environmental structures, use of particular tools, the spatial and temporal arrangements of people, objects, and events contribute to the organization of mental processes, the achievement of tasks, and the development of conceptual understanding. Individuals learn through interactions with people and things. As Stevens and Hall have pointed out (1998; Stevens, 1999), learning is not merely the development of mental structures, but also the development of *embodied* knowledge and practice, or *disciplined perception*; through the resources of talk, embodied action, particular tools and representations, practitioners learn and use their bodies in coordinated ways that reflect characteristic modes of thought, verbal discourse, and ways of seeing within a discipline. While Stevens and Hall focus their attention on visual practices central in a discipline, other studies show that additional forms of perception may be central to knowing within a field.

The majority of the studies noted above investigate how individuals or groups of individuals coordinate their activities in accomplishing routine tasks or solving well-defined problems. One exception is Keller and Keller's (1996a, 1996b) account of an artist blacksmith "thinking and acting with iron." In this study, the authors describe how a blacksmith creates a piece of ironwork by coordinating a number of visual, aural, and sensorimotor "images." Like the composing process described in studies of writing (Bereiter & Scardamalia, 1987; Flower & Hayes, 1994), Keller and Keller's blacksmith engages in an iterative process of visualizing goals, planning a means for creating those goals in form, and acting on the plan with a mind open to alterations

and new ideas as the form evolves. In this creative system, activity is distributed across the blacksmith and specific tools and structures in his environment.

Choreography, too, is a creative task, but one undertaken by multiple individuals. In this distributed system of activity, the choreographer's tools and material are *dancers* with minds and bodies of their own. Together, choreographer and dancers engage in reflection on the kinesthetic and visual effects of movement, coordinating perceptual and intellectual ways of knowing across multiple minds and bodies. The multisensory images developed, enacted, revised and coordinated within a single individual in Keller & Keller's study must be developed, enacted, revised and coordinated among multiple individuals in the making of a dance. How does a creative system (and individuals within the system) learn through the process of composing? The specific roles of choreographer and dancer and the progressive nature of composing make choreography a good case for understanding the relationship of individual cognitions to "system thinking" and to the learning of the whole.

In this paper, I present a model of the interactions of choreographer and dancers as a distributed system of activity. This model is based on an ethnographic study of choreographers and dancers composing in their studios.

Study Design

Participants in this study were ten professional choreographers and dancers in contemporary dance. Each participant was videotaped at least once in rehearsal and/or teaching a class; studio sessions ranged from 1to 4 hours. Participants included a solo performer as well as groups ranging from 2-15 members; each was videotaped at a different stage in the rehearsal process, from initial start on a dance to the day before performance. After the studio session, I later interviewed each participant, playing back selected studio clips to stimulate recall and discussion of recorded events. When interviews were complete, all participants and their ensemble members were invited to a group discussion about the composing process. At this meeting, each participant also drew a timeline of the entire rehearsal process for the dance I had observed in progress.

Data (video records, field notes, collected artifacts, and interview transcripts) were analyzed for major tasks involved in composing a dance. Once these were identified, I examined how the roles of choreographer and dancer, the structure and nature of rehearsal activities, and the discipline-specific ways of knowing and representing knowledge contributed to the accomplishment of these tasks and to changes within and across different episodes of rehearsal. I analyzed the interactions of choreographers and dancers as a system of activity and sought to understand the specific contributions of each of these roles to the function of the system, and how both individual and joint cognitive activity helped to move a composition from initial conception to final performance.

Choreography as a System of Activity

Results of the study highlight ways that participants used rehearsal activities to reflect on, share, and coordinate both kinesthetic and visual perceptions of movement and, in so doing, establish mutual understandings of the evolving dance. Choreographers and dancers working together create a dance, although they have different roles and functions in the accomplishment of this task. One challenge for a theory of cognition based on a distributed system is to show 1) how the products of the system change from one occasion to another, and 2) how the relationships between the different "intellectual partners" in the system contribute to this change (Salomon, 1993). In Figure 1, I summarize the distributed system of both individual and joint activity in the making of a dance. The figure shows how the dance itself progresses from a few ideas to a polished performance and how the relationships between choreographer, dancer(s), and the tools they work with contribute to this change.

The three columns in Figure 1 comprise the entire distributed system of activity in composing a dance. The central column depicts the evolution of the dance over time and the joint activities of choreographer and dancers that contribute to this change. I've listed in this column (bottom to top) the general stages of rehearsal and the nature of activities at each stage. Choreographers essentially engage in the same activities that writers engage in when composing—they plan, generate material, and revise multiple drafts—though in dance these are largely social and embodied processes.

The columns on the left and right in Figure 1 describe, respectively, the individual cognitive activities of choreographer and dancer(s). These, too, change over time, and they have a reciprocal relationship with the central joint activities as indicated by the arrows. Salomon (1993) has represented the reciprocal relationship between individual and joint cognition as a spiral, explaining that "individuals' cognitions engage in activities affording distributed cognitions, which in turn cultivate individual cognitions" and so forth (p. 119). In Salomon's diagram there is a single spiral; I have used the spirals in Figure 1 to show how two specific roles in this system contribute to the cognitive accomplishments of the system overall. Below I describe more specifically the distributed nature of rehearsal activities and the transformation of relationships between choreographer and dancers as a dance is composed.

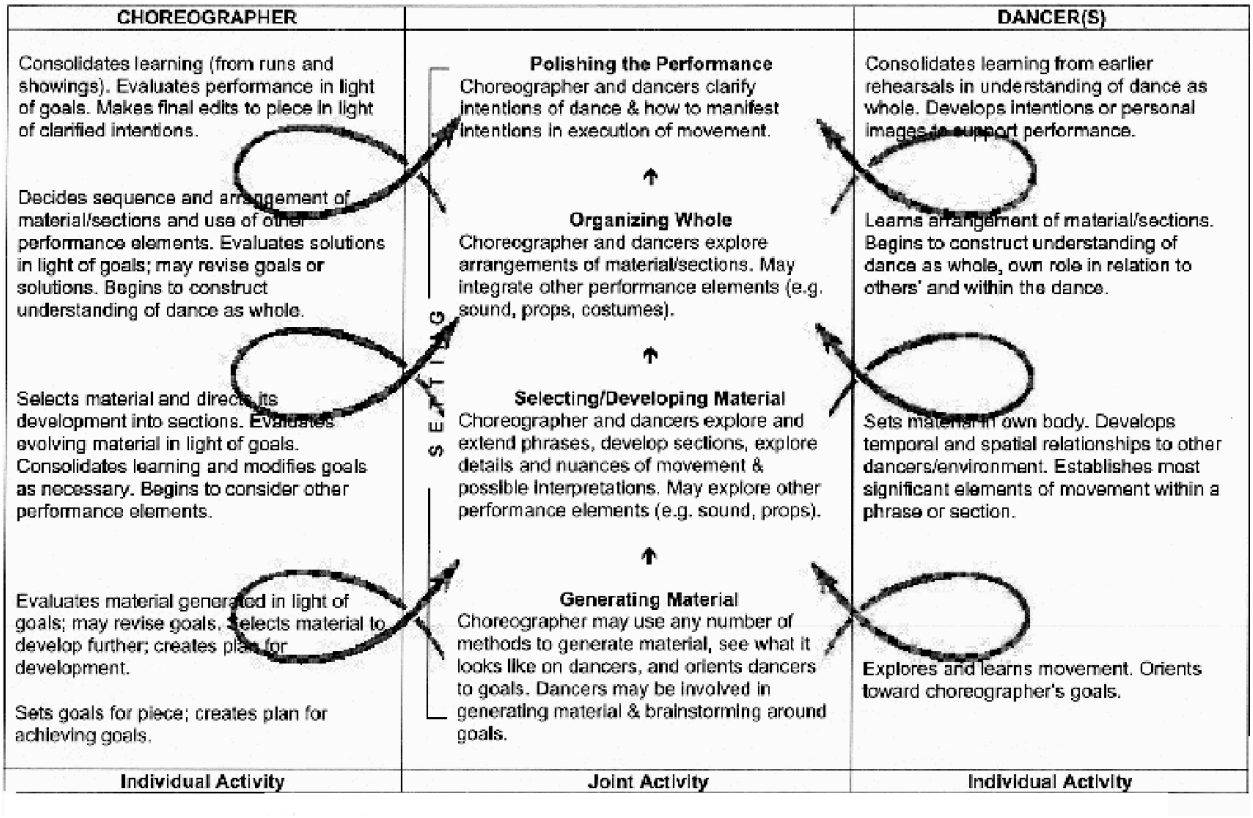

Figure 1. Diagram of how choreographer and dancer's individual and distributed activities contribute to composing a dance

Activities in Composing a Dance

The activity of "setting" appears in Figure 1 vertically in the central column, alongside and encompassing all phases of composing; this is an activity unique to dance. Dancers commonly speak of "set movement" or of choreographers "setting a dance on dancers." When a dance is *set*, it exists (to greater and lesser degrees) as a specified sequence of movements that can be repeatedly reconstructed during performance. Because setting is more or less an infinite activity, encompassing the process of "settling on" decisions for the composition as well as setting movement in and on bodies, I have used it here as an umbrella process over the joint activity of choreographer and dancers as a whole. Like any artist, choreographers learn from working with their medium, but in this case, the medium is human movement, and dancers must continually construct and reconstruct the very art object being created. This "reciprocal learning"—the choreographer shaping the dance even as it takes shape in the dancers—is an integral part of composing in dance.

Generating Material

In the same way that writers generate words and sentences, choreographers generate movement vocabulary and phrases. Movement material in dance may be generated in two ways: choreographers may seek to embody a specific idea in movement (i.e. "sharp"), or they may simply experiment with movement to see what

ideas or images it connotes. From the start, however, choreographers rely on their dancers to represent their ideas—to embody, remember, and perform their ideas back to them—so that they might be evaluated and revised.

Popular images of choreography suggest that choreographers come into the studio with all the movement worked out ahead of time; the choreographer teaches the movement, and the dancers learn and perform it. This was a rare occurrence in the rehearsals I observed. More often, choreographers engaged their dancers in any number of activities designed to distribute the task of generating material and orient all performers toward a common understanding of the composing goals. These activities quickly generated a pool of available movement vocabulary, bearing the mark of each ensemble member. Whether through improvisational exercises, writing tasks, brainstorming sessions, or "thrown material," dancers generated movement that represented them—their ideas and experiences, their physical attributes and abilities, their particular movement habits or preferences. Thus choreographers regarded dancers not as passive clay for molding, but as active problem solvers on whom they relied for generating original material.

Selecting and Developing Material

During this phase in the composing process, participants moved from generating material to setting particular phrases and then manipulating those phrases in a number of ways—extending or reorganizing them, changing who would perform them, or how and where they would be performed in the space. Through practice and multiple repetitions of movement sequences, dancers and choreographers explored the details and nuances of movement, as well as its possible interpretations. In the process of deciding how the arms should be used in one section to complement the legs, for example, a choreographer and her dancers found that a certain move with elbows out and limp wrists created "scary hands"—an image they decided to develop further. These rehearsals zigzagged between two different types of dialogue: an internal dialogue in which each dancer attended to her individual perceptions, and an external dialogue in which those perceptions were shared, evaluated, and negotiated by the group.

During this stage, choreographers repeatedly stepped in and out of the roles of their performers in order to understand the movement from inside; study participants explained that the process of alternating between being "inside" an image, perceiving it kinesthetically, and being "outside" the image, observing as a spectator, is essential in choreography for evaluating movement images and/or clarifying intent. Over these rehearsals, dancers added to an ever-increasing score of multi-sensory cues they would use to reconstruct the material—physical sensations and qualities of movement as well as spatial and temporal relationships to other dancers and to features within the environment.

Organizing the Whole

The number and complexity of design and logistical considerations increases when choreographers reach the stage of organizing the dance as a whole. Attention in this stage moves away from development of separate sections and exploration of material to more whole-text considerations: What is it the choreographer wishes the audience to experience overall? What is the unifying structure that makes sense for the piece? To answer these questions, choreographers consolidated knowledge gained over previous rehearsals and revisited or revised goals for the dance as a whole. Choreographers at this stage of the composing process often used video cameras, pen and paper as *tools to think with*—to record, represent, and coordinate a wide range of information relevant to the organizing task. Dancers, too, acted not only as records/recorders of information, but also active intellectual partners, joining the choreographer in thinking through the dance, proposing solutions as problems were identified. In one rehearsal, for example, a choreographer shared with her dancers a sketch she had made of a tentative structure for the dance as a whole. Here the sketch acted as a mediating tool; the choreographer not only read from her sketch, but also modified it (crossed out sections, drew arrows, wrote notes in the margins) in response to discussion with her dancers.

Organizing the whole marks an important shift in the relationship between choreographer, dancers, and the dance; what begins as an idea in the mind of the choreographer at the start of rehearsals must eventually become a fully formed work performed independently by dancers. Organizing the whole marks a point at which dancers shift from practicing and developing movement to *inhabiting* the movement and imbuing it with meaning.

Polishing the Performance

At this stage in the composing process, the dance exists as a "complete draft" and can now be "run" (repeatedly performed) from start to finish. Choreographer and dancers can begin to experience the dance as a whole. The process of making final edits in dance is called "polishing" or "cleaning"; it is a process of clarifying both the aesthetic *intent* of the dance as well as its physical *execution*. Choreographers often used video cameras at this stage to gain an objective view, or called in trusted colleagues to provide editorial feedback. For both dancers and choreographers, the final stage of rehearsal was a time to more clearly articulate ideas and intentions for the dance, and to subject all aspects of the dance to the unifying aesthetic that was developed while organizing the whole.

Dancers viewed this stage of composing as extremely generative, the stage in which they create "an experience that goes kinesthetically and every way from the beginning through the end." During these rehearsals, dancers developed an "internal fiction" to support a fully embodied performance of the dance. Like actors' objectives that give credibility and purpose to their lines, dancers develop an elaborate subtext to provide intentions for their movements, frequently constructed from remembered experiences from daily life (including prior rehearsals), images visualized while performing, or invented dramatic scenarios with other dancers. These were largely personal subtexts, rarely shared aloud. In the end, dancers consolidate in their lived performance all that they and the group as a whole have learned over the rehearsal process, the history of the activity depicted in Figure 1.

Roles & Function of Choreographer and Dancers

The unique roles that choreographer and dancers play in composing a dance can be described in terms of how they influence the operation of the distributed system as a whole. Hutchins (1995), for instance, has distinguished between *evolution* and *design* in describing how a system changes over time. Evolution, Hutchins argues, is adaptive change by a system in terms of itself. Such change can be characterized as "local adjustment" by members of a system in relation to situations and events happening within the system. In contrast, design is a process conducted by an "outsider" on representations of the system. Design in Hutchins' view includes a more global perspective on the system; design "precedes and guides an implementation of changes that are intended to be adaptive" (p. 349). Hutchins' comments were related to his study of crewmembers on a Navy ship and how the task of navigation is distributed across multiple persons and technologies. Hutchins concluded that the changes he observed in the organization of the navigation team were in part evolutionary and in part a process between evolution and pure design.

Such a combination of change processes can be seen in the functioning of a dance ensemble as well, yet these processes are more clearly divided between the roles of choreographer and dancer. Choreographers must keep in mind an executive view of the dance as a whole, projecting forward and casting back over rehearsals in order to shape and develop movement material into a unified composition. While not necessarily "outsiders" of the system, choreographers do (literally) step outside the constructions of the system in order to conduct design operations. The changes they implement in the system are intentional, the result of supervisory reflections on the whole. Choreographers are primarily responsible for the design function within the system; as shown in Figure 1, they conduct executive activity: making choices about the options that will be explored, planning a path of action, evaluating the results. When one of the choreographers, for example, engaged her dancers in "round robin" watching, she did not forfeit the role of choreographer but rather engaged her dancers *in the design function* of the system. This might also be said of choreographers who ask their dancers to generate material independently for the dance. In these instances, dancers essentially posed and solved for themselves mini compositional problems.

In contrast, the changes dancers implement in the system are primarily evolutionary. Dancers adapt locally to direction from outside. In learning movement, for instance, they learn how to execute it in their own bodies, and they learn to make the movement their own. They make adjustments to their local views of the dance, to their actions in relation to other dancers and to the environment as they rehearse. Through their suggestions for changes, their spontaneous improvisations and/or mistakes, even the "internal fictions" they may create to support the performance, dancers influence the composition of a dance within the terms of the system itself. One example of this local adjustment is the self-monitoring and correction that dancers make as they receive direction from the choreographer, or when they rehearse independently. Like the choreographer's actions,

dancers' actions, too, further the process of composing (the task of the system) but in a way that is less intentional in terms of the overall design. In the joint activities of choreographer and dancers (the middle column in Figure 1), the evolutionary and design functions of the system are woven together. The interpersonal dependencies of the system in promoting change toward an end goal are most evident here. Choreographers stepping into the role of dancer in order to understand how to modify or develop a phrase may be one example of this interdependency; how dancers function as the choreographer's record of the evolving text is another.

How a Creative System Learns

The relationship between choreographers and dancers that emerges from looking at choreography as a distributed system is unique. This relationship represents a model of learning through creative work that has been little explored in studies of cognition. Although there is much to say about the *perceptual* aspects of thinking and problem solving in dance, I concentrate in this paper on the distributed qualities of the art form. Below I examine what and how choreographer and dancers learn over the course of composing a dance in relation to current theories of cognition and learning, in order to highlight what we might learn from this case.

A Unique Model of Collective Learning

As a case of collective learning, the relationship between choreographer and dancers is unlike other models of group learning currently recognized in cognitive research. The relationship between choreographer and dancers does not fit, for instance, the traditional didactic model present in many classrooms. Choreographers in this study rarely knew ahead of time the particular knowledge or skills they wanted their dancers to acquire. As a result, they were often inventing and solving problems alongside their dancers. While direct instruction *was* evident in rehearsals when specific movement was taught or corrected, it was used to accomplish particular *tasks* in the making of a dance; it does not describe the general relationship between choreographer and dancers and how the system learns.

The composing process in dance is also not a true collaboration between choreographer and dancers. As one choreographer in the study noted, proposals offered by each member of an ensemble do not carry equal weight, and the group does not deliberate over creative decisions. While the dancers participate in the composing process to varying degrees, it is the choreographer as I have described above who plays the executive role. He or she creates openings for dancers to participate in the composing process and decides exactly how their contributions will be used.

Apprenticeship is another model of how people learn from interactions with one another, but here, too, the model is not appropriate to describe the relationship between choreographer and dancers. While dancers may indeed learn something about choreography by participating in a dance, they are not apprenticing choreographers in this situation. Nor is the choreographer (necessarily) a master teacher teaching dancers how to improve their dancing. Lave and Wenger (1991) have expanded on the concept of apprenticeship by looking more broadly at how learning occurs within a community of practice, or group of practitioners in a field. They use the term "legitimate peripheral participation" to describe how a learner or "newcomer" to a community of practice proceeds through various peripheral roles, increasing in responsibility and skill requirements, to the role of "expert". This description of communal learning may be partly true of the dance community generally (if one views a choreographer as the "expert"); novice choreographers often dance in other choreographers' work at the same time they are composing their own pieces. But the sets of skills choreographers and dancers practice in rehearsal are very different from one another, and many dancers never wish to choreograph. Furthermore, the model of legitimate peripheral participation does not work to describe the learning that choreographer and dancers experience in the making of a single dance. The model of learning represented by choreographer and dancers as co-participants in a system of activity may be worth looking for in other contexts, as I will address further on.

Learning as a Creative System

Other researchers in addition to Lave and Wenger have tried to describe how learning takes place among members of a community of practice or system of activity. Hutchins (1995) for example, diagrams how an organization changes over time using the Navy ship as a case study. He demonstrates through his research how both the individuals and the practice change through the activity of the system. He uses the system itself as his unit of analysis, describing redundancies built into the system, how people learn various roles and move

through roles of increasing responsibility, how the system functions to deal with turnover in personnel, with problems or breakdowns, and with innovations in practice or technology. His case, however, is a highly coordinated system; the problems it goes about solving are routine. The system he describes does not seek and solve creative problems nor does it attempt to articulate and realize an aesthetic intention using a metaphoric vocabulary.

Although the system Hutchins describes is unlike the system comprised of choreographer and dancers, his definition of learning is broadly applicable. He describes learning as "adaptive reorganization in a complex system" (1995, p. 270)—he argues that the definition works well for learning situated in the socio-material world and it works equally well for private discoveries made in moments of reflective thought. What is it that one adapts to in each of these cases? In most of Hutchins' examples, Navy personnel are adapting to moment-to-moment changes in the environment; people are shifted around and new tools are engaged as the system adapts to problems presented by the environment itself, or by the task at hand. In reflective thought, it may be changes in representations that individuals adapt to, brought about by mental manipulations.

What is it that individuals or the system is adapting to in dance? The data presented here suggest that choreographers and dancers are continually adapting to changes in the state of the dance, changes that they have *wrought themselves* in an effort to realize particular goals. The setting and revision of goals central to creative work may be thought of in itself as an adaptive reorganization in light of what the system has produced. This may be one way to think of composing generally: the system undergoing adaptive reorganization may be a choreographer and her dancers, or it may be a writer and his ideas on paper. In describing design activity specifically (using as examples the design of a shawl, or of a health care system), Schon (1990) uses the word "synthesis" to describe similar processes of formation and transformation in the work. He views design as a conversation with materials *and* with other individuals; designers learn through successive trials that effectively change the design situation with each iteration, and they learn through the process of communicating across the different frames they may hold on a design problem. Schon does not say here whether these different frames are a consequence of individuals' specific roles within an activity system, but this "dialogue across frames" may also characterize the interactions between dancers and choreographers and provide another perspective on how a system learns.

Learning has also been conceived of as conceptual change, especially by researchers interested in individual conceptual structures or cognitive strategies—learning has often been measured by the degree or quality of change in one's thinking or skills. Beyond change conceived as before and after states, diSessa has raised the question of how concepts work and develop. DiSessa and Sherin (1998) argue that the core problem of conceptual change is "shifting the means of seeing" and that " 'seeing things' in the world—gaining information about them—is a complex cognitive accomplishment" (p. 1171). If, from situated perspectives on learning, a concept is not a particular mental representation residing in the mind of an individual but abstractions over people acting in settings, then conceptual change is the change in this "pattern of people, things in the world, and neuronal activations" (diSessa & Sherin,1998, p. 1173). This may be the best way to describe how a group or system undergoes conceptual change: a group itself may "see things in the world" and as a group, shift the means of seeing or coordinating information. This shifting may be another way to describe Hutchins' "adaptive reorganization in a complex system" and the transformations that choreographer and dancers undergo over the course of composing.

The "Design Group" Model: Implications for Education and Research

The relationship between choreographer and dancers, I have argued, presents a unique model for learning. The roles of choreographer and dancers function differently to effect changes in both the design and evolution of a system. If the model of learning this system represents is not a didactic model, not a true collaboration, not apprenticeship or legitimate peripheral participation, what kind of model is it? I would propose that a choreographer and her dancers is best characterized as a *design group*; other contexts in which such a relational system might be found include an architecture studio, advertising agency, or an advanced research laboratory. Although further study is needed, it may be that similar roles and dynamics exist within these systems, functioning to affect the design and evolution of creative work.

Are there other places where the design group model *should* be found, where this model of collective learning and creating would in fact be constructive? This model does not describe the typical classroom—such collective learning does not often happen here, nor design, nor the fostering of individual creativity through the

creative work of the whole. Teachers are generally viewed as having the responsibility to impart to students specific knowledge and skills, and students generally learn from lessons designed *for* them. In contrast, dancers and choreographer join in a shared, creative enterprise; they are *in something together*, even if that "something" may not be fully formulated at the start. Choreographers, on some level, trust the particular expertise of their dancers, trust/expect that their dancers will bring new insights to the collective endeavor and that the work will evolve in relation to what is produced. Although the system as a whole learns in this model, it is not the model of learning most teachers are encouraged to use as the basis for their lessons.

There are exceptions. The choreographer role may in fact aptly describe those teachers we have frequently referred to as "gifted" or "natural"—teachers such as Vivian Paley (e.g. 1981), who take notes and carefully observe their students, using students' words and actions to design and facilitate the next educational experience. Perhaps too often teachers don't engage their students in orienting activities, don't ask students to generate their own material, or join them to "mess with it" and see what evolves. If teaching is both science and art, it may be that choreography unveils the mystery of what that "art" entails.

Little is known about how people learn through the act of composing. While a generative, iterative process is central to composing in many art forms, we have no particular word(s) in education or cognitive research that identifies this process as a means of learning and knowing. The sensitivity to their materials that many artists describe may parallel in dance the *intersensitivity* that is fostered between choreographer and dancers over the rehearsal process. In dance, this creative reciprocity is an essential component of composing: choreographers and dancers "develop, strengthen, and nurture their creative individuality via their mutual creativity" (Blom & Chaplin, 1982, p. 184). Further research on creative "systems" may tell us more about what happens in this kind of exchange and how people might function constructively as co-participants in a creative process.

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