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Introduction

The contributions to this issue of the Newsletter result from an international scientific collaboration that has continued uninterrupted for more than a decade, although the specific articles focus on joint research carried out over the past three years. The early history of this work is associated with the exchange program between the Soviet Academy of Sciences and the American Council of Learned Societies. For the entire history of this exchange, Boris F. Lomov was the official representative of Soviet psychology, and since 1976, Michael Cole has been the official representative of the American psychology. A long standing goal shared by both Soviet and American participants has been the constitution of a geniune, ongoing, collaborative project.

To our great sorrow, Boris Lomov died in July of this year, on the eve of a symposium on the topic of communication and cognition at which his long time co-worker, Alexandra Belyaeva and her colleagues in the Communication Laboratory of the Institute of Psychology (Academy of Sciences), were to present, jointly with American colleagues, the most recent results of their collaboration in the study of computer/telecommunications mediated interaction and cognitive development. Even as we mourn the passing of a long time colleague and friend, we recoup some satisfaction from fulfilling one of his long term goals: Soviet-American scientific collaboration.

Two early steps that eventuated in the current project were the creation of the Communication Laboratory at the Institute of Psychology in 1979 and the move of the Laboratory of Comparative Human Cognition from Rockefeller University to U.C. San Diego in 1978 where it came to be closely associated with the Department of Communication. During the early 1980's, there was an exchange of symposia in which scholars from the US and USSR compared views on the theoretical relationships between communication, cognition, and development as well as exchange of junior researchers, who familiarized themselves with the research traditions of their colleagues across the Atlantic.

A next important step came in 1983 during a symposium on development in Moscow when Cole carried with him a computer diskette containing a program written by Jim Levin, then a member of LCHC, and suggested that Soviet and American researchers emulate the pioneering work of Levin and his colleagues in organizing joint activity among school children through a computer network (See the July, 1983, issue of this Newsletter for a description of early LCHC research on this topic).

It required almost two years to solve the social and technical problems associated with Soviet-American computer-mediated interaction. In October, 1985 we initiated the first use of telecommunications contacts through Telenet on The Source and EIES (The Electronic Information Educational Service). The next several months of activity were devoted almost entirely to elaborating the legal and technological base for the work. In the summer of 1986 Alexandra Belyaeva and Vladimir Teremetsky (from the Institute of Automated Systems which is the central networking agency in the USSR) visited LCHC at which time the teleconference analysed in one of the articles presented below was conducted. By October, 1986, we had exchanged more than 4000 pages of text. In the remainder of 1986, intensive discussions were conducted to specify a common strategy of research and identify likely partners. In the summer of 1987 we conducted our first pilot study, a simplified situation in which children in two locations, summer camps in the US and USSR interacted around selected common software in tasks designed jointly by adult researchers at the two sides.

It was not until the fall of 1988 that regular interaction among children in the USSR and the US was established on an ongoing basis. Simultaneously, researchers on the two sides intensified and broadened the scope of their interactions, leading to the current configuration of joint research with 3-4 sites in both the US and USSR interacting on a regular basis, and researchers in other countries beginning to add their voices.

On the last page of this issue is a listing of the people who are currently involved in the project and many of those who have been involved at different times in its history. We are surprised to note the size of our "small project;" the numbers belie the familiarity we feel from collaborative work, frequent communication, and simple survival over time, transformations, and tribulations. It is important to note that other participants in the research sites, although unlisted, are crucial parts of the work. The children and their families, the staffs at the schools and centers, college-age students beyond those listed -- all have contributed generously.

The articles to follow represent only a small proportion of the joint work conducted so far. They are offered here in the hope that they will evoke comments and suggestions that will enrich future efforts.

Computer-mediated Joint Activity in the Service of Human Development: An Overview

A. V. Belyaeva
M. Cole

In this article we will describe a program of scientific research directed at several interlocking goals. At what might be termed the highest level of the system, our concern is to create a model of joint activity between citizens of the USA and USSR that would transform their conceptions of their historical circumstances in a fashion mutually beneficial and acceptable to both countries. In currently popular terms, our concern at this level of activity is with the formation of a global consciousness.

A common assumption uniting this collaboration among psychologists, sociologists, linguists, educators and communications scholars is that human consciousness arises in the course of communicative activity among people with different interests and perspectives. Consequently, consciousness cannot be studied "in vacuo." As A.V. Lektorsky (1984), the Soviet philosopher has pointed out, concrete practical activity, cognitive processes, and communication are intimately linked in the formation and maintenance of consciousness.

In describing perspectives for study of the formation and development of consciousness, E.P. Velikhov, V.P. Zinchenko, and V. A. Lektorsky (1988) urge the formation of a "uniting link, a kind of conceptual bridge" uniting the interdisciplinary study of consciousness. Velikhov and his colleagues consider the major task facing the study of consciousness to be the creation of new methods and evaluation of existing methods of interacting with both individual and social consciousness, especially for purposes of studying its development. Interpreting consciousness as a "working" process that participates in and constitutes the life process of human beings, the authors emphasize the importance of a deeper understanding of consciousness for dealing with practical problems of raising a new generation under rapidly changing technological circumstances. We agree with these positions, which provide important presuppositions for all of our work in this project.

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At what might be called the "second," or "scientific-political" level, we have sought to investigate the potential of new communications technologies, in particular, computer-mediated telecommunications networks, for enabling scholars located in the USSR and the USA to cooperate on a daily basis to construct a model scientific collaboration addressed to a social problem faced by citizens of each country. This level constitutes the frame for the practical activities which provide the context for the needed new methods of interaction.

Finally, at what might be called the "lower," "concrete activity" level, which constitutes the actual concrete, common object of activity, we have sought to demonstrate the potential of the new information technologies, when properly used, to promote cognitive and social development among school-aged children.

These three levels of goals are deliberately connected in the overall structure of the project in two ways. First, we view the lower level goals as a tool for achieving the higher level goals. That is, from the very beginning, we conceived of the task of organizing new forms of cognitively stimulating communicative activity among children as an instrument for achieving a qualitatively new system of scientific cooperation among the adults. Second, we believe that each level of activity is helpful in providing a clearer understanding of the impact of new technologies on the development of human consciousness in the late 20th century.

While implementing the three levels of our model system of computer-mediated joint activity, we have found the following theoretical positions put forward by Velikhov and his colleagues to be particularly relevant:

1. For purposes of both scientific research and humanistic practice, there should be a tight link between the process of investigating consciousness and the process of consciousness formation within the research itself.

2. The study of consciousness requires a methodology that employs conceptual schemas and models not only as a means of description and representation, but also as a means of conducting the research.

3. It is possible to study developmental changes in the structure of consciousness at moments when there is a shift from the subjective to the objective, from being for oneself to being for another, by studying patterns of coordination and discoordination among participants in joint activity.

4. The process by which new states of consciousness arise (what Velikhov et. al. refer to as "phase transformations") is the source of both pedagogical and social opti-

mism. It is in such moments that something new emerges: new actions, new images, new views of situations, and ways of thinking.

We will proceed with this discussion of our progress to date in several steps. First, we will summarize briefly the scientific-political events which resulted in the formation of this project. These events determined both the higher order goal which has constrained all of our activity and our choice of instruments for achieving that goal through the organization of children's communication. Second, we will summarize the theoretical approach which has guided this effort. Third, we will describe the overall strategy we developed in the face of rather severe constraints on the amount of resources available and often-severe resistance from existing political and bureaucratic structure. Next we will turn to a summary of results obtained so far, first in terms of constructing the required overall system of interactions that would serve as a medium for achieving both higher and lower level goals, and second in terms of both the concrete new forms of work among the adults and learning/communicative activities of children.

The Initiating Events

This project grew out of efforts by Evgeni P. Velikhov, Vice-President of the Soviet Academy of Sciences, and David Hamburg, then-president of the American Association for the Advancement of Science and still-president of the Carnegie Corporation, to demonstrate that, given proper conditions, American and Soviet scientists could work cooperatively together to solve problems of mutual concern to both countries. It is worth mentioning that this idea arose in 1985, at a time when relations between the US and the USSR were quite strained; hence, any effort to build mutual confidence was looked upon by the sponsors of this work as a useful step toward reducing the dangers of military conflict.

The concrete problem that the two men decided upon as a focus for their joint effort was the changes occuring in the nature of educational activity owing to the introduction of computers into the teaching/learning process. On the one hand, the decision to focus on computers and education as the concrete object of joint research was a natural choice for both men. Dr. Velikhov had recently been charged with the task of seeing to it that new information technologies would be rapidly and widely introduced not only into the Soviet education system, but also into all manner of scientific work. Dr. Hamburg, as president of the Carnegie foundation, had a vital interest in the improvement of American education, and it was widely accepted that such improvements would require intelligent use of the potential provided by computers.

On the other hand, the decision to focus on computers and education was very complicated from the perspective of their desire to create a model of peaceful joint scientific activity. We will discuss four areas of special difficulty here. First, owing to many years of ideological conflict, many citizens in both countries were deeply suspicious of any form of joint activity which might expose their children to "propaganda" that could undermine their loyalty to their own country's values. Whereas cooperation (for example) in the area of joint verification of nuclear tests could be considered a "purely technical" problem, in which the neutrality of science could stand as a technical guarantor for political decisions, cooperation in the area of education could easily be interpreted as opening up one's children to foreign propaganda. Moreover, in so far as the project actually results in improved educational performance by children in the other country, the results could be seen as working against the long term interest of each country in dominating the other.

The second area of difficulty arose from markedly different immediate priorities regarding computers and education in the two countries. In the US, micro-processors were already becoming widespread and were beginning to be used not only for teaching programming and computer science, but as a tool for general education. A special concern of both the American researchers and the Carnegie Corporation was the need to insure broad participation in the still-new forms of computer-mediated education and especially to promote a markedly increased participation in such activities by minority group children and women. The special concern in the USSR was to teach programming languages and to train young people who would go directly into work systems demanding computer skills.

The third constraint was financial. This research project was not a part of the existing Five Year Plan of any Soviet institution, requiring in fact the cooperation of several institutions for its realization. Analogously, it was difficult for the American side to imagine dropping its ongoing work and to seek finances for the support of a large cooperative project.

The final constraint we had to deal with was the marked inequality of relevant technological achievements of the two countries. All during the existence of this project, the USSR has lagged far behind the USA in the availability of the kinds of micro-computers which are at the heart of

computerization of elementary school education. This discrepancy gave rise to two closely linked difficulties. First, there was fear on the American side that any joint project would result in an assymetrical transfer of technology from the USA to the USSR. Second, there was an almost-total lack of the basic equipment needed on the Soviet side to carry out the joint research: very few computers that could run even the simplest of software packages then (and now) in use in American schools, virtually no telecommunications modems available to the Soviet researchers, telephone lines of notorious unreliability, and an absence of experience in the use of computer-mediated telecommunications (except for one institute which had not dealt with young children's education).

General Strategy For the Research

These difficulties, in conjunction with the goals set for us by Hamburg and Velikhov, set the general parameters of our work. We responded to the attendant challenges by elaborating a plan which dictated an overall institutional-structural framework for the research, based upon the following strategic considerations:

1. We would seek to develop a system of scientific cooperation around the problem of creating models of ideal teaching/learning experiences using existing, widely available, computer technologies.
2. These model teaching/learning activities would take full advantage of existing computer-mediated, telecommunications technologies as a natural and necessary condition for geographically distributed researchers and children to work together on a daily basis.
3. We would concentrate our efforts on children of elementary school age, where, evidence indicated, fundamental improvements had to take place if there was ever to be a marked improvement in general educational achievement. Concentration on elementary school-aged children had the important added advantage that a great deal of the best available software was written for children of this age and computers of the desired "low-tech" type.
4. We would, from the beginning, take most seriously the concerns of our citizens that one side might gain unfair advantage as a result of the project. To this end, we committed ourselves at the beginning to a system of maximal openness and joint responsibility, seeking, in effect, to create a SINGLE system of scientific research with minimal asymmetrical transfer of technology and maximal sharing of responsibility both for the everyday conduct of the research and its products.
5. In order to be able analytically to separate barriers to cooperation arising from the special nature of Soviet-American relations from the many factors that impede such cooperation-at-a-distance WITHIN each country, we decided that the research teams representing each country should themselves include geographically distinct institutions.

These considerations gave rise to the overall, schematic structure of the Velham project. We will describe this structure in greater detail below, but for present purposes it is helpful to keep in mind that the work has involved researchers at each site within each country working simultaneously in three systems of joint activity which constitute three levels of a single, unified, model system for teaching and learning mediated by computers: a local system where children engage in various intellectual tasks embodied in part in computer programs, an INTRA- national system where participants within each country experiment with inter-site communication in their own language and culture and INTER-nationally, where children and researchers in the two countries interact with each other to enrich their local activities and to address issues of joint concern that do not arise naturally in more locally-oriented activity systems.

Scientific Foundations: Joint Mediated Activity

At the very core of our effort to create a model system of computer-mediated joint activity is an agreement among the researchers in the two countries that human psychological processes in all of their manifestations arise in the course of human beings' practical, goal oriented activity. Further, we agree that

> ...practical activity itself must be understood in its specifically human form, namely, as joint or collective activity in which each individual enters into certain relations with other persons; as mediated activity in which man places between himself and an external, naturally emerging object other man-made objects functioning as instruments or implements of activity; and finally, as historically developing activity carrying in itself its own history (Lektorsky, 1984, p.136).

At an abstract level, it should be clear why we find this formulation so congenial to our task. The fundamental purpose of this project is to apply what is known about the process by which cognition arises to the problem of how to promote the "arising" of new forms of cognition among both adults (researchers and other citizens) and children (the next generation whose cognitive and social develop-

ment is a matter of common concern). The basic form of joint activity we are proposing is mediated through fundamentally new media (computers and telecommunications networks). These new media are certainly "instruments and implements" of our activity, both in the arena of international relations and in education. But they are more, because our use of these tools has fundamentally changed the environment of development for children in industrially advanced countries, and hence both the nature of human experience in the world and the nature of human consciousness.

At the most general level, adoption of the mediational approach to mind summarized by Lektorsky is based on the assumption that the special qualities of human nature when compared with the nature of other species are:

1. the ability to create and use artifacts, through which people cumulatively modify their own environments and their special mental qualities as human beings, and
2. the ability to pass the accumulated accomplishments and failures of one generation to the next generation through language and culturally organized activity.

This idea is, of course, at the heart of all theories of human nature that derive from Marx and Engels. It is also to be found in the work of non-marxists scholars such as Clifford Geertz, George Herbert Mead and John Dewey.

Humanity, from this point of view, is seen as a dynamically developing bio-social-cultural system which creates a special "level" of the environment, specific to human beings. In American social sciences this level of structure corresponds to culture, which many agree corresponds to "the man made part of the environment." In the Soviet Union, the man-affected part of the environment has been referred to as the "technosphere" (Vernadsky). Within both the USSR and the USA there are also traditions, to which we subscribe, that consider a further level of structuring within the "technosphere" which Lottman refers to as a "semiosphere," the systems of meanings that structure human behavior within the "technophere." The semiosphere, in turn, is packaged into "cultural practices" or "activity systems" within culturally organized contexts that provide yet a further level of constraint on the morphology of activity.

Within this framework, the scientific challenge confronting this project is to understand the new forms of cultural practice that arise under conditions of international, computer mediated, interaction, between citizens of countries which have a recent history of antagonistic relations.

Applications to Organization of Children's Activity

Because the creation of new forms of joint activity for schoolchildren is both a goal and a means in the study of joint activity among adults, we have quite naturally found ourselves using theories of mediated human activity that focus on ontogenetic development. Reflecting both this central concern with children and our own developmental histories, our work on this project has been heavily influenced by psychologists of the "socio-historical" school of psychology associated in the Soviet Union with the names of L. S. Vygotsky, A. R. Luria, A. N. Leontiev, V. V. Davydov, V. P. Zinchenko, and several others (see Davydov, 1988; Luria, 1979; Valsiner, 1988) and in the United States with such figures as J. S. Bruner (1986), U. Bronfenbrenner (1979), and others including members of the American research team (see Cole, 1988; LCHC, 1983; Wertsch, 1985 for relevant reviews and commentaries). Focused on the development of children, this school developed a methodology for the study of the development of psychological functions that is especially adaptable to the problem of constructing new systems of joint activity.

At the core of their methodology is what they termed the method of "dual stimulation." According to this method, children are involved in a task that is somewhat too complicated for them to solve "bare handed." The activity in which the task was embedded includes as elements many objects, including other people, that can be used to solve the problem. For example, in studies conducted by Luria (1929/1978) the task was to remember lists of items (the "object stimuli") that exceeded children's raw memory ability and the extra elements (stimulus means) included pencils, paper, and a supportive adult.

By putting the child into such a situation, the adult maximizes the opportunities for the child to act constructively to devise a way to reach a solution to the problem. Perhaps the child will use the auxiliary means provided by the teacher/researchers; perhaps s/he will use verbal actions to comment on what is going on or to enlist the adult as a mediational means. Either way, the researcher can observe the process by which the solution is reached. It is this process, whether characterized quantitatively or qualitatively, that constitutes the "dependent variable" of interest to the investigator.

Closely related to the method of dual stimulation, which focuses on the way in which children come to master new mediational tools is the concept of a formative experiment. In the classical method of experimentation, all

subjects are confronted with equivalent tasks, all are treated identically, and their differential success in dealing with those tasks is assessed. In the formative experiment, the experimenter takes an active role assuring that all children complete the tasks. What varies is the amount and kind of intervention from the adult which is necessary to attain this invariant outcome. Through this method, the analytic goal of the method of dual stimulation is combined with the pedagogical goal of providing maximal conditions for development.

Another central idea adopted from the socio-historical approach is that there are distinctive age periods in development that are characterized in part by a leading activity, i.e., a form of activity which is a central preoccupation of both adults and children. Of central relevance to our work are three kinds of leading activity,play, learning, and communication. In the ordinary sequence proposed by developmental psychologists, play is a leading activity of early childhood, learning a leading activity of middle childhood, and communication a leading activity all through childhood. Because we have set ourselves the goal of creating maximally powerful learning contexts, we took advantage of the novelty of the synthetic activity we were seeking to develop by creating contexts that deliberately mixed play, learning, and communication. This activity was conducted in specially constructed after-school settings, which generically might be termed "computer clubs," although the specific interpretation varied somewhat from one site to another.

In the results sections which follow, we will describe how we combined these forms of activity with the method of dual stimulation (with its focus on the study of children's active appropriation of new mediational tools) and formative experiments (with their emphasis on promoting development as a condition of its analysis). This combination yields as a basic unit of analysis "joint mediated activity in a teaching-learning context." A major goal of our research at the lower level of the overall project is to specify and apply these principles of development in a manner that will optimize children's development within our joint activity systems.

Within the overall flow of activity within our experimental activity contexts we have also sought to conduct a variety of "mini-experiments" that would allow us to single out for study particular kinds of computer programs widely used to promote children's educational development. These programs are submitted to analysis as an integral part of our efforts to use them to create effective environments for psychological development. They include variations in the interactional arrangements (including whether children work together or alone, with experts or novices, etc.), the additional auxiliary means that are provided, the sequence of instruction within the program, and the extent to which they involve communication through telecommunications.

Special Aspects of Computer-mediated Activity

Although our ideas about how to study development through variations in mediational means of activity are adopted from the early work of the socio-historical school, we cannot adopt their ideas untransformed to our present circumstances.

Despite important differences, the central organizing principle of earlier work on the appropriation of mediational means is highly relevant to our objectives. In particular, it leads us to draw an analogy between pencil - paper and computers as media of communication. Furthermore it leads us to consider deeply the tight link between the acquisition of new tools for mediating activity and the mastery of new modes of thought.

Following the model for acquisition of basic literacy, we have come to treat the computer as a kind of prosthetic device for the acquisition of more complex higher psychological functions: improving systems of logical memory, inference, and problem solving. [Note that in principle, this point of view commits us to treating the computer as a medium through which the child interacts with the world to achieve goals. One does not "hold conversations with a computer" from this point of view except in a very special, bracketed way. Rather, one speaks "through" the computer with others, and with oneself at later times.]

The addition of telecommunications immediately broadens and makes more common sensical the idea that the computer is a medium of communication. When one is carrying out joint activity through a computer network with someone elsewhere in time and space, the computer both acts as and feels like a communication medium. At the same time, artful arrangement of interactions between activity settings both amplify andserve as a conduit for new goals within activity settings. Thus, telecommunications provides an entirely new tool with which to build more powerful educational environments.

We have attempted to make deliberate use of the special potential in telecommunicated joint activity among children by creating mediational objects that were either highly impractical or impossible previously. For example,

as described in greater detail in a later section, we have created a "Wizard" with its own mailbox who writes to the children and the researchers in ways designed to mix play, learning, and communication, to increase reflective thought, to ease conflicts where they arise, and to stimulate interest in potentially fruitful new kinds of collaboration.

The mediational view of computers and educational activity also serves as a constant reminder that even where the computer is the center of attention it is not the only mediational means in the context. Following a mediational strategy, one is led to think about resources that could be placed in the context to make the children more effective problem solvers. Hence, the environments of computer mediated activities we created are also rich not only in pencils and papers, but maps, models, encyclopedias, etc., as well.

In this connection we should mention another mediational resource in computer-mediated educational activity—other children and the teacher. From existing American research, including that of some of our research group, we knew that under many circumstances it is advantageous for elementary school children to work in pairs or triads, with the teacher's role converting from that of "information giver" to "orchestrator" or "coach." Hence, we were particularly concerned to make use of the mediational potential in small group work. [It is probably worth adding that this view has the added feature of reducing by a half to two-thirds the instrumentation costs in any given activity setting.]

Additional methodological considerations

The special conditions of interaction within our model system posed additional methodological problems to which we have applied methods synthesized from various social science disciplines. Some of these will be discussed in connection with specific lines of research, but two classes of such problems are of sufficiently general importance to warrant discussion here. The first concerns the special challenge of attempting to study the development of the researchers and their activities; the second concerns the problematic relationship between communication and consciousness which are especially acute in the present case.

"Bootstrappng" Development of Researcher Activities

In designing the present system, in which activities at one level serve as instruments for the activity at another level, we have found particularly useful the key insight of the early socio-historical theorists that it is a myth to believe that human beings can accomplish a voluntary act (such as reducing conflict with another) by "will-power." Rather, as Alexander Luria wrote more than half a century ago,

> [voluntary behavior] is the ability to create stimuli and to subordinate [oneself] to them; or in other words, to bring into being stimuli of a special order, directed at the organization of behavior (Luria, 1932, p. 401).

Considered at the level of children's activities, the "special stimuli" we have used are complexes consisting of computer-based tasks, often presented in the form of games, messages from children in far off places, and from a mythical wizard that arrive through the telecommunications network, etc.

However, we also had to extend Luria's principle to encompass the activities of adults: not all the good will in the world, he reminds us, suffices to permit us, as researchers, to engage in desired new forms of joint activity unless we can create new stimuli to which we can subordinate ourselves. In our terms, the communicative/educational activities we organize among schoolchildren using computers and computer networks must be considered specially created stimuli from the perspective of adults which are directed at the organization of adult behavior, in particular, behaviors that focus on new forms of cooperation, subordinated to the goal of creating new forms of joint activity of the children from our two countries.

The difficulty facing us as the adult researchers, of course, is that we have no benevolent adult to arrange a supportive environment for us. We must somehow "bootstrap" our own constraints and supports. For this aspect of the work, we have found it necessary to expand the methodology applied by the classic socio-historical scholars to encompass the special historical conditions under which we are working and to encompass the fact that we are simultaneously interested in designing a system in which the goal of promoting the development of children is a means of bringing about changes in adult behavior.

For example, as an aid in pursuing the goal of organizing a context for cooperation between Soviet and American researchers, we have supplemented the conceptual appa-

ratus of the socio-historical school by using as a "special stimulus," or "mental model" the famous Robber's Cave experiments of Kurt Lewin's students, Muzafer and Carolyn Sherif (1956). In that work it was demonstrated that groups of children brought into a state of dislike and fear through competitive interaction could be brought to a friendly, more unified state by confronting them simultaneously with a common problem, the solution of which could be achieved only through their joint efforts. In this model, when sufficient joint problem solving has been accomplished and the groups begin interacting in a friendly manner, the internal social organization of each group is different than it was either in the initial state before the groups started interaction and from the "state of war."

By analogy, the conditions we are dealing with are ones in which scientists in the US and USSR have long been in a state of competition, if not outright conflict. As a condition for creating harmonious cooperation, we chose a common problem, the need of our children to master new information technologies, the solution of which is a necessary condition for the continued development of humankind. In so far as we are successful in achieving the desired qualities of interaction and thereby enhance our local successes through joint efforts, the systems we design can be considered a model of the process referred to by the Soviet members of this group as perestroika and by the American members as re-mediation.

Inferences about Psychological Processes

It is obvious that at all of its levels, the functioning of our model of telecommunications-mediated activity is based on the verbal activity of the participants. Verbal mediation is necessary even for the most simple actions that would ordinarily go unexpressed in other communicative circumstances. Consequently, we are obligated to find ways to objectify cognitive activity in verbal form as a condition for realizing our project.

During all of human history, scholars have posed the problem of the adequacy or inadequacy, and even the possibility or impossibility, of expressing an idea (image, thought...) in words. V.A. Lektorsky made this point when he wrote that:

> Interesting ideas usually emerge from the depths of consciousness, and their verbal formulation often requires hard work... all ideas appear in some objectified form, although the latter need not be verbal... The translation of a verbally unformed idea (that is, unformed even in terms of inner speech) is not simply the activity of expressing some ready-made content in a different material but the development of the content itself (1984, p. 144, 145)

And perhaps the richest expression of this essential insight was provided by O.Mandelshtam, "I forgot the word that I wanted to say. And thought, unembodied, returns to the hall of shadows."

Owing to the special role of verbalization in mediating joint activity within the system, the model of communication that we have set up constitutes both a unique OBJECT of investigation and a condition for the development of the activity itself. Using a new means of interaction— telecommunications—with its own specific possibilities and constraints, this model possesses the following characteristics:

1. The "potential for communication" which adheres in any cognitive activity as a consequence of its social-mediational character (Lektorsky, p. 149), becomes necessity, an "imperative for verbal explication."
2. There occurs a qualitatively new form of human communication which did not exist in earlier historical periods— a special type of oral-written dialogic and even polylogical speech, which stimulates and demands a new form of literacy.
3. Accompanying the emergence of this new system of cultural mediation is a new kind of "cultural memory" existing in the form of the accumulated verbal texts, constituting a spatial-temporal mosaic reflecting the historically and logically non-random links in the development of the interactions.

Although the qualitatively distinct nature of the system of interactions that we are investigating clearly calls for the development of new scientific practices, we have simultaneously attempted to determine the extent to which already-existing models for the analysis of verbal interaction can be applied in our research. Consequently, when creating concrete cognitive-communicative situations for collaboration and joint cognitive development, and in grounding our approach to the investigation of verbal mediation using specific methods of analysis, we have drawn on the theoretical and methodological achievements not only of a variety of Soviet and American experimental psychologists, but of scholars from neighboring disciplines as well.

First, we draw upon investigations of referential communication and problems of understanding in dialogue, which help us to understand the role of general (often ambiguous) presuppositions and the "referential field" in

verbal communication (Belyaeva and Kharitonov, Robert Krauss, and James Wertsch among others).

Second, we use a conception of three types of criteria, constituting a set of interconnected, bipolar continua of "verbalization strategies" developed in the Communications Laboratory at the Institute of Psychology by Belyaeva and coworkers, Artem'eva, and others. Here we have in mind such criteria for the verbalization of images as: "direct" (spatial-geometric) versus "indirect" (metaphorical), "static" versus "dynamic," or based on "elements" versus "wholes."

Third, we use the classification of verbalization types specifying the temporal relation of verbalization to action, that is, cases in which the verbalization follows the action, accompanies the action, or preceeds the action developed by Vygotsky, Levina, Luria, and others. In using verbal indicators for reconstructing stages in the process of the development of conceptions in the course of joint activity, we have draw upon investigations conducted by Davydov, Lomov, Koltsova, Rubtsov, Cazden, and Martin.

For clarifying and evaluating several factors affecting the balance or imbalance of verbal interaction accompanying joint actions of some kind, we have found it productive to distinguish two kinds of dialogue, interpretive and informational, which allows us to apply methods for organizing cognitive-communicative activity and methods for analyzing verbal data carried out in experiments by Lomov, Belyaeva, H. Clark, and others.

A special concern in the current system that is evoked by the conditions of communication in our system is that the "charm of an underspecified world" which characterizes face to face, oral communication displays its underside— underverbalization can all too easily give birth to misunderstanding, "undercooperation," and "under- development." At all levels of the system any complex phenomenon, as we have emphasized, must be verbally mediated. However, the path to such verbal mediators resides in the construction of their images, which requires a "search and construction of their attributes," which in turn requires detailed description.

In recognition of this problem, we have attempted to verify the utility of methods of analysis (developed in the Communications Laboratory at the Institute of Psychology) that trace the ways that participants verbally express the attributes of objects, focussing on the verbalization of the key cognitive operations of measurement, comparison, and evaluation within different cognitive-communicative interactions. This same line of work has also provided us with ways of conceptualizing the role of imagistic- metaphorical verbalization for creating adequate understanding in interaction, including the important process of creating a joint image of the results of joint activity (Belyaeva, Koshelyuk, and Kharitonov).

Finally, in working toward a synthetic methodology adequate to this project, we have found ourselves going beyond psychology to draw upon methods of analysis developed in other social science disciplines. In recognition of the fact that we are participants in the very system that we are seeking to build, we have drawn on the method of participant observation from anthropology, in which the analyst relies on fieldnotes which then serve both as a description of the system and raw data for self-reflective analysis. In recognition of the fact that a great deal of our raw data consist of written messages, which must be related to other behavioral observations in a principled way, we have included sociologically and linguistically trained scholars in our project in order to take advantage of new techniques for the analysis of written and oral discourse.

Developing the Overall System

The desired participant structure of the overall project at the level of research sites and telecommunications links as of May, 1989 is pictured in Figure 1. Early on we dubbed our effort the "Velham" project to signal our intention to implement the desire of its sponsors that we create a viable system of scientific cooperation based on mutual respect and equivalence of both contribution and gain. The virtual point of "balance" uniting these two systems is in the telecommunications satellite through which the participants are linked. On the left side of the figure is a major node representing the American partici-

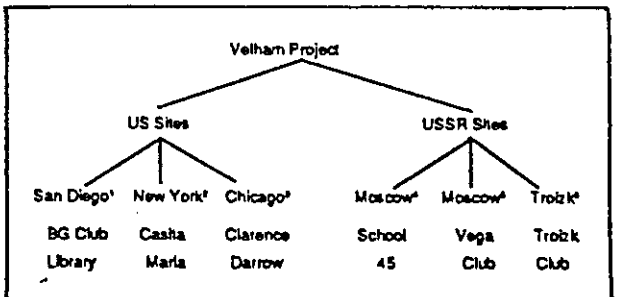


Figure 1: Structure of Participating Research Groups

pants, on the right side a major node representing the major Soviet participants. Under each national node are three major sites where researchers and children come together in concrete activity settings which generate the major data concerning computer-mediated educational activity.

In light of the scarcity of resources, the existence of multiple sites on each side requires brief comment, since it might appear that one site within each country would be sufficient to create the needed conditions of international communication. It was our belief at the outset (based on our own prior experience and the existing literature) that many unanticipated difficulties would arise as researchers attempted to organize new forms of computer telecommunicated activity among children. Were we to restrict ourselves to one site in each country, we would be unable to deconfound difficulties that arise from interNATIONAL communication from difficulties that arise purely from the fact that cooperation is mediated by telecommunications rather than face-to-face interaction.

Hence, in effect, we set out to create two balanced systems of interaction: one a cluster of interacting Soviet sites which were simultaneously in interaction with a cluster of American sites. We set as a minimum two sites on each side. Over time there has been some shifting around of the precise cast of characters, but at present the configuration as given in Figure 1 is the following:

In the USSR, central among the three research nodes is the Communication Laboratory of the Institute of Psychology, Academy of Sciences and its associated research site at a youth center associated with the Korchatov Institute of Atomic Physics. The other two sites are School #45 in Moscow and a youth center in the nearby town of Troizk

In the U.S.A. the central research node is the Laboratory of Comparative Human Cognition, San Diego and its associated sites at a youth center and library in the nearby suburb of Solana Beach. The other two nodes are a youth center in East Harlem, New York City, directed by researchers from Hunter College of the City University of New York and Teachers College, Columbia University, and a cluster of daycare centers associated with the Erikson Institute of Early Childhood Education in Chicago.

In addition, on the Soviet side considerable technical support has been provided by the Institute of Automated Systems, while on the American side, logistical support has been provided by staff at the Carnegie Corporation.

Although it is too schematic for many purposes, this diagram makes clear a major characteristic of the system: It is highly distributed geographically, both within and between countries and there is NO DIRECTOR. Instead, there are two COORDINATORS, Alexandra V. Belyaeva from Comlab in Moscow and Michael Cole from LCHC in San Diego. Responsibility for conduct of the system rests in the JOINT decisions of these two people, who are charged with responsibility both for coordination of the work of the distributed systems of which they are a part INTRA- nationally and INTER-nationally.

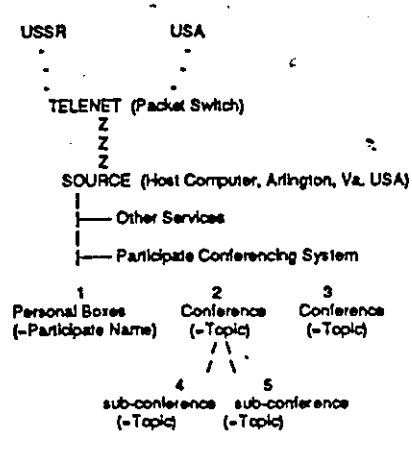
Developing Interactions Among the Researchers

At the outset we confronted the task of identifying research groups with responsibility for developing computer-based communicative/educational activity that might have an interest in participating in a system of joint research as a part of their ongoing activities. The explicit strategy of formulating the conditions of participation in this way arose from two key considerations. First, we needed to provide researchers in each country with experienced counterparts who would be perceived as worthy partners on the basis of their past performance. Second, we could not afford to create the entire superstructure of the project *de novo* in light of monetary constraints. Hence, we sought partners with ongoing projects for whom a modest increase in resources for purposes of communication, combined with the natural interest in Soviet-American cooperation, would be sufficient incentive.

Creating a Medium for Interaction at a Distance

In a purely technological sense, the common medium for interaction between investigators in different geographical locales (both within and between countries) was the structured teleconferencing system called Parti on The Source which exists on Telenet. This utility was chosen because Telenet could be reached by a local phone call from each of the basic research sites (in Moscow, by calling a modem at the Institute of Applied Systems, which was connected by a leased line to Helsinki and Vienna). In addition, for some years the American researchers on the project had been using The Source to unite researchers and children in systems of activity similar to those planned for this project. Figure 2a, on the next page, gives a diagram depicting the computer conference structure and Figure 2b depicts the method of logging in to the Parti conference system accounts. In a later section of this report we provide more detailed information about the workings of this system. Here it is sufficient for pur-

Figure 2a: Project Conferencing Structure



1: Personal & Urgent Notes can be sent to and from these boxes. Examples: COMLAB, LCHC, MCOLE, SASHA, VLAD, REAL WIZARD, VOLSHEBNIK, VEGA CLUB, CASITA MARIA, CDARROW

2, 3, 4, 5: Conference Notes can be sent to Topics. Personal boxes who are invited and join the topic get notified of updates and can read from and write to the Topic.

2: Examples: VELHAM, SUMMER EXPERIMENT, COMIMECO

3: Examples: RESEARCH CENTERS, JULY88, ISTOCHNIKI

4, 5: Examples: SURVIVING, CHICO, BOTANY, CUBES WVEM, SOCIAL ANALYSIS

Figure 2b: Sample logon

```
Connect to telenet by dialing 2330233
TELENET
714 202A
TERMINAL= <cr>
@c 30124
 > id tcn268
  Password:    xxxx
   -> parti
  "What is your participate name:" LCHC<cr>
   "What is your password:      XXXXX<cr>

      URGENT NOTES (1)
      PERSONAL NOTES (4)
      VELHAM (2)
      CHICO (3)
      SURVIVE (1)
      WVEM (2)
      SPRING89 (4)

    ACTION on Inbox—> (Read)
```

poses of understanding the general nature of the kinds of communication that characterize our system to note that message flow on this system is of several kinds. Most important are messages of two kinds:

1. Those sent from researchers at the various sites for purposes of planning joint activities, describing work with the children, and discussing theoretical or technical issues;
2. Those sent from children at one site to children at other sites as a part of the educational activity organized for them by the researchers (here we include teaching and technical staff in the category of researchers, although there is a complex division of labor among the adults involved).

Except for a brief period during the summer of 1987 when we conducted our first pilot experiment connecting children in joint activity using computers, the communication system was used exclusively by adults until October of 1988. Since that time, children's messages have been a regular part of the flow of message traffic, enabling us to state that at present we have an adequate communication medium for pursuing our research goals.

The problem of establishing common goals

In light of the desire of scholars in the two countries to promote better international understanding, this goal would seem rather easy to achieve, but in fact it turned out to be a major barrier which was overcome only after several false attempts. The difficulty resides in the phrase, "as a part of their ongoing activities," although it manifested itself differently in the two countries.

For example, in the United States we identified several centers with ongoing research projects involving children and computers. However, each center adopted a somewhat different strategy toward their subject matter. Center A focused on a particular computer language, seeking to develop rich activities on the basis of increasing programming skills, the specific content of which was to be driven by children's own interests. Center B focused on providing children with computer tools such as word processors, data bases, and intriguing micro-worlds. While Center A was interested in creating new kinds of activities using their programming language, they were not interested in the micro-worlds promoted by Center B, while Center B was not interested in teaching programming.

Efforts were made to find a common meeting ground among centers by creating new activities at a "neutral" research site created explicitly for this purpose. But now a new class of problems arose. Those who gathered face-to-face at the specially created site were quickly able

to formulate interesting possibilities for computer-based activities for children, but maintenance of this activity would require special staffing and hardware. In addition, the newly formed "face-to-face" combined group recapitulated the problem they set out to solve: Their group had created a new form of activity which fit their local/combined needs, but was not coordinated with the ongoing activity of the other, distant, sites, with whom they were supposed to be engaged in joint activity! The initial problem was simply displaced, not solved.

Somewhat different problems, with similar negative consequences for our efforts to create a new form of scientific interaction using the potential of computer networks, occurred in the Soviet Union. For example, at Center C a major strategy for developing its program of research was to conduct "computer camps" in which Soviet and American children could be brought together for several weeks in pursuit of the goals of reducing international tensions and exploring new forms of computer-based education. Simultaneously, at Center D the focus was on the creation of model classrooms organized around local area networks. Again, researchers in the two centers met and worked to create joint activities which might satisfy the goals of both groups. But again, the result, while interesting, did not fulfill the major goals of either institution and its development would have required the creation of a new research entity—for which there was insufficient money.

In the course of confronting these institutional barriers to creating the kind of "virtual research group" uniting geographically distributed centers within each country, we had to deal simultaneously with a further difficulty: computer networking as a fundamental part of the ongoing activity of ANY of the Soviet groups, and only a subset of the American groups. Hence, while we conceived of telecommunications as a crucial medium of coordination of already-similar goals that would allow synergistic interaction, we had to confront the fact that from the point of view of the participants, integration of dense computer-based communications required a major reorientation of daily activities.

Furthermore, this reorientation of effort required that the participants give up some degree of local autonomy in the interests of participation in the joint activity. When it became clear that this reorientation and renunciation of autonomy would be necessary without the provision of major new resources, researchers who found the idea of participation attractive at the outset responded in one of several ways. In at least one case, a participant made a major effort to appropriate the entire project into a single institution, concentrating all resources on that Center's goals. In other cases, participants regretfully withdrew because the performance demands on them by the local institutions could not be met if they continued to give time to the joint enterprise in the absence of a large infusion of resources.

This process was painful for all involved. At a general level there was genuine desire by everyone to conduct the proposed research. And by no means were the unsuccessful attempts along the way uninformative. We even managed to conduct one brief experiment of organizing joint activity among Soviet and American children at one site within each country as part of a summer camp from which we obtained important glimpses about difficulties to come when we finally succeeded in creating a multi-site system of ongoing interactions. However, all were repeatedly frustrated by the shortcomings of the partial systems we succeeded, at great effort, in creating.

As we became more experienced in recognizing the deep problems posed for potential participants by the conditions necessary to satisfy the constraints and to achieve the goals of our project, we eventually were able to identify potential participants whose goals and resources were sufficiently compatible to allow us to move on to a next stage of collaboration which we find ourselves in at the present time. We will describe the achievements of this next stage below. Here we will confine ourselves to noting that perhaps the first major result of our work was to demonstrate just how difficult it is to identify joint goals of sufficient common interest to motivate the very considerable intra-site readjustments that commitment to inter-site coordination requires.

Summary of Results

In this overview of our project we have been able to provide no more that a sketch of the rationale and history of our efforts to date and of the directions that the work has taken. In the following sections we will present several lines of concrete research which represent each of the different levels of the research (interactions among researchers about basic concepts related to the overall goals, interactions among researchers about use of particular programs and work with children, interactions among children, and descriptions of results contained in field notes).

Drawing on the sections to follow and additional materials that space restrictions will not permit us to include, we can summarize our results thus far as follows (additional details will be provided in ensuing publications):

At the most general level, two results stand out:

1. A unified model system has been created. Within it a unique cultural formation has emerged from the interaction of two socio-cultural environments, Soviet and American. The model system has recognizable borders which are flexible, but which can be defined, and which retain their integrity in the face of internal transformations. Its temporal dimension can be analyzed in terms of phases of initiation and transformation, of moments of development and moments of degradation, and so on. The model system can be visualized to a greater or lesser extent as a multidimensional whole or according to its separate dimensions; there exists in principle the possibility of distinguishing various of its components and specifying their links, their functions, and the possibility of relating them to different "dimensions."

2. In creating this system we have succeeded in overcoming a series of barriers—technological, political, cultural, psychological, bureaucratic, interdisciplinary, communicative. Of great importance, we believe, is the fact that this effort has been the result of a completely joint effort among the participants at all levels, which constitutes at least a small step toward the kind of change in global consciousness which constitutes our major goal.

More concretely, the following results stand out:

3. We have completed an analysis of an international teleconference which enriched the initial theoretical foundations of our model system.

4. We have analyzed critically several leading software programs on the basis of jointly planned and jointly executed experiments involving telecommunications and on the basis this work designed modified programs and procedures which are currently being investigated.

5. We have created a special mediational "virtual object," "The Wizard," as a means of overcoming various sources of discoordination that accompany telecommunicated joint activity among children.

6. We have developed a system for the collection and analysis of written descriptions of children's activities with computers that permits principled connections to be drawn between verbal behavior and states of individual and social consciousness.

7. We have been able to demonstrate reliable differences in developmental outcomes depending upon the kind of organization of communicative-cognitive activity (cooperation and interaction, parallel activity without interaction, and individual activity).

8. We have been able to trace the dynamics of children's interactions mediated by computers in a learning environment, from exchange of information and actions to interaction and cooperation, and further to the decline in desire for interaction after complete mastery of the object. This cycle repeats itself during changes in circumstances with the introduction of a new "potential for communication."

9. Higher levels of self-consciousness (reflexivity) and generalization have been achieved as a result of the new kinds of verbalization demanded by participation in the model system, both among children and adults.

10. We have demonstrated the specific role of imagistic-metaphorical verbalization in naming and making sense of new cultural objects in the socio-technical environment and in modelling the goals and results of activity.

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Figurative and Metaphorical Components in the Process of Denominating the New Technological Milieu

(on materials drawn from the MOST-86 and July-88 computer conferences)

A. V. Belyaeva
M. E. Koshelyuk
M. Cole
P. Griffin

In recent years, Soviet scholars have been researching situations involving the perception and verbalization of the image of complex, multidimensional stimuli that approximate real objects. Belyaeva and Nosulenko have studied the perception of complex sound signals and the verbalization of their images (Belyaeva & Nosulenko, 1984, 1985; Lomov, Belyaeva, Nosulenko, 1986; Nosulenko, 1988) and Belyaeva has supervised analogous research into complex visual stimuli (Belyaeva & Samojlenko, 1983; Samojlenko, 1986; Kharitonov, 1985, 1988). Komilov and his colleagues have investigated the features of image verbalization for several multimodal stimuli connected with labor activity (Zhukova, 1981; Komilov, 1976a, 1976b, 1979).

Connecting the verbalization of images to an activity system not only complicates the physical picture of the object but also alters its cultural status. When an object has a particular value (e.g., practical, aesthetic) within a culture, the task of seeking to denominate it becomes an independent and highly motivated undertaking. It is quite difficult to model such a situation in a laboratory experiment. As a rule, the verbalization of images of this kind and the search for a suitable denomination for them involves highly skilled professionals (e.g., writers, scholars, scientists, politicians) and occurs in the context of varied activities performed with the object, covering a long time-span and encompassing a broad range of communication situations. We can avoid the difficulties involved in simulating this sort of activity in a laboratory by working with a natural experiment, i.e., by analyzing activities that were undertaken for reasons outside of their ultimate value to the study of image verbalization.

The object of activity in the natural experiment

In our experiment, the object whose image was to be verbalized was a new technological milieu: the use of the computer as a means of communication. As discussed in the next article of this volume, the object participates in a simultaneous dual process — it is being created while it is being denominated. While a concrete objective definition is plausible in the case of simple perceptual stimuli provided *a priori* by the researchers in a laboratory experiment, it is not plausible to provide such a definition for a complex cultural object emerging in a natural activity. Hence, the description of our object requires a different strategy.

In 1986 (when our first data were collected), the object "computer used as a means of communication" had become significant to contemporary culture, yet it lacked stable denominations in the idiom, hence its suitability for our study. In this section we will describe some aspects of the object while elaborating on the almost paradoxical claim that it is "new" while being already significant. We will concentrate on the domain of education to demonstrate the significance of the object.

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The newness of the object.

The initial use of the computer was as a stand-alone information processing tool. Soon it became common to use computers as information retrieval tools — first obtaining information from a structured data base on a remote computer system and then using the local computer's processing capacity. For about 20 years, information scientists have gone a step further: connecting a local computer to a remote computer's "on-line" service and processing information before retrieving it. Given the shared technology and the shared information (and facilitating the shared tasks), these scientists also developed the "bulletin board" and "electronic mail" (e-mail) capability so that the remote computer system could accept messages sent by a user who connected to the system and make them available for reading by some other user (or set of users) who connected to the system from a different place or at a different time. Now such communicative use of computer technology has been expanded both in terms of who uses it and what form it takes. Scientific researchers (Catlett, 1989), business people (Piturro, 1989), and even kindergarten children (Anderson, 1989) use not only person-to-person e-mail and group electronic bulletin boards but also newly developed computer-conferencing systems especially designed for users who are not computer professionals but have specific topics to discuss and specific tasks to work on collaboratively while being physically distant from each other.

In spite of some time-depth and the gradual spread of this object "computers used as a means of communication," there are many indicators that it is "new" as a cultural object. For instance, in August of 1989, the journal "Management Review" announced, "Finally, a cure for 'telephone tag' and the high cost of business travel: computer conferencing" (Piturro, 1989, p. 43). In the same month, the journal "PC Magazine" queried, "Say the words 'electronic mail' and people will know exactly what you mean. Or will they?" (Simone, 1989, p. 175). Zuboff (1988) reports on machine-based innovations in several companies; along with the expected studies of factory and office automation, one company was studied for its innovative use of computer conferencing. Zuboff's work focuses on dilemmas and transformations that highlight the "newness" of the computer used as a means of communication.

The claim of "newness" also finds support in publications by communications theorists and psychologists. Cathcart and Gumpert (1983) note the gap in the literature concerning e-mail communication with computers, noting that it should be studied in contrast with other communication situations involving computers and should be analyzed so as to be categorized accurately with respect to non-computer related communication events. Kiesler, Siegel and McGuire (1987) claim, "Culturally, computer-mediated communication is still undeveloped" (p. 247). They list technical and cultural issues that need to be studied including the question, "How do people develop a communication network social structure using a technology in social transition?" (p. 249).

Some relevant research has been undertaken. Kiesler and her colleagues, for instance, have studied group behavior in computer-mediated communication, using choice-dilemma problems with small groups of persons for short periods of time. Contrasted with face-to-face communication, they report qualitative differences in the decision making processes for subjects using e-mail to communicate in the task situation. Roughly, the results indicate more egalitarian participation in computer-mediated decision-making situations, but also, more disorganized, less polite, and less efficient processes (Keisler et al. 1987, pp. 253-254). Keisler and her colleagues argue that these negative aspects can be related to the lack of a mature, developed culture wherein functional normative constraints could operate.

Maddox (1982, cited in Keisler et al.) conducted a natural experiment of e-mail use by a group who were collaborating at a distance to develop a new computer language. The data spans a year and 232 issues; the negative aspects Keisler found in the controlled studies appeared only on certain kinds of topics. More than half of the issues were resolved before the group had face-to-face meetings, suggesting the e-mail was effective, and the participants reported positively with respect to the task and to their long distance collaborators.

Hiltz and her colleagues have reported on both contrived and natural experiments with e-mail and e-conferencing systems (Hiltz and Turoff, 1982; Hiltz, Johnson & Turoff, 1982; Hiltz, 1984). They have demonstrated that research can assist in the design of developing computer communication systems as well as revealing information about the positive and negative impacts of the communication in various domains. Hiltz has made use of the automatic computer records from e-mail and e-conferences to assemble data for quantitative analysis involving, for example, differential frequency of use, as well as adapting Bales' (1955) coding system for small group interactions to the new medium.

The significance of the object in the domain of education.

"...[T]his 'second industrial revolution' heralded by the advent of computer-communications technologies" is analyzed by Robins and Webster (1987, p. 145) with respect to its effect on education:

> A recurrent theme of this comment and pressure has been that in the Information Society the computer/IT [Information Technology] *illiterate* (a highly resonant and threatening metaphor to be illiterate in this day and age!) will be severely disadvantaged, particularly as regards employment...This vocational prediction has been, we suspect, an especially powerful mobilizer of educationalists. (p. 146)

However, Robins and Webster argue against a curriculum designed under the pressure of technological determinism (that is, practical use of the machine "as is," for example, how to operate disk drives and keyboards, use word processors, spreadsheets, and data bases). They call for the development of a critical awareness of the social nature of technological change, both on the part of adults planning education and on the part of the students participating in it.

Our examination of educational practices involving computers in the United States (LCHC, 1989; Cole, Griffin & LCHC, 1987; Griffin & Cole, 1987) focuses on cases which counter technological determinism. By promulgating the use of the computer as a means of communication, the technology can be subordinated in contexts of activity where teachers, peers, academic subject matter domains, and wider societal concerns play a major role.

> Studies of the use of telecommunications as an integral part of overall educational activity consistently find that, when properly organized, telecommunications provide rich opportunities for children to articulate new goals. It enables them to reflect on their own learning, to use writing as a tool of both communication and thought, and to create social contexts which are not merely "passive backgrounds" for learning but arenas for goal-oriented, reflective problem-solving...(LCHC, 1989, p. 80).

Simply providing the technology for e-mail, electronic bulletin boards, and/or computer conferences is not sufficient. Computer mediated access to other people in other contexts will not automatically provide benefits to the educational processes (Diaz, 1988; Levin, Riel, Boruta & Rowe, 1985; Newman, Brienne, Goldman, Jackson & Magzamen, 1988); however, when the means are used to facilitate joint activity at a distance, interesting results have been reported including increases in critical reflective activities, and in motivation, as well as gains specific to academic subject matter domains. Demonstrations of the plausibility and effectiveness of involving children in computer mediated communications include a long-distance newspaper, the "Computer Chronicles" (Riel, 1985), an Intercultural Network, focusing on social and natural sciences and practical problems (Riel, 1986), as well as computer-mediated bi-lingual communication focusing on literacy (Diaz, 1988).

Educational activity can also be the context for adults' use of computer-mediated communication. High school science teachers, for example, used a specially designed computer conference system (Katz, McSwiney & Stroud, 1987). There were three tiers of results that the teachers valued: (1) The isolation teachers often report (being the only adult in the locale doing, for instance, physics) could be overcome by interaction with teachers at a distance; (2) Participating in group (of 40) discussions about teaching increased the store of teaching strategies that teachers could reflect on and choose among; (3) Specific information about particular aspects of the science being taught could be gained from other teachers as well as from practicing scientists active in the computer conference.

The benefits of having both adults and children involved in computer-mediated communication about educational activities have been taken up by the several larger-scale projects which have developed in the US and internationally. These include: the AT&T Long Distance Learning Network, FrEd Mail, the McGraw Hill Information Exchange, and the National Geographic Kidnet (c.f. Riel 1988, for a summary description of such projects).

The need for basic research on the object.

The above information should make the case that the object "the use of the computer as a means of communication" is new and significant in the domain of education; however, the matter is not closed. Kaye (1988, p. 363) notes "...there is a strong element of hyperbole in much of what is currently said about the potential for education of computer-mediated communications ...often in the absence of any serious analysis." We have referred to studies which (1) compare computer-mediated and face-to-face communication, (2) evaluate efficacy of computer-mediated communication with respect to standards for well-known problem-solving tasks or the rate at which a group resorts to face-to-face meetings, (3) estimate the value of

the medium by collecting frequency of use data and/or user response to questionnaires, and (4) evaluate the efficacy of the medium by the frequency of practice or measures of achievement in particular academic domains. In many cases, of course, the aim of the projects reported were to demonstrate the feasibility of using the computer as a new means of communication; an existence proof is sufficient. Especially in the complicated cases connected to well-organized educational activity situated in institutional settings that had previously made little use of computers or of other communications technologies, the existence and maintenance of the computer network can be counted as an important achievement.

Another set of efforts to analyze computer-mediated communication involves the reflective analysis of participant-observers and/or logical analysis of the features of computer-mediated communication systems. In this vein, Scollon (1983) reports on the use of computers to mediate communication among people spread around the globe and unlikely to meet face-to-face as a group, while Black, Levin, Mehan & Quinn (1983) report on a system used to mediate between people who attended the same university campus. In these cases, the significance of timing in computer-mediated communication is highlighted. Since messages can be transmitted very quickly in e-mail or computer conferences (several initiation-response rounds can occur in one working day), there is a good possibility that several participants can jointly contribute to the development of an idea, as is also possible in face-to-face or telephone communication; yet, with e-mail or computer conferences, the "non-real time" element offers time for participants to work at very different paces, to look up information, to self-evaluate their contributions, to seek advice from colleagues. Thus the processes associated with time are hypothesized to be related to differential quality of participation as well as to differential frequency of contribution by members less likely to contribute under real-time conditions.

In spite of these studies and analyses, Kaye's call for more analytic efforts is still valid. The noticeable gap is in research into the basic processes involved in a computer-mediated communicative event. What do people do when using e-mail and computer conferences? What are the structures and functions involved? What images of this new object effect their communication? When Kaye (1988, p. 366) described three kinds of computer-mediated communication, he noted, "In a way it is regrettable that terms like 'mail,' 'conferencing,' and 'information banks' [referring to data- bases] are used to describe these technologies, because they provide metaphors which are inappropriate." It is this process of denomination of the new object in the context of people using a computer conference that we investigate here.

The activity in the natural experiment

We had the opportunity to study the verbalization of the image of the new object in a communication situation which actually made use of the new computerized communication technologies. We used materials from computer conferences associated with the Soviet-American Velikhov-Hamburg Project, whose aim is to develop and test an approach to the use of computers and new communication technologies in the teaching of younger school children (see the previous article, this volume, for details).

The project's computer conferences.

A computer conference, in this context, is defined as a natural communication event with a varying duration, taking place as an interchange mediated by computerized communication technologies, organized in the form of a polilogue (having more than two participants), and committed to the resolution of certain tasks, including the discussion of certain problems. Since 1986, in the course of the Velikhov-Hamburg project, we have instituted over two dozen computer conferences, complementing other forms of computer-mediated communication (*viz*, person-to- person and locale-to-locale e-mail, as well as real time computer chats or "written conversations").

The development of the different conferences have been naturally occurring by-products of the use of computerized means of communication for our main project tasks and opportunities, growing over time to aid in the accomplishment of our work. Most of the conferences are binational, having participants from the USSR and the USA. A few are intra-national for issues (and translations) relevant only to one country. Sometimes conferences are accessed from a more broad international base: Some topics have involved scholars from Europe and Asia and sometimes the USA and USSR participants use the conferences when their other work takes them to a third country. Some conferences are quasi-permanent, having been maintained for over two years. From these, there are four kinds of spin-off conferences: (1) temporary conferences that focus on particular time frames when certain short-term experiments and/or delegation visit business requires it; (2) "sub-conferences" that develop from the longer term more general conferences as tasks and commentaries associated with particular topics become more

frequent and specialized; (3) "sub-conferences" that are set up as an incentive for the growth of previously underdeveloped topics or tasks; (4) "sub-conferences" that are set up to encourage participation from particular members, for example, child participants. The roster of participants varies from conference to conference and over time; some have had as few as five members, and some over thirty. The conferences and sub- conferences have names which index their function and topic to the members (CHICO is about children's communication; ISTOCHNIKI is about theoretical foundations; POND and LOGOPLUS are about particular educational computer activities; FALL88 is about the autumn of 1988).

As a general rule, the native language of the writer is used to post notes and the receiving side translates. The Russian language has most often been transliterated into the Latin alphabet; there has been an experimental period during which Cyrillic alphabet was transmitted while a special tool for receiving it was being developed and currently we have access to a new remote computer system, ADONIS, which has facilities for posting messages in both the Cyrillic and the Latin alphabets.

The specific computer technology used also varies. Micro-computers, often lap-tops, with user-friendly communications software and modems connect participants to office or residential telephones. A local telephone call connects them to a packet-switch utility and, by satellite, to a remote host computer which offers e-mail and conferencing software by subscription to the general public. We have used USA based hosts (The Source, EIES, TCN, Peacenet) and have just begun using a USSR based host (ADONIS). There have been some special cases in the telecommunication arrangements. Occasionally, participants do not directly access the host computers — the conference notes and e-mail are "portaged" by another participant. Some portaging involves "downloading" to disk from the host which most members use, and then "uploading" to a different host with other e-mail or conferencing facilities (including Arpanet and Bitnet used by many USA participants, the Bank Street Exchange especially organized for New York City participants, Debishell organized for child participants in San Diego). Other portaging has involved downloading messages and hand delivering disk copies or print-outs. Occasionally, too, a member does not use a modem and telephone connection but rather a leased line or a Local Area Network for a part of the process.

Messages posted in our conferences are sometimes from individuals and sometimes from groups. Some groups are long-standing and reflect previously existing local institutions (e.g. LCHC, COMLAB, CASITA MARIA) and others are *ad hoc*, reflecting spontaneous collaborative responses from people in face-to-face contact. In addition, there are messages from a special class of participants, Electronic Wizards (see the next article in this volume for detailed discussion).

The conference being studied.

For this analysis, we focus on the first conference of our project. The MOST computer conference ran from July 21, 1986 to August 22, 1986; it was made up of over 100 messages. MOST was organized as a direct result of a visit to the USA by a Soviet delegation consisting of A. V. Belyaeva and V. E. Teremetsky to prepare and plan the Velikhov-Hamburg Project. This was the computer conference's central task. Thirty-two scholars and scientists participated, primarily from the USSR and the USA, but also from, for example, Japan, Great Britain, Denmark, Italy. This particular computer conference was selected for analysis precisely because its identified tasks naturally included seeking suitable denominations for the new technological milieu.

On several occasions, however, we also draw comparisons with another computer conference (JULY-88) which was held from July 6 through 26, 1988. This computer conference was also motivated by the visit to the USA of a working group from the Soviet side of the project. The participants in this computer conference were 14 Soviet and American project members, who at the time were located in various points in the USA and the USSR. Thirty-four messages were initiated.

Methodological notes.

The analysis is based on advances in research on the verbalization of the image as developed in Belyaeva's Communication Laboratory in the Institute of Psychology, USSR Academy of Sciences. The aims are (1) to investigate how a complex cultural object is denominated in the course of natural communication events; (2) to define the role of figurative-metaphorical components in the evolution and thematic organization of polilogic discourse; and (3) to define the role of figurative-metaphorical components in the process of group problem-solving. Since the research used materials from an interchange mediated by computerized technologies, we also expected that our work would contribute to the investigation of the nature of computer-mediated interchange.

Constraints on procedures. Several circumstances constrained the analysis and influenced our choice of procedures. First, as discussed above, we regard the computer conferences we analyzed as natural experiments on the verbalization of an image of a complex cultural object. This situation, unlike a laboratory experiment, offered no opportunity to isolate and monitor the variables that influence the use of figurative-metaphorical components in an interchange. The picture of inter-connections here was far more complex and required a great deal more interpretation. Second, the task of verbalizing the image of the object under consideration was not expressly placed before the computer conference participants but came up naturally within the framework of their interchange and their activity. This allowed us to analyze the conditions wherein a similar task might arise (c. f. Newman, Griffin & Cole, 1989, ch. 3&4). But, on the other hand, in the absence of a precisely articulated task -- the development of a suitable denomination — the participants in the interchange were not obliged to reach agreement on that subject.

A final constraint derived from the nature of the materials collected in the computer conferences. Since the material for analysis is natural linguistic output, opportunities for the application of quantitative methods to process our results are severely limited (c.f. Griffin, Cole & Newman, 1982). The content of the messages was of central interest, in the light of our research tasks. We were therefore compelled to develop elaborate coding algorithms and rely on expert coders to prepare our analysis. The methods were developed and carried out in the USSR, where the expertise in analysis of verbalization of the image resided, but the majority of the materials were in English. Thus, the limited availability of English -speaking coders, the large volume of material, and the novelty of that material prevented us from enlisting a large number of experts, whose coding reliability could be evaluated statistically. In order to enhance the reliability of our results, we endeavored to compile a precise algorithm for the expert coders to use and to apply it repeatedly, resolving coder disagreements by consensus based on the algorithm. Wherever possible, the results were subjected to statistical treatment.

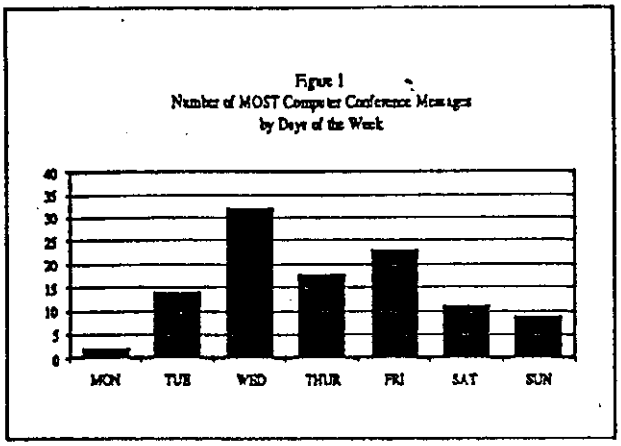
Determining units in the data. Substantial difficulties arose in the demarcation of units to be coded because the material of computer conferences can be viewed from several different perspectives. A computer conference may be viewed as (1) a text organized around some defined content; (2) a protocol of the process of group problem-solving; (3) a record of a particular kind of a communication event, a polilogue. Each of these perspectives suggests a different method for dividing the material into units, *viz.*, (1) topics and subtopics; (2) stages in problem solution; (3) replies and stages of the polilogue's development.

When analyzing the material we could not use one type of unit demarcation without considering the others. When examining the thematic structure of the computer conferences, we had to consider the theme as a content- communication unit, not as a mere logical unit of content. The general topic of the conference resonated in (and was constituted by) the topics (themes) of separate messages, as is expected in polilogue communication events. Similarly, when identifying the subtopics in each separate message as the content-communication units on the next level, we had to view them not only as a way to interpret the topic of the message, but also as a function of the general thematic structure of the computer conference as a whole. The sub-topics identified for one message were not necessarily of the same order as those in another message; when the same sub-topic occurred in more than one message it would not necessarily be equally covered and would be identified on different bases in each message. However dissimilar the sub-topics might be from this perspective, they had to be treated as similar with respect to representation of the functional thematic units of the polilogue as a whole.

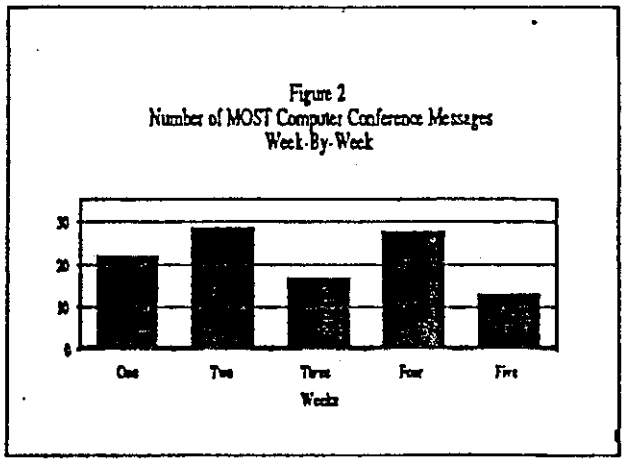
When demarcating the units from the point of view of the process of group problem-solving, it is necessary to consider not only the cognitive, but the communicative element. We based our work on Bales' method for analyzing group discussion (Bales, 1955, 1972). (Mikhalevskaya, 1985, and Gurevich, 1981, discuss the method's shortcomings and virtues.) This method has been widely applied and has previously been used to analyze computer conference materials (Hiltz, 1982, p. 105-110).

Sequential partitioning. No matter which perspective is used to demarcate units to section the textual material, there are no automatic and clear operational criteria for identifying the chronological partitions in the material. The arbitrary selection of a chronological unit would have led to the demarcation of fragments with no internal organization either substantive, functional, or communication-oriented. Although all the messages are dated, it would have been pointless to section the computer conference by days, since (1) the computer conference participants lived in different time zones, which meant that the telecommunications network was in use round the clock; (2) the time of message dispatch did not coincide with the

time of its receipt, which varied according to when different readers "logged in" to read conference notes and according to the timing of the special "portage" arrangements for those not directly accessing the main host computer.



Preliminary analysis indicated a pattern of message intensity by days of the week. Message frequency grew from the beginning of the week to mid-week and slackened off from mid-week to the end of the week (see Figure 1). Just as the fragments of face-to-face interchange are separated by pauses, this computer conference material falls into rhythmic weekly intervals. This demarcation has less to do with the internal logic of the polilogue than with the social organization of time to which the chronological rhythm of the telecommunications system use may be attributed. We came to regard the weekly intervals as chronological units (stages) in the computer conference. For the frequency of messages week-by-week, see Figure 2.



Stages in the procedure. Each message in the MOST computer conference was coded in three different ways: two related to content and one adapted from the Bales' system of problem-solving categories for face-to-face polilogues. In addition, procedures were established to investigate more deeply than these codings would allow and to describe links between these codings. Our procedure has six steps.

(1) A leading content theme was singled out for each message. To do this, expert coders gradually compressed each message. From the original message text of varying lengths, we derived a summary that would fit on an index card; from that, we derived a summary not exceeding fivesentences; from that, we derived a message title. All the candidate themes thus identified could be arranged in a limited number of groups. We derived 4 such groups and then coded each message as belonging to one of these lead themes of the computer conference. The week-by-week prominence of each lead theme was analyzed.

(2) Returning again to the full original text of the message, sub-topics were identified in each message. Reviewing the roster of candidate sub-topics after we had processed all the messages in the computer conference, we could identify 17 sub-topics that recurred throughout the computer conference. The sub-topics so derived included 3 that were identical in definition to 3 of the lead themes. We then coded each message according to the conference-wide sub-topics it contained. The coding was more differentiated and presented a larger number ofintersections than in the previous stage. While our procedures dictated that each message could have only one theme, any message could have a larger number of sub-topics. We investigated the correlations between the appearance of these sub-topics and the lead themes identified in step 1 above. The thematic load of the messages (the average number of sub-topics touched upon) was analyzed and we investigated the correlation between thematic load and each of the lead themes, overall and week-by-week.

(3) Based upon the structure of the computer conference identified in the preceding steps, thematically organized communication chains were analyzed. We grouped all the messages with a shared theme and examined the organization of links among them. We also grouped all the messages with shared sub-topics, looking for patterns with respect to the overall thematic structure, *viz.*, how the sub-topic emerged, with what other sub-topics it was linked in the course of the discussion, what sub-topics

were "spin-offs" from it. Further we examined groups of sub-topics to discover the ways in which the sub-topic was discussed, *viz.*, whether or not a problem was articulated, and, if so, in what form, the course whereby it was resolved, and the form of the result.

(4) As a supplement to the qualitative analysis in the preceding stage and based on the results of step 2, the links between sub-topics were subjected to cluster analysis.

(5) The structure of the process of group problem-solving was analyzed using Bales' method for all the messages taken together, then separately for the lead theme of special interest, the one involving metaphor.

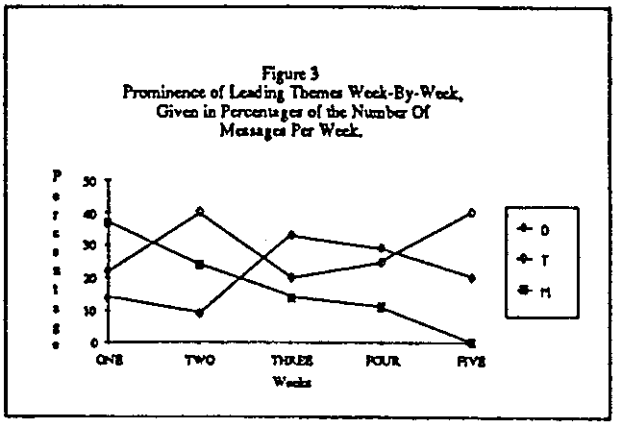
(6) The internal organization of the metaphor theme was separately analyzed. The individual basic denominations used in referring to the new technological milieu were singled out, and their prominence, types, relations to the referent, and the basic transformations they underwent in the course of the discussion were analyzed. At this stage, we drew an active comparison with materials from the JULY-88 computer conference.

Although the entire analysis we performed was committed to resolving our own tasks, a similar algorithm may, by and large, be useful more generally for theinclusive analysis of communication events such as computer conferences.

Results

Thematic patterns. The analysis revealed four basic themes in the MOST computer conference.
(1) 34 messages (32.4% of total) were designated with a K, indicating "coordination [koordinatsiya] of interaction." This theme concerns the organizational and technical issues of the current computer conference.
(2) 19 messages (18.1%) were designated with an M, indicating "metaphor." This theme concerns the search for a suitable denomination for the new technological milieu.
(3) 21 messages (20%) were designated with an O indicating "experience [opyt]." The theme focussed on the computer conference participants' concrete experience in using computers and new communication technologies.
(4) 31 messages (29.5%) were designated with T for "theoretical analysis." This covered the discussion of general issues pertaining to the nature, organization and utilization of computer-mediated communication.

Of special interest to us, the independent status of the metaphor theme is evident in this sorting of the material: It accounts for one-fifth of the entire computer conference volume, and, if one considers only the substantive messages, excluding messages on coordination, then metaphor accounts for more than a quarter (26.8%) of the total volume.



These themes made their first appearance in the MOST computer conference in the following order: coordination [K] in message 1; metaphor [M] in message 5; theoretical [T] in message 11; and experience [O] in message 17. An analysis of the prominence of the four themes week-by-week showed that messages about coordination were distributed equally through the entire computer conference (with negligible differences week-by-week). As depicted in Figure 3, the metaphor theme predominated in the first week, the theoretical discussions dominated the second and fifth weeks, and the experience theme predominated in the third and fourth weeks. Note also that the contribution made by metaphor theme messages to the weekly discussion steadily decreased. These results suggest a dynamic process which can be sketched as follows: "word -> concept -> referent -> concept." At the beginning of the discussion, it proved fruitful to articulate the issue of the idiom in which the object of the computer conference was to be discussed. Substantive issues subsequently moved into the foreground bringing with them the need to address the field of reference, i.e., the experience, of the computer conference participants. The object of the discussion was initially registered through figurative-metaphorical components, paving the way for discussion on a higher, conceptual plane.

Sub-topic patterns. Seventeen basic sub-topics were uncovered in the MOST computer conference messages. The following list indicates the designation we used for the sub-topic, a brief description, and the number of times the sub-topic recurred.

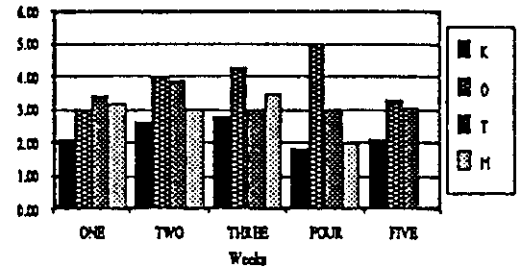
D -divergent approaches to teaching principles (3)
S -material expenditures on telecommunication (4)
E -computer communication equality principles(7)
V -problems of the organization of the main project (8)
R -analyzing telecommunication materials methods(11)
F -forms of telecommunication (12)
L -linguistic/cultural differences/ telecommunication (11)
Q -particular nature of mediated communication (14)
J -issues of interaction between people and computers (14)
G -goals when using telecommunication (15)
C -telecommunication and joint activity organization (21)
A -pedagogy with telecommunication activities (21)
H -telecommunication technical and program issues (35)
W -specific uses of computers in education (36)
K'-coordination (as in leading theme) (43)
O'-personal experience (as in leading theme) (37)
M'-metaphor (as in leading theme) (35)

(Note: Since more than one sub-topic could occur per message, the last three sub-topic counts differ from those derived when these categories were used as leading themes.)

This sub-topic listing encompasses a fairly wide range of issues. About 3 sub-topics (3.1) were touched upon in each message. The amount of topic density varied in relation to the kind of lead theme a message had. The highest index of density was for the "experience" theme messages (4.2); descriptions of working experience provide an opportunity to touch upon a broad range of issues with no need to expressly reconstruct the links between those sub-topics. The lowest density was for the "coordination" theme (2.2); the theme is linked to sub-topic H (technical and program issues). When current issues of the computer conference were discussed in the messages, the issue was as a rule raised in the form of a practical task (reasons for data loss during transmission, ways of systematizing file transfer, etc.).

For the messages with "metaphor" and "general theoretical" themes, the topic-density is close to the average (3.0 and 3.4 respectively). Messages with either of these themes functioned to expand the computer conference's thematic structure. Since the indices of topic density for the metaphor theme are so close to the average for the computer conference, we can postulate that the figurative-metaphorical components contribute to the evolution of the computer conference's structure, its content. That is, the topic density of messages devoted not to content as such but to ways of representing that content linguistically corresponds closely to the direct discussion of the content.

Figure 4
Weekly Variations in the Average Topic Density of Messages Categorized by Leading Theme



Note in Figure 4 that the index of topic density per message varies from week to week, reaching its maximum in the third week (3.0) and dropping below the level of the first week by the end of the computer conference. (2.9 and 2.8 respectively). This indicates a natural culminating point for the computer conference as a communication event. The dynamic of the indices of topic density for the major themes by and large corresponds to the dynamic of their quantitative prominence. As can be seen from Figure 4, the highest average weekly indices of topic density were logged for metaphor [M] and general theoretical [T] in thefirst week, for experience [O] and T in the second week, for O and M in the third week, for O in the fourth week, and for O and T in the fifth week. This distribution corresponds closely to that depicted in Figure 3 above, where only leading theme distribution is considered. The leading themes in a given week are at the same time the most information-dense, the richest in content. This suggests that it is valid for us to isolate the thematic dynamic and the role of figurative-metaphorical components in the evolution of that dynamic.

In view of the small volume for each identified sub-topic and thevariation in volume from sub-topic to sub-topic, it is difficult to provide a sophisticated yet reliable evaluation of the dynamic of evolution in the computer conference's thematic structure. There were some observable tendencies, however: Sub-topics about goals when using telecommunications [G] and about telecommunication and joint activity [C] were more prominent in the first week; in the second week, joint activity [C] and telecommunication and effective pedagogy [A] were prominent; in the third, sub-topic A continued to be important and the nature of computer mediated commun-

ication [Q] was also prominent; in the fourth week, sub-topic Q maintained its prominence; finally, in the fifth week, sub-topic Q continued and was joined by prominent discussion of analytic methods for telecommunicated material [R] and forms of telecommunication [F].

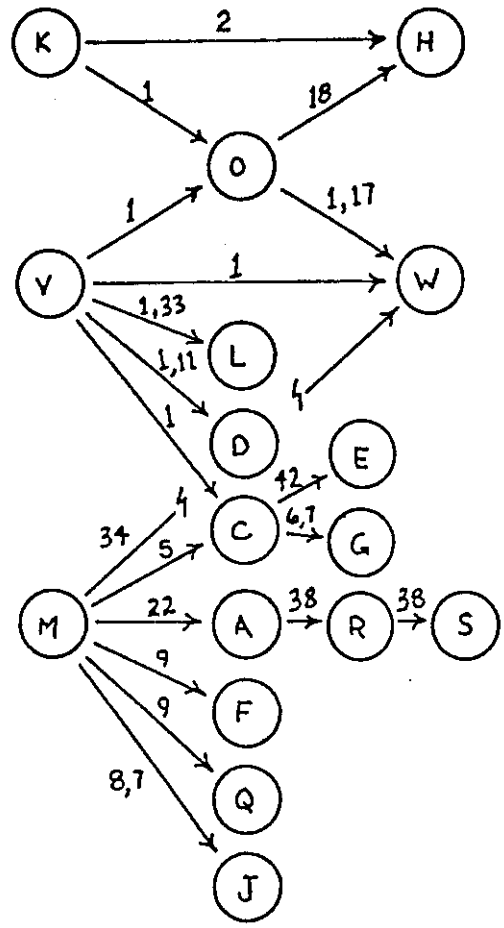
This pattern suggests that the "word -> concept -> experience -> concept" dynamic (noted above in the discussion of the leading themes) is coupled with a perceptible transition from the discussion of the goals and general problems of the organization of joint activity to a more differentiated discussion of concrete kinds of joint activity, followed by a discussion of the more general features of the use of new communication technologies (its specific nature, forms, and methods of analysis).

These two types of dynamic are interlinked chronologically. So, for instance, sub-topics G (goals when using telecommunications) and C (telecommunication and joint activity) originated in message 5, in which the metaphor theme [M] was first raised. As will be demonstrated below, sub-topic A (telecommunication and effective pedagogy) is quite firmly linked with theme O (experience with computers). Interpreting this result from the perspective of the role of figurative-metaphorical components in this particular cognitive/communicative event, we can say that those components engender a discussion of more general questions and of the meaning of the activity that is being performed.

This was confirmed in the next stage of analysis. Although the metaphor [M] theme was not among the most quantitatively conspicuous during the first stage of analysis nor the most substantively conspicuous during the second, it was found to play the key role in the evolution of the computer conference's thematic structure. An analysis of features involved in the inception of sub-topics showed that 10 basic sub-topics originated with the discussion of metaphor [M] (see Figure 5).

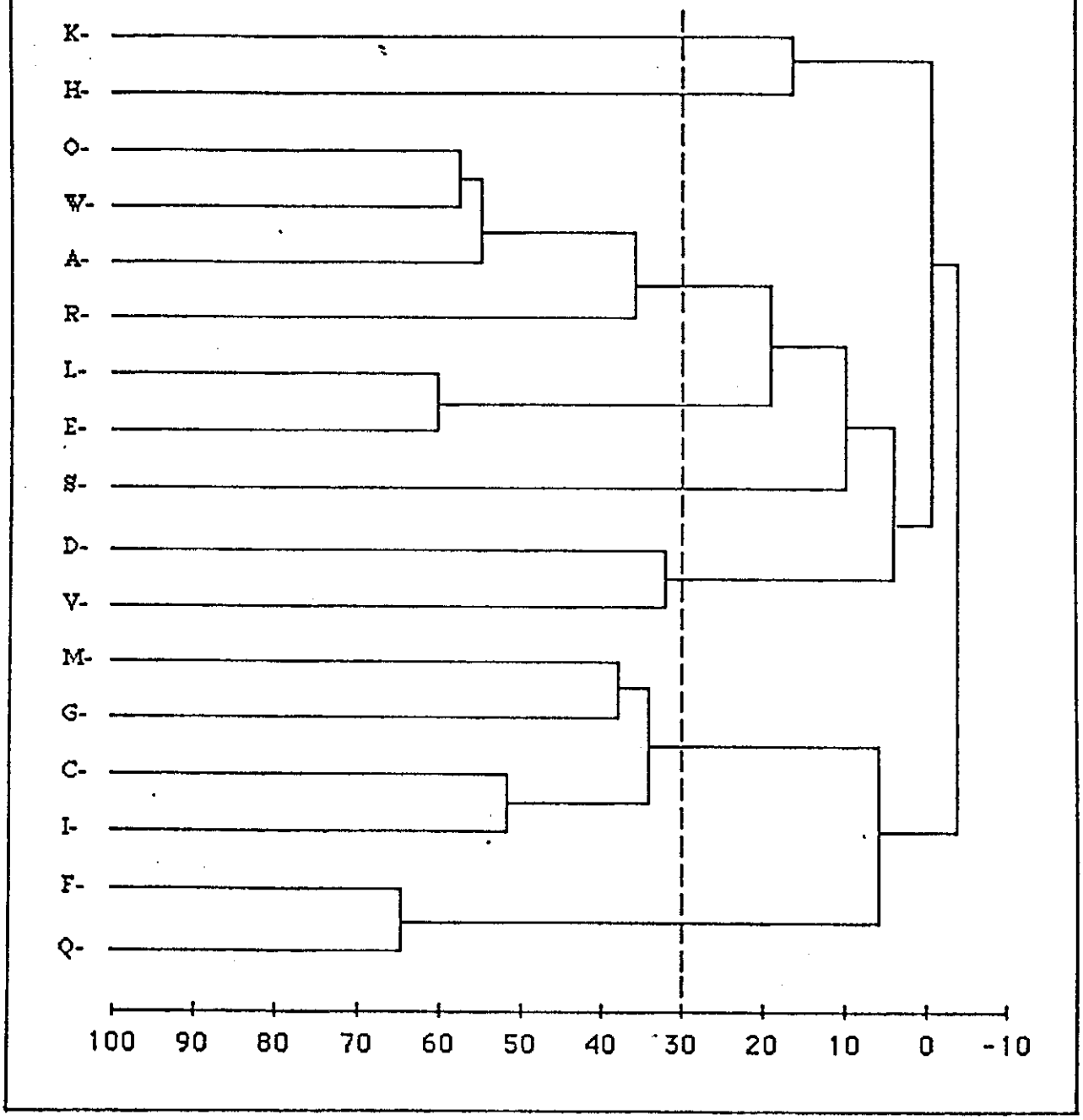
Confirmation of the interlinking of the dynamic revealed by the lead themes and the one revealed by the sub-topics is found in a cluster analysis of the links arising between sub-topics (see Figure 6, opposite page). The use of cluster analysis at this stage of the analysis made it possible to disclose basic tendencies in those interconnections. Upon substantive analysis, the picture proved to be far more complicated and difficult to interpret. A 0.30 correlation coefficient brought five significantly differing clusters to light:

Figure 5
Links Reflecting the Inception of Sub-topics in the MOST Computer Conference



(1) V (project organization) and D (divergent teaching approaches principle);
(2) M' (metaphor), G (goals when using telecommunications), C (telecommunication and joint activity), and J (people and computer interactions);
(3) O'(experience with computers), W (computers and communication technologies in education), A (telecommunication and effective pedagogy), and R (analytic methods for telecommunicated material);
(4) L (linguistic/cultural differences in telecommunication) and E (participant equality in telecommunication);
(5) F (forms of telecommunication) and Q (nature of computer mediated communication).

Figure 6
Cluster Analysis of Links between Sub-topics
in the MOST Computer Conference



The topics of coordination [K'], technical and program issues [H] and costs [S] did not correlate significantly with any of the other sub-topics. The structure of the cluster tree reveals the following general groupings:
(1) K' and H;
(2) Q, W, A, R, L, E, S, D, V;
(3) M', G, C, J, F, Q.

Three points summarize the results of the analysis of sub-topic inception and of the links they formed in the course of the discussion:
(1) Sub-topics K', O', and M' are separated. This confirms the validity of grouping the messages in the computer conference according to the lead themes which correspond to these sub-topics: coordination [K], metaphor [M], experience [O], and general theory [T];
(2) The links between sub-topics in the course of the discussion differ somewhat from their links on inception. For instance, sub-topic C (telecommunication and joint activity), whose inception ties in with sub-topics M' (metaphor) and V (project organization), came closer to sub-topic M' in the course of the discussion. A qualitative analysis established that the joint activity sub-topic [C] was actually raised twice in the MOST computer conference but the basic line followed in the discussion of that sub- topic tied it closely to the metaphor topic [M']. On the other hand, sub-topic A (telecommunication and effective pedagogy), which was also brought up by the metaphor discussion, was more intimately linked with sub-topic O', about experience with computers. While it originated in a discussion of the properties of a specific metaphor (comparing computer-mediated communication with a bridge), sub-topic A actually features in the computer conference as one of the parameters used in describing experiences with computerized communication technologies (sub-topic O');
(3) The cluster analysis data confirm the key role played by figurative-metaphorical components in the computer conference's structural development. In the course of discussion, a group of sub-topics — goals when using telecommunications [G], telecommunication and joint activity [C], and people and computer interactions [J] cluster around the metaphor sub-topic [M'] (correlation coefficients, 0.34). Sub-topics F (forms of telecommunication) and Q (nature of computer mediated communication) also tend in this direction (the correlation coefficients between sub-topic M and sub-topics G, C, J, F and Q being, respectively, 0.25, 0.42, 0.34, 0.39, and 0.16). These sub-topics connect with the metaphor discussion not only in their inception but also in the actual course of discussion. In terms of content, they unify the more general issues raised in the MOST computer conference. Here the subject of discussion is the nature and rationale of telecommunication. This pattern corroborates the results achieved when the dynamic of the lead themes is correlated with the relevant sub-topic dynamics.

Message chains and the salience of the metaphor theme. To discuss the salience of the metaphor theme in the MOST computer conference, we shall consider how messages are chained together, what features in a note can be associated with subsequent uptake and which seem to inhibit uptake. It is instructive to compare messages 1 and 5, in each of which a leading theme of the computer conference originated: message 1 originated the coordination theme [K] and message 5 originated the metaphor theme [M].

In message 1, the reasons for launching this computer conference were explained, its tasks were defined, and a list of problems pertinent to it was presented. As it turned out this was not a fruitful way of articulating those problems. Although message 1 contains the suggestion that the participants share their experience in using computerized communication technologies, there were only isolated responses to this. An intensive exchange of experience evolved only after several similar requests had been made much later on (e.g., messages 38, 52). Message 1 was not the only one in which uptake difficulty occurred: A question first raised in message 30 had to be asked repeatedly before sub-topic L (discussion of linguistic and cultural differences related to telecommunications) began to develop.

An examination of sub-topics linked to the coordination theme, by tracing their initiation and by cluster analysis, show similar delays and infelicities. While sub-topic V (organization of the project) was brought up in message 1 as an object for planning and discussion, the project being organized was never directly discussed, though the computer conference participants were periodically faced with specialized questions that touched upon certain aspects of that project. The topics that were "spun off" from this continued probing -- sub-topics L (linguistic and cultural differences), O (experience with computer technologies), and D (principles of divergent approaches to teaching) — were organized as a chain of questions and answers or a series of answers. In the case of sub-topic E (participant equality in telecommunication), which was also presented in the form of a question, the only answers volunteered were confirmations of how important that topic was. Sub-topics H (technical and software problems) and W (specific uses of computers in education) did not form an integral whole organized as a single communication-

oriented entity; rather, they represented isolated aspects of the discussion of the problem. Overall, then, the coordination theme [K] was organized as discrete question-answer chains relating to the computer conference's current tasks.

Message 5 was organized in a fundamentally different way. It suggested that a start be made by discussing the extent to which the metaphor carried in the computer conference's title [MOST is Russian for "bridge"] was applicable to an interchange mediated by computerized telecommunication technologies. Different metaphors that could be used to describe various kinds of interfacing (the organization of person/computer interaction) were mentioned at this time. This message immediately generated several responses. In message 6, the issue of a suitable denomination for telecommunication was raised in connection with the goals of the interchange. In message 9, the history, advantages, and shortcomings of the "bridge" metaphor were discussed, and the features of telecommunication, uncovered through comparing its various forms (networking and bridge connections) were enlisted to support the arguments. The emphasis placed upon the role of the human factor (active involvement) in telecommunication led the next participant to inquire about concrete ways of using telecommunications (kinds of activity), and so on. We note that the development of this discussion is typical not only of message 5 but also of messages 9, 47, etc., which are linked with the discussion of problems pertaining to denomination and concrete metaphors.

The organization of sub-topics related to the metaphor [M] theme of message 1 differs considerably from those linked to the coordination theme of message 5. Here observation-observation chains predominated. Sub-topics that spun off from the metaphor theme can be categorized in one of three ways: (1) They were identically organized in all the same observation-observation chains, as for sub-topic Q (the particular nature of mediated communication); (2) They were initially discussed within the same messages as the metaphor sub-topic [M'], an aspect of it, and thereafter formulated as problems and spun off separately, asfor sub-topics A (telecommunication and effective pedagogy), J (issues of interaction between people and computers), C (telecommunication and joint activity), and G (goals when using telecommunications); or (3) They were never separated out at all and continued to refer back to the metaphor theme, as for sub-topics F (forms of telecommunication) and W (specific uses of computers in education).

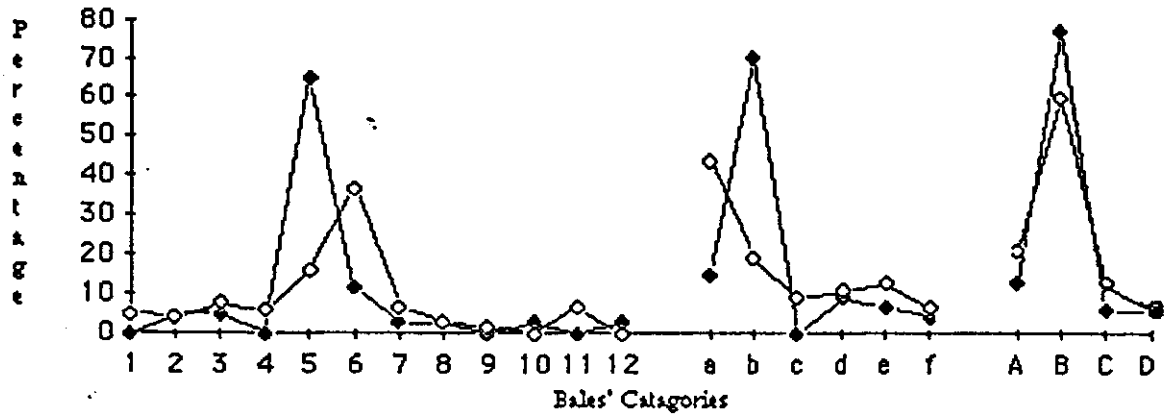
In summary, message 1 states precisely formulated problems as discrete issues but exhibits difficulties of subsequent uptake, while message 5 has no such precise, differentiated articulation of problems and exhibites rich uptake. The organization of links between messages within the associated sub-topics accordingly differs. In message 5, then, the discussion began before the problem was precisely formulated and laid the groundwork for that formulation.

We interpret this divergence in the organization of discussion as follows: A precise articulation of a problem segregated a priori provides both a rigid thematic framework for the discussion and rigid criteria upon which the relevance of any answer (the extent to which the answer correlates with the resolution of the problem that has been posed) is evaluated. When there is no such framework, it becomes possible to set forth and generalize one's experience freely, adhering to one's own logic. Discussion participants thus have more opportunities to exhibit their own idiosyncracies (preferences in the selection of themes, expository style, etc.) and are to some extent placed on an equal footing in the discussion. In the a priori formulated discussions, the solution is rooted in professional competence; in the other case, that competence is supplemented by linguistic and general cultural competence. There is evidently less potential for frustration in the second instance, which serves as a stimulus to the discussion and allows it to take a freer form.

Problem solving analysis using Bales' categories. By analyzing the computer conference as a group problem-solving process we were able to verify the validity of the interpretation (given just above) of the characteristics associated with successful chains of messages. We will very briefly report on our use of the Interaction Process Analysis (Bales, 1955, 1972) on the messages in the MOST computer conference. (We will not describe the data reduction and analysis procedures or the category system, here, for reasons of space and because the materials are widely available and most familiar having been used in many studies of group-problem-solving. Instead, we provide the "glosses" for the categories which are of interest for our particular purposes.) Our first interest was to see if the Bales profile of the MOST conference resembled other published information about group problem-solving processes. Figure 7 (next page) provides our results.

Data obtained in other research using the Bales' method allowed us to evaluate the reliability of our results. One of the norms concerns category B— the cluster of codes that

Figure 7
Contrasting the Metaphor Topic With Other Messages in the MOST Computer Conference, Using Bales' Catagories.



KEY:
Filled Square = Messages in Metaphor Topic
Open Square = Other Messages
Percentage = Expressed as % of Total Number of Messages
Bales Catagories Focused on Here:
a = exhange of information
b = exchange of opinion
c = mutual control
e = lessening on interpersonal tensions
B = attempts to solve problems

are considered "attempts to solve the problem." For Mikhalevskaya (1985), this category accounts for 56% of all the statements made in face-to-face groups; we had a somewhat higher index, 65.69%. Hiltz and Turoff (1982, p. 109) present different results for face-to-face interchange at 68.5% and for computer conferencing at 76.83%. The results of our coding of the MOST conference, then, fall within the range of published data, which would indicate that it is reliable. The pattern of differences between the face-to-face and computer conference norms suggests that the following proposition should be further tested: It appears that attempts at problem-solving are, by and large, expressed on a rather higher plane in mediated interchange than face-to-face. This could be linked to the larger number of statements made in a polilogue and the fact that messages are keyboarded, not spoken.

Another dependency established by Bales was also confirmed: Expressions of positive emotions outnumbered those of negative feelings by two to one (in our cases, 19 to 10). There were, however, several salient features where our MOST data diverged from expectations based on published norms. For instance, the "information -> opinion -> proposal of solutions" dynamic was absent from the evolving discussion. In our case, an exchange of opinions predominated during the first weeks and was later eclipsed by an exchange of information. Attempts at mutual control, which tend to come up when a decision is about to be made, were understated in general and in the latter weeks were entirely absent. We may assume that there is a connection between this and the specific nature of the given computer conference, in which no mention was ever made of coming to any definitive solution and where many of the participants were encountering each other for the first time.

Our second interest in the problem-solving coding was to examine the features of a discussion whose mainstay was the use of figurative-metaphorical components. Figure 7 presents data for messages from the

metaphor topic separately from those for the remaining messages. A significant difference was found when correlating category a (exchange of information) and category b (exchange of opinion). Category b predominates for messages of the metaphor topic, and category a for the rest. Further, 68.6% of all category b messages, which were concentrated in the opinion-exchange phase, belonged to the metaphor group. It appears that the figurative-metaphorical components really are conducive to the fruitful development of a discussion (exchange of opinions). Of greater importance, however, is the fact that the role of figurative-metaphorical components is most vividly manifested in the intermediate phases before the decision is reached. Although we are unaware of any other data gathered from group problem-solving situations which confirms the result, it is consistent with frequently stated hypotheses on the role of metaphor in theunconscious preparation for decision-making (see, for example, Vejn & Moldavanu, 1987).

The discussion based on figurative-metaphorical components had one more strongly distinguishing, albeit less explicit, feature. Categories c (mutual control) and e (expression of a lessening of interpersonal tension) were almost entirely absent from metaphor messages, but were found more frequently among the other message types. This confirms our supposition that a discussion that rests upon figurative-metaphorical components is on the whole less frustrating and more free-ranging.

The third interest that we had in the results of using the interactional problem-solving coding involved the contributions of individuals. Of particular interest is the comparison of the individual styles of group discussion participation adopted by the authors of message 1 and message 5, the most active individuals in the computer conference. Here, as in the contrast between the metaphor theme and other messages, there is also a difference in prominence of categories c (mutual control) and e (expression of a lessening of interpersonal tension). For both participants, category b (exchange of opinion) predominated over category a (exchange of information). From the perspective of the prominence of categories c and e, the style of the author of message 5 bore more resemblance to the features of the metaphor theme discussion (which message 5 initiated), while that of the author of message 1 came closer to the features of the discussion of the remaining themes. It may be assumed that reliance upon figurative-metaphorical components in a discussion connects with a less explicit tendency toward domination. This is expressed in a focus not only upon the task at hand but also upon the processes occurring within the group, in attempts to influence the group decision. A comparison of the profiles of the authors of messages 1 and 5 with those of the two other most active participants demonstrated that status within the group (the author of message 1 being one of the computer conference organizers) plays no determinative role here, inasmuch as the personal profile of the other computer conference organizer had more in common with the personal profile of the author of message 5.

Metaphors used in MOST to denominate the new object

In the above sections, we have analyzed the MOST computer conference in various ways. Metaphor was seen to figure in the structure of the leading themes that emerged with the "word -> concept -> referent -> content" dynamic; as we examined sub-topics, metaphor again proved relevant to issues of inception, cluster analysis, communication chains, and problem-solving interactional codes. At this point, we focus concretely on the metaphors used by the MOST conference participants in their messages.

Frequency and classification of metaphors used. MOST produced over 120 words and expressions containing a more or less explicit metaphorical component. Taken in the aggregate, those expressions fall into two large groups.

The first group of metaphors consists of words and phrases used to denominate realia not directly connected with computer mediated communication: e.g., "get the ball rolling" (begin the discussion), "little shells with little selves" (the isolation of people in themodern world), "it's almost as if we have been holding the seat or keeping eggs warm until the birds come back" (the impossibility of predicting how the discussion will develop). Examples of this group are found in virtually any communication event; as a rule they are one-time only occurrences in the event. These kinds of metaphors are difficult to separate from non-metaphorical expressions since, in time, the metaphor often acquires the status of a direct denomination (as in "the conversational ball" related to "get the ball rolling.")

The second group, of greater interest to us, was used for the denomination of telecommunication as a whole and of its individual aspects or forms. Its boundaries were clearly delineated, and individual expressions recurred repeatedly, providing the subject matter for specialized discussion. It was the prominence of this group of expressions and words which made it possible for the MOST computer

conference to be regarded as a natural experiment in the verbalization of the image of a particular object—namely, the use of the computer as a means of communication.

Many of the metaphorical expressions are variations of one another, i.e., modifications of the part of speech, kindred words, adjectival supplementation. When all expressions which are variations of one single metaphor are grouped together, the following six metaphors can be analyzed as the content of the discussion in MOST about the object, "the use of the computer as a means of communication:"
(1) "Bridge" was used 94 times with 9 variations in 20 messages by 15 different participants;
(2) "Portage" was used 31 times with 4 variations in 15 messages by 12 participants;
(3) "Patch" occurred 15 times with 4 variations in 6 messages by 6 participants;
(4) "Open-world classroom" was used 4 times with no variations in 2 messages by 2 participants;
(5) "Global teleapprenticeship" occurred 5 times with 4 variations in 3 messages by only 1 participant; and
(6). User interface metaphors were studied in 17 variations occurring in 9 messages.

The user interface metaphors cannot be counted with the same certitude as the other five metaphors we studied. Unlike the preceding five metaphors, the user interface metaphor variations are linked not so much with modification of the word as with the concretization of theoriginal metaphor. User interface expands into three metaphors*(iz.*, conversation, model world, collaborative manipulation) each of which is subsequently concretized in numerous variants. User interface metaphors are closely linked to forms of interaction among people; it is often difficult to determine when people are using the reference to the human interaction as a direct reference (ignoring, for the rhetorical purpose at hand, any tie to computer-mediated communication) which they intend as a comparison/contrast with user interface and when they are using the terms as metaphorical references to develop the concept of user interface. Hence, the job of drawing precise boundaries around this class can be expected to be a complex undertaking and we limited our study to the 17 cases which were most clear metaphorical uses, rather than exhausting the corpus as we did for the other five metaphors.

In the course of the discussion all the metaphors were subject to some degree of criticism. Generally speaking, no universally-acceptable metaphor was settled upon. However, in the concluding phases of the discussion, many of the metaphors (bridge, portage, composition, patch, etc.) were beginning to be used as set turns of phrase. The various metaphors did not appear in succession, one replacing another, but were discussed in parallel. Message 5, which originated this topic, contained the "bridge" metaphor (later discussed in messages 7-9, 15-22-26-41, etc.), the "portage" metaphor (later discussed in messages 7-9-10-15-16-22-24-27-51, etc.), and user interface metaphors (later discussed in messages 7-12-13-14-24-27-36-37-38, etc.). Part of this parallel process was the constant introduction of new metaphors or metaphor variants (teleapprenticeship in 13; composition in 27; appropriation in 37; open-world classroom in 46; patch in 47, etc.).[2]

Denomination, polysemanticity, and metaphor.

It is not only the case that metaphors develop in parallel for the same referent, but it is also the case that the referent for a given metaphor changes constantly, if subtly. In our data, for example, at one time, a given metaphor is spoken of as a metaphor for the medium; at another time, as a metaphor for communication in the medium. The use of metaphors in the MOST and JULY-88 computer conference created a situation characterized by a multiplicity of denominations for the same referent and a multiplicity of referents for the same denomination.

This situation makes it possible to come up with a novel denomination. Turner (1983, p. 34) drew attention to an analogous relationship between the symbol and its meaning [significate] in ritual. The metaphorical nature of language, the polysemanticity of expressions and the multiplicity of denominations in "traditional" cultures has been noted several times in the literature (e.g., Afanasiev, 1982, pp. 21-22; Cole & Scribner, 1977, p. 58 ff; Lotman, 1987, p. 18; etc). In traditional cultures, there is often intensive activity involving new denominations, intensive linguistic development. The instability of word-referent relationships provides an opportunity to widen or modify the meaning of a word, to transfer the meaning to new objects, and even to uncover the features of a new object as activity related to its denomination is undertaken. Osip Mandelshtam (1987, p. 42) described the process:

> The living word does not designate the item but freely selects, as if for a domicile, a given item-specific import, a corporeality, a sweet body. And the words wander free about the corporeal entity, as the soul wanders about a body abandoned but not forgotten.

Averintsev (1979, p. 52) ties the process explicitly to metaphor:

> Between the mundane word and the philosophical term there should always lie a zone in which words are freed from rigid bonding to their 'place' in life... this is the zone of the metaphor.

We can demonstrate some of the dynamics involved by focussing on the "bridge" metaphor in the polilogue computer conference. First, it is necessary to point out that the metaphors function as a system. Taken as an aggregate, they embrace virtually all essential relationships in telecommunications, *viz.*, (1) "person (group of people) <—> person (group of people)," which breaks down into (1a) "user <—> user" and (1b) "programmer <—> user;" (2) "human being <—> computer;" and (3) "computer <—> computer." Each metaphor functions as part of a system of links, but often temporarily disengages itself from the rest of the system to focus on certain aspects.

The "bridge" [most] metaphor was used to pinpoint group-to-group relationships. In addition to associated direct references, the focus can be seen in the opposing elements that were identified during the discussion of the metaphor's usefulness: The "bridge" metaphor brought out group to group relations in discussions of (1) the *fait accompli* of unification & the grounds for unification; (2) hostile relations & amicable relations; (3) active involvement & passivity.

At the same time, each of the metaphors used to pinpoint a part of system of links can be transferred to the system as a whole. For example, the "bridge" metaphor and its variations come to be used to designate (1) the current computer conference, (2) telecommunication as a whole, (3) some non-computer specialized forms, e.g., interactive video-link exchanges, (4) any satellite telecommunication, (5) any computer-mediated telecommunication, (6) any means of communication in the broad sense of the word, (7) any link (c..f. the Russian expression "navodit' mosty" [to build bridges] meaning to establish links), and (8) any interchange.

Analogous analyses apply to the other metaphors in the polilogue communication of the MOST computer conference. Each can be seen to "specialize" in the development of one aspect of the system of links relevant to the general referent, akin to Mandelshtam's "item-specific import" and Averintsev's note of "their 'place' in life." But at the same time, each can, in Mandelshtam's terms, "wander free about the corporeal entity."

It is noteworthy that material drawn from the computer conference serves to demonstrate the need for this kind of dual relationship between the word and the referent. In the computer conference, as noted above, several topics were typically developed in parallel. Compared to targeted laboratory experiment situations, this is unusual. Yet it is also characteristic of the everyday practice of linguistic creativity, when a person participates in numerous relatively independent communication events. Since the traditional laboratory experiment as a rule models just one such event, the multiplicity of denominations noted here as a condition for fixing upon a new denomination falls out of focus and tends to be attributed to the inadequacies of individual metaphors. Evidently, a multisemantic, flexible relationship between the metaphor and its referent can only evolve on condition that the situation in which the discussion takes place is also flexible, free, not frustrating — precisely the kind of situation demonstrated above in our analysis of the thematic, sub-topic and problem-solving interactions associated with the metaphor theme in this conference.

Concept development, analysis by synthesis, and metaphor.

In addition to participating in a system of links concerned with the social relations of telecommunications, the metaphors can be analyzed in relation to a system of conceptual links. The aggregate of metaphors encompasses the basic conceptual relationships into which the concept of "telecommunication" falls. Telecommunication may be viewed as: (1) a form of personal interchange and interpersonal relationship; (2) a type of technical modality that mediates an interchange; or (3) a means (form) of computer use. All three instances are a matter of "genus-species" relationships between concepts. When metaphorical expressions are used, however, the "subsumption under a more general concept" adopts a specific form. We shall demonstrate this taking the "bridge" metaphor as an example.

The comparison of "bridge" and telecommunication does not initially bring to light features that are specific to the concrete means of communication but, rather, those features that are common to means of communication as a whole. So, for instance, in message 9, the fact that a bridge may be used both for establishing friendly relations and for an act of aggression was pointed out as a shortcoming of the "bridge" metaphor. The author of message 15 objected, saying that the goal for which a modality may be utilized is not one of its *a priori* features.

We take this and similar examples throughout the corpus as a demonstration that an expression used as a

metaphor simultaneously fulfills two functions, being (1) the designator of a concrete object (or class of objects); and (2) one version (a "prototype") of a more general concept. The comparison takes the form of matching a particular item and another particular item, but the content of that comparison is between the particular and the general, this being the actual underpinning of "subsumption under a more general concept." The metaphor performs the groundwork for concept formation; it is a preconceptual form of generalization.

This proposition is confirmed by an analysis of the features of the developmental dynamic of the metaphor theme during the MOST computer conference. This theme expanded as a chain of metaphor-metaphor comparisons, which ultimately uncovered certain essential attributes of telecommunication (its goals, forms, modes of utilization, features) that later became the subject of independent discussion, spinning off as independent subtopics. The discussion of metaphor in the MOST computer conference was actually a preparation for the discussion of the nature and attributes of the computer conference on a conceptual plane.

The identification and preparation of the discussion of those sub-topics was based upon analysis through synthesis. Examining all the transformations undergone by concrete metaphors in the course of discussion and metaphor-metaphor comparison, we identified the following basic types of operations performed with metaphors:
(1) Analysis and modification of the sign itself (translation from one language to another, etymological analysis, the parsing of a part of speech, adjectival supplementation and the formation of compound words);
(2) Analysis and refinement of the meaning of the word and its referent (addressing the word's direct referent and the cultural experience that is linked to it; the definition of the meaning of the word or the concept that is designated by the given word; the enlistment of a kindred term);
(3) Analysis and explication of a personal attitude toward the given word, its "private rationale" (reference to personal experience with respect to the referent of the given word; explication of the associations it elicits; reconstruction of the image or "visual pattern" elicited by that word);
(4) Analysis and modification of the new referential situation (refinement, replacement or sectioning of the referent; reconstruction of the situation in which the new denomination was first manifested; change in the status of the denomination with respect to the referent — primary or secondary denomination, metaphor or analogy, conventional denomination or term [concept]; analysis of the metaphor's intended audience).

All four types of operation were applied to each of the basic metaphors discussed in the MOST computer conference, although the operations varied depending upon the intensity of the discussion of the metaphor in question. The subject for reflection and modification was the entire totality of relationships in which a given metaphor is included as a significative formation. This served to alter the "sign/referent" relationships, as mentioned above. Reflection on the meaning of a word and its referent, the refinement of the actual referential situation, and also the combination of the diverse systems of links to which the referent belongs, due to metaphor-metaphor comparison, ensures the demarcation of the metaphor's essential attributes and helps in working out the relevant concept.

Metaphorical denomination and specific activity

Our analysis of metaphorical expressions confirms their link with the purposive and semantic structures of reality. To investigate this, we compared the basic metaphors from the MOST computer conference with those in the JULY-88 computer conference. MOST was held when the Velikhov-Hamburg project was first being organized. The priority task of MOST was project planning. The JULY-88 computer conference was held two years later, by which time the project had acquired an official status, and had been the subject of a number of concrete studies. The tasks of JULY-88 included the conceptualization of the outcomes of work done thus far and planning for the year ahead. In both cases, metaphors were enlisted to denominate the same referent — namely, computer mediated communication.

The author of JULY-88's introductory message attempted to construct an image portraying the organization of work on the project as a comparison between immediate (face-to-face) and mediated (E-mail and computer conference) interchange. The authors of message 2 suggested the construction of a discrete image for each of the stages of work on the project. The author of message 4 suggested the metaphor of "walls across the path of communication, one wall after another," which became a basic metaphor in this computer conference. The metaphors of "soil" as a multilayer developing system (message 13) and "ascent to a mountain summit" (message 21) were also introduced. All three metaphors feature the multilayer aspect (message 21 speaks of repeated ascents to the summit), which bespeaks an attempt to construct a more differentiated image. The multilayer aspect was absent from all the metaphors used in the MOST computer conference.

Another substantial distinction is that the metaphors from the JULY-88 computer conference focus on emergent difficulties while those from MOST concentrate on the possibilities of overcoming difficulties. At the beginning of the discussion of the "bridge" metaphor in MOST, the author of message 7 says: "On the traveler's difficult journeys, transportation by portage was replaced - all right, then, not by bridges but by locks or, putting it in a different way, fords were replaced by bridges. In other words, the obstacles faced by travelers were eliminated by the efforts and hard work of the builders of roads." Telecommunication was portrayed as a means to overcome obstacles in MOST but in JULY-88 it was portrayed as having obstacles.

These differences correspond to the different stages in the development of the project of which the computer conferences were a part. When the work was first being organized it was necessary to focus attention on the mere possibility of organizing the telecommunication. Therefore the "bridge" and "portage" metaphors pinpointed the way (the means) of overcoming difficulties, which later engendered a discussion of problems pertaining to the organization of joint activity and the role of general goals in that activity. By the time of the JULY-88 computer conference, the possibility of organizing joint activity had already been confirmed by working experience on the project. In the course of this work, however, various difficulties had been encountered on numerous occasions. If the project was to develop further, those difficulties had to be recognized and ways of overcoming them had to be defined, hence the metaphors referring to barriers and repetitive trials. The computer conference participants' tasks were such that it was possible to ignore the difficulties in the first encounter, whereas in the second it was necessary to focus on them, perhaps even to exaggerate them.

Two diverse images of telecommunication were constructed in these two computer conferences. The choice of metaphor is constrained by the place which the referential object occupies in reality and by the current tasks of activity. The constraint defines the system of attributes identified within the object as well as the systems one may obviate at the given stage of activity. At the same time, the attempt to construct an integral image, the search for a metaphor, is linked with the pivotal points of activity: its planning (the image of the goal, the "requisite future") and its summing-up (the image of the result). Metaphors appear precisely at those points when the subject of activity is faced with the task of generalizing.

Conclusion

We have not investigated all the ways in which metaphors function in cognitive-communicative processes. The metaphor's emotive function has not been studied; however, the link we established between the use of metaphor and certain features of the organization and participation in group discussion (absence of domination, reduced frustration) could prove fruitful in helping to disclose the mechanisms of the metaphor's emotive function. Similarly, we have not elaborated the heuristic function of metaphors. Several MOST computer conference messages (primarily those connected with user interface-type metaphors), noted that metaphors make it possible to construct new objects. Work reported above can be seen as contributing to such a study, in particular, the analyses of the duality of the process of denomination, of the metaphor's link with planning and result generalization, and of the links between metaphors and the tasks of current activity. (The next article in this volume focuses on the heuristic function of metaphor.)

The analytic procedure applied in this study may be a fruitful approach to further analyses of complex communication events involving both face-to-face and computer mediated interchange. The use of the computer conference as a form of natural experiment on the verbalization of a complex cultural object has given us a more differentiated conception of the role played by figurative-metaphorical components in image verbalization and the evolution of communication in general.

We have demonstrated that figurative-metaphorical components play a key role in the verbalization of the image of complex culturally significative objects. Metaphors in polilogue situations like a computer conference supply resources in the search for a denomination for a new object as they allow for a multiplicity of names with an undefined referent and the reconceptualization of the systems of relations in which the sign is included. As a concrete form of analysis through synthesis, a communication event in which metaphorical expressions develop constitutes a preparation for conceptual generalization. The specifics of denomination are contingent upon the place occupied by the communication event in larger structures of activity, the use of figurative-metaphorical components being closely linked with the semantic and purposive structures of activity.

We have seen, from the perspective of problem-solving interactions, that figurative-metaphorical components are

closely linked with the stages occurring before a definitive solution is reached. Furthermore, when a polilogue relies upon figurative-metaphorical components, a discussion can begin before the problem is clearly formulated in detail and tends to be associated with a free and flexible organization. It appears that a tendency to domination as a personal idiosyncracy hampers the utilization of figurative-metaphorical components. However, discussion which relies on figurative-metaphorical components serves as preparation for a discussion of a wide range of problems connected with the features of the object of denomination and can be a fruitful way of launching that discussion. The recourse to abstraction as represented by the use of metaphor in a polilogue opens the way for the participants to "ascend to the concrete" in naming their object and accomplishing their tasks.

Notes

[1] The rise in the index of thematic density for type M messages in the third week ties in with the introduction of new metaphors.

[2] A comparable situation arose in the JULY-88 computer conference. The three basic metaphors which functioned in parallel were steny [walls], pochva [soil], voskhozhdenie na vershiny [ascent to a summit].

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The Heuristic Function of Metaphor and Issues in the Use of the Electronic Wizard

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In the course of our work on the Velikhov-Hamburg project, it has been essential to address widespread concern that introducing new technologies to young children may have a negative impact on their development. We will address this concern, theoretically and practically, in terms of the concept of a "quasi-object," and suggest two means for handling the issue: First, harness the conditionality of play activity and, second, use the computer for communicative activity. More specifically, we address the practical problems of introducing children to computers and to participation in computer-mediated activity by making use of a "quasi-object," the Electronic Wizard, which is a tool for harnessing play to the process of problem solving for both adults and children. We illustrate our general approach to the use of metaphor as a heuristic device in this report on studies of the Electronic Wizard, which demonstrate (1) links of the Volshebnik (the Soviet Electronic Wizard) to Russian folk culture (2) the verbalization of the image of the Volshebnik by children involved in a short computer based teaching/learning experiment, and (3) links of the American Electronic Wizard to the Fifth Dimension, a synthetic cultural device for educational, communicative computer use by children and (4) the verbalization of the image of the Wizard in the context of the Fifth Dimension.

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Machines versus humanism?

Childhood play and social bonding with adults and peers are properly regarded as important for healthy development. If children use computers, some believe that they will lose interest in (or at least time from) spontaneous, creative play; perhaps they will be so attracted to the machines that they become alienated from the people around them. Such fears may be exacerbated as one observes, hears about, or reads in newspapers about adults with undiscriminating enthusiasm for computer games, "computer addiction," a separate "hacker" culture, and diverse ways of attributing a mystique to the computer. The kind of anthropomorphizing about computers that we notice is also a special concern: It is not so worrying when people attribute to pets an ability to love and protect as another human would, but it is worrying when the capability to think, to plan, to take away jobs, and, in general, to control us, is attributed to machines.

It sometimes appears that children are very susceptible to the lure of computers. For many children, as soon as they are in a setting with computers, computer games seem to monopolize their attention. The games often have a strong motivational charge (Malone, 1981) both by virtue of the computer's features (rapid action, graphic quality), and, by virtue of the social situation that often surrounds their use (prestige for high scores among players, and, for many games, even financial rewards for the owner of a game disk). There is often a distinct ideological load in the concrete topics of computer games that increases their attractiveness for children as well as the concerns that society has about using computers with children.

Our practical experience with children suggests that these fears need not be realized, even in settings where children are allowed to use computer games. An analysis of the computer as "quasi-object" helps to situate our experiences and to suggest what educators need to consider to insure that education using computer games avoids such pitfalls.

The "quasi-object."

According to Terkel, "The video game is a graphic, dynamic representation of the computer's internal 'programmed world' that controls the game," (quoted from Zuev, 1987 p. 134). A computer game may take the form

of a narrative or some other play activity, but it is also a representation (usually in a non-narrative form) of the computer's internal programmed "world." In fact, virtually any use of a computer involves such a duality—the form and content of the interface to the human co-exists with the machine language. The appearance of such a duality suggests that an activity involving a computer can be understood to involve a "quasi-object" and a consideration of this concept will help us to arrive at a deeper understanding of the potential and problems of computer use with children.

There is always duality in situations that produce quasi-objects — the real and the ideal is the paradigm situation. Consider a creative activity, when something new is being made. At the very beginning, there can be an image, an ideal of the resultant final object. That image is a quasi-object. It is not uncommon for a creative activity to include several successive quasi-objects whose content and form differ widely. Each of these "drafts" of the final result (each quasi-object) holds within it the duality of the real and the ideal, when seen from the point of view of the whole creative activity. Satisfaction, completion of the process, is an acceptance that the ideal has reached a concrete instantiation in which the merger of the ideal and the real is adequate. But, satisfaction is not guaranteed because there are various ways in which quasi-objects may merge "the real and the ideal" (Gulyga, 1987b, p. 213); for example, there may be a merger which subordinates conciousness of the activity to the accomplishment of the desired results (Ogurtsov, 1988, pp. 18-21), or there may be a merger which exhibits a lack of correspondence between the objective content and its realization in consciousness (Ramishvili, 1979, 1983, 1987).

Quasi-objects have been studied as part of the process of artistic creation and appreciation. The content of quasi-objects which emerge in the process differs from the concrete form of the resultant object, i.e., from the "actuality" the quasi-object helps to constitute. Ramishvili (e.g. 1979, 1983, 1987) demonstrates that a given content presents itself initially in consciousness through an object's perceptual indicators, while its essential indicators present themselves preconsciously, on the level of an expectation, set, *Einstellung*; that is, for different parts or stages in the process, the quasi-objects have systematically different content.

For a computer expert, the duality in a situation of computer use may be obvious — the quasi-objects can be situated in the full process. A question arises, however, about the availability of the full process to specific individuals at specific points in their development. The problem can be stated as follows: What are the circumstances in which the quasi-object constitutes a **facilitation** of the subject's **development**, rather than becoming an **obstacle**, allowing the activity to be treated as complete when only a quasi-object has been constructed? Either fate is possible.

To explore this problem further, consider some studies of myths, another example of a quasi-object.

> As soon as the initial link between concepts was forgotten, was lost, the common people began to accord to metaphorical analogy all the significance of actual fact and made it the grounds for the creation of a host of fabulous legends [myths]. (Afanas'ev, 1982, p. 23)

In our terms, quasi-objects came to be treated as objects and could constitute an obstacle to development. A. V. Gulyga writes on this subject that if "myth is the unconscious level of thought, where the real merges with the ideal," then, in the artistic image "the merging of the real and the ideal takes on a conditional character, and there arises a dualistic situation wherein something both is and is not (the principle of play)" (Gulyga, 1987a, p. 213). In our terms, quasi-objects then become both "quasi" and "full" objects and can facilitate development.

Given the widely variable content of quasi-objects and the varying ways quasi-objects merge the real and the ideal, criteria must be used to determine if a quasi-object is an obstacle to development. The hallmark of a quasi-object that is **facilitative** of development is that its image has the attribute of **conditionality** (Gulyaga, 1987). On the other hand, an **obstacle** occurs when a quasi-object is wrested from the context of the activity in which it arose and comes to be regarded as an **absolute** (Mamardashvili, 1970). This is a frequent occurrence when the result of the activity is ideologically charged. In such cases, the quasi-object becomes a transmuted form:

> The initial (real) relationship here cannot carry through in its actual form because it has been withdrawn from a particular system of links or because those links have been effaced. The mediating links and dependencies of that relationship are cancelled by the action of other links which edge it out as if it were wholly denuded, ... self-sufficient, a spectral thing (Mamardashvili, 1970, p. 387).

In our terms, we can ask whether the computer activities, including (but not limited to) exciting games, are likely to yield quasi-objects for children which can facilitate their development: Can we develop systems of educational activity such that the images developed by the children maintain links to systems of activities and can the images be imbued with the attribute of conditionality? Our approach to thischallenge involves the use of a metaphor, the Electronic Wizard, as an important tool.

Metaphor as quasi-object and heuristic tool.

A metaphor contains all the elements of a quasi-object.There is duality: The literal referent contrasts with the actual intended referent. There is a system of links to contexts: First, both the literal and the intended elements are linked to the communicative activity which gives rise to (and a purpose for) the metaphor; second, each element is constituted by a system of attributes, some of which make the metaphorical link "work" and others of which make it clear that a metaphor rather than a simple identity statement is being used. Conditionality is central: Were a metaphor to lack conditionality it would be simply an identity statement — to say that a teleconference is like (or not like) a bridge is to accept the conditionality of both terms.

In our analysis of materials from teleconferences used to develop new activities (see the previous article, this volume), we demonstrate that the totality of metaphors used there determined all the basic systems of attributes of the object being verbalized and all the necessary systems of conceptual relations through which the object's content could be revealed, even though the metaphors prefigured the purposive discussion of the object's essential attributes. In this sense, the metaphor as a quasi-object is like the quasi-objects analyzed in the creative artistic process. Major points emerged in that analysis of the adult use of metaphors in teleconferences: First, the metaphor used in the communication activity is a model of the newly emerging object which is being created by the communication activity that is making use of the metaphor. Second, using metaphor makes it possible to "grow" genuinely new objects, that is, objects for which clear identification and formulation are not available *a priori*. Metaphor is a "bootstrap" — a way to start on an activity even though the motive/goal is underspecified. The metaphorical model can be treated as a pre-cursory plan in perceptual terms; hence, metaphor can facilitate truly creative problem solving.

Our approach allows us to grapple with an interesting methodological difficulty. Two dynamic processes are occurring simultaneously: The image of the metaphorical relation is transforming (with many intermediate steps) into a concrete object, while the concrete object is itself developing. Demarcating the attributes of such an image (be it an interim or an end result) turns out to be an exceedingly complex undertaking. Even in art, which represents the cultural system's "purest" process of image objectification, there arises the same exceedingly complex problem — namely, that of delimiting form and content in a work of art. D. I. Ramishvili (1987, pp. 3-4, 90 ff.) emphasized the intrinsic interconnection of those two features when stating that form in a work of art is nothing other than "the actuality of content."

In psychological research aimed at revealing features of the subjective image of an object (especially the verbalized image) a common method is to vary the way the object is presented to the subject, without, however, allowing the subject to act upon the object in order to change it (e.g.,Krauss, 1987; Belyaeva & Nosulenko, 1985). Though fruitful for resolving a broad range of other tasks, this approach offers little information about the heuristic (or, more broadly, the regulatory) functions of the metaphorical model, since the procedure separates the dynamic process of image construction from the dynamic functions of the image in activity.

This is not, however, a purely methodological problem. For the subject to become aware of the goals of his own activity, it is necessary to separate the process of constructing the image from the process of embodying the image. This separation assumes that the image of an object will be embodied outside that object, in some other object (since the image always exists in some particular material vehicle). From this perspective, the **metaphor** is a concrete form of that separation, since by definition (see, for example, Murav'ev, 1987, p. 218), it connects with "the transfer of the attributes of one item (one manifestation or aspect of being) to another."

We constructed and used the Electronic Wizard metaphor in our work with the children, understanding that the method for analysis and for the children's development meant that we would have to grapple with active subjects actively constructing the image rather than being "controlled" in the ways common to laboratory experiments. We also understood that for this quasi-object to have a chance of being facilitative of the children's development, we needed to promote the conditionality of the image and to maintain its links to contexts of activity.

The conditionality of play facilitates development.

We have so far discussed adults who both invented metaphors and made use of these quasi-objects to develop new objects; the inherent conditionality of metaphor for metaphor-makers could be relied on. For the children, however, the teachers and researchers have a role in constructing the Electronic Wizard metaphor and there is a danger that the inherent conditionality of the metaphor may be unavailable as children construct their images of the Electronic Wizard.

It is useful to consider a relationship between illusion and metaphor: Standard perceptual illusions, like those used in psychological experiments, involve dual appearance, but they are illusions precisely because the control of the conditionality of each appearance is not in the concious awareness of the subject. When the illusion is "known" to be operating, the subject is no longer completely under the control of the illusion. Metaphor can be thought of as a conscious illusion — an invoking of the duality for some intent by the metaphor-maker. In a social, inter- psychological situation, one person's metaphor may be another's illusion if the conditionality of the literal term is not appreciated. But it need not rest there. Vygotsky (1978) used the term Zone of Proximal Development to describe inter-psychological developmental situations: While a youngster may begin development in an environment where a more knowledgeable other person regulates the activity, the transfer of control to the child's intra-psychological functioning can occur and should be arranged for. So, the question becomes, what is required to provide access to the conditionality of the metaphor to the children operating in an activity with it?

As noted above, Gulyga (1987a) links play with the conditionality that allows quasi-objects to facilitate development. Conditionality is one of the defining traits of a playful attitude toward reality (Elkonin, 1978; Bateson, 1976). I. V. Berlyand (1987, p.150) writes: "Play is defined by the acknowledgment of conditionality, of duality, of a dualistic attitude," and on these grounds likens play to aesthetic activity. If the conditionality of play is acknowledged, then a playful attitude toward reality can be connected to an awareness that the results of one's own activity are conditional and can facilitate the subject's awareness of the goals of his own activity. Daiute (1989) provides examples and analysis of the "critical thinking skills such as analysis, synthesis and evaluation" (p. 17) in samples of play of school age children.[1] (C.f. Bruner, Jolly & Silva, 1976.)

Thus, providing for a play activity that combines children using computers and metaphors suggested by adults can be helpful in developing the conditionality we seek. Bateson (1976) considers play as a kind of metacommunicative activity, making a natural bridge between our play contexts and the principle method by which we avoid the obstacles to development that are possible when quasi-objects are invoked.

Communication links avoid development obstacles.

Making the computer's mediating role more salient can help to insure that there are firm links from the quasi-objects developed in activities with computers to contexts of activity. When we have used computers with children we emphasize that they are a means of communication. The children use word-processing and telecommunications programs on the computer in order to write and read descriptions of computer-mediated activities they participate in, as well as their thoughts and opinions about computers and more general topics. They exchange these materials with others, locally, nationally, and internationally.

The children have a wide set of experiences with ordinary verbal communication (face-to-face contacts, over telephones, in letters), which provides a background for their use of computers as a means of communication. They are familiar with the reciprocal rights and obligations of "users" of means of communications; they are aware that communicative events seldom "stand-alone" but are connected to motives and objectives involving past and future events. Children's prior understanding of communication can be made the expectancy set (*Einstellung*) for their entering experiences with computers.

Experience in situations that involve the obviously communicative use of computers provide an interesting complement to experience with computer games. The interchange that takes place between the computer user and the (game) programmer or developer via the programmed products is thereby placed in a wider context of communicative interchanges. As we attempt to develop a realistic and flexible approach among children toward modern technologies, we can rely on an expectancy set "computer as a means of communication" to base firmly the computer activities in the actual situations of use, in order to avoid transmutations of the image of the technology that would have computers be the "spectral" entity that Mamardashvili (1970, p. 387) associated with other quasi- objects.

However, a host of serious practical problems attaches to the organization of mediated interchange between children. These include the following: a paucity of communications programs designed for use by children, insufficient experience with computers by many children, elementary typing skills, and too little development of information regarding the goals and methods for using computerized communication technologies in education. If children alone are involved in the communication interchanges, these difficulties may prohibit the communicative use of computers by the children. It is useful to seek concrete ways of incorporating adults into that interchange so that the problems can be avoided, and, more generally, so that education involving computers can profit from the key role which the adult plays in the child's mental development.

The Electronic Wizard.

Drawing upon the ideas of the cultural-historical school of Vygotsky, Luria and Leont'ev, we first founded the Wizard for re-mediation of activities involving children experiencing difficulty with schooling (LCHC, 1982, p.58). Re-mediation signifies a modification of the means whereby the mediative mechanism regulates coordination with the environment (c.f. King, Griffin, Diaz & Cole, in press). As Bruner (1985, p. 604) notes, "...when we try to impose the novice-to-expert regimen on children—which is principally what school is about — it very often produces a massive turning off of cognitive activity." The Electronic Wizard can provide a "ventriloquation" (c.f. Bakhtin, 1973) so that the power asymmetry between adults and children in educational activities can be modified. The Wizard is a re- mediative mechanism that regulates the child's relationship with other children through telecommunication, his interrelationships with other children and adults in a face- to-face setting, and his attitude toward the task at hand.

Concretely, the Electronic Wizard is a partner in communication whose role is filled by teachers, research psychologists, and college students. In their own personas, these people could be the "experts" that might "turn-off cognitive activity." The introduction of the Electronic Wizard makes it possible to alter those relationships by moving the Wizard into the position of authority in such a manner that both the child and the more expert adult are jointly subordinated (stand in opposition to) that authority.

Practical aspects of computer-mediated communication make it a particularly interesting medium for investigating the development and use of the image of a wizard. On the one hand, in this medium, the identity of the sender of a message is severely underspecified; sex, age, ethnicity, even species-membership must be established by the communicative partners in the communicative activity rather than being "apparent" as it is in the context of face-to- face and even telephone communication. Unlike books and letters, computer- mediated communication has speed and informality in the exchanges, allowing for very active participation by the receiver in the construction of the sender's image, resulting in ambiguity or multiplicity of the form of the image dependent on the different activities of different receivers. The **form** of the Electronic Wizard is, thus, a function of the activities of the child being communicated with — of the child's imagination, of his magic.

On the other hand, however, in this medium, there is an ease of preserving and transmitting information from parts of the society that are remote from each other in place, age and social circumstances. The Electronic Wizard with whom a child communicates can represent multiple viewpoints (and can be enacted by different people participating in the educational activity) allowing more flexible presentations of the **content** than could be achieved in face-to-face educational encounters.

From the researchers' point of view, wizard characters in general and the particular features attaching to an Electronic Wizard, can be used as a metaphorical model that can function as a heuristic tool for investigating the development of an image among child subjects as well as being a heuristic tool for facilitating effective and positive use of modern computer technologies in educational settings. Researchers can manipulate the functioning of the Wizard, analyze the results, and chart directions to take in optimizing its use; the results of the use of this metaphorical model can also be examined to identify more general aspects of the fruitful use of modern technologies in education.

The Electronic Wizard is at the same time part and parcel of the children's learning activity. For children — unlike adult metaphor-makers, who can clearly see that this is a conditional image — the conditional nature of the Electronic Wizard is by no means obvious. Since an awareness of conditionality, a playful attitude toward metaphorical models, is vital to their effectiveness in activity, then the child's real attitude toward this image must be ascertained and a truly playful attitude must be shaped, if the Electronic Wizard is to be effectively used.

Four aspects of the Electronic Wizard

The following sections represent our approach to using the Volshebnik and the Wizard. In each case, we first display a system of links which the respective Electronic Wizards are bound to in the activities with the children, and, second, we examine the images of the Wizard that grow among the children. Although the reports of the four aspects are not duplicated for the US and the USSR situations, we should state that all aspects can be applied both to the US Wizard and the Volshebnik.

Linking the Volshebnik to myth

The first priority here must be to unravel the systems of links that combine in the image of the Electronic Wizard. The Electronic Wizard is a folk tale character. The folk tale itself, however, is a quasi-object that may be traced to myth and ritual (Propp, 1986).

In the framework of analyses of the folk tale's functional structure (Propp, 1928), a wizard can be harmful ("the wicked wizard"), or it can be a helpful support. In the structure of ritual, those functions combine in the person of the sorcerer (the priest, the shaman). In Russian, the word for wizard/magician [volshebnik] may be traced etymologically to the word for magus [volkhv], which in turn is linked with the name of a Slavic god (Veles, Volos) (Ivanov & Toporov, 1974, p. 54). This allows Uspensky (1982, p. 140) to claim that "the magus, being a priest or shaman, served Volos." Ivanov and Toporov (1965, pp. 15, 27, 159-160, 174) regard Volos as a god of cattle whose basic function was economic but who was, however, also linked with spiritual activity and, more importantly, with sorcery and such folk tale characters as Baba Yaga, Koshchei the Deathless, the Tsar of the Wood, and the Tsar-Bear, who belong, as it happens, to that category of folk tale characters characterized as wizards.

Propp (1986, p. 167) has demonstrated that the origin of such folk tale heroes may be traced back to one single totemic personage. Krinichnaya (1988) examines the features and evolution of the totemic forebear and lists magic among his functions:

> The magical function, being attached from the very outset to the image of the totemic forebearer, had no independent significance whatever, and acquired a definitive rationale only in conjunction with economic or martial functions. The purpose of that function was to ensure reproduction in the natural world and in society and success in economic occupations and in inter-tribal clashes (pp. 61-62).

> Accordingly ... the purpose of the magus, in whose person one of the hypostases of the totemic forebearer was initially represented in a syncretic unity with others, consisted in ensuring the wellbeing and security of the society" (p. 65).

That function of the wizard as society's caretaker is achieved through knowledge. The literature contains numerous references to the fact that one of the basic functions of the magus (the shaman, etc.) is to preserve and transfer experience in various forms (Artem'eva, 1987; Galdanova, 1987). Afanasiev (1982, p. 378) listed the mastery of "higher, supernatural wisdom" among the basic particularities of warlocks [veruny] and witches [ved'my], whose names are also etymologically linked with knowledge.[2]

Levi-Strauss (1985, p. 176) notes that the shaman furnishes language to express states of consciousness, thus making it possible to categorize those experiences. Karl Jung (1988) ascribed an analogous role to archetypes, and included among the basic archetypes the image of the Wise Elder, the great master and teacher, and the Great Magus, the archetype of rational understanding (pp. 146-148). From this perspective, enormous importance attaches to the relationship of the totemic forebearer (and, accordingly, the magus) to man's biological genesis (his Ur-forebear) and to his social genesis, which occurs during the rite of initiation and admission to the social group (Krinichnaya, 1988, pp. 44-52), as well as to the forebearer's functions as cultural hero (ibid., pp. 54-61). Propp (1986) traces the folk tale back to the initiation rite, a procedure as ancient and fundamental as the rite of burial.

As this analysis of the literature demonstrates, the wizard as a folk tale character is a fairly complex image backed by an extensive cultural tradition. Though the image of the wizard is multifaceted (merges several systems of links), his functions include the preservation and transmission of social experience. In that sense, the wizard is a personified embodiment of cultural experience and of the mechanisms whereby that experience is transmitted, being the universal prototype (archetype) of a vehicle of cultural experience. The form of this image is constrained by its magical function but the content of the image is derived from its function of preserving and transmitting cultural experience. Using the wizard as part of the Electronic Wizard metaphor with the children provides ample opportunity to nourish links to a rich cultural context that can avoid the obstacles to development that such a quasi-object might otherwise encounter.

Verbalization of the image of the Volshebnik.

The first appearance of the Electronic Volshebnik happened over a three-week period in August of 1987 when we had our first opportunity to conduct simultaneous, coordinated, joint, international research.[3] We worked in two locations, one in Pereslavl-Zalessky in the USSR and the other in San Diego, California in the USA. At each site, we cooperated with local agencies sponsoring summer programs for children —a youth camp in the USSR and a community social services agency in the USA. A small group of children (about a dozen primary school age at each site) worked with us for three weeks, for a few hours every other day. A primary part of their experience was with the computer as a communicative device for local and long- distance communication with each other and with the Electronic Wizard. They communicated about a variety of computer activities they were engaged in — using programming languages, playing recreational games, and using programs designed for use in educational settings, especially those designed to develop intuitions relevant to mathematics and science. Besides telecommunication, the work in Peraslavl-Zalessky also used a local area computer network, a LAN. The LAN allowed for real-time exchanges with the Electronic Wizard enacted by a researcher in a room adjacent to the one in which the children met (cf. Griffin & Cole, 1987 for a discussion of related real-time computer- mediated communication in the US).

Thus, the Volshebnik and the Wizard were included as participants in the communication situation, along with the two groups of children. We report here on the verbalization of the image among children first experiencing computers at the same time as they met an Electrinic Wizard, concentrating on the three-week experience of the Soviet children. Analysis was performed on the the following materials:

(1) Telecommunicated notes entered into sub-conferences organized by our project in the Parti computer conferencing system. Of the 289 messages sent and received over the course of the three week experiment, 172 were established, by thematic analysis, as especially suitable for this analysis. These included the notes to and from children, and those to and from the Electronic Wizards.

(2) Materials from the mediated interchange with the Volshebnik through the LAN in the USSR site, which include 7 protocols of child/Volshebnik real-time computer mediated communication, 20 pieces of electronic mail from Soviet children and 14 from the Volshebnik.[4]

(3) Materials from conversational interviews with the children in the USSR after the camp project was over, together with materials supplied by field notes made during the project.

To investigate a metaphorical model like the Electronic Wizard we must examine the ways in which that image is verbalized; such evidence can be related to how the image is represented in consciousness. Here we review the data for the reconstruction of the verbalized image of the Electronic Wizard.

The first source of data is the actual material from the children's computer mediated communication. It contains little explicit verbalization with the wizard's image as a main topic of extended discourse. However, data may be extracted from an analysis of the attributes ascribed to the Electronic Wizard. The lexicon for those attributes is quite meager, and primarily expresses an unqualifiedly positive emotional attitude toward the Electronic Wizard (e.g. "dear," "friend," "kind," "best of all").

Questions which the children addressed to the Electronic Wizard in their telecommunication afford richer data. These questions confirm the evidence of a positive attitude and provide evidence that the children were actively constructing an image. Furthermore, the nature of the questions indicate the process underlying the children's construction of the Electronic Wizard's image. Here, for example, are the set of questions which a group of Soviet children put to their Volshebnik:

How old are you?
Who are you most fond of?
Which [of the children] do you like most?
Do you have any friends?
Where do you live?
Do you want to live in San Diego?
How are you doing?
How are you feeling?
What do you eat?
How many languages do you know?
What do you know about computers?
What computers do you have?
Do you think up questions yourself or have you been programmed?
How did you know that I like the turtle?

These questions are exactly like those found in corpuses involving children from the US. There is one exception: In a similar set of questions from American children, it is

certain that there would be some asking whether the Wizard is male or female. In part this is due to a structural difference: It is fully grammatical for an American English Wizard to be referred to as either "he" or "she" (or even "it"); whereas, the Russian grammar assigns masculine gender to the Volshebnik. But, it is also important to note that the messages from the American Wizard often play with the issue, emphasizing that its gender is either unknown or changeable. Except for this issue however, the questions listed are well representative of those asked by children in both countries.

From the children's questions it is apparent that to the children the Volshebnik is an anthropomorphic being (is a certain age, lives somewhere, eats, has emotional attachments). Knowledge (about languages, computers and particular children) is included as one of his attributes. In only one question is doubt cast upon the Volshebnik's anthropomorphic nature, suggesting that it might be "programmed." Other links of the image to a computerized milieu clearly figure in two questions and are present, although less obvious, in the question about the turtle which refers to an aspect of a program the children worked with. In addition, the question about languages spoken and the two about where the Volshebnik lives, link the image to crucial aspects of the rest of the communicative milieu — these topics were regular parts of the computer mediated communication between these Soviet children and their American counterparts.

It is apparent that the children's image of the Volshebnik has not been wrested from the actual context to take on a "spectral" quality. The process of construction for the Electronic Wizard "quasi-object" is securely tied to real aspects of the children's practical activities. The development of the image can be related to humanistic concerns focussed on in the communicative educational setting, as well as to the material technology used for work locally and for contact with those at a distance.

Further information on the image being constructed can be derived by contrasting the thematic structure of the letters addressed to the Volshebnik and those addressed to the children's foreign peers. In the peer letters, specific computer programs are more frequently mentioned, while the letters to the Volshebnik involve questions of overall attitude toward the computer. This reflects a differentiation between the general sense of the activity and the specific action components (c.f. Vygotsky, 1987, Chapter 7, for a related distinction between sense and meaning). As we notice the children using the Electronic Wizard to coordinate the semantic component of the activity, we can recognize the same role of transmission of cultural knowledge that has been ascribed to pre-electronic wizards (see above).

The second source of data involved the purposive stimulation of image verbalization. The results are derived from a conversational interview. Although the conversation was free-form, the purpose was to disclose the features of the children's folk tale semantic and the particular features of their conceptions of the Electronic Wizard. Specifically, it was found that:

(1) The majority of the children differentiate precisely between real people and folk tale characters (wizards, sorcerers, fairies, etc.), and have no difficulty in verbalizing the grounding for this differentiation. We shall cite some examples from the interviews to illustrate this:

> a) "A person ... does everything himself, with his own hands. But a sorcerer doesn't do things with his own hands, he's helped by magic."
> [Researcher: "But what's magic? What's the difference between that and everyday life?"]
> "Well, magic ... it's marvelous. When something marvelous happens it's called magic."
>
> b) "Wizards are people who do magic."
>
> c) [Researcher: "What does a wizard do—why is he called a wizard, or a sorcerer?"]
> "Because he can do sorcery?"
> [Researcher: "But what does doing sorcery mean?"]
> "He can make good or bad things happen, let's say. Let's say, bewitch someone."

From these excerpts it is evident that the Volshebnik's image is represented in the children's consciousness primarily through his magical function;

(2) The folk tale semantic is not wholly differentiated in the children's consciousness. The children had difficulty answering questions on types of folk tale characters (Who is in folk tales?) and concrete examples of those characters (What wizards do you know?). If the researcher introduced folk tale characters into the conversation, the children did their best to establish distinctions between them. The basic marker used in this distinction was an evaluative attitude: "kind" (wizard, fairy) and "evil" (sorcerer, sorceress). The children also had no problem ascribing concrete folk tale characters (Koshchei the Deathless, Baba Yaga, the Snow Queen, Grandfather Frost, etc.) to the categories they had identified;

(3) Although the structuring of the Electronic Wizard's image relies upon the folk tale semantic, the children tried to separate that image out as an independent element. Though the children were able to distinguish the Electronic Wizard from folk tale characters, the basis of that discrimination —the word "electronic" — carried no acknowledged semantic load for them (that is, the opposing pole was not verbalized). Further, one notes the positive emotional attitude toward the Electronic Wizard ("kind") and the impreciseness of his perceptual image (the difficulties they had in visualizing him). Mediated communication between the two groups of children (his transmittal of letters) was the only function of the Electronic Wizard that was named.

The interview revealed an important problem for at least two of the children: They appear not to have developed the playful conditionality as a part of their image of the Electronic Wizard. One child answered the researcher's question about whether or not the Electronic Wizard was real by expressing an inclination to believe that he was. Another said, "It's not a being because he can't show himself. He's in the actual machine ... I reckon he's electronic because in there he can see the electronic current transmitted by the machines."

Summary: Overall, the analysis allowed us to:
(1) define a strategy for collecting data on the verbalized image of the Electronic Wizard, i.e. to gather indicators (ascribed attributes, the content of questions, the thematic structure of children's messages) from the materials generated during the computer mediated communication with the wizard and to conduct interviews to stimulate purposive verbalization of that image;
(2) provide a description of traits in the Electronic Wizard's image — its imprecision, its emotional charge, its anthropomorphic nature; and
(3) suggest a need for additional work to be done about shaping a playful attitude toward the Electronic Wizard (an awareness of the conditionality of that image).
Purposive work on differentiating the way the folk tale semantic is represented in the child's consciousness could be one of the means of achieving that goal.

Linking the Wizard to the Fifth Dimension

A Fifth Dimension is a special micro-world ruled over by an Electronic Wizard, in which children are citizens and in which a variety of computer related activities take place. The Fifth Dimension (hereafter 5th D) can serve as a resource for adults (as Wizard's Assistants) to forge strong links between contexts of activity and the quasi-objects that a child develops as he/she is constructing images of the Wizard and of the new computer technologies. In the 5th D, it is normal (almost routine) and often necessary for children and adults to discuss and debate their images of the Wizard and of the computer hardware and software that they encounter. Opinions, descriptions, questions, hypotheses about the characteristics and attributes of quasi-objects fill the face-to-face communication as well as the electronic mail and conference notes generated as part of the activities. (The fieldnotes analyzed in the next article of this volume provide some flavor of this atmosphere.)

Unlike the case in other educational encounters with adults, the children's contributions are more likely to be rooted in their developing images and less likely to be forced approximations of the "known information" controlled by the adults. We believe that this less powerful position of the adults allows them to make significant contributions to discourse about the developing images, since they are freed from the specter of coercion (c. f. Schelling, 1960). The children's verbalizations have such weight in the discourse because of three aspects of the 5th D: (1) The Wizard (not the adults) is the rule- maker, permission-granter, and arbiter of disputes. (2) The route for children to become what the adults are (Wizard's Assistants) is clearly marked and more quickly attained than in the larger world. (3) The children have adult-like rights and responsibilities about their current and future activities as they control the choice among tasks and over levels of effort in their journey through the micro-world.

The first 5thD was constructed in the Spring of 1982 in the US, in San Diego, California (see this Newsletter, Volume 4, No. 3, p. 55ff). The name is derived, according to the first message from the Wizard to the first child-citizens, by elaborating on the familiar and easily exemplified four dimensions that are theoretical constructs from the domain of physics (point, line, cube, time). The intention was to reflect a relationship between culturally elaborated knowledge that children could encounter in educational activity and the unknown "next" elements in the cultural store of knowledge that would be constructed by developing children.

In June of 1989 the group working in 5th D's in California wrote about them in an informal publication (The Fifth Dimension Forum) for parents and other community members:

(3) Although the structuring of the Electronic Wizard's image relies upon the folk tale semantic, the children tried to separate that image out as an independent element. Though the children were able to distinguish the Electronic Wizard from folk tale characters, the basis of that discrimination —the word "electronic" — carried no acknowledged semantic load for them (that is, the opposing pole was not verbalized). Further, one notes the positive emotional attitude toward the Electronic Wizard ("kind") and the impreciseness of his perceptual image (the difficulties they had in visualizing him). Mediated communication between the two groups of children (his transmittal of letters) was the only function of the Electronic Wizard that was named.

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In June of 1989 the group working in 5th D's in California wrote about them in an informal publication (The Fifth Dimension Forum) for parents and other community members:

What's the Fifth Dimension? It is a place where Elementary School children can go and play with computers after school. There is one at Solana Beach Library, and another at Boys and Girls Club of Solana Beach. Students from UCSD under the supervision of Prof. Michael Cole will give you any kind of assistance. Physically the Fifth Dimension is a box with 20 rooms. It has three entrances and/or exits. When anybody becomes a citizen of Fifth Dimension she decides what entrance to take, depending upon what game she wants to play. Once you are in you have to play by the rules. There is a Wizard in the Fifth Dimension, he has written down the Constitution of the Fifth Dimension and a [task] card [and] consequence for each game. Each room has two games. Each game consists of three levels: Beginner, Good, and Expert. The kid decides what level he wants to play depending on where he wants to go. The consequence card tells him where he can go after the game is completed. The beginner level gives him access to a small number of rooms, while the expert level gives him a bigger variety or rooms. There is also a "Dare Room". You can say this is the "room of luck." No games are in there, the kid throws the dice and the number that she gets is the room that she has to go. The kid has to go to that room and it doesn't matter whether he has already visited it or not. There is a computer "Debishell" in the Fifth Dimension where children can write or receive letters from the Wizard [and other children]. Everyone has a mailbox in the computer where they receive their mail. It is recommended that all the Citizens of the 5thD read the Constitution and the rules, and follow them. Remember the Wizard observes everything. He is the one that accept you as a citizen of the Fifth Dimension and he can ask the kid to leave if he doesn't behave accordingly. Once the citizen has been in each room he will receive a t-shirt of the Fifth Dimension becoming a Wizard Assistent. The Wizard Assistants should help the new citizens giving them advice and hints to play the games.

A single and intersting flaw stands out in this description. The word "games" is used to describe all the computer activities, even those that are widely viwed as educational "courseware" specifically supporting school curricula in literacy, mathematics, or sciences. (In the next section reference is made to the specific academic content activities that are called "games" in the context of the 5th D.) The basic goal in creating a 5th D is to arrange for synthetic activities that merge education, peer relations, and play. In Dewey's (1938) terms, we are creating contexts for guided discovery of culturally elaborated concepts, tools, and practices whose acquisition is the goal set by society for its schools. Working in afterschool settings, freed of the institutional constraints of classrooms, but with an obligation to promote the children's educational development, we have sought to create environments which are rich in attractive goals for the children to discover, while insuring the highest possible level of their voluntary activity. In developmental psychological terms, we attempt to create teaching/learning interactions where assimilation and accomodation are in the closest possible balance (Piaget, 1971), so that both development and learning will occur.

Further, we make communication the centerpiece of our work. When children must communicate with each other in the process of working with complex cultural objects they must "abstract away" from the multiplicity of specifics and in so doing, obtain experience of what Piaget calls reflective abstraction. The difficulty with instantiating these ideas in practice, is that neither Dewey nor Piaget provide a way of conceptualizing the relationship between actions of the individual and the inter-actions of multiple individuals, coordinating in real activity for purposes of promoting cognitive development. Piaget's is a theory built on individual invention as its focal developmental process, whereas instantiation of Deweyesque ideas about educational activity requires a psychological theory of learning and development that takes culturally mediated social interaction as its basic unit of analysis.

It is for this reason that we have sought to elaborate the ideas of Soviet psychologists Lev Vygotsky (e.g. 1987), Alexander Luria (e.g. 1932), and Alexei Leontiev (e.g. 1981); for a variety of historical reasons, they were the 20th century's leaders in formulating a principled, cultural theory that has historically accumulated activity systems as its basis. According to this view, the cooperations of the individual that constitute the social situation are of benefit to individual development in two ways: First, children can be competent participants in the whole activity before they can engage in it independently;

Second, the external environment provides multiple provocations to objectify and reflect on one's own actions. The crucial systems property that one strives for is voluntary cooperation in goal directed activity, because it is this property of activity (and here Piaget and the Soviet socio-historical pyschologists would certainly agree) that affords the maximum conditions for development. The 5th D. and its Wizard acts as attractors for such voluntary activity among the children.

The Wizard protects the potential for this voluntary activity. As a quasi-mythical entity who hypothetically rules the 5th Dimension, adults and children alike can complain to the Wizard when things don't work. The Wizard that has evolved is both helpful and playful. At the same time, he/she is forgetful and not entirely reliable. So, the children quiz the Wizard and complain about the Wizard and speculate on who REALLY the Wizard is. The adults enter into this fiction not only when they are with the children at site, but very importantly, when they return to their research laboratories and answer the children's mail using both their real identities as researchers and college students and as the Wizard. As a consequence, the children are guaranteed feedback on their letters. Moreover, this feedback is tailored to the child's developmental needs as established while at site, or on the basis of fieldnotes. (See the next article in this volume for further discussion of fieldnotes).

Verbalization of the image of the 5th D Wizard

The children reported on here work with the 5th D twice a week typically over a long period of time (for some as long as two years). This contrasts with the work reported above based on the short three week experience with the Volshebnik. The data are from children's electronic mail to the Wizard and to other children as well as from fieldnotes taken by particpant-observer's of the 5th D sessions.

Explicit verbalizations of the image are sometimes in the second person, addressed to the Wizard itself, and sometimes inthe third person, addressed to others. Here is a sample:

> Your nice you write to us. — Female, 9 yrs.
>
> I think you're smart and rich. I think you ride in a limo and own a mansion. — Male, 9 yrs.
>
> He seems nice, I'm not sure who he is, he seems to live in a computer and he must be real small. — Male 9 yrs.
>
> I think the Wizard is an intelligent being who likes to help people get interested in computers. I think the Wizard is a male because the way it talks to me. — Male, 10 yrs.
>
> I'm not sure who he is but I think I know where he lives. On the way to school there's a big hill with a white house on top. I think he live there! The Wizard's a "he" because most wizards are "he"s so that's why. We get mail and send everything on the computer. — Male, 7 yrs.

As can be expected, the verbalization tends to be more elaborated when addressed to a third party rather than to the Wizard, who is being imagined as the communicative partner (hence not as much in need of elaborate description of itself) as well as the referent of the message. In both cases, the attributes are usually positive and in either case markers of conditionality can be observed (e.g. I think; He seems; I'm not sure).

Note the duality in the fourth example where the ten year old boy asserts the Wizard is a male, but, then, in the same sentence uses the non-specific gender pronoun "it" to refer to the Wizard. This contrasts with the last example from the seven year old boy who three times simply uses the male pronoun to refer to the Wizard, but then provides a comment justifying the gender assignment. In each case, we can assume that the gender of the Wizard is being treated as conditional, but the older boy appears to consider the debate to be open, while the younger one appears to be simply providing evidence for some external audience ignorant of the "facts."

Two other examples of explicit verbalizations of the image demonstrate another complicated situation that indicates conditionality. In the same discourse, both second and third person referents are used:

> You're a dudical radical very good old friend of mine. He's a very good Wizard. You are much nicer than the wizard in King's Quest. [King's Quest is a popular computer adventure fantasy game.] And that's no lie! The wiz in the 5th D does good magic but the one in King's Quest is bad powers. —Male, 6 yrs.
>
> You insulted my brother once, but I know you were just kidding. The Wizard's okay. I don't like him because he expects mail from me every single day. I do like it because sometimes he writes me nice letters. — Female, 9 yrs.

The older child switches person when she switches topic. The assertion about the Wizard's kidding might be taken

as a commentary on herself kidding by pretending to address such a conditional entity, a joke that stops when she starts to weigh positive and negative attributes of the image. The younger child, however, interleaves the pronouns. While discriminating among wizards as positive and negative, he loses the discrimination between addressee and referent.

The final example of explicit verbalization illustrates the kind of overt questioning of the duality between the real and the ideal that occurs:

> My name is Henry. I am 7 years old. What is your real name? Where do you live? I do not believe there is any such thing as the wizard. I go to The Children's School. There is no such thing as the wizard. I am in the second grade...

The participant observer notes the playful atmosphere that surrounded this communication:

> After another sentence or two the computer hung up our connection for some mysterious reason. Well needless to say, it couldn't have happened at a better time! I told Henry that I had no idea what happened but that the Wizard probably didn't like what he said about not existing, etc. so he hung up on us. Well, the look on Henry's face, as he stared at me in utter disbelief, made it almost impossible for [the teacher] and me to keep a straight face!

As described above with respect to the Volshebnik, the verbalizations that are not explicity about the image of the Wizard provide additional information about the children's varied images, for example:

> I really like calling you Wizzy and Wizzzzz. I really like writing letters to you and I really like getting letters back. And I'm going to miss you over the year (sniff, sniff). — Male, 10 yrs.

Of particular interest is the information available as children articulate their image of themselves as Wizard's Assistants. Here are two examples:

> Dear fuzzy wiz,
> I like being a wizard assistant because you get a t-shirt, a big letter, and you get to help people. I help everyone do their job and keep the peace and quiet but sometimes I mess up. And I do expert on games other times. As a WA you get to help put computers away. I had to write a big big letter and finish all games. It took five months.
> Bye,
> [Male Name]— 8 yrs.

> Dear USSR,
> I think that you are right that kids should have fun and help each other out. But I disagree [with a prior letter stating that it wasn't good for some kids to be singled out as Wizard's Assitants]. I am a wizard assistant and I like it alot. It makes me kind of popular got to know everyone here and becoming a wiz assist is a good thing to work toward becoming.
> [Male Name]— 10 yrs.

The image of the Wizard is reflected in the responsibilities taken by the children who become assistants as well as by the ancillary benefits they perceive as associated with the role.

Again mirroring the study of the Volshebnik, we can examine the image that develops as the children question the Wizard and the Wizard responds as in the following interchange:

> Dear Wiz,
> Are you being good? When is your birthday? My name is [Male First and Last Name]. What's your name? Now I love you.
> [First Name] — 6 yrs.

> dear [Child's Initials],
> It was a delightful surprise to get a letter from you. Thank you so much for it!!! You sound quite curious, and I will try to answer you as best I can.
> My name, as you know, is the wizard. You can capitalize it if you want, but it's not important. Many call me the wiz, or wizzo and those are fun too. But all over the world I am known by many different names. Some are Volshebnik, el Mago y la Maga, kobito, zanzibar, and there are many others. Once I was known as Merlin ...
> Yesyesyesyes I am being good. In fact my entire being is good! One might call me a good being. According to my calendar, my birthday was the triblingth of Flimmie, way way way way way back in Murret. However I am young at heart in spite of this. So metimes the older you become the younger you get.
> Oh do write me again, [First Name], it is such fun writing you!!!
> bye, from you-know-who (with love!)

Besides such exchanges devoted to the theme of identity, the Wizard in the 5th D also participates in exchanges that are a mixture of general themes and specific computer activities, related to the children's and the Wizard's "work" in the micro-world. The following makes reference to a program that allows the printing of greeting cards and posters:

Dear Wiz,
This is [Girl's Name]. Are you going to be in the computer? I want to tell you about Print Shop. The game was fun and neat. We printed out ice cream, sunsets, and flowers. The wiz is very nice and we wrote that on a sign. We worked soooo much on the computer and we had soooooooo much fun.
I would like to see you but if you are in the computer how can I?
are you pretty?
From
[Name]

dear [Name]
Thank you thank you thank you
for your letter about the Print Shop!!! I am tickled yellow that you had such fun. A sign for me? How swwweeeettttt!!!
If you would like to see me you have but to imagine me, and that is as good as I can tell you. . .
Until later, I will be in the computer waiting for your letters. . .

Sometimes the mixed theme letters involve very specific aspects of the 5th D. The imaged Wizard not only knows about certain computer programs, but also is responsible for concrete materials, like diskettes needed to run certain games. In the following example, the identity theme is reduced to a mere social opening fomula and the 5th D business is the focus:

Dear Wa Wa Wiz,
How are you doing? Last week I was playing Oregon Trail. We got realy really far but there was no second disk. So we played Tetris and I got a high score. I was quiet for the first hour and 1/2 but the last 5 minutes I wasn't quiet anymore.
that's it.
From the No-no-Noah — 8 yrs.

Dear No-no-noah
I hear that a certan young Wizard'S Assistant has been looking for the second disk to Oregon trail. Wellll...your wish is my command. Check out oregon trail and see what you find.
Happy trails and happy fording!!! (Or happy whatever you do today)
The wa-wa-wiz

The communication between Noah and the Wizard is interesting in several respects. Although containing quite a bit of specific detail about the 5th D computer activities that both Wizard and child orient to, the interchange indicates a playful tone as the Wizard responds to Noah's phonetic play with names. Note also that the child comments on his own behavior control while the Wizard accepts his responibility for that by simply referring to him with the high status marker, Wizard's Assistant.

The length of the relationship between children and the Wizard in the 5th D and the variety of topics that are discussed allows for firm links to contexts outside the 5th D, including family relations. In some cases, the Wizard brings children, computers and parents into the communicative milieu. The following extended example of an electronic mail interchange illustrates the two levels of context links — involving various computer programs in the 5th D and involving sibling relations from the home context. [N. B. The rooms in this 5th D are named after countries, so U.K. is for the United Kingdom.]

From [elder brother name], to wizard
Thu May 26 16:52:52 1988
Dear Wizard, In the U.K. Room I played Missing Links [a reading teaching program] and got 99.44. On the easiest part I got the 99.44. I then played part of another game when we had to stop. The story I was using was "The Lion the Witch and the Wardrobe" by C.S. Lewis. I picked it because I've read the book many times before. In the Spain Room I played Graphicas [a mathematics teaching program that is in Spanish], because we couldn't find Bumbles [a different mathematics teaching program]. I made two mistakes in animales, because I didn't use the Spanish-English dictionary. Then I made 0 mistakes in vehicules, because I used the Spanish- English dictionary.
No I have not taken Karate.
From, [elder brother name]

From [elder brother name] to wizard
Tue May 31 16:27:38 1988
Dear Wizard,
So far today I have found out the names of 6 Chinese Provinces, and their capitals. They are: ShangTung, and Tsinan, Chiangtsi and Nanch'ang and Hunan and Ch'angsha just to name a few. I found these in the Atlas at the Library. I have also played Shark [a mathematics teaching program] and have gotten to the 9th level.

From Wizard, to [elder brother name]
Thu Jun 2 13:45:12 1988
Dear [elder brother name],
I loved your two letters that you sent me! You sure are learning many new things in the Fifth Dimension!!!!
Can you tell more about China?
Write and tell me about your new adventures in the Fifth Dimension!! Is [younger brother name] your

brother? Who is older? I will look for your letter soon in my mailbox!!!
Love, The Wiz

From [elder brother name], to wizard
Tue Jun 7 16:22:15 1988
Dear Wizard,
Hi !!! It's me [elder brother name]. [younger brother name] is my brother (a curse)! And I am the elder. What exactly are you? Some supernatural creature? A monster? A body of UCSD students?
Thats all for now,
[elder brother name]
ps/ Tell [another child's name]to answer my letter.

From Wizard, to [elder brother name]
Thu Jun 9 11:26:43 1988
Dearest [elder brother name],
HHHHHEEEEELLLLLOOOOOO! THIS IS THE W*I*Z*A*R*D*!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
I really liked your letter. You are a very good with words....keep up the excellent writing!!!!!!! In answer to your questions I am a supernatural being....I can take any shape or form although I have never been a body of UCSD students!!!!! I look forward to hearing from you again in the verrrryyyy near future!
Why is your brother [younger brother name] a curse? I would like to have siblings because then I would have another to share my thoughts with and play with and do my wizardly magic with!!!! I will look for your letter in my mail box..... Love,
The Wise Wizard

From [younger brother name], to wizard
Tue May 31 16:46:50 1988
dear wizard
I played whinny the pooh and devils dictionary on missing links [the same reading teaching program the elder bother used, but with different data]. I used the dictionary to look up four words. Secreted, futtility, endeavor, ascertain.
I was trying to find out what the mind was.
from [younger brother name]

From wizard, to [younger brother name]
Thu Jun 2 13:47:43 1988
Dear [younger brother name],
Do you play Missing Links with [elder brother name]? Those were very difficult words that you looked up in the dictionary....next time you see them you will already know what they mean!! Please write again soon and tell me about your further adventures in the Fifth Dimension!!!
Love,
The wondering Wizard

In this communicative interchange, the Wizard and the computer technologies are not at all divorced from contexts of activities. This of course makes it impossible to develop the same sorts of measures of image formation that can be developed in a laboratory situation. However, it is exactly the complicated links, playfulness, and variety in these communicative interactions, that allow us to claim that the quasi-objects developed here are not the potentially damaging obstacles to development — the isolated absolutes that divorce the ideal from the real.

Conclusion.

If ever a wizard (or at least some heuristic tools) were needed to help educators and researchers, it seems to be now and in our problem domain. "Computers make slow progress in class," proclaims the title of an article (Holden, 1989) in the prestigious journal, Science. The author chronicles the disappointment of the promise of a computer instigated educational reformation in the U. S:

> In contrast to the early days, few people now believe [the computer technology] has the power to transform education... Computers will unquestionably become an integral part of precollege education, if only because they are increasingly a fact of life everywhere else. But how, when, and whether the incredibly rich potentials offered by new technologies will be realized remains a mystery. (p. 909)

Facing the mystery, those interviewed for Holden's article do **not** argue about computer hardware or software (although the majority of the commentators are most celebrated for their inventions in these areas); instead, the article describes a "battle" about defining learning and teaching. John Anderson identifies the crucial issue as a matter of "the degree to which one views [the] learning experience as self-directed versus prescriptive" (p. 908).

It appears that what has been going on among these researchers for two decades is exactly what we characterized in our discussion of metaphors as quasi-objects: We construe the metaphor as an imprecise model of the result of activity which allows for the evolution of the activity even before its goals have been precisely defined.

But, it appears that the evolution of this research activity has not been facilitated by the various existing quasi-objects; in fact they have functioned as obstacles to the development of society. There is little conditionality attributed to the quasi-objects that individuals have constructed. The opposing positions in the debate are "abso-

lutes;" the images of the alternatives are verbalized such that "didactic" can be treated as an insult from one side while "romantic" is used an insult by the other side.

In general we find ourselves in sympathy with the "constructionist" position for defining teaching and learning: which holds that "...students do not learn by having information poured into them, but 'construct' their own knowledge" (p. 909). In the Science article, as in the rest of the literature in the last 20 years, constructionism appears to be a defensible approach toward defining learning processes. However, in the article, again as is often the case elsewhere, two criticisms are leveled at this perspective: (1) There is nothing a teacher can do for the student who has to learn for himself; (2) Constructionism is "...idle talk... by people who like to deal in abstractions" because there is no "sufficiently articulated, detailed theory..."

Our goal is to develop the work described in this article deriving heuristic functions from metaphor, in particular the Electronic Wizard, so that we can further develop our image of the learning and teaching processes. We believe that our approach can help to develop the image of culturally mediated constructionism as a learning process while avoiding the problems indicated by the above described criticisms.

An important feature of our image of the Wizard responds to the first criticism: We agree that children do need to be protected from the overpowering weight of others' expertise so they can construct knowledge creatively as their own, but, also, that the adults in society need to provide a medium that will allow the children to construct without isolating them from their cultural heritage. The roles available to children and adults in communicative interchanges involving the Electronic Wizard can be manipulated to meet these needs.

The second criticism can be addressed with reference to our use of metaphorical models as heuristic devices. It is true that our final result, "a sufficiently articulated, detailed theory" is not *a priori* available. But, as we use metaphor as a bootstrap, we do have pre-cursory plans available that are useful as long as we are engaged in activities that emphasize their conditionality and potential for change.

In the work reported above, the actual communicative interactions between the Wizard and the children are the chief sources upon which the Electronic Wizard's image is constructed, and, therefore, those interactions provide the means of directing that process. In addition to relying on wizards as well-elaborated folk characters, we can specify novel scenarios, for example, those involved in a Fifth Dimension, to organize specific new cases of child-wizard interactions. But we are involved in a reflexive process: As we arrange new child-wizard interactions to promote the children's understanding of new technologies and to enrich their development in other academic domains by using computers, we develop more understanding of what it means to provide interactions that contain developmental "germ-cells" (Davidov, 1986,1989; Engestrom,1988). We learn more about what we want to mean by "learning and teaching." Reflexive processes are consistent with our interpretation of the wizard's image as an imprecise metaphorical model. The result of activity under such conditions (and the model for subsequent activity) is the "quasi-object," whose content diverges from the concrete form of its actuality.

We know the Electronic Wizard as a conditional entity; here, we have focussed on its use within the framework of a process of interchange mediated by computerized communication technologies. Even so, we have glossed over several important features of this aspect of our research, such as, (a) the mail between adults in the project and the Electronic Wizard, (b) the differences between the use of computer conferences and computer mail for the development of the Wizard and the children.

Another important focal framework for studies of the Electronic Wizard involves the specifics of the learning activity pursued by the children. We have not dicussed the features related to this. It is important to consider features of the Wizard that are related to different parts of the learning activity (as detailed, for instance, in Davydov, 1986; Leont'ev, 1981; Rubtsov, 1987): (a) the motivation of learning activity; (b) the selection of types and forms of task articulation; (c) the organization of assistance in tackling those tasks; and (d) the way the results of the children's activity are evaluated. The Electronic Wizard's features can also be considered as a function of the domain of learning and characteristics like how related it is to the local context or the context that is local to peers or adults available in computer mediated communication.

We have in this article argued for the necessity of an approach like ours to this kind of topic, demonstrated that it can be practically accomplished, and illustrated the kinds of results that can be expected. The approach carries a future in it, one that is all the more interesting because it is not fully specified.

Notes

[1] While this reasoning assigns to play a very important role in human development, it is not unusual to value play so highly: For example, in J. Huizinga's studies of culture, play is accorded a universal culture forming status: "...[Human] culture arises in the form of play, that it is played from the very beginning" (1955, p.46). (S. S. Averintsev (1969) likens this view of culture to that of Hermann Hesse.) For another example of the improtance assigned to play, methods for teaching through play have been strongly advocated, even for adults (e.g. Emel'yanov, 1985; Ladenko, 1987).

[2] A. Ya. Gurevich's interpretation of the phenomenon of the witch hunt (1987) is interesting from this point of view. He is of the opinion that the witch hunt had to do with the official culture's assault upon traditional, popular culture, since witches were the basic vehicles of that popular culture (the custodians of knowledge).

[3] The research planning and project coordination was performed on a daily basis through a computer hook-up (the communication subsystem Parti of the Source computer network was used). In the spring and early summer, the researchers involved were spread among various cities in the USSR and the USA, integrating this work with their ongoing investigations of communication and computer use with children in their home institutions. In the USSR, coordinated by Alexandra Belyaeva, researchers were involved from the Institute of Psychology, the Institute of Automated Systems, and the Institute of Programming Systems (all of the USSR Academy of Sciences) as well as researchers from the Academy of Pedagogical Sciences. In the USA, coordinated by Michael Cole and Peg Griffin, researchers participated from the University of California at San Diego, Bank Street College of Education, Massachusetts Institute of Technology, Harvard University, University of Massachusetts at Boston, City University of New York, and the Bolt, Beranek and Newman, Inc. In each country, college students participated as teaching and research assistants —in the USSR, from Moscow State University and in the USA from the University of California at San Diego.

[4] Due to voltage fluctuations in the rural electricity supply, computer operation was disrupted on occasion and diskette material was lost.

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Phase Transformations as Discursively Occasioned Phenomena.

D. Edwards

Introduction.

This paper attempts to bring together some theory, method and data. The theoretical strand derives from the social- historical school of Soviet psychology, and takes up a notion of "phase transformations" that is suggested in a recent article by Velikhov, Zinchenko and Lektorsky (1988). The method is a form of qualitative discourse analysis, as this has been applied to text and conversation by researchers interested in how such materials embody social organization and processes of knowledge and understanding (cf, Potter and Wetherell, 1987; Edwards and Mercer, 1987; Edwards and Middleton, 1986). The data are extracts from field notes which describe activities and interactions in the Velham project's "5th Dimension" (see the previous article, this volume for a general description of this).

The analysis focuses upon a series of identifiable occasions when the text shifts between an engagement with moment-to-moment sequential description, conversation or narrative, to a more top-down, generalized or conceptual perspective. These occasions are seen as discursive versions of what Velikhov et. al. refer to as psychological "phase transformations," in which a "reflexive-contemplative layer of consciousness" alternates with "the layer of being (or layer of event/activity)" (1988: 102). According to this view,

> Action in the reflexive layer is a link between sense and meaning, a means of transformation of one into the other... When complex problems are solved there are opposing and cyclic processes which attribute meaning to senses and attribute senses to meaning... This is the main function of consciousness... To attribute meaning to sense is to detain the implementation of the programme of action, to play it in one's mind, to think it over. (1988: 104).

The appeal of this notion of phase transformations for the present analysis derives not only from the relevance of its central definitions, but also from its suggested links with social or communicative settings ("when being for oneself transforms into being for another" p.105), and with conceptual development ("it is in these moments that something new is born, a new action, image, a new vision of a situation, a new idea, sense, etc." p.105).

The discursive phase transformations that we shall examine here are shown to occur at specific junctures, both in the texts, and in the joint activities that those texts purport to represent. These junctures are identifiable as communicative discoordinations (c.f. Luria, 1932), where the flow of joint activity or of textual reconstruction runs into some difficulty of joint understanding, or of anticipated understanding (by a prospective reader), of argument or of explication. Furthermore, it is one of the strengths of the analysis that it is equally applicable to many different stages and levels of the project — to the examination of children's thinking as well as that of the field note authors, and even that of the senior researchers, as developments in their thinking are embodied in their recorded meetings and telecommunications.

The present analysis deals with a restricted set of data, which is the sub-set set of field notes on "5th Dimension" activities, that were sent as telecommunications to the Velham sites in the USSR and USA between October 10th, 1988 and May 16th, 1989. The notes are informal ethnographies written mainly by undergraduates who were enrolled in Michael Cole's "Practicum in Child Development" course at UCSD, where they were assigned to assist in promoting the children's out-of- school activities, and who wrote up fieldnotes about those activities as part of their course work. Some field notes were contributed also by full-time researchers on the project, as was the first set of notes that we shall examine below. One or more notes were sent at a time, often with a few introductory remarks (not analysed here), as tele-communicated conference notes to the sites in the Soviet Union and other parts of the United States, via the Parti system on the

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Source computer network. The data are referred to via their Parti telecommunication conference name and number. Thus, "CHICO 67" is message 67 in the CHICO (children's communications) sub- conference. In quotations from field notes I have occasionally performed minor corrections of spelling and grammar, so as not to aggravate difficulties of English-Russian translation.

Phase transformations in discourse.

In order to identify "phase transformations" within the field notes, we need an operational definition that deals with recognizable features of texts. We shall define them as sudden shifts of focus or topic, in which there is movement in either direction between simple engagement in sequential activity or moment-to-moment narration, and a more generalized conceptual formulation or explanation of the activity. The analysis will concentrate upon identifying how and when such shifts occur — how they are "occasioned". This notion of "occasioning" is twofold. It refers both to the timing or placing of the changes, and also to their content. Shifts from narration to conceptual analysis, for instance, occur at identifiable junctures or moments in the activity or text, being prompted by particular kinds of circumstances. Thus, we can study their "occasioning" in terms of their timing and placing — when and where they occur. But in addition to that, the conceptualization itself, its semantic content, can be shown to be fitted to its occasion. Content is designed for context, for the pragmatic work it has to do according to how and when it is placed.

At least two general settings are involved within which these occasioned shifts of consciousness can be said to take place. The first of setting is the activity of the "5th Dimension" — that is, the interactions and dialogue between children and their adult assistants, of which the field notes are reports. The second setting, equally important and also more directly studiable as text, is the field note itself. In constructing field notes, the writer-analyst does not merely report upon an earlier communicative interaction, but begins a new one, the construction of a textual version of those earlier interactions, which displays for a prospective reader the writer's own shifts of description and analysis. Indeed, our information about the children's "original" activities and talk is no more than what the field notes record. Rather than worrying about the lack of objective neutrality in the field notes, we are able to turn this circumstance to advantage. The writers' other role, as participants in the events depicted, reveals how their own phase transformations are intimately bound up with those of the children with whom they were interacting. The field notes are taken not as as neutral records of events, but as the data themselves, as analysable texts that depict and comment upon events.

It is an advantage of this approach that we are able to identify changes of consciousness at all levels of the project, for the investigating scientists, and for the student participants who write the field notes, as well as for the children. In addition, we are able to demonstrate how those changes in levels of consciousness occur within similar sorts of contexts, and how they perform similar sorts of discursive work. A link is suggested between the microgenetic "occasioning" of higher-level conceptualizations in adult speech and text, and the ontogenesis of such conceptualizations in children. These findings suggest a hypothesis for further work, that it is through the coordination of these two processes that children's conceptualizations are provided for and socialized — becoming verbalized and "occasioned" as they are for adults.

The presentation and analysis of textual data is typically a lengthy process. We shall restrict ourselves here to a few case studies, which will demonstrate the kinds of results that can be achieved.

Case 1: An analyst's phase shifts

In field note WVEM 134 we can see how the writer moves between two levels of text: narrative description, and higher-order conceptualizations. Shifts from description at the level of serial narration to categorized generalizations can be seen to be prompted by the occurrence of some problem that needs attending to and accounting for, after which the text moves back again to the serial narrative. These shifts are not merely ones that we can detect through our own subjective interpretations, but are ones that are marked overtly by a variety of textual devices.

EXTRACT 1, FROM WVEM 134

...But trouble started here.1 We would turn to the program page and there was no snail!!!! The first time we did it there was the snail, but Noah made some mistakes in typing in, went back to correct it, and the snail was nowhere to be found! After several times going in and out into the program, checking and rechecking to find the snail, Noah calling Lisa S. [the site coordinator -DE] for help, and to see what he was doing, I was a wreck! (In case you didn't know, Lisa S. is his sweet-

heart, and every little achievement Noah makes poor Lisa has to witness it). I was trying to see how to fix the situation on the spot. Yes, it dawned on me "Control T", the magic "control T."

In extract 1, the description of Noah's behaviour as problematical is taken as the occasion for an explanatory account of it. Note how this shift out of the narrative and into explanation is textually marked off both by the use of brackets and the interpolating phrase "In case you didn't know..." Speakers and writers deploy a wide range of devices for marking off speech or text which has a different status from its context. In extract 2, in the paragraph which follows 1, note how the term "Well..." marks the shift to a higher order of generality, this time a summary of where Noah's attention generally was.

EXTRACT 2, FROM WVEM 134

I said, "Noah let's go to the beginning of this game. Let's do quit and reset the game." Well, Noah's eyes were on Lisa, on Pond2 on the one side, Island Survivors3 on the other, as he was trying to go in and out of the game, we had to repeat it several times, and... finally he managed to hit the right keys in the right sequence, after the nth time of trying it. Okay, we did control T and we kind of thought we got the right pictures back or at least there was the infamous snail! We got back to the main program and ready to program once again. But no snail again! We tried several times, to no avail... and I don't really remember what happened but somehow I sneaked and got control of the keys and managed to get the right pictures back. Or, I think, it was both of us together. I had a vague sense of all of the in-and- outs of this software, and Noah somehow operates like that (in alternating splashes of total vagueness and doing exactly the right thing), and somehow we managed to put it back together piece by piece, and... finally we managed to edit the main menu, and, yes, had the snail captive to start programming the cube!

Extract 2 also includes the use of changes in verb tense to mark shifts from narrative to analysis. These uses of tense are particularly instructive. In the phrase "and Noah somehow operates like that (...)," the verb switches from simple past tense for narrating events, to the timeless present, suitable for generalizing about what Noah is like all the time. Then the following brackets again mark off the generalization itself from the rest of the text.

In Extract 3, the adverb "always" (and later, the phrase "in all this ordeal") signal the shift to a general past, a general state of affairs, rather than specific episodes, as does the auxiliary "would" in extract 1. These uses of verb tense and aspect serve to mark out shifts in the level of generality in the account. Thus, the resumption of descriptive narrative is signalled by the boundary marker "Okay" ("Okay. We programmed it...") and the tense reverts once more to simple past. Similarly, in "it's like cutting through the fog," the use of present tense again marks a shift to analytic generalization. These shifts of tense correspond not only to shifts in levels of conceptualization, but correspond also to changes of "voice" (in Bakhtin's sense). As author, the writer IS WRITING field notes in the present tense. As interactor with the child, she WAS INTERACTING with Noah.

EXTRACT 3, FROM WVEM 134

Noah was always there next to me. In all this ordeal, he looked here and there at the other games, but he knew fully well that our goal was to answer the mail!!! Okay, we programmed it, and both he and me were kind of vague of what was required to program it. Again, we got it the same way as before. Starting with the obvious first step and as doing it getting a sense of what was essential and what was not; it's like cutting through the fog. Finally, we both had it. An empty side is represented by a turn, while a side with a picture is represented with a turn plus the picture!

The TENSE shifts in Extracts 2 and 3 correspond both to changes in VOICE, and also to changes in CONSCIOUSNESS. So, "I don't really remember what happened but..." (Extract 2) changes voice from actor to analyst, acknowledges the analytic problem of narrating events from memory, and introduces the subsequent summary/precis of what happened, in contrast to the moment-to-moment narrative that, presumably, better field

records or a more accurate memory would otherwise allow. The "account" (memory failure) is therefore an "occasioned" one, in both of the senses we have defined; it occurs at a specific juncture, in order to address some trouble that the narrative has run into, and also its content is designed for that occasion — it attends to and explains the problem.

In Extract 3 we can also see how the expression "Finally, we both had it" marks the switch back into simple past tense and thus into the lower-level narrative of sequential events, locating itself at the end of that sequence. Then immediately, what it was that "we both had" is given in present tense, as we switch into higher-order generalization, the formulation of a rule: "An empty side is represented by a turn, while a side with a picture is represented with a turn plus the picture!"

While tense switching is a device that is available within both conversation and written text, we see here some markers of phase transformations which are exclusively textual, such as the use of brackets, and of paragraph boundaries, which perform work that in spoken conversation might be done by intonational features. It is important to note, however, that there is no one-to-one correspondence between phase transformations and all of these textual devices. Tense switching, brackets, adverbial modifiers, rhetorical structure and the like are not exclusively used for marking phase transformations, but are flexibly available to perform a wide variety of discursive practices, to set aside parts of the text from others, to locate speaker and events in temporal relation to each other, and so on. What we are showing here is that one of the things they do is to signal when phase transformations are occurring. What identifies the different levels of consciousness as such is our reading of the text — it is part of our competence as readers that we can distinguish sequential narrative from analytic generalization.

EXTRACT 4, FROM WVEM 134

Now, to the next goal to answer the letter. We first glanced at the first letter which was from Chicago, I think, and they were very non-specific. Noah was not interested in that letter and I could no longer think that quickly of how to make that letter interesting to him. It seemed to me that the kids in Chicago have low level questions and don't have much idea of how to play the games. However, it would have taken some ingenuity from my part to have the kids answer those letters, because they have to think back at the time where they were first starting to use the computer or the game, and that is very hard for them to do. For instance, one of the letters was talking about not been able to fish in IS [Island Survivors - ed.], which I guessed has to do with the difficulty that if you don't sit down at the edge of the lake you can't fish.

Phase transformations are identifiably "occasioned" by problems that arise in the course of interaction and communication. In Extract 4, it is the problem of getting Noah to want to answer a letter from Chicago. The writer places her higher-level analysis in the past this time, marking it as what occurred to her at the time, occasioned by the problem with Noah, but again formulates the generalization itself in the present tense, as befits a general truth — "It SEEMED to me that the kids in Chicago HAVE low level questions and DON'T HAVE much idea of how to play the games...". But note again now the generalization itself is offered as an occasioned- account, an explanation of the particular difficulty that arose in the course of simple narration.

In Extract 5, the difficulty for the adult participant-writer is the issue of having to write an e-mail letter herself, but to do so as if it were written by the child Noah.

EXTRACT 5, FROM WVEM 134

(...) While I was typing the letter in, I hesitated a lot whether I should write "I" or "we", as we had originally started the letter, but this is supposed to be kid-to-kid interaction, right? and everyone would recognize that I'm not a child! I couldn't hide under the name Sasha or Michael for that matter, so I decided - maybe wrongly - to write it as if Noah had worked alone.

Having posed the problem, the writer shifts to a more general level of conceptualization, and re-formulates the problem in terms of the project's organizational constraints — "but this is supposed to be kid-to-kid interaction, right?" Observe not only the familiar shift to present tense, but also the dialogical, rhetorical structure of the text, the "but", and the "right?", as if arguing with someone — the project directors maybe, or the Velham team

generally (i.e., the imagined reader), or perhaps with her own conscience concerning this small deception, or maybe she is voicing her own twin roles as participant and as writer-analyst, or as writer of a set of field notes that must stand as an example to new student assistants (she later suggested this latter role herself, upon reading a preliminary analysis). Perhaps all or several of these addressees are relevant. The important point, however, is a more general one — that it is an argumentative search for an appropriate conceptualization of what she is doing, an attempt to formulate a dialogically understood account of her actions. Again, we have a cognitive-communicative problem, occasioning a shift to a "meta-cognitive," analytic level of consciousness with different "voices" acting out the different levels, and with the conceptualization (the account, or explanation) clearly constructed for the situation that occasions it. Conceptualizations generally arise in this manner in these data, as occasioned formulations, occurring at precisely defined relevance points in the text, being oriented to the specific problematic matter at hand in the narrative, "accounting" for it, via contextual information, direct explanation, or generalization, and attending dialogically to the reader's anticipated understanding.

Case 2: Analysts' and children's phase transformations.

The field note, WVEM 130, written by a different author (a student, less experienced than her tutor who wrote WVEM 134) offers further rich data for studying discursive phase transformations, but this time with more material relating to the children's conceptualizations. (The material makes reference to the Wizard of the 5th Dimension; see the previous article, this volume, for a description.)

EXTRACT 6, FROM WVEM 130

[Aaron.L is aged 5, Aaron B is aged 11. Tao is another student assistant].

Aaron B. was older and obviously experienced in the game. He and Tao consulted each other back and forth as to what their next move should be. They seemed to have a good, mature relationship with each other. Aaron L's lack of skill with the game was sometimes a source of irritation for Aaron B. He sometimes became impatient, but whenever this happened Tao would try to place Aaron B. in the role of teacher, or get the boys working together in some way. (ie: have Aaron L. punch the keys and have Aaron B. instruct him where to go).

(...)the Aarons and I became involved in a debate about the Wiz. Aaron L. didn't see why we had to write to the Wiz since he should already know everything we did today because he is a Wiz. (He sees him as God-like!) Tao explained that he can't know what we did if we don't tell him. Aaron L. grumbled a little at this. I asked him what made him think the Wiz was a "he". Both Aarons argued that Wizards were "he's", but then when I pointed out that women in books had "Wizard-like" powers, Aaron B. began arguing for the possibility that the Wiz is a "she". His main point was that he had a girlfriend who was very strong - she could beat him up - and if his girlfriend could do this, then certainly our Wiz is capable of being a woman. Aaron L. displayed remarkable argumentative skills for his age. He felt that the Wiz must be a "he" because Wizards wear pointed hats and a woman's neck is too small to support such a hat. He said it would fall over her neck. (?) Aaron B. shot this argument down as he pointed out by citing various movies I had not heard of, that not all Wizards wore hats. At this point Aaron L. buried his head in his arms on the desk and said he was thinking. It was adorable. Whenever he got frustrated and couldn't come up with anything to support his view he "checked out" in this manner. We never did resolve the argument because Aaron L's mom came up and he had to leave.

Note again, how phase shifts in the field notes are discursively marked. The first paragraph of Extract 6 is written in what may be called the timeless past — at the first level above simple narrative, describing the general pattern of events, what generally happened, rather than narrating actual incidents as they occurred in real time. Its first sentence invokes the properties of age and experience (which are clearly pervasive features of the child in this interaction, contextual conditions oriented towards expla-

nation — towards helping the reader to understand the report that is to follow). The terms "seemed to have", "was sometimes", "whenever", and "would try" are also overt markers of this generalized level of description.

Paragraph 2 then marks a boundary as we cross into simple past narration, but again signals its micro-shifts (occurring even within sentences) to generalization and analysis, via tense changes — "because he IS a wiz", and again also by the use of brackets — "(He sees him as God-like!)".

These data also offer information about how phase shifts may occur FOR THE CHILDREN. These are the points at which the children move to a higher level of consciousness, formulating analysis and explanation, or top-down (categorized, non-sequential) conceptions of things. These shifts appear to be occasioned discursively in situated action and interaction, as they are for the analyst writing the field notes, by the raising of problems and by engagement in argument. In paragraph 2, Aaron L's conceptual formulation about the nature of the wizard is occasioned (prompted) by the problem from which he seeks to escape, that of having to write to the wizard, and also by the disputation on this that he is drawn into with the writer-observer. Note how his conceptual formulation is designed precisely to accomplish its pragmatic interactional goal — of not having to write (the pragmatic goal), because the omniscient wizard should know it all already (the conceptualized account). This example again demonstrates an important feature of conceptual accounts, one which we defined at the outset — that their qualitative nature, their CONTENT as well as their placing in the talk or text, is itself analysable in terms of occasionings — that is, in terms of how that content is designed to accomplish contextualized pragmatic actions. This point has an important consequence for both method and theory — we should expect children's conceptions of the wizard (and of other things) to be sensitive to the communicative context in which those conceptions are formulated, both in their content and in their placing (where and when they occur). The notion of higher-level accounts and generalizations being "occasioned" includes both of those things — content, and placing.

Similarly, later in paragraph 2, observe how Aaron L's formulations about the gender of wizards are portrayed as being argumentatively constructed, formed in response to questioning and disputation by the adult, and by the older child, Aaron B. Both of the children offer generalized and categorized formulations of the nature of wizards, but do this in a way that is pragmatically occasioned by their positions in the dispute. So once again, for the children, we have shifts to a more abstract, analytical level of thought, occurring in talk at junctures where troubles and argument call for them, and designed to fit particular communicative contexts. The same kind of sequence is identifiable in this brief extract from the field note LOGOPLUS 169:

> Mike [the child] said his objective for today was to make a disintegrating cube.4 But first he had to move his shapes around as usual. I asked, "Why do you spend so much time cutting and pasting?" He replied, "Because I like to be organized and it's fun!!" I guess you can't argue with that.

Here we have a report of a joint activity which runs into some kind of discoordination. The adult perceives the child's behaviour as not goal-oriented, and questions his actions, in a critical manner. In response, the child moves to a more conceptual level of thought, generalizing beyond the immediate case to some general principles which govern it. His account is taken by the adult as sufficient warrant to halt the argument.

Case 3: Issues of social-moral development

The field notes contain a wealth of observations and comments upon the matter of phase transformations in children's social and moral development. These observations and comments also lend themselves to analysis as texts, such that conceptualizations of social-moral issues and episodes can be shown to arise out of the occurrence of discoordinations between children, or between children and adult observers. They are also occasions upon which the reader of the field notes, the researcher or discourse analyst (myself), when puzzled or surprised by the field note writer's account, also formulates conceptions. Extract 7 is a case in point. 'Jenny' is aged 11 years; the writer is a male student.

EXTRACT 7, FROM WVEM 22.

> Today, Jenny came in both a bad and hyper mood. I asked her why and she replied:
> "I'm mad at that boy [David], because he won't admit that we were going around. I'm going to bug him today until he admits it. I'm in that stage of life right now you

know."
I was shocked at this, especially her last line of the stage she's in. Why? Because I do not remember ever thinking about girls as girlfriends until about the seventh or eighth grade. Maybe I started late or kids are just more socially advanced these days than when I was a kid. (...)
After we wrote to the Wizard she told me that she wasn't going to bug David after all, rather she was going to use him and abuse him, since he had used her to get popular. I asked her their relationship and she stated: "That it lasted three days and that they had French Kissed. That is the reason he didn't want to admit that they were going out. I'm not embarrassed to admit it why is he?"
Shocking?!! At least I think so. She asked me for my opinion (on whether or how she should use David). I told her that she shouldn't use him. She then decided to write to the wizard and asked him his opinion. Both girls asked the Wizard for his opinion on how they should treat boys before they left. Today, I learned how much more socially advanced the kids are than when I was a kid. Also, a new perspective from a girls point of view on how guys treat them.

In Extract 7 the writer is confronted with something unexpected, something "shocking", which prompts him to re- examine his understanding about children's social development, including his own development. Perhaps he developed late, or children generally develop earlier than they used to do; in either case, there is an interesting and culturally familiar association between behaviour which causes moral indignation, and being "socially advanced". But let us pursue a more fine-grained analysis. The discoordination between the child's perspective and his own prompted an articulation of the basis of that discoordination, and the formulation of concepts of advancement and development that could account for it. When reading this field note, I (DE) reacted somewhat as the writer had done, but I was surprised not at the girl Jenny, but at the writer himself — at what I thought was his naivety about the behaviour of 11-year-olds. Indeed, Jenny seemed to me quite normal, and I found her statement "I'm in that stage of life right now you know" particularly charming and amusing. She appeared to be displaying a meta-conception of herself as a normally developing individual, as if her problems might be calibrated against some textbook series of developmental milestones. We all appeared to be engaged in layers of phase shifts, prompted by discoordinations of perspectives. In response to some discoordination with her boyfriend David, Jenny was prompted to conceptualize her own development and think through, in dialogue with the student assistant and the "wizard", what her campaign of action should be. The student assistant, shocked at her precocity, is prompted to speculate about his own development, about development in general, and about how the world has changed since he was young. And my own thoughts, upon reading his, were to articulate for myself why I found his reaction so unlike my own.

Similar series of social-moral discoordinations and conceptualizations occurred with other field notes. Extract 8 is taken from a long field note about an 11-year-old who was considered difficult by many of the adults and children in the 5th Dimension. The student assistant (and author of the field note) expresses abhorrence at the boy's actions and talk. The text is presented here divided into four numbered sections that relate to the analysis that follows.

EXTRACT 8, FROM WVEM 152.

(1) I then asked what he liked to do and he replied, "I like to shoot up helpless ghosts and goblins, I like shooting them up. I don't like the thinking, I like no thinking just eating and killing no thinking." As he was telling me this, he was incessantly killing all the ghosts and goblins that appeared on the screen.
(2) I know I shouldn't judge people, but I'd hate to see
(3) what kind of person he might turn out to be,
(4) he reminded me of a psychopath!!!!

In Extract 8, the boy's apparent enjoyment in destructiveness appears to trouble the writer. The point of interest for this analysis, however, is how her account of the episode is structured. We can identify four stages:
1. Narrative description of, or engagement in, some ongoing activity.
2. Some sort of problem or discoordination of perspectives arises, giving rise to a cognitive- affective reaction.

The actor/writer becomes aware of herself having reactions and making judgments.
3.Generalization, as the episode or person is placed in the context of other episodes or persons.
4.Conceptualization of the issue, aimed at resolving or accounting for the problem.

This is a robust structure that can be mapped onto the other extracts and analyses that we have done. In extract 7, for example, the text moves through narrative description ("today, Jenny came in...", through discoordination, reaction and self-awareness ("I asked her why... I was shocked at this..."), towards generalization ("I do not ever remember thinking about girls until...") and finally, conceptualization of the issue ("Maybe I started late or kids are just more socially advanced..."). Each of these steps is an ingredient in how shifts towards self-conscious conceptualizations may be realized as occasioned phenomena in interaction and discourse.

Extract 9 is also a treatment of socialization or moral developmental issues, and shows the same four-step phase transformational structure. Again, the four stages are numbered to correspond with the analysis above.

EXTRACT 9, FROM CHICO 67.

(1)... David would answer nearly every question I addressed to Noah. (2) It got so bad I finally turned to David and asked, "Do you always know what he wants?" David laughed and immediately replied in his characteristic cocky tone, "Yes. I can read his mind." (3) The interaction between these two reminded me much of that between Chad and Ryan on my first day of site. Chad and Ryan were very giggley and silly. They shared private jokes and initiated a lot of physical contact with one another (ie: arm grabbing, wrestling). David and Noah also whispered private jokes to each other and seemed to have their own intimate relationship with silliness. (4) I observed David and Noah's relationship to be slightly sexual in nature as was Chad and Ryan's (as later pointed out to me by prof Cole). That is, sexual in the sense that they are in a struggle to determine their own sexual (male) identity and role.

Other Phase Transformations.

There is a further range of phase-transformational phenomena for which there is no space here for detailed analysis. Here are brief summaries of some of these. They are presented not as facts or conclusions, but merely as phenomena which have an obvious face-value interest which warrants further analysis.

(1) *Researchers' telecommunications.*
The Soviet-American researchers' telecommunications with each other about the field notes include remarks by the sender or respondent which address what the notes contain that is of interest, how they should be read, and so on. Communicative discoordinations are again the occasion for conceptualizations. For example, in messages from the American side, the problematical status of the field notes as textual "accounts" rather than objective records of events, arises in WVEM 22 in response to "the problem of evaluation which our Comlab colleagues have been asking."

(2) *Child tutors.*
The practice in the 5th Dimension is to get the more expert children to help teach or coach the less experienced ones. Confronted with the difficulty of producing adequate explanations for relative novices, often in the form of written instructions or game- playing hints, the children are forced to develop explicit conceptualizations and verbalize what may previously have been mere performative competence. Teaching becomes an opportunity for learning, as they try to put into words what they know, or how they do what they do, in ways that take account of the other's lack of understanding. For teachers as well as learners, reaching higher levels of consciousness is a social-communicational accomplishment, and a kind of phase transformation. Indeed, this is the basis for the undergraduates' involvement in the project.

(3) *The tutors as students.*
The adult authors of the field notes were often university students, who were themselves operating under more expert supervision from the main researchers. This intermediate role provides possibilities for examining how these student-tutors developed their own conceptualizations of what they in turn were helping the children to understand. For example, CHICO 67 contains a rich description of how one of the student assistants, having learned more from a full-time researcher about the activity she had already been supervising, then returned to the 5th Dimension, to unpack and re-build what the children had earlier learned.

(4) *Long-term developmental changes.*
While these data are most appropriate for examining short-term shifts in levels of consciousness, as these arise in the course of moment-to-moment communication, they also contain accounts of interactions with a cross-section of children of different ages. Different kinds of interactions and conceptualizations are reported for children of different ages. In WVEM 43, for example, we appear to have three stages of conceptualizations of the nature of the "wizard" (at ages 5, 7 and 12), which are realized in the children's communications. The 12-year-old is reported as having apparently come to terms with the dichotomy between fantasy and reality, being comfortable with the notion of make-believe, so that without having to believe in the wizard's having an ordinary material reality, he "is able to work with the program, not being distracted by the notion of the wizard and whether or not it's real". Emily, aged 5, is also comfortable: she "accepts him completely", his unreality being not yet even an issue for her. But Henry aged 7, "is extremely distracted by the notion of the wizard. This is evidenced by the fact that, when writing to the wizard, his comments and questions focussed on who the wizard was and how it was impossible to be a 'wizard'..." (details of Henry's letter are included in WVEM 43). The children's activities and talk are presented in this account as evidence of phase-transformational ontogenetic development, in that the children are presented as going through stages of (i) Emily — naive engagement with the wizard, not consciously conceptualized, but merely acted-out: (ii) Henry — active confusion, confrontation, contradiction and arguing-out, as the issues of reality and identity are problematical and need to be sorted out: (iii) Cory — the reality-fantasy issue is now conceptualized, and can be operated with comfortably.

Conclusions.

In general, these textual analyses show that phase transformations, while important in child development and conceptual learning, are not restricted to that context, but are closely linked to a general feature of all conversation, where accounts are occasioned. Communication troubles, of the sort we have been dealing with here, include things such as: evident lack of joint understanding with another person (disagreements, questionings, surprise at what they say); difficulty in verbalizing a description or explanation; having to find a way of including in a narrative something that is difficult to understand or explain, or which is contrary to expectation. As such, communication troubles are a frequent occasion for "accounts," wherein the speaker attends to the communicative problem by offering some sort of formulation, conceptual generalization, explanation, etc., of the difficulty.

There are psychologically different sorts of conceptualization that have to be done. People may draw upon ready-made formulations, or have to create new ones where old ones are inadequate, or re-work old ones, especially where other people in the conversation may object and argue, or offer alternatives. The developmental process is part of a more general communicative phenomenon, which includes the ways in which the writers of the field notes and the researchers themselves struggle to explain (verbalize and communicate) their observations, and to provide rhetorically adequate formulations (i.e., accounts constructed against the possibility of others disagreeing) of what is going on. Phase transformations are identifiable in discourse, arising as part of its rhetorical structure. To the extent that children are learning to verbalize ideas, construct explanations, conceptualize difficulties, with older children and adults, the availability of phase transformations in discourse renders psychological development empirically studiable as an interactively occasioned phenomenon. It is the same availability of phase transformations for discourse analysis that renders them communicational features for the participants themselves.

Phase transformations are studiable in ANY textual materials as discursively occasioned phenomena. The interesting thing here is how such shifts occur at all levels of involvement in the project — for the analysts and researchers, for the student-assistants, as well as for the children. Two kinds of shift can be distinguished, though they arise in the same kinds of interactional contexts.

(1)For people (adults and children) who already have the concepts and may have thought of it all in just the same way before, the actual use or application of those concepts — the shift to a more conceptual level of discourse — may be occasioned as a "microgenetic" process, by the raising of issues or problems of mutuality and interpretation.

(2)For people (adults and children) who have not yet had the concepts, the shift is occasioned in the same way, but has more obvious ontogenetic implications, as learners come to think conceptually about things they may have been doing routinely or unconsciously. The raising of such conceptualizations with a more capable partner affords the chance for the novice to learn how to cast such conceptualizations in a culturally ready- made, conventionalized, verbal way — learning how to talk about tasks and verbalize new understandings.

It seems that children's, observers' and principal researchers' understandings of what is going on may all have a common basis. There is a kind of ontogenesis for everybody. For example, on each occasion or context that the researcher-analyst moves to the more conceptualized, higher-order level of talk, this may be a new context, a new working out of the old ideas, and an opportunity for the further development of theory, or perhaps the questioning of theory, or the occasion for working out new insights, needing new terms of reference. It is conceptually ontogenetic for the adult theorist, just as it is for the child in the 5th Dimension. Discourse analysis is justifiably intolerant of any strict separation between the processes of knowing in which "objective observers" and "subjects observed" are engaged. The whole process of doing this sort of research, from the activities of children to those of the researchers and theorists, is amenable to the same sort of analysis.

Four micro-stages were identified, in which conceptualizations were interactionally occasioned: engagement, discoordination, generalization, conceptualization. While this was the general pattern for the data examined, other data suggest the possibility of a reverse path. As well as going from sense to meaning (Vygotsky, 1987; Velikhov et al., 1988), it is possible to go from meaning to sense. That is to say, we not only learn to put conventional meanings upon rich situated experiences, but learn also to flesh out learned conceptions through subsequent situated experience. Thus, many of the field notes offer evidence of students first acquiring conceptual notions such as "zone of proximal development", or merely understandings of the design and rules of games in the 5th Dimension, and only later gaining a "sense" of those things in actual practice, often via difficulties of practice or application. Through situated joint action and communication, sense gives rise to meaning (in the phase transformations we have examined here), and also ready-made meanings come to "make sense."

Our analyses suggest that conceptual formulations do not arise as decontextualized statements of how people think, or of what people believe. They are constructed to do interactive, communicational work. This leads us into a different understanding of "cognitive development" from how traditional, individualistic developmental psychology thinks of it, where what children say is likely to be taken out of context and treated as evidence of an underlying consistent model of the world. Rather, we are driven to studying conceptualizations as realized in action, as situated, social, communicational, conventionalized (cultural), and contextually variable. We need a methodology of communicative action. Conceptualizations are things people do, not things people have.

Notes

[1] The computer activity involves "Super Factory," an educational program produced by Sunburst Communications, Inc.

[2] "Pond" is an educational program produced by Sunburst Communications, Inc.

[3] "Island Survivors" is an educational program that is part of the Voyage of the Mimi series, available from Sunburst Communications, Inc.

[4] The computer activity involves "LogoWriter," an educational programming language produced by LCSI, Inc.

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Participants of the Velikhov-Hamburg Project

The list on the facing page includes those who are currently active in the work. The names are followed by an indicator of where they work, the kind of expertise they provide, and their status. A second list includes those who have been instrumental in our work in the past. The lists are undoubtedly incomplete, given the number of people who have shown interest and given help to this work in the USSR and the USA. To offer comments or ask for further information, address inquiries to either of the coordinators.

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