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The Influence of Schooling on Concept Formation: Some Preliminary Conclusions*

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During the past two decades there has been an unprecedented outpouring of psychological research on the cognitive consequences of schooling. There have been important companion efforts in anthropology and sociology. It is fair to say that despite all of the effort that social science has put into assessing the influence of schooling on cognition, there is no unified theoretical account of our cumulated data. Lacking an agreed upon theory, different analysts distrust each other's data; methodological wrangles are at the center of attention; a bore and a necessity.

We will not seek to summarize the extant data in detail. That has been done often and competently (for a recent review see Rogoff, 1981). Instead, we will present a schematic overview of the main phenomena that stand out from the haze of uncertain procedures and less certain assertions that count as facts. The reader should keep in mind that disputes about basic facts are not trivial. *All* research on the effects of schooling has been carried out with contrast groups constructed on the basis of social forces beyond the analyst's control. The natural logic of constructing school-nonschool comparisons founders on the equally natural fact that schooling is not assigned at random to human beings, not even human beings of a specified age. In technical parlance, experimental comparisons of the influence of schooling are not possible because we do not have random assignment of subjects to groups. There is evidence from many sources that even in countries that instituted universal education programs following World War II, children have not been selected at random to go to school. Among the characteristics that have been found to differentiate children prior to entering school (in addition to demographic characteristics like sex and economic status) are performances on various cognitive tasks used by psychologists to measure intelligence and development. (See Fahrmeier, 1975; Irwin, Engle, Yarbrough, Klein, & Townsend, 1978; Sharp, Cole, & Lave, 1979). Since the domain of influence specified for this discussion is the influence of schooling on concept formation, these indications of selectivity must concern us. In common sense terms, we might suspect that children who go to school have been selected for their intelligence. If we use cognitive tasks to assess outcomes of schooling, our tests may mistakenly measure prior ability.

Another whole set of injunctions concerns the problem of equivalent test conditions. Instructions, materials, procedures all ought to be equally familiar to comparison groups. We prefer, for the moment, to postpone this discussion. There is a sufficient body of data that meet the normative standards of our disciplines, taken singly, to permit generalizations that can win wide acceptance. It is in juxtaposing explanations for first order generalizations that troubles arise, troubles which will bring us back to the question of method and generalization.

What the data tell us

Putting aside the certainty that matters are vastly more complex than any simple partialling of the data can convey, the following assertions appear a promising basis for further discussion:

1) For cognitive tasks where the basis of solution chosen by the analyst is based upon functional relations among problem elements, especially if those problem elements are common to everyday experience, Schooled and Nonschooled populations perform alike. Age comparisons in such tasks reveal that there is an increase in correct performance from childhood to adulthood (roughly, 6-20 years).
2) For cognitive tasks where the basis of solution chosen by the experimenter requires the use of taxonomic classification systems Schooled populations outperform Nonschooled populations, *unless* the taxonomic structure of the task is made explicit.
3) For cognitive tasks where specialized information processing strategies are a part of the analyst's solution to the problem, Schooled populations outperform Nonschooled populations in ways that relate directly to the hypothetical strategy (e.g., rehearsal).
4) For cognitive tasks where language itself is the analyst's topic, Schooled populations are more likely than Nonschooled populations to treat the topic as hypothetical.

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Two interpretive frameworks

The facts, as they say, appear plain enough. How are we to account for them? Assuming that low level methodological artifacts cannot be martialled in sufficient number to shake our belief in the generalizations we have just made, what more general ideas can account for them, and the forms that they take in various parts of the world today?

All accounts for the consequences of education would agree that students learn new configurations of activities. At this point, consensus leaves the discussion. Within and between disciplines we have no agreement on how various phenomena are to be interpreted. However, all is not chaos. Among the contending voices there are configurations of ideas, theoretical strategies perhaps, (paradigm's in Kuhn's term) that claim a broadly acceptable framework of interpretation. Dominant among these paradigms are developmental theories which see development as the gradual replacement of one qualitatively distinct configuration of adaptation for another. These accounts claim too that a developmental transformation occurs at the level of the basic level of the theory's unit of analysis (a word for Luria, Vygotsky, Burke, Austin; a schema for Piaget, Norman and Rumelhart, Schank and Abelson and many others).

After discussing a generalized version of a developmental account of schooling effects, we will present an alternative approach which views schooling effects in terms of systems of mediated activity.

A developmental account of the data

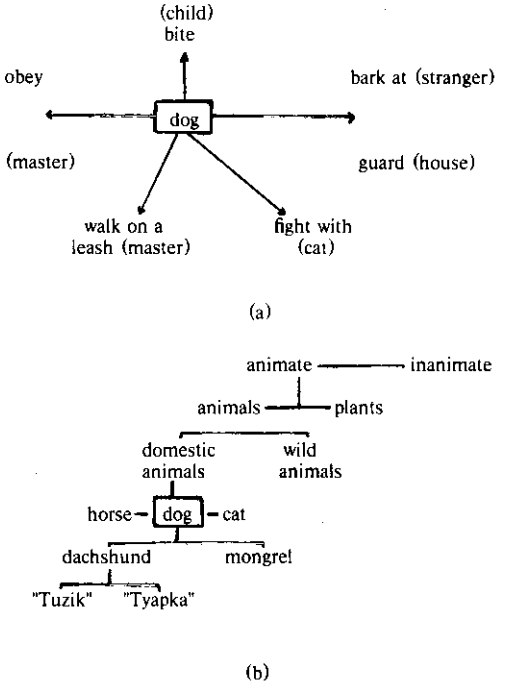
In their most common form, developmental accounts of schooling effects go beyond the notion that there are developmental sequences characterizing different functional systems to implicate basic differences in the content and processes of conception as well (Greenfield, 1972; Luria, 1976). Such theories also hold that "in some way" the basic units upon which conceptual thought is based are likely to undergo fundamental changes as a result of schooling.

Theories vary in the basic unit of analysis they posit, posing difficult problems of data interpretation when we move from one experimental instantiation of a theory to another. To keep this discussion to manageable length, we will present one theory from this class of theories, in this case the work of Alexander Luria. We select Luria's work because he presents a very concise account of this kind of theory using as an example a kind of data for which we have relevant school-nonschool comparisons. The data are from a free association test administered under Cole's direction as part of a project to assess the influence of schooling on concept formation. The data have been reanalyzed by D'Andrade as part of the discussion which produced this paper.

Luria (1982) presents a theory of the development of word meaning which stands as one expression of his more general theory of development. He gives the following example:

> ..."dog." For a small child, a dog may be something terrible if he/she has been bitten by one, or it may be something quite pleasant if the child has grown up with a dog and is accustomed to playing with it. Thus the word "dog" has an affective sense. This affective sense is the essence of the word's meaning. During the next stage, the word "dog" evokes the memory of a concrete experience (a dog being fed, a dog guarding the home, a dog keeping thieves away, a dog carrying things, a dog fighting with cats, etc.). In other words, the word "dog" begins to give rise to a whole range of concrete images of situations. For a child who is studying science, and even more so for a college student, a dog is an animal that is included in an entire hierarchy of mutually subordinate concepts.

Figure 1
Scheme of the structure of semantic fields in ontogenesis.



What we have said above may be illustrated in. . . . [Figure 1].[1] The first diagram illustrates a word's meaning structure when a concrete image has replaced affective connotations. Here, word meaning involves actual practical associations or concrete situations. Each element is connected with this word on different grounds. A dog obeys its master, guards the house, bites a child, etc.

The structure of word meaning takes on an entirely different character at later stages. The lower diagram illustrates that the word enters into a system of hierarchically connected and mutually subordinated categories. It acquires, as linguists say, a paradigmatic character. The word's meaning is situated in an hierarchical system of abstract oppositions. Thus, a dachshund is not a mongrel, but they belong to the same category; a dachshund is a dog not a cat; a dog and a cat are animals and not plants; etc. These categories are mutually subordinated in a hierarchy. They form the system of abstract concepts and are distinguished thereby from the concrete situational relations characteristic of words at an earlier stage of development. At the stage of concrete concepts, the key role is played by situational, object-actuated bonds; whereas at the stage of abstract concepts, the key role is played by the verbal and logical hierarchically constructed bonds. We may therefore say that changes in meaning simultaneously involve changes in associated processes.

Thus, following Vygotsky, we would conclude that word meaning develops even after the object reference of a word is stabilized. This fact means that the structure of

[1]Figure 1 is our facsimile of Luria's diagram (1982, p. 52).

> consciousness also changes. During the earliest stage of ontogenesis, consciousness has an affective character. During the next stage, it begins to assume a concrete character. Words, through which the world is reflected, evoke a system of practically actuated connections. It is only at the final stage that consciousness acquires an abstract verbal-logical character, which differs from the earlier stages both in its meaning structure and in psychological processes, although even at this stage the connections that characterize the previous stages are covertly preserved (Luria, 1982, 51-52).

This account nicely summarizes the view that development proceeds by a series of stage-like transformations from an undifferentiated to a differentiated system, and hence to a system which is described as rational, logical, integrated by rules and maximally adaptive, e.g., fully developed. Development, by this view, creates new systems at the level of the basic units of analysis in the theory.

Note, however, that old systems don't go away entirely. As Luria puts it in one place, "the connections that characterize the previous stages are covertly preserved." The question of what happens to the old systems when new ones are invented is a difficult one in developmental theory and we will not be able to resolve it here. But we can get some idea of what Luria means by his examples; early, lower order processes reappear in times of stress, alcohol, brain damage. In this context, the image that is evoked is of primitive systems being "uncovered" when the layer above them is peeled away. This image is very pertinent to Luria's interpretation of functional systems in the brain (Luria, 1976). However, it is not the only kind of example that Luria gives. In discussing results from experimental tasks involving word classification, he notes that he and others used these tasks to compare the cognitive processes of people who vary in their "socioeconomic living conditions and their level of school" tend to classify according to iconic, concrete-situational principals. He is at pains to note that these subjects "can also understand the other, categorical, form of classification, but they consider it 'unimportant.'" (Luria, 1982, p. 63)

An example contrast: What's the first thing that comes to mind when....? Luria's account of the change in meaning from the concrete-situational to verbal-abstract stage is precisely the change that schooling is found to produce in a variety of cross-cultural data.

As a concrete example, consider the data in Figure 2. (See page 22).

The data in Figure 2 are a classification of the words given as an associate to "duck" by groups of Mayan people living on the Yucatan peninsula. Each of the groups labeled across the top of the figure consists of twenty people, more or less evenly divided between male and female. The groups labeled "Maya" are from families where Mayan is the dominant language used in the home, although the children attend school where Spanish is the language of instruction. "Mestizos" are people who speak Maya and Spanish, and among whom Spanish dominates as the language of choice in most situations. Ladinos are people of European descent who are unlikely to speak Maya. Culturally the Mayan families would be considered more traditional than the other two groups; economically these families are likely to be poorer and more agricultural in orientation.

Subjects were read words one at a time from a list consisting of 15 words, 5 each from one of 3 common categories of words in use in the community. They were instructed to say the first 5 words that they thought of each time they heard a new stimulus word (e.g., "duck"). Each subject was read the list in a different, randomly constructed order, and all of the response words were recorded as they were spoken.

The data entries in the figure represent the entire set of responses arrayed according to the semantic relations between stimulus word and response word. Scanning first the data for the most educated group, we see that high schoolers demonstrate a configuration of responses in which categorically and semantically related words dominate. All other groups respond in a very similar manner to each other, and differently from the high schoolers; they designate characteristics of the thing named. Some of these characteristics are physical features of the object (its color), others are typical actions that can be done to or by the object.

It should be clear, even at a glance, that the pattern of performance that distinguishes the word associations of the groups contrasted by amount of schooling fits very neatly into Luria's developmental model of word meaning. Taken at face value, the conclusions to be drawn from such results are far reaching indeed: schooling produces a fundamental restructuring of the lexicon upon which verbal reasoning is based. Here the notion that certain functions develop little or not at all in the absence of schooling has wide implications because it is built into the basic unit of analysis; into the structuring principle of the contents of thought.

Conclusions with such far reaching implications aren't drawn lightly, and at this point virtually everyone pauses. Are there data which would lead us to modify the implications that are looming at us? Is there a really important way in which primitives think like children?

Doubting data. Although there is a long tradition of using free association data as a window on the organization of the lexicon, there have also been data warning us that there are *no* transparent windows on the organization of lexical knowledge. Thus, while shifts in the organization of responses like those shown in Figure 2 have repeatedly been obtained, their developmental status is much debated.

One line of research undermining straightforward developmental interpretations was initiated by Stoltz and Tiffany (1972). They collected free associations from college students using two lists of words. The first list consisted of a set of relatively high frequency English words (e.g., "erotic" vs. "sexy"). The second list consisted of lower frequency synonyms of the same words. They found that the same subject would produce word response configurations differently for the high and low frequency item of each synonym pair; high frequency items produced Luria's "verbal-abstract" response system, while the low frequency words produced "concrete/situational" responses. The existence of two levels of development in the same person at the same time for two instantiations of the same concept makes it very important for theories of the development of word meaning to get a lot more specific about the status of "lower stages" in the system of psychological processes. In this case, different stages correspond to different frequencies of experience.

A second line of research that gets us to doubt that

Figure 2
Responses to the stimulus word, "duck"

	Ladino High Sch	*Mestizo 8-10*	*Mestizo adult*	*Mayan 8-10*	*Mayan adult*
Is a kind of a duck	fowl 6	small one	"	"	male
	pajaro	"	"	"	female
	"	"	"	"	"
Is a characteristic of some ducks	wild 3	large 3	fat	fat	dirty
	black	old	tall	small 3	yellow
	"	black 2	small	large 4	black
		dirty (?)	black	black	useful
		pretty	white	dirty	necessary
			valuable	clean	clean
				many (?)	pretty
				pretty 2	white 3
				good	large
				white	small 2
				brown	
				useful	
Is a kind of duck	female duck 3	ducklings	female ducks 3	"	duckling
	"	"	"	"	"
	"	"	"	"	"
Is like (constrasts with) a duck	goose 5	chicken 2	"	chicken	chicken
	sea gulls	turkey	"	turkey	"
	chicken 5	"	"	dove	"
	hen 3	"	"		
	dove				
	eagle (bird)				
	cardinal				
	turkey 2				
	peacock				
Is a part of a duck	wings	wings	feathers	"	"
	bill 2	bill	beak	"	"
	feathers	"	wings	"	"
Ducks are found in/near/at	sea	water 4	water	sea	sea
	nest	house	lugar (?)	water	water
	water	grass	sea	"	house
			market		land
			house		yard
					town
Ducks have	nest	egg	egg 4	egg 4	egg 2
	egg	"	"	"	egg-ova
	"	"	"	"	"
Duck (Typical action)	swim	swims 5	to fly 3	to walk	to swim 4
	(flying)	gobbles 4	walks 3	to fly 2	to fly 5
	"	flies 4	to swim 4	swim	"
		walks 2	lay (eggs)		
			flying		
			to bathe		
Ducks are used for (object)	food	meat	food 3	food	
	"	food	meat		
What one does to ducks	"	to kill	to sell 3	to take care of	
	"	to eat	to breed	to take	to eat 6
	"	to breed	"	to eat 3	to breed
				to marinate	to sell
Uninterpretable	spread out	pineapple	spread out	candle	to spread out
	"	stick 2	stick	sprout	to paint
	"	to raise	solar	"	"
			sick		

changes wrought by age or schooling represent transformation in basic thought units in the sense previously discussed demonstrates that by changing the context of elicitation, differing pictures of the lexical organization of the same words can emerge. So, for example, when noneducated people who demonstrate situational-

concrete associations in a free association or object sorting study are presented the same words in sentence frames and asked to make judgements about the acceptability of the sentences produced, the pattern of their responses shows clearly that they are reproducing a "verbal-logical" hierarchy of word meanings (Cole, Gay, Glick, & Sharp, 1971).

Taking another look. It is almost certainly possible to reconcile these data on variable lexical organization with modified versions of a transformational, developmental theory. These theories are ambiguous about the cognitive status of lower stages, and expansion from existing assumptions to account for the conditions under which they will come to control behavior is one normal line of approach on the existing anomalies. But there are good reasons for arguing that a reformulation of the entire set of issues be attempted.

To begin with, recent debates on the nature of conceptual change have made clear the difficulties of arguing that qualitatively new and more powerful structures of intellect emerge *at the level of basic units* [which is what the word represents in Luria's system of the schema in Rumelhart and Norman's (1980) system]. These arguments have been summarized (by Fodor, 1975; Keil, 1981) and need not be gone over here. However, the underlying message is clear: in some sense, the competencies underlying adult conception must be present at birth. Conceptual change can only be change in the functional organization of existing conceptual systems. New functional configurations exploit pre-existing possibilities in the phylogenetically coded possibilities of homo sapien's interaction with its niche in nature.

This point of view extends beyond arguments over the nature of language considered in the narrow sense into a re-evaluation of the nature of conceptual development more generally. What began in the 1960's as a theoretical argument between constructivists and behaviorists over the factors controlling conceptual development has blossomed into a new, as yet poorly articulated, counter-framework. Empirically, research is discovering the existence of cognitive sophistication in younger and younger children (Gelman, 1978; Mandler, 1981 and passim). It is doing so by adapting strategies of research that insinuate themselves into the flow the child's interactions with the world under conditions that are as close to natural as possible (French & Nelson, 1982). As Donaldson (1980) so nicely puts it, experimental arrangements should make as much "human sense" as possible, so that factors other than those relevant to the focal activity do not flood the system.

Finally, this point of view is consistent with that tradition of cross-cultural research on cognition which interprets cultural differences in terms of the different functional activity systems that organize a universal set of basic conceptual competencies (Hutchins, 1980; Laboratory of Comparative Human Cognition, in press(a), in press(b); Scribner & Cole, 1981). The substance of this alternative approach can be illustrated by reconsidering the data in Figure 2 and the circumstances under which they were collected.

An alternative explanation. A person comes to you and tells you that you are supposed to say the first thing that comes to mind when he pronounces each of a set of words. The description of the experiment includes the written instructions, and something about the institutional setting. But what about the subject's interpretation of the request? Won't it be important in determining the nature of the words he thinks of first? Luria certainly thought so. He built a lie detector system on the notion that one could learn a great deal about underlying cognitive organization depending upon the interpretation that individuals put on a specific word. One could even use this information ("covertly preserved") to construct a lie detector (Luria, 1979).

How would we apply this line of reasoning to the school/nonschool comparison? We might ask, "Has this person ever encountered anything like the task I am posing?" If they have encountered something like the task we are posing, we might want to investigate its structure to see what it could tell us about what the subject was likely to do. In Luria's terms, we might want to find out when different kinds of organization are considered important enough to use in guiding behavior.

Here we come upon a central paradox in this enterprise. Schooling is an historically accumulated set of activities which has as its general function the preparation of immature humans to adopt adult mature human roles. Among the wide variety of systems of enculturation, the participants in discussions of the influences of schooling usually have in mind a multi-year curriculum more or less based on the model extant in our public schools today. That is, children attend classes where 25-30 children are instructed by an adult. Instruction focuses on literacy and numeracy as essential tools for acquiring knowledge and operating the technical and bureaucratic affairs of an industrialized or industrializing country. Whatever other functions a school may fulfill (and they are many) practice in manipulating information through operations on language (directly or through writing) is a central basis for evaluating success.

When we approach two men to participate in our experiment, we encounter people who differ in several respects with regard to information they can draw on to interpret our instructions.

First, the educated subjects have a great deal more encounters with *words.* Whatever else goes on at school, there is a lot of talk. Moreover, it is talk about common objects entering into diverse relations that are perfectly interpretable as concrete events ("José gave a banana to Lupita") except that the reader might not know a José or a Lupita. While this situation might cause a little confusion at first, a few pages into his/her first primer and the novice will begin to realize that books are about "any old" José and Lupita. Books are about words. So is a lot of the rest of the curriculum. Nor do words have to make any particular human sense; they have to make school sense. Later on we learn what it is about.

When we approach a person who has had such experiences he of course wants to know who we are and what we are doing. We explain ourselves. We are there to help improve the education of children. Education, all agree, is a good thing, so people cooperate with us. When we give our instructions they seem to understand what we want. They respond to each word we present as if they understood our instructions to be "When I say a word, tell me the first *word* that comes to mind." They seem to be invoking school as the context to interpret the experiment. Like their encounters with

school-like activities, the experiment is about *words.* They respond with words appropriate to the context as-they-interpret it.

The uneducated subjects had also heard of school, and they had some notion of what we meant when we spoke to them about improving their children's education. But they had little experience with interactions mediated by print and the kinds of content areas of the curriculum that foster extensive commerce with words in multiple contexts. They too seemed to understand our instructions, responding readily with words in response to stimulus words. Significantly, the words that they gave are themselves evidence that the subjects' understanding of the task overlapped considerably with the experimenter's: only a few words are not readily categorizable in terms of their semantic relations to the stimulus word (and in those few cases, our limited knowledge of Spanish and Maya may have induced a wrong identification of the word). Yet the context evoked by these subjects was not school (not too surprisingly since they have experienced little enough of it long enough ago to make it seem remote). Rather, it seemed to be other contexts where, in daily life, one encounters the object named. Instead of providing words that are similar to the words offered by the experimenter,the nonschooled subjects appear to be describing objects that are named by the experimenter in terms of the empirical events within which the objects are embedded.

The reader who finds this kind of explanation plausible may well be moved to shake her head over the difficulty of doing clean experiments in cognitive psychology, and the bore that methodological purity often represents. Not a little of our own work has been an exploration of the limitations on generalizations that comparative cognitive data permit (summarized in Cole and Means, 1981).

We postponed the discussion until we had motivated differing theoretical interpretations of the basic phenomenon, because we see no way of deciding deep theoretical divisions on the basis of a theory-free method. If, as we propose, the basic conceptual "building blocks" that characterize all presumed stages of conception are there from the beginning, what kind of theory of development is implied and how does schooling contribute to the manifest changes in the structure of mediated activity that characterizes adults and children in ours and other societies?

Standing Luria on his head. We have chosen Luria as a foil for this discussion because he lays out the developmental position so neatly in his work. He also offers the basis for the reformulation that we need. In the work already referred to, and in the work of others in Vygotsky's school who have grappled with the shortcomings of the originators' work, we have the basis for a multilineal theory of development which is culturally guided and biologically constrained.

The starting point for such a reformulation is Luria's recognition that new developments do not *replace* old ones, they reorganize the functional organization into which previously present elements enter. In simplest terms, what Luria takes to be transformational changes in the basic elements of thought are transformations in the systems of mediated interaction of which the individual is a part.

Luria's own examples are a good starting point. He says that an "affective sense is the essence of the word's meaning." We can understand this as follows: if a child has seen a dog only once and was terrified by it, and has learned that "dog" applies to the creature, the strong affect of the original event may well be dominant in the child's understanding of "dog." But there is no reason to take this example as typical of all lexical items in the child's vocabulary. In order to "respond affectly" to the word dog, the child is also demonstrating recall of a concrete situation and is abstracting features of that situation which correspond (according to some mapping, not necessarily the adults') to the prior events. That is, "concrete-situational" and "abstract" aspects of the concept were co-present in the child's representation, but not dominant as evoked.

The same holds true for the next stage, when the word "dog" is said to evoke the memory of a concrete experience ("a dog keeping thieves away"); this description of a memory is itself an abstraction, yet one in which affective components are easy to imagine. Luria need not say that "a concrete image has replaced affective connotations." He has good evidence to show that the system replaced remains in the person's repertoire. From the work of ingenious cognitive psychologists we know that the systems presumably "acquired" are present from the beginning. Thus the task becomes to account for the transformations in the functional organization of activity during ontogeny. In the present case, we want to understand schooling as a distinctive form of activity. Once we have some notion of schooling's special properties as a system of activities, we can ask what functional cognitive systems it promotes, and the role of these systems in other domains of activity.

Posed in this general fashion, the issue of schooling influences on conception opens onto a discussion of the role of schooling in society. To avoid yet another vast sea of uncertainties, we can reduce schooling to its bare-bones essentials: schools are contexts set aside from other activities where adults teach children skills that are assumed of universal relevance to adult practices in *other contexts.* Schools as contexts are distinguished by the organization of social interaction, the tools and materials that are required to obtain information about what one needs to do in order to fill various social roles, and the incentives for trying.

Virtually since their beginning, organized around literate practices, schools have placed enormous value on lists of objects. Represented in graphic form, these lists allowed new forms of inspection, because the representations were relatively fixed in time and space. This functional reorganization of information and problem solving led to the use of new criteria of grouping, criteria we recognize as systematizing, and became a central part of the technological armorarium with which we address the world. But even at the beginning, before the invention of the alphabet or typography, schooling perpetuated the dream that Man could get a catalogue of all the world's contents, which when properly classified and memorized would represent full knowledge of the world. As ludicrous as it may appear now, an ancient Egyptian scribe who had listed all of the known world's objects by name and categorized them into nine broad classes could declare that the

manuscript was a "Beginning of the teaching for clearing the mind, for instruction of the ignorant and for learning all things that exist." (quoted in Goody, 1977, p. 101).

So, perhaps we could agree that schools are a place where a special kind of activity goes on. It is an activity that involves exchanges mediated more by words than by objects, although these exchanges have been arranged by the society for the purpose of allowing people better to operate on objects in non-school contexts. Among activities largely mediated by words, schooling is distinguished by a set of practices designed to teach specific skills involving language and extensions of language in the form of writing and numeracy.

From the current perspective, resolutions of questions about the influence of schooling always depend jointly upon the context in which the activity is acquired and the context of application. Following Friere (1970), we can conceive of schooling as a social process involving activities in two contexts, the "theoretical context of dialogue between teacher and learner" and the "real, concrete context of facts, the social reality in which men exist." Within each of these contexts, language plays an important, *but different* role. In the theoretical context, one's practices involve manipulations on words. This teaches us more about words and more about manipulating them. We learn ways to remember long lists, to search for connections between concepts where no connection is obvious (except in the teacher's expectation that we will find one if we work hard enough). In some instantiations, it teaches that "meaning is in the text" (Olson, 1977) and it promotes modes of discourse in which the structure of written text enters into the structure of speech (Greenfield, 1972).

The structure of communication that characterizes the theoretical context constrains the conceptual processes characteristic of schooling. It shapes the characteristic cognitive activity of the school context, which leads neo-Vygotskian scholars to declare that "Theoretical thinking is. . . .the new psychological structure that emerges at primary school age." (Markova, 1979) (assuming a society in which schooling has the characteristics of contemporary industrial societies). Bartlett (1958) characterizes these activities as "closed system," "experimental" thinking, in which systematic search and comparison procedures are the norm. As many have pointed out, the procedures of the school are designed to allow the assessment of individual achievement, or its darker side, failure.

What about the other contexts that people find themselves in, those contexts which we so glibly gloss as "everyday life," those contexts from which schooling was separated in the first place? Obviously no single contrast can capture the richness of the distinction we are trying to make; rather, for each way in which we claim something characteristic of schooling, there is a potential contrast with other systems of interaction. The clear implication of the work we have been referring to is that activity is mediated by language in a different way: partialling achievements between participants is no longer a necessarily prominent aspect of interactions, social flexibility in bringing information to bear on a problem is far greater, the goals of the activity are likely to bear a more direct relationship to individual actions than is true of schooling, and except in special cases, writing and language are not so clearly organized to manipulate words in the absence of manipulations on objects and people.

Some summary considerations

We are currently in the process of exploring the implications of the position we have been outlining here. Going back, for a moment, to the four generalizations about schooling effects that we offered at the outset, we can feel comfortable that we have not done violence to the facts. In those cases where the goals of the activity arranged by an experimenter conform to everyday goal structures, we expect performance to increase with age. In those cases where the goals of the activity arranged by the experimenter conform to structures which are specific to schooling, we expect exposure to schooling to influence the organization of cognitive activity. The resulting pattern of school/non-school differences will depend upon features of the contexts and activities that are tapped by the experimental task. In some cases features of the discourse mode (Scribner, 1977), in other cases familiarity with specific materials or optimum processing strategies will be seen to shape the specific functional organization of activity.

Although our account of schooling influences may not do violence to the facts, it may also be argued that it hasn't done much to raise us above the facts. To the question, "what is schooling's influence on concept formation" we have answered "it changes the mix of cognitive organizing principles that guide peoples' actions, depending upon the contexts in which they find themselves." This answer commits us to a study of the relation among contexts to which schooling is connected as a social institution as well as a description of cognitive activity in those contexts. It's a long and difficult enterprise as generations of anthropologists can attest. However, it is not a road that we are traveling from the beginning. We have offered a reinterpretation of a developmental theory that shifts the basic unit of analysis. It does not deny the centrality of language in the process of the development of new functional activity systems. Rather, it focuses our attention on the factors that control which organizational principles are appropriate. The data speak unequivocally on one issue. Schooling provides increased experience with language. Language is the storehouse of the theories accumulated in human experience to account for experience of the world. Access to the experience of schooling is access to a treasure trove of tools for dealing with our lives. What influence schooling exerts will depend jointly on our access to the tools and the raw materials (e.g., non-school real world contexts) within which to tinker with our (k)new-found possibilities.

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Perspective-taking Versus Content in Understanding Lies*

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Our common cultural knowledge, i.e., knowledge which is shared by others in the culture, is a neglected topic in cognitive development. The young child is often thought of as a little scientist exploring the world and discovering the principles of its operation. We often forget that while the scientist is working on the border of human knowledge and is finding out things that nobody yet knows, the child is finding out precisely what everybody already knows.

The basis for social cognition is usually thought to be perspective-taking which is characterized as a general capacity to think about other people's mental states that develops somewhat independently of content knowledge. In this paper I provide an analysis of children's understanding of lies that highlights the importance of cultural knowledge. I argue that the initial understanding of lies does not require perspective-taking but rather knowledge of the shared beliefs between the two people in interaction. When perspective-taking does come into play in the course of development the mutual beliefs of the interactants still play a fundamental role.

As part of a larger study of deception (Newman, 1981; Newman & Bruce, in preparation) I showed three skits to 48 subjects, 12 each from grades one, three-four, six and college. The skits were produced for telecast on Sesame Street and featured two Muppet characters, Ernie and Bert. In each skit Ernie deceives Bert. For example, he gets Bert to share a cookie or he tires Bert out so Bert won't be able to get angry at Ernie for losing a cherished toy. In my interview procedure I showed the skit all the way through so the subjects could see the punch line at the end. I then played the skit again, this time stopping the videotape at designated places where I asked questions to elicit their interpretation of Ernie's actions to that point.

The skit that will serve as an example in this paper goes like this: Ernie is seen returning home with a bag of groceries. Bert is anxious to know if he got everything on the shopping list particularly if he got the bananas. Ernie pulls one banana out of the bag and begins peeling it. Bert looks disturbed and says that he likes bananas too. As Ernie continues to peel the banana and to ignore Bert's desire for some banana, Bert gets angry and confronts Ernie about sharing. Ernie apparently realizes his selfishness and admits that, as a good friend, he should share it. He says "I'm going to divide this banana up so both of us can have some". But Ernie turns his back and while Bert can't see gobbles down

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the rest of the banana. When Ernie turns back around Bert is surprised and angry to see what Ernie did but Ernie insists he's sharing it. As he hands Bert the peel, he says "See, I took the inside part and here's the outside part for you." Bert faints.

In the course of my interview about this skit, I stopped the tape at the point Ernie said he was going to "divide the banana up." I asked several questions including whether Ernie was lying or telling the truth and why the subject called it a lie or called it the truth. I will use three aspects of the subjects' answers to these questions to illustrate my analysis of the development of the understanding of lies: 1) the notion of literal truth; 2) an age progression in subjects' reasons for calling Ernie's utterance a lie; 3) the tendency of older subjects to think that Bert realized Ernie's joke just before he fainted. In each case, I will contrast a cultural knowledge base analysis with the more standard analysis based on a generalized perspective-taking ability.

Literal Truth

Table 1 shows that almost all the subjects considered Ernie's utterance, "I'm going to divide this banana up," to be a lie. But here we can see an increase with age in the number of subjects who thought Ernie's utterance was *both* true *and* false. All but two of the 27 subjects who said Ernie was telling the truth or partly telling the truth made reference to the idea of "literal truth." These subjects recognized that what Ernie said is, in itself, true but that it implies something that is false.

Table 1
Age Comparison of Judging Ernie's "divide this banana up" Utterance as a Lie or the Truth (Frequencies)

	Grade				
A Lie or the Truth?	*1st*	*3-4th*	*6th*	*Coll*	*Total*
Truth	0	1	1	1	3
Lie	11	5	4	1	21
Partly both	1	6	7	10	24
Total	12	12	12	12	48

What these older subjects are doing is distinguishing between the literal meaning of what Ernie said and the meaning that was conversationally conveyed in the context. These subjects are displaying an interesting analysis of language use, i.e., of how sentences convey meaning in ordinary interaction. This understanding is related to but distinguishable from perspective-taking per se. What the subject needs to know is, first what the sentence "I'm going to divide this banana up" means and second, what is implied by the use of the sentence. Neither of these require considering the mental states of particular characters. The first requires only a knowledge of conventional sentence meaning. The second is an inference anybody would make. The point is that the older subjects' understanding of literal truth demonstrates a sophisticated analysis of the system of conventional beliefs that Bert and Ernie share.

Reasons for calling it a lie

The subjects' reasons for saying Ernie was lying provides a second example of the subjects' analysis of the shared or mutual beliefs of the two characters. Table 2 shows the frequency of response for the four age groups for four levels of reasons. (These categories considered as an ordinal scale are correlated with age (Kendall's tau $= .42$ $p < .001$)).

Table 2
Age Comparison of Reasons for Calling Ernie's "divide this banana up" Utterance a Lie (Frequencies)

	Grade				
Justification Type	*1st*	*3-4th*	*6th*	*Coll*	*Total*
Plain lie	4	1	1	1	7
People don't eat peels	4	5	4	2	15
Bert expects	1	3	2	3	9
Ernie misleads	0	1	2	5	8
Total	9	10	9	11	39

Each of the levels makes progressively more explicit Ernie's intention to set off the inference process that misled Bert into thinking Ernie would share the inside part of the banana. The first level is the "plain lie." These subjects simply asserted that what Ernie said was false. For example a first grader gave the following reply:

S: He's lying because he didn't give him any.

These responses did not mention any mental states or any inferences made by the characters.

At the next level, the subjects mentioned facts (i.e., "you can't eat the peel") that would be the basis for Bert inferring that Ernie had meant that he would divide the inside part but Bert's actual inference is not mentioned. For example, a fourth grade boy answered:

S: I think he's lying. You know, its not fair. He gets the good part that you can eat. The other, and Bert gets the part that you, just, just the plain old banana peel. Can't eat that.

The third type of reason for calling Ernie's utterance a lie cited the fact that Bert expects to get some of the inside part, suggesting that Bert actually made the inference. A sixth grade girl gave this answer:

S: He's telling the truth but he's not telling it the way that Bert's thinking because Bert thinks he's going to get some of the part you eat, not the outside. And Ernie's, he's giving him the outside.

A fourth kind of answer says that Ernie was misleading Bert into making that inference. An undergraduate answered:

S: Well, he is misleading Bert again. He's in the strict sense, he's, is gonna share the banana so that they can each have some. But he's making Bert think that he's gonna get some, that Bert will get part of

the banana and so literally, no, I guess he's not lying, but, but again he is.

We can see that the first two levels display what Piaget (1965) would call "realism." Piaget observed that when presented with stories about lies, young children judged lies by the magnitude of their discrepancy from objective reality rather than by the intentions of the liar. For example, young children in Piaget's study considered a story child's lie about seeing a dog as big as a horse to be more naughty than a lie about getting good marks in school presumably because the mother in the story would see the assertion about the dog as more obviously false. That is, everybody (the child, the mother *and* the subject) know that a dog can't be as big as a horse. Older children make reference to the naughtiness of the liar's intentions, e.g., the second child's plan to obtain a reward for good grades.

When a child judges that a story character has lied and the judgment is based on realism, he is judging actions by the features that are "objective" in the sense of being true, evident to and shared by the characters in the story. The analysis I am offering, which is consistent with Piaget's, replaces the term "objective" with the term "mutually believed." Mutual belief refers to the beliefs held in common by two (or more) people in interaction. Philosophers of language (Schiffer, 1972), and researchers in other branches of cognitive science (Bruce & Newman, 1978; Clark & Marshall, 1981; Cohen, 1978; Cohen & Perrault, 1979), have used the concept to explain how meaning and reference are accomplished in ordinary interaction. The concept is particularly useful in understanding lies. The intentions behind one character's lie are not shared or mutual knowledge between the story characters. If we assume that shared facts or mutual beliefs are easier for a child to think about than private facts such as intentions that are contradicted by the objective appearance, then it is easy to see why children would cite "objective" mutual beliefs when judging a lie.

According to this analysis, then, the first step in understanding lies is to see the discrepancy between two facts that are among the set of propositions which are mutually believed by the two characters. In the skit, for example, first there is an assertion that Ernie is going to share the banana and then there is the fact that he does not. To see this discrepancy, all the child has to know is what the accepted facts are and what the liar's utterance conventionally means.

Consider again the four levels of reasons for calling Ernie's utterance a lie. Like the first level, the second level is a judgment about the mutually believed situation. This level is interesting, however, because it shows that the subject has performed an analysis of the shared situation. The subject points out how the mutually believed situation is to be understood. Namely, Ernie's actions did not count as sharing because sharing an edible item is understood by everybody to be dividing up the edible part.

When a subject expresses a theory about the mental processes of a particular character, as in the second two levels, it does not represent an entirely new kind of understanding. The subject is now attributing the subject's own analysis of the situation to one of the characters. The point is that the child's interest in the intentions and inferences of particular characters is not a new kind of thought that emerges from nothing but is based on the analysis of the system of mutual beliefs already expressed in the level 2 interpretations.

While perspective-taking is undoubtedly a capacity that develops in children, it is not the beginning of social cognition. It depends on a vast fund of knowledge about what everybody knows including all kinds of logico-mathematical and world knowledge that the child assumes he shares with others around him.

Recursive perspective-taking

A final illustration of the importance of content in social cognition is an example of what is called recursive perspective-taking. Miller, Kessel, & Flavell (1970), for example, used the cartoon convention of thought balloons to represent people thinking about people thinking about people. . . .and found an increase with age in the number of embeddings or recursions subjects could handle. This capacity is often viewed as independent of content. But let me illustrate how such recursive representations can be built on shared knowledge.

We can see recursive perspective-taking in the responses of seven (mostly older) subjects who said that just before Bert fainted he would have seen that Ernie had told the literal truth. These subjects themselves believed Ernie told the literal truth so they already attributed to Ernie an analysis and intentional manipulation of the shared situation. But, in addition, these seven subjects realized that Bert also could have shared that analysis. That is, they believe that Bert thought about Ernie thinking about Bert's understanding of the shared situation. This shows that these older subjects considered the analysis of literal versus conveyed meaning to be available to the characters as common knowledge and as the basis for Ernie's joke. Recursive perspective-taking would not occur unless the subject attributed his own analysis of the mutually believed situation to Bert and Ernie.

These examples suggest that understanding a lie is as much related to the subtlety of the subject's analysis of the mutually believed situation between the two characters as it is to a capacity for perspective-taking. In fact, perspective-taking can be seen, from this point of view, as dependent on the subject's prior analysis of the mutually believed situation.

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Teasing: A Case Study in Language Socialization and Verbal Play

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The following narrative was related by a young mother from the working-class community of South Baltimore. Nora here recalls an incident that occurred in the cafeteria of the junior high school:

> When I got free lunch, you know, we went through the cafeteria, and the group in the table would all stand up and say, 'You got free lunch tickets' (teasing singsong), you know, and they, all of 'em around the room start hittin' the tables and everythin'. And I would stand up and I says, 'Well, well, you all think you're really teasin' somebody. At least I know I'm agettin' somethin' free and you's ain't. Hahaha. What do you think of that?' And they shut their mouths, boy.
>
> They did. And the ladies that give the food out, they just laughin' their tails off back there. They say 'Did you hear that little girl, she stood up there.' And I sit down and I says, 'You see, I'm gonna enjoy my free lunch.' I was eatin', boy, eatin'.
>
> And I says, 'I even got 15 cents to buy me a fudge bar.' (laughs) They come in there with bologna sandwiches in them bags. I'd say, 'You can eat that stale bologna. I'm gettin' jello on the side of my plate.' (laughs)

Nora tells this tale with pride and pleasure. Her proficiency in the art of teasing enabled her to outwit her peers and to transform a potentially painful experience into an occasion for self-display.

Teasing is related to several other interpersonal skills valued by Nora and her family. These include the ability to express anger, to argue well, and to fight, if necessary. To be poor is to get pushed around, and so one needs to learn early how to stand up for herself. Discussions with Nora concerning child-rearing and language learning, and video-recorded observations of Nora interacting with her young daughter Beth revealed that teasing was an important strategy of early language socialization in this family.

In addition, teasing is a complex form of verbal play, marked as such by modification of the normal pattern of speech. These modifications include distinctive patterns of stress and intonation, recurring use of formulaic expressions and specific lexical items, and organization of speech acts into a characteristic discourse form.

Thus, teasing as language socialization and teasing as verbal play are alternate ways of approaching this type of social interaction. These complementary perspectives will provide a framework for a preliminary description of teasing as used by one mother-child pair from South Baltimore.

Teasing as language socialization

The concept of language socialization bridges three major questions: How do young children acquire the linguistic and sociocultural knowledge that enables them to communicate appropriately? What are the beliefs and values that caregivers hold about language and language learning? And what kinds of language socialization strategies do they use with novice speakers? These questions are particularly important as applied to children and caregivers from low-income families, as very little is known about how poor children learn language during the early years of life.

A previous analysis led to the identification of direct instruction as a strategy used by three low-income families to socialize their two-year-olds in language and speaking (Miller, 1982). That description was based on data from an ethnographic study of early communicative development in the white, working-class neighborhood of South Baltimore. The subjects were Amy, Wendy, and Beth and their families. At the beginning of the study the children were starting to combine words and ranged in age from 18 to 25 months. Each was her mother's first child. Family income was $5,000 or less per year. All of the mothers had lived in the neighborhood for at least five years and spoke the local dialect of nonstandard English. Two had eighth-grade educations; one was a high school graduate.

The study was longitudinal in design. A get-acquainted period was followed by a series of video-recorded observation sessions, each lasting one hour and spaced at three-week intervals over a period of eight months. The children were observed in their homes as they interacted with their mothers and other family members. Audio-recorded interviews with the mothers provided another source of data.

The analysis of direct instruction revealed that the mothers believed in the importance of teaching two-year-olds to talk and that they routinely gave direct instruction in language and speaking during the mean length of utterance period of 1.5 to 2.5 morphemes. That is, they explicitly told the child what to say or how to say it, or quizzed her on these matters, using such teaching devices as elicited imitation, prompts, directions to ask or tell, and tutorial questions. It was argued that these instructional interactions are effective ways of transmitting various kinds of social and linguistic knowledge. They provided opportunities for learning to answer and ask what-questions; to assert and comply verbally and nonverbally; to participate appropriately in conversation; to take care of "babies" in mothering play with dolls; and rhyme, sing, and play verbal games.

These findings concerning direct instruction tell part -- but by no means all -- of the story of language socialization in three families from South Baltimore. Many questions remained to be answered. Particularly intriguing was the finding of variation across families in the frequency of direct instruction: While all three families

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used this strategy on an everyday basis, there were individual differences in the incidence of direct instruction. In an attempt to identify other language socialization strategies, I began by examining the data from the family that engaged least in direct instruction and found that teasing complemented teaching in Beth's family.

This preliminary analysis of teasing was based on the transcripts from the first six video recordings. The samples covered the age period from 25 to 28 months, when Beth's mean length of utterance ranged from 1.8 to 2.2 morphemes. The transcripts had been prepared for the original study and included a record of child speech and of other people's speech and a running description of nonverbal behavior (See Miller, 1982). For the present analysis, I added further prosodic and paralinguistic information to the transcripts.

A total of 20 teasing sequences involving Beth and Nora were identified (across six hours of video recordings). A sequence consisted of at least two turns (where the second could be nonverbal) concerning a single disputed issue. The majority of issues concerned conflicting claims to valued objects (e.g., dolls, toys) or to special relationships (e.g., attachment between mother and young child). At issue in the remaining sequences were valued abilities (e.g., prettiness, maturity).

From a discourse standpoint, the typical teasing sequence began with Nora issuing a mock challenge, threat, or insult and Beth retorting with a denial or counterclaim. Following this initial exchange, mother and child exchanged a series of denials or counterclaims. The interaction then continued until one speaker yielded to the other, the speakers negotiated a mutually acceptable resolution, the argument ended in stalemate, or it escalated into an exchange of ritual blows.

The following sequence, drawn from sample VI, illustrates these discourse features:

Beth's age: 28 months
Setting: livingroom of Beth's home

	Beth	*Nora (mother)*
N has been trying to redirect Beth's activity		
		I'm gonna get the baby. (singsong)
	[very short latency]	
wheeling around toward doll	my/	
		No, it ain't your baby. That's my baby. (very rapidly)
kneeling next to doll, looking at N	that Peggy baby/	
picking up doll		It's Peggy's baby?
holding doll to chest, looking at N	yes/	
		Well, where's mine?
walking into middle room	I find yours/	
		No, that's alright.
		You don't have to find it. Come here.
		That's alright. I got a baby in my belly.

This sequence revolved around the issue of conflicting claims to my doll. The sequence opens with Nora threatening, "I'm gonna get the baby." Beth replies, "my," asserting her claim to the doll. Next we have an exchange of counterclaims: Nora says, "No, it ain't your baby. That's my baby," and Beth, kneeling next to the doll, looking at Nora, retorts, "that Peggy baby." In the remaining turns Nora and Beth negotiate a settlement: Nora concedes that the doll is Peggy's and Beth offers to find a doll for Nora.

In addition to having a characteristic discourse form, teasing was set apart from the surrounding stream of talk by a variety of contextualization cues. Gumperz (1977) defined contextualization cues as aspects of the surface form of utterances -- such as prosodic and paralinguistic features and lexical and phonological choice -- which signal how message meaning and sequencing patterns are to be interpreted. Several of the cues that allow for the contextualization of teasing are illustrated in the example. These include singsong intonation, emphatic stress, unusually short switching pause, rapid delivery, use of the modal particle, "well," and frequent use of possessive words.

Other contextualization cues that marked teasing sequences were formulaic expressions, such as *hahaha, heeheehee, yeayeayeayea,* and *heck on it* and special voice qualities such as provocative and sympathetic tones of voice. In addition, teasing sequences were accompanied by repeated or prolonged mutual gaze and, in some cases, by teasing gestures, such as rubbing one index finger over the other or putting up one's dukes.

This, then, is a general description of interactions in which Nora teased Beth. From a language socialization standpoint, it is necessary to ask what these interactions meant to Nora. One source of evidence in this regard comes from the interpretative comments and asides that Nora made spontaneously during three of the sequences. In all three cases Nora referred approvingly to Beth's anger. For example, "I like her when she gets mad. I'm tellin' you, she'll she'll take that ashtray and throw it, dump it all over the floor and she'll tear up stuff like this. She's got a temper." (Beth VI). Additional data were obtained at the end of the study (after all the video tapes had been collected) when Nora helped to transcribe child speech. As we viewed the tapes together, Nora offered interpretations of various interactions, including teasing sequences. For example, in response to one teasing sequence she explained as follows her reasons for teasing: "Teasing will make her want to learn on her own, it encourages her to be independent, makes her mad, gives me a chance to encourage her if she has trouble (defending her claims or displaying her ability). I say, 'You're still little. It's alright.'" Nora added that one can't tease too often because Beth will just give up, she'll be too insulted.

The evidence, then, from Nora's spontaneous comments during teasing sequences and from her reactions upon later viewing video recordings of teasing sequences provide some clues about her interpretation

of teasing per se. In addition, Nora's remarks in interviews conducted throughout the study help us to fit teasing into the broader picture of her beliefs concerning child-rearing and language learning.

Nora repeatedly expressed her intention to equip Beth with the skills she would need as she grew older and ventured out into the world. To Nora this meant not only teaching Beth the names of people and things, teaching her what to say in conversation, and encouraging her to be affectionate and sympathetic (Miller, 1982). It also meant instilling in Beth the qualities of strength, pride, and independence and helping her to learn how to control hurt feelings, how to defend herself, and when to speak up in anger. Teasing sequences provided one context in which these valued qualities and skills could be transmitted.

Another way of putting it is that teasing sequences provided one context in which Beth could learn through active participation in interaction with mother. This raises the question of what Beth knew about teasing. Micro-level analysis of teasing sequences across the six samples revealed advances in Beth's understanding of various aspects of teasing. That is, she became more adept at interpreting her mother's messages and at producting her own. For example, in the early samples Nora's openers in teasing sequences were often repeated or rephrased several times before Beth responded. When she did reply her responses were limited to denials or counterclaims. By the final sample Beth responded promptly to a single opening utterance. This is illustrated in the above example. Mother says, "I'm gonna get the baby," and Beth very rapidly retorts and takes possession of the doll. From this we can infer that Beth understood her mother's utterance as a threat requiring immediate counteraction, both verbal and nonverbal. By the final sample Beth had also added several dispute tactics to her repertoire: She could yield to her mother's argument, contribute escalating claims, and take an active part in negotiating a resolution of the conflict.

In addition, the final sample contained three sequences in which Beth responded with marked counterclaims or challenges to her mother's preceding utterance, which was unmarked or unclearly marked as a teasing opener. Whatever Nora's original intention, Beth transformed the interaction into a teasing sequence. Interestingly, all of these interactions were preceded by commands from Nora to which Beth refused to comply. These sequences suggest that Beth was beginning to try out the role of teaser and that she did so first in contexts of defiance.

There were developments, too, in Beth's use of contextualization cues. From the very beginning and consistently throughout the samples, she used a large proportion of possessive constructions and marked her utterances appropriately with emphatic stress.

Singsong intonation underwent particularly dramatic change. In the first three samples Beth used singsong only once and this in imitation of her mother's preceding utterance. In sample IV she produced a total of 33 utterances with singsong intonation, and only 5 of these occurred within teasing sequences. An examination of the remaining 28 instances revealed that the majority were formulaic expressions such as *yeayeayea*, directed at no particular person, and occurring in contexts of self-expression or display, as Beth reveled in her own physical agility. Less frequently, singsong intonation occurred in contexts of defiance or as Beth seized possession of some object. From the adult standpoint, Beth's use of singsong was an instance of overgeneralization. She had not yet narrowed down the contexts of appropriate use. From Beth's standpoint, this explosion of singsong was a form of practice play, pleasurable for its own sake but also a way of understanding this type of intonation. In sample V singsong was used in much the same way but much less frequently. And, finally, in sample VI Beth used a singsong intonation appropriately in the course of a teasing sequence.

Teasing as verbal play

So far I have described teasing from the perspective of language socialization. Different facets emerge if we look at teasing as a form of verbal and social play. In teasing one modifies or plays with the pragmatic resources of language. To tease is to convert a dispute into a mock dispute.

Garvey (1977) has shown that social pretense requires a considerable amount of communication. That is, each partner conveys in various ways that he or she has adopted a playful attitude. This may be accomplished by enacting a role or identity, that is, by adopting the appropriate voice quality, content of speech, gestures, and so on. Other types of communication of pretense include signals such as laughter or giggling and explicit mention of pretend transformation.

In teasing sequences Nora -- and Beth to a limited extent -- enacted the functional role of contestant. They used various dispute tactics, marked their utterances with emphatic stress, provocative tones, and rapid delivery, seized possession of disputed objects, and made fighting gestures. Nora signalled the playful nature of these disputes by smiling and laughing. Beth gave no such signals in the early samples, suggesting that she did not yet understand that teasing disputes were not to be taken literally. Beginning in sample IV, however, she too signalled her appreciation of teasing as play, and in one sequence Nora explicitly drew attention to this: "She knows I'm playin'. Look at those eyeballs. Get out of here. Look. She wants to laugh. I see her wanna laugh. She wants to laugh. I could see that smile startin' to come on." (Beth IV).

One of the reasons that social pretense requires considerable metacommunicative work is because of the unstable nature of the frame, "this is play" (Bateson, 1972). If one isn't careful, a tease can slip into a real dispute. Nora was acknowledging this aspect of teasing when she said that one shouldn't tease too often or the child will become insulted and stop trying. On another occasion she complained that another adult teased unkindly, "(He was) teasin' her, but still that can go through a child's mind." (Nora VI).

Teasing exists, then, in intimate relation to real disputing. In this it is similar to "playing the dozens," as practiced in certain black communities. Playing the dozens is a type of ritual insult, often sexual in content, and tightly constructed out of rhymes or puns. According to Abrahams (1962), the strict formal structure of playing the dozens is necessary because of the highly volatile nature of the issues. This type of verbal play is, in his words, "perilously close to real life." For this reason it is learned and practiced first in safe situations,

that is, in interaction with other adolescent males. Among adults it can lead beyond the verbal to physical fights.

Teasing too is learned initially in safe contexts. Beth's first experience of teasing occurred in her own home in interaction with mother, who did not retaliate for real. By the time Beth ventures beyond the row-house stoop to more dangerous encounters, she will have had considerable practice in teasing. One wonders what will happen when Beth takes teasing into the first-grade classroom. Will teachers be able to distinguish between a tease and a real dispute? Will Beth find contexts in which she can display her verbal dexterity, her playfulness? Regardless of what happens in the classroom, there is no doubt that when Beth is teased about her free lunch ticket, she will know how to respond.

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Microcomputer Communication Networks for Education

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The image of computer based communication has been changing recently, with the development and spread of microcomputers. Previously, the image was of a large centralized machine, that serviced a large number of people, each connected to a central node. With the decrease in the cost of microelectronics, we are now seeing an unprecedented spread of personal microcomputers, distributed geographically and isolated from each other.

Along with this increasingly distributed processing capability comes a changing set of concerns. In the past, concern was concentrated on problems of centralized control and monitoring. Paradoxically as we approach 1984, we find ourselves faced with problems much nearer the other end of the spectrum. With stand-alone microcomputers appearing in classrooms and in homes, concerned individuals and institutions are beginning to worry about the isolating effect of computers. The arcade phenomena of individuals totally engrossed in their own worlds to the exclusion of all others, is a chilling image. Teachers find themselves with new power and flexibility but often isolated from their peers with sometimes overwhelming responsibilities to use these potentially powerful new educational tools in meaningful ways.

There are a number of ways to deal with this issue of isolation in microcomputer use. One new communication medium that may help consists of microcomputers interconnected via the telephone system, supporting microcomputer-based text message systems. There exist add-on peripherals ("auto-dial modems") for the common microcomputers that allow them to access the regular telephone system, dial a call, transfer information, and then hang up. The cost of using such systems for long-distance direct interaction is still high, and the use of typing for interaction is still a bit awkward. However, a different kind of use for this system has some interesting potential.

Members of the Laboratory of Comparative Human Cognition and the Teachers Education Program at UCSD have been exploring the potential use of non-real time media for education, in cooperation with members of the Center for Cross-Cultural Study at the University of Alaska, Fairbanks. We have been investigating the use of "non-real time" interaction using computers. We have recently examined the ways in which electronic message systems on centralized computer systems can be used as an educational medium (Black, Levin, Mehan, & Quinn, 1982; Quinn, Mehan, Levin, & Black, 1982). Our current project is aimed at developing and studying the use of non-real time communication between microcomputers located in schools. Messages will be created by teachers and their students on their microcomputers, which are located in their own classrooms or in the school's media center. These messages will then be automatically transmitted over telephone lines in the middle of the night, and waiting messages will be retrieved. There are a number of advantages of such non-real time message systems:

1) Non-real time interaction alleviates time and distance constraints on interactions between teachers and students. This is important in both the extreme difficulties posed by rural settings and in less extreme but real difficulties in coordinating over distance and time in suburban and urban settings.
2) The microcomputers and telephone lines are used for message transmission during a time that they are normally unused.
3) The cost of using the interconnecting network and the mail drop computer is much lower at night.
4) The communication time (and thus cost) is minimized, as the text files are transmitted as quickly as the line will allow, since generation and reading of messages is done "off-line" (on the local microcomputer).
5) The teachers and students do not need to remember and successfully execute the many obscure details of connecting to and using a network, since this is done automatically by the microcomputer.

*This project is the joint effort of many members of LCHC and the Teacher Education Program at UCSD, including J. Levin, H. Mehan, D. Newman, A. Petitto, M. Riel, and R. Souviney, and R. Scollon and S. Scollon of the Center for Cross-Cultural Studies, University of Alaska, Fairbanks. The software for the pilot network has been implemented by Neil Fraser with the assistance of Daniel Blackman.

A typical scenario of the operation of such a network is shown below:

12:15-12:17pm A teacher in an Oceanside California school reviews a program designed to teach about ecology. He wants to use it in a way similar to that described by a teacher in McGrath, Alaska in a message received yesterday. He asks a question about that use, and addresses it to the teacher in Alaska and to a UCSD professor in whose continuing education course the Oceanside teacher is participating.

1:23-1:24pm Two children in the Oceanside classroom read a message from students in a class in Rochester, NY, and compose a reply message.

3:30pm The teacher starts a program which will send all waiting messages and then goes home leaving the program running.

2:03-2:10am The message program dials the local Telenet number in Escondido, California using an autodial modem, logs into The Source Computer, and sends the message to the Iditarod School District's (McGrath, Alaska) Source account, to UCSD's account, and to Rochester's account, then logs off The Source Computer, and hangs up.

4:01-4:08am The microcomputer's program dials Telenet again, and logs on The Source a second time to retrieve messages. They are copied onto a floppy disk on the microcomputer. The program finishes retrieving messages, logs off The Source, and hangs up.

8:11am The teacher opens up his classroom, and finds messages waiting. He finds five messages waiting for his students, and two messages for himself. He reads a message from a teacher in Chula Vista asking about how he organized his classroom to create the classroom's electronic newspaper that he sent out from Oceanside the previous day. The teacher responds, creating a message that will get sent out that night. He also receives a message from UCSD, posing some discussion questions for the course. He answers one question immediately, and saves the others to work on later that day.

Designing a microcomputer network to be a productive part of a classroom's functioning requires software development based on an analysis of the actual uses of the system by teachers. Thus, a fundamental part of our work involves careful observation of the use of the system and how it impacts classroom practice, as well as its functioning in programs of continuing teacher education. These systematic and controlled observations will provide an effective means for assessing the system's value for education.

Our pilot microcomputer network initially interconnects a classroom in San Diego and a classroom in a rural school district in Alaska. We are designing this network so that it is suited for use by teachers and students while at school, structuring the network to meet their specific needs for instruction, consultation and interaction. In constructing and testing this new instructional medium, we are drawing upon work done both at UCSD and at the University of Alaska which studies the nature of classroom interaction, designing alternate classroom structures for teacher education and using electronic message systems for instruction in university courses.

The software to support this network is being written in UCSD Pascal, and will run on Apple II computers and D.C. Hayes Micromodems. The system is initially using The Source System (a commercial computer system which offers accounts for relatively low cost) as a mail drop, although the software is flexible enough to use any computer that can answer a telephone call for this function. UCSD Pascal is a "portable" language, so our software will run on other microcomputers as well. We are using The Source Computer as a mail drop because it is available through both Telenet and Tymnet national computer networks. In this way, schools in San Diego and in Alaska are able to access The Source simply by calling a local telephone number. All of Alaska and almost all school districts in San Diego county (as well as most of the United States and parts of the rest of the world) have local (non-toll) telephone numbers that access either Telenet or Tymnet.

The system will be implemented on a larger scale during the summer of 1982, interconnecting teachers taking a course entitled "Interactive Media for Education," jointly offered by the Teacher Education Program and the Communications Program at the University of California, San Diego, with teachers in a course entitled "Introduction to Word Processing for Language Arts Teachers" offered by the Center for Cross-Cultural Studies at the University of Alaska, Fairbanks. In this way, we will have a larger number of teachers who are familiar with the uses of this system who will be prepared to participate from their classrooms in the fall of 1982.

The reason such a system has not been implemented before has to do with two recent developments. First, recent advances in microelectronics have lead to the development of relatively inexpensive microcomputers and a decentralization of processing. Second, these developments and others such as the installation of a communication satellite system have lead to an increasing distance-independence of communication costs. These two developments have made it economically feasible to create networks of interconnected microcomputers communicating in non-real-time.

We will be studying two related issues: The complexity of "discourse structure" and the quantity of messages that can be generated in the new media. Our previous studies of non-real time instructional interaction using text-based communication described the development of "multiple threads" of discourse, in striking contrast to the hierarchically nested topic structuring of real time interaction (Black, Levin, Mehan, & Quinn, 1982). This complexity can present problems to the participants attempting to follow conversations in message systems. A second problem with text message systems is the flood of messages that can descend on users, many of which might be classified by the recipients as "electronic junk mail." These two potential problems must be dealt with in the design and use of a system such as the one we are developing; if not people are likely to abandon its use as they become overwhelmed with the complexity and quantity of messages.

One approach to these problems is to allow both the originators of messages and the recipients to add "struc-

ture" to the text in messages. We will be exploring this notion of structured text (described in the article on "Interactive Text" in this issue). This structuring can also be added by "mediators," people who read messages and add or modify the structure in these messages or new messages, structure that is then forwarded on to others to assist them in evaluating and selecting information that they are likely to find useful. Much of our interest in microcomputer-based message systems focuses on the general issue of how to enhance communication among people by allowing them to dynamically create individualized meaning structure in the interaction.

A study of instruction in a very different communication medium can help us understand instruction in more conventional media as well. By observing how different kinds of interactions occur in the educational use of electronic message systems, we can become clearer about the nature of classroom interaction.

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Microcomputers as Interactive Communication Media: An Interactive Text Interpreter*

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For some years now, computers have been used as an aid to writing, with text editing and word processing programs serving as tools for the preparation of printed text. Over the past several years, we have been studying how the use of a word processing system designed for elementary school children can help them learn to write (Levin, Boruta, & Vasconcellos, 1982). Our system, like other such systems, was oriented toward the preparation of messages that would eventually become printed text. Recently however we have started exploring ways to incorporate into our use of microcomputers the unique properties of computer media that go beyond the constraints of print.

One key feature that distinguishes computers as communication media from the mass media (print, television, radio) is that computers are potentially *interactive*, thus allowing the reader of a message to actively participate in the construction of the message. The mass media create a split between the more active creator of a message and the more passive audience for the message. This split is enforced by the "non-real time" character of communication in most of these media, i.e., the creation of a message is separated in time (as well as in place) from the reception of the message.

The new "interactive" computer media, while still carried out in non-real time, incorporate some important features of face-to-face interaction. The decisions about what to say next in face-to-face communication are divided among the participants, as each current speaker monitors the other speakers in real time and modifies the message accordingly. With computers, it is now possible for the writer of a message and its reader to share the decisions about the course of the message.

It has always been possible, through the use of interactive computer programs, to share decisions between the program's creator and the program's user. Thus computer programs have been written to create interactive computer games or, more recently in conjunction with video disks, interactive television. However, existing computer languages have remained esoteric and inaccessible for the majority of people, in part because they have attempted to remain completely general purpose.

To draw an analogy with print, special purpose languages are like special purpose print devices, like tables and graphs. Certainly one could write out in sentence form the current high and low and closing prices for each stock, but it would be difficult both to write and to read. So, special forms of print (columnar tables, musical bars, graphs, different typefonts and fonts sizes) evolved to present different kinds of information.

Similarly, special computer systems for expressing particular kinds of information are emerging. A good example is a system called VisiCalc, which was specially written to express financial worksheets (budgets, ledgers, or other financial records or projections). It is, in effect, a special purpose computer language. It is limited to a particular domain of applicability. But its overwhelming advantage is that it is easy to use to do tasks within that particular domain -- so easy that people who would never dream of "programming" can use it to create "VisiCalc forms" that accomplish complex calculations that would require an extremely sophisticated program in any general purpose language.

We have written a special purpose system for dealing with the interactive use of microcomputers for communication, called the Interactive Text Interpreter. This system makes it much easier to distribute the active involvement in communication between the writer and the reader. There are two kinds of reader involvement that we have incorporated into the Interpreter thus far, input points and choice decisions.

Input points allow a writer to create text that, when "read" through the Interpreter program, stops and allows the reader to type in additional text at specified points. The resulting text is thus a combined effort of the writer of the interactive text file and the user of that file. For example, we have used files like the following with elementary school children:

*This research has been supported by The Spencer Foundation and The Sloan Foundation. The Interactive Text Interpreter has been programmed by Dan Reiswig.

Last night I saw a movie on TV that really gave me
? (Type in the name of an animal.)
bumps! It starred
? (a person)
as a mad
? (an occupation)
who discovers a way to make kids fourteen feet high. The scientist has a goofy assistant, played by
? (a person)
who gets mad because the scientist keeps hitting him on the head with a
? (a noun)
[several more pages of text with the rest of the madlib story here]

When this file is "read" using the Interactive Text Interpreter, the reader sees the first line of text, then at the line which starts with a "?" gets to type in text. When done, the reader sees the next piece of text, and then again gets to type in text, etc. This "madlib" use works out particularly well as interactive text, in part because the resultant text, either on the computer's display or on a printed copy, does not distinguish between the user's input and the framing text. This allows novice writers to create stories that they find interesting while only concentrating on the problems in one area (in this case, word selection given sentence and semantic or syntactic class constraints).

The choice decision option allows the writer to create multiple paths through the text, and allows the reader to choose a particular path. Examples of this kind of text are the StoryMaker programs, created by Rubin and her associates (Rubin, 1982). Since these were written in a general purpose language (BASIC), they are difficult for non-programmers to edit or modify. With the Interactive Text Interpreter, a writer of such branching stories uses a text editor to create text like the following:

>Earth
#is invaded by
#scientists
#is struck by a giant comet
>is struck by a giant comet
#and everyone dies.
#and almost everyone dies.
>and everyone dies.
>and almost everyone dies.
>is invaded by
#tiny
#giant
>scientists
#invent
#discover
>invent
#tiny
#giant
>tiny
#superpersons.
>giant
#superpersons.
>superpersons.

The text is divided into "nodes," which are text units of arbitrary length (in this case, very short). The start of a text node is indicated by a special symbol (>), and branches from a node are indicated by another special symbol (#) followed by the name of the node presented as a direction to follow. These special symbols are interpreted by the Interpreter, which shows text to a "reader" of this story, presents the alternatives, and then presents the new text that the reader has chosen. Any number of choices can be presented, and these choices can together form a strict tree, a partially convergent tree (like the example above), or any kind of interconnected network the writer wants to specify.

These two features can be combined, as in the following poetry prompter:

A cinquain is a poem of five lines. Each line follows a word pattern.
Think of a beautiful thought to express or a scene to describe.
A Cinquain by
? (Type in your name.)
For the first line, pick a title word with 2 syllables.
Do you have a title for your poem?
#yes, I have a title
#Nope, not yet
>Nope, not yet
Okay, what's the most beautiful thing that you've seen in the past year?
Would you like to write a poem about that?
#Yes, beauty
#No, not beauty
>No, not beauty
Okay, pick any two syllable word, and go with that.
?
#2nd line
>Yes, beauty
Right. Now pick a word with two syllables that generally describes what you saw. That's your title.
?
#2nd line
>yes, I have a title
Great. Type it in.
?
#2nd line
>2nd line
For the second line of your poem, type in words that have four syllables.
?
[The prompts for the rest of the lines follow here.]

We have explored a use of Interactive Text that illustrates how the limitations of print operate without our awareness. The writing of documentation and instructions is a difficult task. Part of the reason for this is that there are so many potentially different readers of such material, from interested novices who want a quick overview, to beginning users who want a detailed tutorial, to experts who need only a reminder of how some part of the system being documented works. Aids to this problem with print media include extensive indexes/tables of contents, and creative uses of font types and sizes to distinguish material at different levels. Even with these devices, the resulting document is often so awkward that people write several separate documents: an overview, a tutorial, a reference manual, etc. But each of these overlaps the others considerably, and the reader is then faced with the issue of which text

to use for which function.

We have been able to convert several existing instructional texts into structured interactive text, by adding node names and branching, to create interactive document files that help solve this problem. Part of one such file is listed below:

Welcome to the discursive recursive world of Interactive Text.

This interactive text file will help you understand how to create and modify interactive text files.

Would you like
#a general overview
#an introductory tutorial
#a description of commands
#a description of uses
>a general overview
Interactive Text is text which shares decisions between the "writer" (the creator of an interactive text file) and the "reader" (the user of an interactive text file).

[several more pages of text here]

Do you want
#an introductory tutorial
#a description of uses
#a description of commands
>a description of commands
These are the commands you can use in your interactive text files.

Which do you want to see described?
#>
##
#?
[more pages of text with the rest of the structured document here]

One of our goals is to make it easy for teachers and students to use these structured texts. But more importantly, we have attempted to allow them to modify structured texts, and to create new ones. One use for students that we have started exploring is as a "Dungeon Master's Assistant." Students can type in the descriptions of the fantasy world they create for a "Dungeons and Dragons" game, structuring a description for a room or cave as a node, and providing the various exits as alternatives. Or a problem episode can be entered as a text node, with the various possible actions and results provided as the alternatives. In this way, we hope to draw upon the motivating power of this activity to help children acquire the skills of writing, by providing a powerful tool for structuring text and then using that structure.

There are a number of points that have emerged as important in this work so far. First, as a pedagogical tool, the Interactive Text Interpreter is useful, as it makes it easy for teachers to create a whole family of text files for their students. These text files can range from those that provide considerable support for novices, requiring only simple choice input, to files that provide much less support for more expert writers, prompting only for general topic or providing diagnostic help on request. This use of interactive text is consistent with our general view of how to use computers for education, a view in which computers are integrated into the instructional setting in a way that provides "dynamic support" for learning (Levin & Kareev, 1980).

As a research tool, the Interpreter system helps us examine how writers deal with higher level (multisentential) text units. It allows the writer to make these units explicit and allows the reader to make choices at that level. The Writer's Assistant (the text editor we've developed for elementary school students) and the Interactive Text Interpreter both store detailed data on how they are used.

The interactive text notion has helped us start to think systematically about how computers as a communiation medium differ qualitatively from print, and how these qualitative differences affect what new things can now be done in this new medium.

We have just started using the Interactive Text Interpreter in our studies of the problem solving techniques used by children when writing. This is, therefore, a report of work in progress. But even at this point we are struck by the variety of new functions that interactive text can serve. The uses seem to be limited more by our own mind set, having spent most of our lives working with print and other mass media, than by the constraints inherent in the new interactive communication media.

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Dennett, D.C., & Hofstadter, D.R. (Composed and Arranged by), *The Mind's I: Fantasies and Reflections on Self & Soul.* New York: Basic Books Inc., 1981.

This book conducts you through a mind exploring journey that starts out stranded on Mars and closes in conversation with Einstein's brain and other fictional characters. The theme of this collection and commentary is set in the preface: "What is the mind? Who am I? Can mere matter think or feel? Where is the soul?. . . . We believe there are at present no easy answers to the big questions, and it will take radical rethinking of the issues to reach a consensus about the meaning of the word 'I'." The slipperyness of these subjects brings to mind Scott Kim's comment on the flexibility of human perception of letter shapes, in his recent book *Inversions*: "Almost anything with a dot on it can serve

as an I!"

This Cognitive Science reader consists of diverse selections, each followed by commentary by Hofstadter and Dennett. The pieces range from British computer scientist Alan Turing's classic 1950 article "Computing machinery and intelligence" (in which the "Turing test" is proposed) to Polish science fiction writer Stanislaw Lem's 1974 lighter short story "The Seventh Sally *or* How Trurl's Own Perfection Led to No Good." Both pieces address the central issue of simulation and consciousness, but the diversity of point of view leads to new insights.

In their philosophical pun and games, Hofstadter and Dennett raise as a central issue whether the machinery of cognitive science is powerful enough to tackle the "big questions." In considering whether notions of process capture our common sense concepts of self, Hofstadter puns: "Is the soul more than the hum of its parts?" Given the current models of cognition, *The Mind's I* asks whether we can mold minds in new models.

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Malone, Thomas, W. Toward a theory of intrinsically motivating instruction. *Cognitive Science,* 1981, *4,* 333-369.

Thomas Malone takes some important steps toward a synthesis of theories of intrinsic motivation and instructional design, a synthesis that is ultimately necessary for a deeper understanding of phenomena in either field. Malone's primary concern is the application of the principles of intrinsic motivation in instruction and with the potential for educational computer games. He draws on studies of intrinsic motivation to arrive at a characterization of intrinsically motivating environments, then, in light of this summary, he discusses his own research on children's preferences among computer games. He concludes by making definite recommendations for the design of educational software and of instructional environments in general.

Malone's framework includes three categories of features for intrinsically motivating environments: Challenge, related to mastery; Fantasy, related to engaging children's emotions; and Curiosity, related to seeking informative environments. While Malone makes interesting observations and claims in each of these categories, we focus this review on the category of Challenge and his notions about goals as a crucial feature of environments which evoke an intrinsic motivation toward mastery. His discussion of this topic illustrates many of the assumptions underlying his framework. At the same time, his analysis of goals leaves a number of questions and some doubts.

The importance Malone places on goals derives partly from a survey of game preferences he carried out among children who regularly attended a weekly "computer class" at their elementary school. Malone tested the correlations between the children's preferences for the various games available in the setting and those features of the games that are important in his framework. The feature that had the highest correlation with preference was whether the software had a goal. Here he is contrasting games which have a clear object such as shooting down invading airplanes or knocking down a wall of bricks with activities like filling in the blanks in a story where the story-line is specified by the player's choice of words rather than being predetermined by the software. Unfortunately, the importance of clear game-goals, though not implausible, is not as strongly supported, either empirically or conceptually, as Malone implies. On the empirical side, the interpretation of the correlations is confounded since the few programs that lacked goals also lacked the score keeping function, the special effects, randomness and so on that were also positively correlated with preference, and involved a more extensive use of conventional symbol systems -- words and numbers -- than did other games.

Conceptually, Malone talks about the goals in the "instructional environment" as residing in the software and does not relate them to the child's goals in a wider context. This point of view follows from Malone's concern with principles of software design, but leads, we think, to a disregard of the social context of school instruction. We agree that children are intrinsically motivated to seek out interesting goals to accomplish. But the range of possibilities for the source of such goals is not addressed in Malone's analysis. The survey appears to have been conducted in a setting where the children were free to choose among a large set of available software. We suspect that the class more closely resembled an arcade than a regular classroom in which children are constrained by a teacher's curriculum goals. Under such conditions it is not surprising that he found a positive correlation between game preference and software with clear and well specified goals.

Our point can be made in relation to the distinction Malone introduces between Toys and Tools. Toys (e.g., computer games) have their own challenge but Tools (e.g., text editors, programming languages) by their very nature do not specify the actor's goal -- they depend for their challenge on some external (to the software) goal for which they are instrumental. We do not see any reason to think that children will be less intrinsically motivated to pursue goals which are suggested by other children, a teacher, or which they discover for themselves than they are to pursue goals which are presented to them by the games (Toys). We agree with Malone that an intrinsically motivating environment must contain challenging goals for the child to adopt but it is unclear to what extent ready-made goals are necessary components of instructional software. Software need not be the only source of children's goals.

Another of Malone's findings suggests a further problem for using computers in education. His survey indicates that children do not take readily to games involving manipulation of the conventional symbol systems (word and numbers) that are the goal of education. We doubt that getting children actively engaged in such programs is simply a matter of improved special effects and fantasy content. We suspect that software that would be completely ignored in an arcade-like social

environment may nevertheless be used with enthusiasm in a classroom setting where the goal of mastering difficult symbolic systems is suggested in activities arranged by the teacher. For this to happen, the "environment" must, in principle, include the social setting outside of the fantasy world of the software. A solution to getting children to learn words and math may be to provide games and tools that can be used cooperatively by the children and the teacher to achieve educational goals.

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