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Introduction from the Editorial Group

From time to time the editors have solicited or written brief introductions to the issues in a newsletter or commented on some aspect of *Newsletter* policy. What follows is a *brief* account of links between the articles included in this newsletter. In later issues this year we will expand this activity in accordance with the expressed wishes of the readership. In effect, we would like to foster an arena for "meta-discussion" of LCHC's topics. Readers are invited to contribute their comments in modest length (except for cases where immodest integrating ability needs a heady forum).

The articles by Tudge, Martin and Duranti all address the problem of articulating the relationship between the social and the psychological in basic cognitive research paradigms and the theories that generate those particular methodologies. Note that Martin moves beyond the dyad at the same time that she begins to develop the finer theory of social interaction that Tudge calls for. Readers should contrast this with the viewpoints expressed in the Grossen and Perret-Clermont *Newsletter* article (Vol. 6, No. 3, pp. 51-57). Duranti's article usefully read in connection with recent *Newsletter* articles by Emerson (Vol. 5, No. 1, pp. 9-13), Holquist (Vol. 5, No. 1, pp. 2-9),and McDermott (Vol. 7, No. 1, pp. 1-6). The Newman article as well as the Hutson and Thompson studies of computer-based educational activities delve deeper into issues raised in previous *Newsletter* articles (LCHC, 1982, Vol. 4, No. 3; Vol. 2, No. 3 and Vol. 5, No. 3) that highlight the potential of computers as mediating devices.

Because LCHC was founded to create an interdisciplinary attack on the problem of socially organized inequality in its broadest form, a great variety of research programs will be relevant to newsletter readers in some way. In this issue we begin systematically to describe what we see as the emerging themes from articles that have been submitted for publication. In part we are moved to do this because the number of offers for entries is requiring choice among articles. We also want to be certain that in making those choices, our criteria represent the interests of the readership-contributorship as much as possible.

The Effect of Social Interaction on Cognitive Development: How Creative is Conflict?

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Peer interaction has been presented as an effective means of promoting cognitive development by researchers working in the Piagetian tradition both in Geneva (Mugny and Doise, 1978; Perret-Clermont, 1980) and in the United States (Murray, 1982; Ames and Murray, 1982). The task that has been used in most studies aimed at examining this process has been of a type with which Piagetians feel comfortable -- conservation tasks. The general procedure has been to pair a conserver with a nonconserver or a nonconserver with a pair of conservers and to require the members of the dyad or triad to arrive at some common response to the problem that is posed.

This research is to be greatly commended, for by and large American developmental psychologists have focused almost exclusively upon the child in isolation, at least when examining cognitive development. Those who are interested in infant cognitive development are among the few exceptions to this general trend. Researchers who have examined the effects of social interaction upon the cognitive development of older children have reported highly interesting findings, which provide much support for the Piagetian and Vygotskian positions that peer interaction has a good deal of benefit for cognitive development. The important factor, both for Murray and his colleagues and the Genevan group, is that of cognitive conflict, occasioned by pairing children that are at different stages of development.

One problem, however, is that it is not always easy to determine whether the less advanced member of each pair is responding to the interaction *per se* or to the fact that he or she was being presented with the correct answer (Ames and Murray, 1982). One attempted solution has been to pair nonconservers who give differing responses (necessarily incorrect, as they have not attained conservation) to the conservation array.

A more basic problem, however, might lie in the nature of conservation itself. The attainment of conservation is rightly viewed as of major importance in the child's cognitive development. It is unusual, however, in that its developmental "ceiling" is attained at a relatively young age, with little in terms of a developmental continuum. Once children reach conservation of number, say, or length, there is nothing to distinguish them from an adult in terms of their ability to conserve number, or length (at least if the quantities or distances are kept within manageable proportions). Conservers are correct in their judgements, nonconservers are not -- and no amount of extra thinking or activity with materials will make the conserver a "better" conserver. Cognitive development, however, is generally not of this nature; by and large cognitive abilities develop during childhood and adolescence. If social interaction is beneficial for cognitive development *in general,* one must be able to show its efficacy in areas *other* than conservation.

Moreover, it seems to me that this type of peer interaction is, at its core, not so very different from the adult-child interaction research. The work of Wertsch (1980), for example, and Rogoff (in press), has documented well the benefits to the child that stem from interactions with a sensitive adult. This literature, taking as its theoretical foundation the work of Vygotsky rather than Piaget, has a good deal in common with much research into infant cognitive development, in which mother-child (and now, increasingly, mother-father-child) interactions are seen as of crucial importance. Despite obvious dissimilarities, there is one important way in which the peer interaction research, using conservers and nonconservers, closely resembles the mother-child interaction research. This resemblance arises because, in both cases, in both cases one member of the pair is the "expert," the other akin to a "novice." When the task concerns conservation, the "experts" are always correct in their judgement about the nature of the array; when the task involved an adult helping a child to copy a model, the "expert" always knows exactly how to construct it.

Murray and his colleagues argue very effectively that social interactions between peers fosters cognitive development, and provide convincing experimental evidence to support their arguments. So far, however, they have only barely addressed the issue of the generalizability of their results beyond the domain of expert-novice interaction. Perret-Clermont (1980), Russell (1982), and Murray (1982) have provided some experimental data about the effects of pairing two nonconservers, but have not examined in any detailed fashion the results of pairing children who, while not falling into the expert-novice category, differ in their cognitive levels.

A good deal of social interaction, however, occurs between people who are not in the "expert-novice" position -- one person may know more about a problem or a possible solution to that problem than another, but neither of them knows *all* that is relevant to know. This is particularly the case when it is a school context, and peers are working together on a problem.

There is theoretical support for the benefits of such pairing, however. Piaget, after all, argued that interaction between peers was effective in aiding cognitive development, at least in the moral sphere, though clearly none of the children would be considered "expert." Vygotsky's "zone of proximal development," moreover, is not a zone that can only be exploited by adults who are working with children (experts working with novices). Children too may help others attain that proximal level (Vygotsky, 1978, p. 86).

Researchers within both the Piagetian and Vygotskian traditions argue that social interaction is only likely to be an effective means for enhancing cognitive development when there are some initial differences in perspectives between the members of the dyad, corresponding to what Wertsch calls different "situation definitions" (Wertsch, 1984). Within the course of communication, the conflict resulting from the differences in perspectives may be resolved and a shared definition of the situation may be attained. When partners share perspectives initially, the possibilities for this type of creative conflict are lacking, and the potential for cognitive development thereby minimized. (Initial differences on the part of peers working on a problem do not, of course, guarantee cognitive development.)

My research has benefited greatly not only from the "expert-novice" research mentioned earlier, but also from the Soviet theoretical tradition and the work of researchers such as Lomov (1978), Kol'tsova (1978), and Rubtsov (1981), who have concerned themselves with interactions between peers who are more similar to one another than is the case when pairs feature one partner who is an "expert" compared to the other. The research of Lomov and Kol'tsova, for example, pairs children and students who, while differing in their perspectives on a problem, do not fall into the categories of either "expert" or "novice." The results are impressive. For example, in Kol'tsova's work, which involved children learning a socio-historical concept, the children who worked as a group learned the concept much better than those who worked individually. Martin's (1983; this issue) research, which draws upon Soviet theory and research, also provides solid evidence of the ways in which social interaction between peers aids their cognitive development.

In order to examine the effects of social interaction on cognitive development in a situation that more closely parallels a classroom setting than is the case when conservers and nonconserver are paired, I used, as did Martin, a task which could differentiate levels of thinking about the task. It is, after all, a difference in levels of thought (and the resulting differing perspectives on the task) that creates the cognitive conflict that is deemed so important for development via social interaction. Siegler's balance beam task suited my requirements perfectly, for he has established that children use a number of "rules" to predict the working of a mathematical balance that has differing numbers of weights placed at differing distances from a central fulcrum (Siegler, 1976, 1981). These rules reflect successfully more advanced thinking about the problem; children using one rule, for example, only consider the weight variable, while children using a more advanced rule take distance into account as well.

It is thus possible to pair children who are clearly at different levels, and to do so in such a way that even the more advanced child can improve to the next higher rule.[1] Furthermore, unlike the case of interactions between conservers and nonconservers when one partner is correct on all items, and the other (initially at least) always incorrect, all children who use any rule at all are correct on some configurations of weights, while only those who use the highest rule are correct on all configurations.

The aim of the research reported here was primarily to determine the conditions under which pairing children and asking them to agree in their predictions about the working of a balance beam result in their using a more advanced rule at a later time.

The specific hypotheses being tested were as follows.

(1) That children paired with partners who used the same rule (= rule) would perform better than the individually tested children because of the opportunities for discussion afforded by pairing. In the course of discussion, some differences in perspective could become apparent, and cognitive advance could occur because of the conflict that would result.

(2) That children who were paired with those who used a less advanced rule (-1 rule) would perform better than both the individual children and those in the (= rule) group. Because the partners in this group used different rules, there were possibilities for differences in perspectives and resulting cognitive conflict. The more advanced children, moreover, in the course of explaining their position to their less advanced partner, might

become aware of yet more advanced rules.

(3) That children who were paired with a more advanced child (+1 rule) would perform better than those in all other groups. Not only did they have the possibilities for a conflict of perspectives with a peer, but their partner could provide them with a more advanced rule.

The outcome measure was change in rule use from pretest to posttest.

Method

Subjects

Fifty-one kindergarteners (26 boys, 25 girls, mean = 66.6 months, SD = 3.9 months) were gathered from the four kindergarten classes in an open-enrollment public elementary school in downtown Ithaca, New York. All children who returned a parental permission letter were included as participants. (Additionally, 12 children either used no rule at all to predict, and had no idea what would happen, or were not interested. These children were excluded.)

Materials

I used a mathematical balance beam, similar to one employed by Siegler (1976). It was 8 removable sticks placed equidistantly from the central fulcrum. The beam was held stable by a wooden block at either end. The blocks were removable, to allow the children to observe free movement of the beam at the start of the experiment. Metal nuts, which fitted over the sticks, were used as the weights in the pretest and two posttests. In the treatment, when children were paired, the sticks were replaced by clear plastic glasses, while the weights were replaced by identical plastic "ET" figures which were placed into the glasses.

Procedure

Pretest. I explained and demonstrated the working of the beam to each child, after which 14 items (different numbers of weights at different distances from the fulcrum) were presented. In each case the weights were placed on only one stick on either side of the fulcrum, with a maximum of 6 weights on any one stick and a maximum of 10 on both sticks. The number of weights and degree of distance varied systematically so as to exemplify each of the 6 types of configurations used by Siegler (1976). Responses to the 14 items allow an assessment of which "rule for prediction" (predicting whether the beam would balance, or tip one way or the other, if the restraining blocks were removed) each child used.

Treatment. I then assigned the children to one of four treatment conditions:

(a) a control group, in which they were again tested individually;

(b) an "= rule" group, in which each child was paired with another of the same sex and class in school who, on the pretest, used the same rule as themselves;

(c) a "+1 rule" group, in which each child was paired with another (of the same sex and school class) who, on the pretest, was at most one rule above them;

(d) a "-1 rule" group, in which each child was paired with another (of the same sex and class) who, on the pretest, was at most one rule below them.

Assignment to treatment condition was not random, because of limited availability of children of the requisite sex and rule group in each class. Within these necessary constraints, however, assignment was systematic. The treatment took place no fewer than 2 days after the pretest (mean = 4.78 days, SD = 3.05).

In all conditions except for the control group (in which children sat opposite the experimenter), the children in each pair sat opposite one another, with the balance between them. They took turns at predicting, and when a disagreement occurred about the predicted response of the beam to the configuration of weights, the children were asked to explain their reasons to one another and reach agreement on one prediction. At this point the experimenter removed himself, only returning after the children had reached agreement.

Posttests. A minimum of 2 days after the treatment (mean = 2.74 days, SD = 1.35) the children were once more tested individually, to determine whether or not there had been any change in their rule use (measured by change from pretest rule to posttest rule). Finally, a minimum of one month after the first posttest (mean = 35.43 days, SD = 4.36) a second posttest was given to all children, to determine the stability of any changes that might have taken place.

Assignment to rule. Siegler identified four "rules" which children use to predict the performance of a balance beam when different numbers of weights are placed at varying distances from the fulcrum. During pilot testing, however, it became obvious that finer degrees of differentiation were possible. Seven "rules" can be identified, ranging from a reliance totally on guesswork (no identifiable rule is used at all) to the ability to predict precisely what will happen when any configuration of weights is placed on the beam. (Correct predictions are always obtained by multiplying the number of weights by the distance from the fulcrum -- the side with the highest number will fall.) Children who used no rule at all at the pretest stage were not included in the analyses, and no children could predict precisely.

The remaining five rules can be characterized as consisting of two "stable" rules and three "transitional" rules. The two stable rules correspond to Siegler's rules 1 and 2. Rule 1 states that if there are more weights on one side of the fulcrum, that side will fall, while if there are equal numbers of weights the beam will balance. Rule 2 is similar, except that when there are equal numbers of weights on either side of the fulcrum distance from the fulcrum is used to predict which side will fall. The transitional rules are characterized by the fact that a certain amount of guesswork is involved. Rule 0-1, for example, allows a prediction when one side of the beam has more weights than the other, but when the numbers of weights are equal pure guesswork takes over because a child using Rule 0-1 does not yet understand the concept of "balance." Children using this rule are clearly employing a rule, but they have not yet reached the understanding implied by use of Rule 1. Children who use Rule 1-2 have clearly progressed beyond Rule 1, but are still uncertain about the importance of distance as a key variable when the numbers of weights are identical. For example, they may only take distance into account when one set of weights is at the end of the beam and the other set is near the middle; but believe that the sets will balance if they are closer together. Children who use Rule 2-3 are aware that distance is an important variable, even when the numbers of weights are different, but are uncertain as to when the distance is likely to overrule the numbers of weights.

Each session (the pretest, treatment, and both posttests) was audiotaped, and each child was assigned to a rule by both the experimenter and a second rater. Reliability of assignment was 91% and where there were disagreements the protocols were rescored blind by both raters and discussed until disagreements were resolved.

To summarize, the design featured children who were not paired at all (indiv); those who were paired with another who used the same rule as themselves (= rule); those who were paired with another who used a more advanced rule (+1 rule); and those who were paired with another who used a less advanced rule (-1 rule). This design was employed to examine the effects of social interaction between peers upon cognitive development in a situation in which the "expert-novice" distinction did not apply. In the three paired groups different types of interaction were likely, while in the individual group no peer interaction was possible.

Results

The results are summarized in Tables 1 and 2, which give the percentage of children in each treatment group who declined, did not move, and improved from the pretest to the first posttest (Table 1) and from the pretest to the second posttest (Table 2).

Table 1
Percentages of Children Who Moved From the Pretest to First Posttest

	Indiv. (n = 13)	= Rule (n = 12)	+1 Rule (n = 13)	-1 Rule (n = 13)
Decline	30.77	16.67	7.69	38.46
No Move	61.54	83.33	53.85	61.54
Improve	7.69	0	38.46	0

Table 2
Percentages of Children Who Moved From the Pretest to Second Posttest

	Indiv. (n = 13)	= Rule (n = 12)	+1 Rule (n = 13)	-1 Rule (n = 12)
Decline	23.08	16.67	15.38	25.0
No Move	69.23	75.0	38.46	66.67
Improve	7.69	8.33	46.15	8.33

The data presented in these tables, however, do not give an accurate statistical representation of the differences between the groups, because of a lack of independence between all subjects who were paired. (Each pair of children had conversations and interactions specific to their own pair but which differed from those in all other pairs.) All further results, therefore, will be presented once the subjects have been divided into two groups consisting of independent observations. In the first group (Analysis A) are all of the individually tested children, one member of each "= rule" pair and all children in the "+1 rule" treatment group (all of whom had been paired with a child in the "-1 rule" group). In the second group (Analysis B) are all the individually tested children, the other member of each "=rule" pair, and all children in the "-1 rule" group (who had been paired with a child in the "+1 rule" group).

For both Analysis A and Analysis B multivariate analyses of covariance were performed within a General Linear Model analytic procedure (because of unequal cell sizes), using score on the pretest as the covariate. The dependent variables were movement from pretest to first posttest and movement from pretest to second posttest. The main effects of interest were treatment and sex, as well as the interaction between treatment and sex. In no case did sex or the interaction of treatment and sex exercise a significant effect, and they were therefore dropped from subsequent analyses.

Looking first at Analysis A (in which were included all individual children, one member of each "=rule" pair, and all children in the "+1 rule" group), the main effect of treatment was significant ($F(2, 28) = 3.53$, $p < .05$), when movement from pretest to first posttest was the dependent variable. When movement from pretest to second posttest was the dependent variable, the main effect of treatment failed to reach significance ($F(2, 28) = 0.94$, $p = .40$). The relevant mean scores for the group which showed a significant main effect of treatment are presented in Table 3.

Table 3
Mean Movement From Pretest to First Posttest (Analysis A)

	Mean	SD	N
Indiv.	-0.192	.199	13
= Rule	-0.350	.289	6
+1 Rule	0.431*	.198	13

* p < .05 - t test differences from 0 (no movement)

In terms of movement from pretest to both first and second posttest the children tested individually were not significantly different from those in the "=rule" group. Hypothesis 1 was thus not supported. The children in the "+1 rule" group, however, did significantly better than both the individually tested children and those in the "=rule" group at the time of the first posttest, thereby supporting hypothesis 3. Some of that differential was retained at the time of the second posttest, but did not reach significance ($p = .37$).

Turning now to Analysis B, featuring the individually tested children, the other member of each "=rule" pair, and the "-1 rule" group (all those children paired with a child who used a less advanced rule than themselves), there was no significant main effect of treatment either when the dependent variable was movement from pretest to first posttest or movement from pretest to second posttest. Therefore, hypothesis 2 was not supported.

Discussion

It was not expected that a significant proportion of the children would decrease rather than improve their performance. This decrease occurred even in the case of those children who were only tested as individuals, when one might expect that some improvement would take place if for no other reason than familiarity with the test and the materials. The paradox is resolved in part by a closer examination of the data. data. As was mentioned earlier, some children were identified as using "stable" rules while others used "transitional" rules during the pretest. Those using a transitional rule were far more likely both to decline and to improve than peers who used a stable rule ($X_2(1) = 9.59$, $p < .005$). The transitional rules incorporate, by their very nature, some degree of uncertainty. Children who use Rule 1-2, to take an example presented earlier, are becoming aware that distance from the fulcrum is an important variable when the numbers of weights are equal, but are uncertain about whether this holds true in every case or only when one set of weights is at the end and the other near the middle. When a child who uses Rule 1-2 is paired with a child using stable Rule 2, the former is easily convinced of the universal applicability of the distance criterion. On the other hand, when paired with a child who uses Rule 1, he or she readily declines. When a child is not paired with anyone, and uses a transitional rule, the easiest thing to do to resolve the uncertainty inherent in that rule is to shift down to the stable rule below. For a child using Rule 1-2, 12 or 13 of the 14 configurations of weights are answered in a Rule 1 fashion (i.e., the side that has most weights will fall), and it requires less cognitive effort to apply the same rule to the remaining one or two configurations than to take distance from the fulcrum into account.

The broad question of interest for this research, however, derived from a dissatisfaction with the limited nature of much of the research that has examined the effect of social interaction between peers upon their cognitive development. When one examines this process in a situation in which neither partner can be viewed as either "expert" or "novice" the effect of the interaction upon both members of the pairing can be assessed. Moreover, the performance of pairs of children of the same cognitive level can be judged in a more satisfactory manner than by locating nonconservers who differ in their thinking.

It is clear that the social interaction inherent in pairing does not, by itself, lead to cognitive development -- even when conflict is built into the situation, as was the case when children who used different rules were paired. If one takes the performance of children who were not paired as a baseline against which to compare the performance of the paired children, significant improvements were made only by those children who had been paired with a child using a more advanced rule than themselves. At the time of the first posttest, in fact, children in this group did significantly better than children in all other groups. The mean differences between this group and the others was not significant at the time of the second posttest, one month later, although the children in this group still did better, on average, than those in the other groups.

Pairing children who used the same rule proved to be more effective than having children work on the task individually. This finding no doubt resulted because children paired in this way disagreed rarely. What is more surprising is that despite clear differences in perspective and much opportunity for creative conflict, children paired with those less advanced than themselves did not achieve a higher rule use. In fact they declined, on average, more than the children in the other groups. Conflict, for them did not appear to be creative, particularly when the more advanced child used a transitional rule and his or her partner used a stable rule. In a situation like this, the child using the more advanced rule was most often brought down to the stable rule below.

As Perret-Clermont (1980) and others have suggested, one needs to examine not only the nature of the social interaction in which children are engaging, but also the nature of the developmental stage itself. To be at a transitional stage has both benefits and disadvantages. Or, to use Vygotsky's term, the "zone of proximal development" should perhaps be considered as extending behind, as well as in front of the child's present cognitive level.

Notes

I would like to express my great appreciation to the principal, teachers, and children of Central Elementary School in Ithaca. They not only allowed me to collect data there for six months -- they have created a wonderful learning environment. My special thanks must go to Pat Holmes, without whom no data would have been gathered, and to Ann Levatich, who performed great feats listening to countless tapes, transcribing interactions, and bringing reliability to this study.

[1]Of course, this would not be true for subjects who used the highest rule, but Siegler reports that children do not attain this rule until late adolescence, if at all, and my sample consisted of young children.

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The Role of Social Interaction in Children's Problem Solving

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Recently, developmental psychologists have become interested in studying the relation between children's performance on cognitive tasks and the social context in which problem solving occurs (Damon, 1984; Grossen and Perret-Clermont, 1984). Previous work in this area conceptualizes the domains of cognition and social knowledge in one of three ways: first, as basically separate content domains; second, as reciprocal in nature; and third, as mediated, with cognitive structures embedded in the social.

According to the first view, which is not stated as a coherent principle but rather adopted in practice, concept acquisition comprises various formal logical relations, derivable by task analysis of some sort. Knowledge of social topics such as rules of the game or school rules are separate from such content as classification or principles of proportionality. I would argue that the phenomenon of moral development, literature distinct from work on perspective-taking in problem solving, illustrates this traditional categorical division.

In addition to separation on the basis of content, the social and the cognitive domains are separated often on the basis of method: individual performance is measured as cognition while group performance is measured as social outcome. Because there is a lot of evidence to show that people in groups don't do the same things that they do on their own, the two situations are often considered as discontinuous. Although this issue has been recognized for a long time, it is usually social psychologists who have attempted to solve the measurement issues (e.g., Anderson, 1961).

A second way in which social and cognitive topics are juxtaposed is as reciprocal. Piaget is the primary proponent of this viewpoint, claiming that social cooperations and individual operations are characterizable by the same formal properties and develop simultaneously.[1] While Piaget's work examines the emergence of perspective-taking in studies of younger children, studies of older children emphasize the domain of the operations. That is, the nature of the reciprocity of the cognitive and the social in the more fully developed child was not experimentally examined. Although they allow that alternate viewpoints are available through contact with others, "it is meaningless," write Inhelder and Piaget, "to wonder whether it is the cognitive cooperation (or cooperations) which engender the individual operations or the other way around" (1969, p. 118). They are manifestations of the same organizational level from the point of view of the action of the individual child.

Thirdly, there is Vygotsky's claim of mediated individual development: socio-cultural history gives rise to specific material conditions and social relations which in turn shape the development of individual thought. When Soviet researchers find a discontinuity between individual and group performance, they are likely to seek transformative principles which may connect the two situations by a broader contextual model (see Istomina, 1975; Lomov, 1978). Many of their studies demonstrate the "leading" nature of social situations for the formation of individual concepts. At the same time correspondences similar to Piaget's have been noted, in which individual cognitive development correlates with a type of group interaction (Rubstov, 1981). It is the Soviets who pose the problem of how to track the directionality of concept development (as distinct from the problem of measuring task performance) in group versus individual conditions.

My own work with groups of children doing Piagetian tasks together sought to distinguish between the reciprocal and mediated viewpoints. The problem was difficult because at some very fundamental levels children are equally inept at cooperating and at solving problems. It is not at all clear how one could say there is a "leading" factor one way or the other to test.

In many ways too, the positions taken by Piaget and Vygotsky are similar: they both view the child as constructing knowledge; they both distinguish internal from external psychological functions; both claim generally that the social and cognitive develop together; and both are materialists in the sense that they posit the necessity of accommodatory stuff upon which to act.

A methodological issue involved in distinguishing the positions of the two also concerns the correspondence between what's out there in the world to what gets patterned inside the individual: on the group level, cross-cultural work demonstrates the effects of context on cognitive development; on the individual level, we know that differences in performance are found in supposedly homogeneous groups following the same training procedure. So, because of contextual influences on basic thought structure as well as individual variation within similar contexts, two further problems arise: what to include as evidence or, obversely, what to treat as noise across individual and group problem-solving situations, and, how to represent what is changing during the learning process under consideration.

In order to address these problems, I began with a task which is of interest to contemporary cognitive psychologists: the balance scale (Siegler, 1981; Wilkening & Anderson, 1982). The scale has the further advantage of embodying cultural properties of interest to both Piaget and Vygotsky: its functioning can be described by formal logic and the same formal principles may be accessed through a variety of apparatuses.

I had children solve balance scale problems individually and in groups and measured changes in their understanding of the scale according to a rule system delineated by Siegler. Precedence for this type of pre-/posttest design exists in recent work done by Perret-Clermont and her colleagues and in recent Soviet work. Both these sets of studies had limitations, however, in that they did not compare explanatory models and therefore, only derived measures consistent with one analysis. In the Swiss work, for instance, there is an assumption that the same jars and liquids are always signifying the same task; or, in the earlier work, that the comments of the experimenter are outside the analytic frame. Most seriously, there is an assumption that social situations are ephemeral and that new behavior under group conditions is less authentic than individual acquisitions, which are taken as a measure of internal restructuring. Given this assumption, which amounts to a lack of theory concerning the interactive conditions, one can never test whether individual change among children of different operational levels is maintained by a particular form of social exchange or not; one can only say that following a group experience someone of a particular level changed or not.

In work published in 1981, V. V. Rubtsov of the Soviet Union looked at groups of children organized to solve classification tasks. His analysis showed that children who engaged in different cooperative structures of exchange made differential gains; however, the children's knowledge of classification was not categorized prior to the group situation, so his results could not address the reciprocity issue.

In order to study group effects on individual problem-solving, it was necessary to design a procedure and measures that permitted a test of differences between Piaget's and Vygotsky's models. Because Vygotsky views the components of complex thought to be transmitted and located in relation to each other by the teaching/learning process, specific experiences in time become crucial to analyze when accounting for the development of an individual's thinking. That is, a theory of children's interactions had to be developed.

So that I could trace the appearance of new understanding in individuals over the course of group sessions and individual sessions, I created a coding system for behaviors according to the various explanatory models I was testing. The coding scheme included variables that were taken to be measures of individual schemata and of behavior that occurred as a function of being among a group of peers. For example, right or wrong answers were regarded as evidence of individual concepts, while the number of times a child got into an argument could only be a function of being in the presence of another child. Behaviors were also classified according to whether they pertained to the balance scale task and according to whether they occurred when the child was with a group or working alone. Data from group conditions and from tests conducted with each child alone yielded forty-one variables, which were hypothesized to cluster according to their inter-individual or intra-individual nature.

The clusters were validated by factor analysis (Martin, 1983). The results of the factor analysis meant that tests using both the variables of interest and the factors could be grouped into models and compared by means of multiple partial correlation procedures. With these procedures, five models predicting pre- to posttest changes in children's individual conceptualizations of the balance scale principles were tested. These ranged from a simple individual "Rule Use" model to a Vygotskian interindividual factor model.

Testing the models, I found that an individual child's initial cognitive level only partially predicts learning. Group level, or the sum of individual cognitive levels of a problem-solving group, adds to the prediction but does not account for all the variation. According to the best fitting model, the most powerful predictors of learning, after previous learning is partialled, are measures of on-task activity occurring because of the presence of others.

The results of the multiple partial correlations allowed me to conclude that a child's tendency to engage in particular kinds of on-task interactions is a good predictor of subsequent gains, beyond initial skill level. They suggest that inter-individual exchange concerning a task may be more important to look at in a group setting than individual cognitive indicators such as correct answers, when assessing children's problem solving. The results of the analyses, however, supported only the idea that individual and group cognitive activity are complementary; they did not clarify the nature of the complementarity.

In addition to being grouped according to group and individual problem-solving settings, I coded separately the variables comprising the categories of the current analysis for the three group problem-solving conditions each child experienced. In order to delineate the functional nature of the variables in each interactive condition, conducted tests for significant changes in frequencies among the seven variables coded by condition. I examined also the polarity of the relation of each variable in each condition to posttest scores. I discuss the results below and at the same time discuss the problem-solving conditions for the balance scale.

By including three problem-solving settings which were designed to elicit varying forms of cooperative interchange among children, a test of the origins of proportionality concepts, in this particular case, was made possible. By having a theory about each situation and by delineating the functional nature of the variables of interest in those situations, a demonstration could be engineered of how different social arrangements result in different interchanges, and, in different learning.

The basic design of the study had involved pretesting second and third graders on a set of balance scale problems and categorizing the performances according to Siegler's method (Siegler, 1980). The children were matched in groups of four such that group members' skill levels were either mixed or homogeneous (all Rule I users, all Rule II users, or half Rule I and half Rule II). There were nine groups altogether. Three sets of balance scale problems to solve were given in the group situation, each followed by an individual posttest; a final posttest was given to each child about one month after the group experiences. Order of condition was not varied; control groups were included to test for order effects but those results are not important for the present discussion. Children's answer patterns on the individual tests were analyzed along with the coded videotaped record of their performance during the group situations.

The variables comprising the categories of the current analysis were coded separately for the three group problem-solving conditions each child experienced, in addition to being grouped according to group and individual problem solving settings (e.g., correct answers on tests and in group discussion). According to the factor analysis, some variables did not cluster solely on the basis of formal structural similarity but rather showed variability due to task organization differences. This in itself gives some support to the Vygotskian position.

Below, are descriptions of the arrangements of each group condition and of how the behaviors seemed to function in each.

Condition 1: Team Conflict

The design of Condition 1 was patterned on the task arrangement of the individual pretests. I anticipated that by presenting teams of two children with preselected problems to pose to each other, by asking the teams to judge the scale outcome and not to calculate it, and by asking the teams to score each other, that social competitive behavior would be greater relative to on-task behavior. Furthermore, teams should be less likely to exchange information about the scale features in a cooperative manner. In fact, according to the factor analysis in which certain Condition 1 variables clustered, this condition did accentuate individual differences in the tendency to argue and to be "Social." Those measures which, according to post-Piagetian work, should influence the development of individual knowledge, namely, cognitive conflict measures, did not. Children in Condition 1, in total, engaged in significantly more on-task argument than in the other conditions but this related negatively to gain. Apparently, the competitive arrangement of Condition 1 induced counterproductive arguments.

A Number of Arguments Measure did not distinguish remarks directed at a teammate from those directed at the opposing team. A separate category, Cross-Observations, which signified remarks a child made about a problem an opposing team member was working on, measured cross-team interaction. There were fewer Cross-Observations in Condition 1 were associated negatively with gain.

Condition 1 produced more Accurate Predictions on the part of children relative to the second condition, so in one sense, the problems were easier. It also generated a greater proportion of "Social" responses (e.g., "Ha ha, you're wrong") in comparison to "Attention" responses to what happened to the scale (e.g., "Did you see what it did?") for all the groups. Although these patterns did not seem to be related to learning they do reflect the competitive context of Condition 1. Accurate Predictions in Condition 1 were negatively related to gains in posttest scores. In sum, the On-Task group variables in Condition 1 were not beneficial for children's problem-solving, and the tendency to engage in argument was not totally accounted for by cognitive skill level.

Condition 2: Scale Conflict

In Condition 2, the problems given the children demanded that they consider both weight and distance dimensions simultaneously in order to arrive at a solution. Condition 2 procedures, however, focused children's actions on the scale itself by delimiting the place in which they could operate. By having one team place weights on one arm and asking the other team to make the scale balance work on the second arm, the task organization encouraged children to focus on only one arm of the scale. The children were unable to go beyond that which was available in the physical array to integrate weight and distance dimensions on an abstract plane. All groups, some to a greater extent than others, tended to change the questions they asked each other to "which side will go down, ours or yours," a simpler prediction about the differences between the two scale arms rather than one about their proportional relation.

The arrangement of Condition 2 was seen to have heightened children's individual differences in task performance accuracy and in their tendencies to respond to the task with social markers. These results further challenge the view that individual skill differences influence performance consistently across task arrangements. Children working in Condition 2 argued somewhat less than they did in Condition 1 (but significantly more than they did later in Condition 3). Argument and Length of Argument were negatively related to gains. This task arrangement led to a low number of "Attention" responses relative to "Social" ones, as well as to a higher proportion of errors and fewer Cross-Observations.

Condition 3: Experimenter Conflict

The task arrangement of Condition 3 was designed to generate coordinated activities that would lead to proportional thinking about the scale dimensions. This was done by making teams responsible for one dimension each, weight or distance, and asking them to calculate joint moves against the experimenter who had placed weights on one side of a scale. Condition 3 served to reduce Social responding and increase Attention significantly. On-task conflicts decreased but Accuracy and Cross-Observations increased. A greater number of Arguments and Cross-Observations in Condition 3 were related positively to higher posttest scores.

The design of Condition 3 included the participation of an adult in the problem-solving activity. This may seem to account for the reduction in both on- and off-task dialogue, however, the way in which the adult participated was not simply as a suppressor of talk. According to the transcripts, the experimenter interacted with the children as much in the other conditions. The effect of the task structure in Condition 3, which was to establish the goal of joint team coordination against the adult's moves, was what resulted in differences in the frequencies of certain behaviors and in the value of communication for problem solving.

Regardless of initial Rule, children who responded to the Condition 1 arrangement by arguing about the scale were also more likely to remark on the opposing team's operations (although the absolute frequency of Cross-Observations then was low) and less likely to be those who make gains; children who responded with less on-task arguing in Condition 1 were less likely to make Cross-Observations and more likely to be those who made gains. In Condition 3, overall amount of on-task arguing went down significantly, and Cross-Observations increased significantly, but those who did argue were more likely to express Cross-Observations and to make gains. Children who didn't argue in that condition also were not likely to take into consideration the other team's activity and coordinate it with their own.

Conclusion

In a general way, the kind of interactions a child engages in are complementary to a child's cognitive level, as Piaget and Vygotsky both claim. However, in the present work it was found that an individual's initial cognitive level only partially predicts learning. Group level, or the sum of individual cognitive levels of a group, adds to the prediction but does not account for all the variation seen. According to the best fitting model, the most powerful predictors of learning, after previous history is partialed, are measures of on-task activity occurring because of the presence of others.

The variables comprising the categories used to analyze children's problem solving interactions showed variability due to task organization differences. Here, the nature of the relation of task organization to problem solving activity and, in turn, to the probability of individual learning occurring, as measured on posttests, suggests that while "Cognitive" and "Social" development generally co-vary, responsiveness to task organization, a "Social" factor, precedes learning on a particular task. Children's responsiveness to the differences in task arrangements, assessed by the on-task interindividual measures in each condition, may be an overall prediction of how well information that is available in the interaction can be utilized by children of each cognitive level (also see Webb, 1980).

Surprisingly, the occurrence of a particular kind of cognitive interaction (e.g., arguing about the task) is not necessarily an indicator of informative exchange, because it can occur in a context where the task structure (designed to promote interpersonal competition) may vitiate its formal value. For instance, Condition 1 was designed to promote competition by setting up team conflict. The scale was not integrally involved in the organization of the competition, because any task would do. Decentering, or considering another's viewpoint, in that case could relate to the task goal in two ways: it could be unadaptive, since the idea is to keep your information to yourself and win, or, it could be put into the service of preventing the other team from accessing information. Although this was not done for the present analysis, the protocols could be checked to see whether, in Condition 1, on-task arguing was obstructively initiated, as when the challenge

"You're wrong!" is uttered as an opponent makes a move.

Functioning with what Siegler calls Rule I (only noticing the dominant dimension of weight on a scale) indicates a failure to distinguish the distance dimension on a scale task and also says something about the likelihood of making correct guesses about a problem. It does not give an indication of the tendency to engage in on-task argumentation with others. The present data show that the tendency to argue is more or less likely and more or less productive depending on task organization. Under certain conditions, children can be organized to engage in interchange that can promote the creative solution of problems.

The current work did not support a distinction of "Social" and "Cognitive" as they are often juxtaposed. Interindividual activity is both on-task and off-task. As such, on-task conflict may be said to be "Social" control executed in relation to a problem. If we suppose that lower level learners are generally under less interindividual as well as task control, higher level learners might serve as models and challengers, not primarily because of the information they possess but because of their interindividual responsiveness to the task arrangements.

By studying only one instance of a task arrangement, as is the case in most research, the contribution of the "Social" in relation to the task content is untestable. We need to observe carefully the child's world and how scientific information is variously marked and made available by the community. Only then can we begin to account for what in an individual's later school performance appears to be the development of a correspondence between the world abstracted and abstract thought.

Notes

[1]Piaget's position on this point changed; his early work assumed the necessity of socially derived input for schema development.

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Thus [with symbols] man built a new world in which to live. To be sure, he still trod the earth, felt the wind against his cheek, or heard it sigh among the pines; he drank from streams, slept beneath the stars, and awoke to greet the sun. But it was not the same sun! Nothing was the same anymore. Everything was "bathed in celestial light"; and there were "intimations of immortality" on every hand. Water was not merely something to quench thirst; it could bestow the life everlasting. Between man and nature hung the veil of culture, and he could see nothing save through this medium. He still used his senses. He chipped stone, chased deer, mated and begat offspring. But permeating everything was the essence of words: the meanings and values that lay beyond the senses. And these meanings and values guided him -- in addition to his senses -- and often took precedence over them. (L. White, 1958 cited in M. Sahlins, 1976, pp. 105).

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Famous Theories and Local Theories: The Samoans and Wittgenstein

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> His idea of his book is not that anyone by reading it will understand his ideas, but that some day someone will think them out again for himself, and will derive great pleasure from finding in this book their exact expressions. I think he exaggerates his own verbal inspiration, it is much more careful than I supposed but I think it reflects the way the ideas came to him which might not be the same with another man. . . . He says I shall forget everything he explains in a few days; . . . It's terrible when he says 'Is that clear' and I say 'no' and he says 'Damn it's *horrid* to go through that again.' Sometimes he says 'I can't see that now we must leave it.' (From a letter the British mathematician F. P. Ramsey wrote to his mother in 1923 while visiting Wittgenstein in Austria -- cf. Wittgenstein, 1973, p. 78.)

Introduction

A commonplace in anthropology is that a fieldworker should always try to balance a good knowledge of past and current theories with an open-mindedness toward new data and new observations (cf. Malinowski, 1922, pp. 8-9). In fact, in the mundane world of conferences, journals, departments, and academic parties, one often finds anthropologists, as well as other social scientists, accusing one another of being either too close to their data or too distant from any data. I think, however, that this contrast is more ideological than anything else and that in fact over the years we leave behind the question of whether we are seeing the forest or the trees. Instead, to many of us, the people we lived with and studied helped us open a new window on a slice of the universe we couldn't see before. By then, a funny metamorphosis may have taken place. The "local theories" we have been discovering become the tools with which we make sense of the famous theories we were given by our disciplines. We create new audiences for old speakers. Across time and space, local theories not only illuminate famous theories, they may also replace them as the leading paradigm in our own science.

In this paper, I will make this process overt by using what I consider the Samoan theory of language and social practice to illuminate some aspects of Wittgenstein's theory of language and rule-governed behavior. I will first point out some striking similarities between the Samoan theory and Wittgenstein's "later" theory. After briefly considering the Samoan notions of meaning and task accomplishment as always joint, cooperative enterprises, I will suggest that a similar view must have been held by Wittgenstein, at least as revealed by some of his writings and his style of lecturing.

The Two Wittgensteins

It is well known that Wittgenstein's *Philosophical Investigations,* which is considered as the official document of his "later" philosophy, did not meet the same amount of approval and enthusiasm in the philosophical world as the earlier *Tractatus*. For one thing, it is true that *Philosophical Investigations* is not as precise and as organized as the *Tractatus* -- its author seemed to be aware of this and in fact worried about the negative consequences of his own style (Malcom, 1984). I would like to suggest that the "imperfections," as well as its incompleteness, are a part of the message. Wittgenstein's later philosophy is, for one thing, an extremely dialogical genre in which an imaginary interlocutor is constantly asking questions or raising objections, and one can at times lose track of which one of the many voices expressed is the author and which one the commentator. It has been said that Wittgenstein's writing is "therapeutic." I would like to add that Wittgenstein's work, his philosophical "praxis," must be understood as requesting the crucial role of a committed and creative audience. Such a role and the need for conceiving of meaning and interpretation as cooperative achievements are made apparent by comparing some basic points of Wittgenstein's later philosophy with Samoan local epistemology and praxis.

Samoan Theory of Meaning and Social Action

Let me briefly summarize here what I have elsewhere presented as my interpretation of the Samoan theory of meaning and social action (Duranti, 1984). I have been arguing that Samoans do not share what Silverstein (1979) characterizes as the "reflectionist point of view." That is, they do not share the idea that language is a way of representing some already existing idea or that language is a way of representing some already existing reality, either "out there" or "in the mind." On the contrary, Samoans see words as deeds. The same word *uiga* means both 'meaning' and 'action.' This is not to say, in a neo-kantian fashion, that language creates the world, but rather that language is part of the world, and at the same time, a medium for explaining and constraining our social action.

For Samoans, interpretation is a public practice. Samoans do not seem to display concern for the speakers' intentions in producing a given utterance (or in performing other social acts). Thus, for instance, Ochs (1982) observed that Samoan caregivers, in contrast to the Western middle-class ones, do not try to read intentions in the infants' early vocalizations. Even among adults there seems to be a dispreference for explicit guessing about another's unclear intentions (Ochs, 1983) or for defining interpretation as a mental activity. Someone's words are instead interpreted with respect to their effect or consequences and by taking into consideration the relationship between the speaker and other participants or components of the speech event. In another paper (Duranti, 1984), I discuss a case of an orator who gets in trouble for having announced a future action by a third party which did not take place. In the discussion of the events, neither the orator nor anyone else evoked good will or intentions. The meaning of his words is defined by the effects or consequences of his words (e.g., loss of face by the village council) and on the basis of his relationship with the person whose message he delivered.

Wittgenstein's "Earlier" Theory of Language

In the *Tractatus* (1922), Wittgenstein presents the prototypical version of the "reflectionist" view of language. "4.01 A proposition is a picture of reality." Referential meaning is all there is: "4.023 . . . A proposition is a description of a state of affairs." Truth conditions define what is necessary to know in order to understand a given sentence: "4.024 To understand a proposition means to know what is the case if it is true." The relationship between language and the world is isomorphic: "4.04 In a proposition there must be exactly as many distinguishable parts as in the situation that it represents." Given this common *essential* quality between language and reality, the limit of our language and the limit of our world must correspond: "5.6 *The limits of my language* mean the limits of my world." And at the end: "7. What we cannot speak about we must pass over in silence."

Between the late 1920's and early 1930's, Wittgenstein dramatically reconsidered his earlier philosophy.[1]

Wittgenstein's "Later" View: Language as Public Behavior

Let me start with a quote from a well known paragraph from Wittgenstein's *Philosophical Investigations:*

> 202. And hence also 'obeying a rule' is a practice. And to *think* one is obeying a rule is not to obey a rule. Hence it is not possible to obey a rule 'privately': otherwise thinking one was obeying a rule would be the same thing as obeying it. (Wittgenstein, 1953)

This paragraph is often considered as a summary of the so-called "private language argument." Briefly, the main points of such an "argument" are: (1) meaning is not determined by what is in someone's mind (e.g., his intentions); (2) since no rule can determine its own application, common agreement is necessary (cf. Kripke, 1982).

In other words, there must be "publically accessible conditions that warrant the use of words" (cf. Scruton, 1982, p. 282). Each person who claims to be following a rule (or implies so) can be checked by others on the basis of external circumstances and other relevant "criteria." ("580. An 'inner process' stands in need of outward criteria.")

Kripke (1982) suggested that Wittgenstein, in his "private language argument," is not simply denying the possibility of a "private language," but, more generally, the "private model" of rule following. Wittgenstein would thus be rejecting the idea "that the notion of a person following a given rule is to be analyzed simply in terms of facts about the rule follower and the follower alone, without reference to his membership in a wider community." (Kripke, 1982, p. 109)

This view is very close to what I have described as the Samoan theory of interpretation. A certain meaning is possible because others -- organized *in* and *by* social institutions and practices -- accept it within a particular context (i.e., within what Wittgenstein would have called a "game").

Self and Language

Let me consider another similarity.

Samoans, as perhaps members of Polynesian cultures in general, don't seem to have the western notion of "self." Thus, Shore (1982) writes:

> Not only there are in Samoan no terms corresponding to the English 'personality,' 'self,' or 'character,' but there is also an absence of the corresponding assumptions about the relation of person to social action. A clue to the Samoan notion of person is found in the popular Samoan saying *teu le vaa* (take care of the relationship). Contrasted with the Greek dicta 'know thyself' or 'To thine own self be true,' this saying suggests something of the difference between Occidental and Samoan orientations. Lacking any epistemological bias that would lead them to focus on 'things in themselves' or the essential quality of experience, Samoans instead focus on things in their relationships, and the contextual grounding of experience.
>
> . . . When speaking of themselves or others, Samoans often characterize people in terms of specific 'sides' (ituu) or 'parts' (pito) . . . By parts or sides, Samoans usually mean specific connections that people bear to villages, descent groups, or titles. (pp. 136-137)

When I read Wittgenstein's discussion of the problem of the self with respect to using and interpreting language, I found, again, some interesting similarities between his thoughts and the Samoan theory.

Thus, for instance, during his "transition" between the "early" *Tractatus* and the "late" *Investigations,* Wittgenstein was attracted by Lichtenberg's proposal to have a language in which we say "it thinks" instead of "I think" and "there is a toothache" instead of "I have a toothache." (See Kripke, 1982, Postscript; Ambrose, 1979).

> We could have a language from which "I" is omitted from sentences describing a personal experiences. (Instead of saying "I think" or "I have an ache" one might say "It thinks" [like "It rains"], and in place of "I have an ache," "There is an ache here." Under certain circumstances one might be strongly tempted to do away with the simple use of "I." We constantly judge a language from the standpoint of the language we are accustomed to, and hence we think we describe phenomena incompletely if we leave out personal pronouns. It is as though we had omitted pointing to something, since the word "I" seems to point to a person. But we can leave out the word "I" and still describe the phenomenon formerly described. It is not the case that certain changes in our symbolism are really omissions. One symbolism is in fact as good as the next; no one symbolism is necessary.) (Ambrose, 1979, pp. 21-22; the passage between braces is from *The Yellow Book*)

These observations are echoed by the Samoan use of language. Samoans often use expressions where the perceiving subject is not mentioned: '*ua lavea le lima*' 'the hand was cut' instead of "I cut myself," *Mamafa le isu* "the nose is heavy" instead of "I have a cold." And in fact the omission of the perceiving subject is extended in Samoan to third person expressions: *Leaga le ulu* 'the head is bad' instead of 'he/she is crazy,' *vave le lima* 'the hand is fast' instead of 'he/she is a thief,' etc.

Samoan language does not have a reflexive pronoun and there are no such expressions as "I hurt myself" or "he cut himself." Instead, such events are described as "my hand got hurt" or "his leg got a cut."

Interpretation as Cooperative Achievement

A consideration of the strict correlation between the Samoan theory of interpretation and their practice of task accomplishment can further illuminate Wittgenstein's philosophy and render it consistent with certain aspects of his life.

As pointed out by Mead (1937), the Samoan organization of work and task accomplishment is cooperative, albeit hierarchical. The hierarchical aspect of Samoan social organization is not manifested in terms of who takes credit for what has been done, but rather in terms of who is seen as making the decisions and who is more or less active during the accomplishment of a task. Higher ranking individuals tend to be more stationary than lower ranking ones. Furthermore, rank in Samoan society is, perhaps more overtly than in other societies, extremely context-sensitive: "Their [the Samoans'] eyes are always on the play, never on the players, while each individual's task is to fit his role" (Mead, 1937, p. 286). Samoans do indeed see and practice task accomplishment as a joint, collective product rather than as an individual achievement.

Elinor Ochs and I have illustrated this point in the context of our discussion of the changes brought about by literacy instruction in a traditional Samoan village (Duranti and Ochs, in press). We pointed out that Samoans always see people as needing someone else to give them support during the accomplishment of any task (e.g., driving a car, delivering a baby, meeting a girlfriend, building a boat). The role of the supporting party is in fact institutionalized in the notion of *taapua'i* 'supporter, sympathizer' and routinely reenacted in what we call the "*maaloo* exchange." Someone's accomplishment is recognized and, in fact, defined as such, by his supporters' *maaloo*. The person who performed the action or task answers back with another *maaloo*.

> More generally, something is an accomplishment because of and through the recognition that others are willing to give it. Any accomplishment can then be seen as a joint product of both the actors and the supporters. In the Samoan view, if a performance went well it is to the supporters' merit as much as the performers'. This is so true that if the performer receives a prize or some previously established compensation, he will have to share it with his supporters. (Duranti & Ochs, in press)

This view extends to interpretation of utterances. For Samoans, meaning is jointly accomplished by speaker and audience. For this reason, a Samoan speaker does not reclaim the meaning of his words by saying "I didn't mean it." A person must usually deal with the circumstances created by his words as interpreted by others in a given context and cannot protect himself behind alleged original intentions (see Duranti, 1984 for some examples).

This practice of linguistic behavior sharply contrasts with the "reflectionist view," according to which the meaning of someone's words is given by his expressed/recognizable intentions (Grice, 1957). In this case, the audience's role is that of recognizing what is supposedly already there.

In the transition period Wittgenstein struggled with what appeared to be a commonly accepted view of intention as a state of mind.

> 44. Intention is neither an emotion, a mood, nor yet a sensation or image. It is not a state of consciousness. It does not have genuine duration. (Wittgenstein, 1967)

Wittgenstein's choice seemed at times to be in favor of a phenomenological view of intention as "intention *of* something" (van Peursen, 1972). Thus, for instance, when he compares intention with expectation, he writes:

> 56. Here my thought is: If someone could see the expectation itself -- he would have to see *what* is being expected. . . .
>
> But that's how it is: if you see the expression of expectation you see 'what is expected.' (Wittgenstein, 1967)

Other times, however, "Intending" is characterized as a movement not only toward *something* but also toward *someone:*

> 455. We want to say: "When we mean something, it's like going up to someone, it's not having a dead picture (of any kind)." We go up to the thing we mean. . . .
>
> 457. Yes: meaning something is like going up to someone. (Wittgenstein, 1958)

These statements imply a view of meaning as a complex relationship between a speaker, an "object," and some other person.[2] That the "other" -- hearer, audience -- could actually also move toward the speaker and "help out" is not made explicit but is certainly possible. The belief in the audience as co-author is manifested in Wittgenstein's style of teaching as recounted by G. H. von Wright (quoted in Malcom, 1984):

> From the beginning of 1930 Wittgenstein lectured at Cambridge. As might be expected, his lectures were highly 'unacademic.' . . . He had no manuscript or notes. He *thought* before the class. The impression was of a tremendous concentration. The exposition usually led to a question, to which the audience were supposed to suggest an answer. The answers in turn became stating points for new thoughts leading to new questions. It depended on the audience, to a great extent, whether the discussion became fruitful and whether the connecting thread was kept in sight from the beginning to end of a lecture and from one lecture to another. (pp. 15-16)

The need for the "movement from the audience" is in fact traceable to this seemingly contradictory statement made in the Preface to the *Tractatus:*

> Perhaps this book will be understood only by someone who has himself already had the thoughts that are expressed in it -- or at least similar thoughts.

(Wittgenstein [1922], 1961, p. 3)

These words seem to imply that language by itself cannot explain. Meaning is not all in the text. New meaning is not simply in the expressed propositions. It must be created cooperatively.

But given the individualistic theory of interpretation and work in Cambridge in the 1930's and 1940's, it was very difficult for Wittgenstein to elicit the cooperation that he seemed to call for -- his war against "philosophy" he fought it by himself. I think this aspect of Wittgenstein's social and intellectual environment was partly responsible for his frustrations and disappointments. The debates and discussions inspired by his lectures and by his posthumous works are however totally in keeping with this program, which called for a cooperative, collective effort at figuring out meaning as a form of life. Across time and space, some of that cooperation is still going on.

Notes

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[1]A number of sources have been reconstructed as partly responsible for Wittgenstein's "turn." Rossi-Landi (1973/1983) discussed the possible influence of the Marxist economist Piero Sraffa (see also Malcom, 1984). Trinchero (1967), among others, mentioned the possible impact of a paper by Brouwer, heard by Wittgenstein in Vienna in 1928 and in which Brouwer argued that logic is not primary or basic with respect to natural language, but in fact is based on the latter. As pointed out by Rossi-Landi (1981), however, one must be careful not to separate too sharply between the "first" and the "second" Wittgenstein. In fact, as I suggest at the end of this paper, the "late" philosophy is already emerging in some "early" statements.

[2]This is in fact the "instrumental" notion of sign advocated by Bühler (1934).

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Functional Environments for Microcomputers in Education[1]

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Introduction

For the last several years, researchers at the Center for Children and Technology have been conducting a program of research on the use of computers in education. One of the central themes of this research is that the computer is a tool that can be used for a variety of functions or purposes. Thus, we talk about the computer operating within a "functional learning environment" (FLE). Here, functional means that the learning activities have a function or purpose from the point of view of the child.

In this paper, I discuss three projects undertaken at Bank Street College in which we implemented and studied such environments. These studies raise fundamental questions about the design and implementation of FLEs, particularily the relationship between the children's purposes and those of their teachers. Coordination of divergent purposes within a FLE turns out to be a critical factor in the success of classroom microcomputer activities.

While research on microcomputers is relatively new at Bank Street, concern for FLEs is quite old. Since its beginning in 1916, the college has been at the forefront of the progressive education movement founded by John Dewey. A central theme in Dewey's (1901, 1938) writing on education is the notion that classroom activities must be related to the child's experiences, interests, and goals. This was a radical proposal for an era in which the teacher stood at the front of the class and lectured or conducted drills. Although the general notion has found wide acceptance in United States schools in recent decades, many teachers find it impossible to implement because of limited resources, materials, and training. It is the hope of many people in the field of educational computing, including staff at Bank Street, that the microcomputer can be a resource for engaging children's interest and fostering a more creative learning process.

In this paper I will first describe the notion of FLE in more detail, and will then present observations about three projects that have tried to create FLEs. These projects concern the use of the Logo language in Bank Street classrooms, a project on science and mathematics education, and the creation of a network of microcomputers. In each case, the observations illustrate the importance of coordinating the goals of children and teachers.

Functional Learning Environments

We start with two assumptions: (1) Children are intrinsically motivated to work on tasks that are meaningful to them; and (2) The most effective educational environment is one that provides meaningful tasks, i.e., tasks that embody some function or purpose that children understand. While some children enjoy learning about a particular topic "for its own sake," in most cases, facts and skills are best learned in connection with larger tasks that give them significance or meaning. In this way, not only are children motivated to master the facts and skills, but they have a framework in which to understand the cultural significance of the facts and their relation to other facts. For example, a science project in which children attempt to answer specific questions about whales and their habitats by constructing a database provides an environment for learning scientific categorization schemes as well as specific facts about whales. It can also demonstrate to the children the variety of resources -- such as textbooks, encyclopedias, and films -- that are available in our culture for obtaining the facts, and confront them with the need to cull information from several sources.

Our assumption, however, leave two fundamental questions unanswered. First, we must understand where the goals that the children are interested in come from -- are they inventions of the children or are they imposed by the teacher? Second, we must understand the relation between the goals that children undertake in the classroom and the tasks they will be confronted with in the real world outside of school. Unless students can apply the knowledge and skills they have acquired in school to tasks outside the classroom, any FLE will have been for naught.

Our approach to the first issue takes a middle position between the idea that the teacher must impose problems and the idea that children must invent their own classroom activities. On the one hand is the traditional view of education, and on the other is a radical version of the child-centered approach to education based on interpretations of the writings of Dewey as well as Piaget (1973).

It is very clear that Dewey felt that the purely child-centered approach was as erroneous as the traditional view that the teacher must impose the classroom tasks. The teacher has very important responsibilities which include suggesting tasks and presenting to the children alternative interpretations of problems. In many respects, Dewey's approach is more consistent with the socio-historical approach to child development presented in the recently published writings of Vygotsky (1978) and Leont'ev (1981), in which the importance of the teacher-child interaction is emphasized, than with the universalist approach of Piaget, which deemphasizes the cultural context (Laboratory of Comparative Human Cognition, 1984). According to these theorists, the child's initial attempts to solve an arithmetical problem, write a story, or operate a computer program are carried out in interaction with teachers or more experienced children. What the child internalizes is not what the expert says, but a version of the interactions that constituted the joint activity. Thus, without coercion, these interactions guide children toward the cultural interpretation and significance of the tasks in which they are engaged (Newman, Riel & Martin, 1983).

Meaningful tasks may come from a variety of sources. One source is the spontaneous ideas of the children themselves: most children have some topic which they simply "like." However, for some school topics this source may not be the most important. Teachers can make classroom tasks meaningful by showing children their significance in terms of a variety of uses for the skills involved, or in terms of the adult world they will be entering. The FLE created in this way can be a simulation of a real problem (e.g., role-playing commercial transactions as a context for doing arithmetic calculations), or it can be a real problem (e.g., actually selling food at a school fair to raise money to buy a classroom computer). The FLE can also be of a more abstract nature (e.g., a geometric problem can provide a meaningful context for calculating the size of an angle, providing that geometry itself has meaning within the children's experiences). A teacher can create interesting FLEs by crossing traditional discipline boundaries (e.g., by showing how geometric concepts such as triangulation can be used in geography to solve navigation problems).

Our approach to the second issue -- the relationship between classroom and real world goals -- is closely related to the first. We suspect that the usability of school learning in later life is inseparable from the variety of FLEs in which it is embedded. Being able to see the same fact from multiple perspectives (i.e., recognizing the different uses it can have) engenders a flexible approach to acquiring knowledge that would otherwise be absent. This flexibility makes it possible to adapt the knowledge to new functional environments that cannot be specifically anticipated in the classroom.

Microcomputers can play a very useful role in FLEs because of their capacity for stimulation and because they themselves are important tools for the solution to a variety of interesting real-world problems. They also provide fluid and manipulable symbol systems in which many intersting abstract problems can be represented and solved. But they cannot be expected to function on their own. A teacher must build the bridges between the tool, the school task, the thinking skills, and their functional significance for the culture beyond the classroom.

Logo in a Classroom

Logo is a programming language popularized by Seymour Papert (1980) and colleagues. According to Papert, Logo is an environment in which children can learn fundamental mathematical concepts and powerful problem-solving methods without the intervention of teachers. Papert takes his inspiration from Piaget, who has argued forcefully that

> each time one prematurely teaches a child something he could have discovered for himself, that child is kept from inventing it and consequently from understanding it completely. (1970, p. 175)

One of Piaget's (1965) earliest examples was the game of marbles played by boys from preschool to adolescence. In Switzerland, where Piaget studied the game, adults were not involved. The children learned from each other. Not only did the children master the complex rules of the game, but they came to understand that the rules were not absolute but a matter of convention and agreement among equals. The same kind of process is at the heart of Papert's claims for Logo: Without the imposition of adult authority and adult ideas, children can come to an understanding of the nature of concepts such as recursion that are as fundamental to programming as cooperative agreement is to games with rules. Of course, the peer play group for marbles included undisputed experts; the same may not be true for programming, which is seldom mastered by young children. This weakness in the analogy might lead us to question peer interaction as a basis for learning programming.

The initial interest in Logo at Bank Street, however, was not in testing its adequacy as a peer group FLE but with quite a different question. Researchers from the Center for Children and Technology set out to see if experience with programming would enhance planning skills in children. It was a reasonable hypothesis since writing a program is like creating a plan for the computer to execute. The question was whether there was any transfer from the activity of programming to other experimental tasks that also required making a plan of action but did not involve computers.

The researchers arranged to do their study in two classrooms at Bank Street's School for Children (SFC). The teachers in the SFC are highly committed to the child-centered approach to education, and were eager to try out Logo and the pedagogy developed by Papert. Neither teacher was an expert programmer, although each had taken a course with Papert prior to the study. The teachers were, however, experts in creating functional learning environments for children and approached the new task with enthusiasm.

For two years, the researchers observed and interviewed the children and teachers in the third and sixth grade classes. Pre- and post-tests were administered using a chore-scheduling task based on the work of Hayes-Roth and Hayes-Roth (1979). The findings concerning the transfer of Logo experience to the experimental planning task were very clear: The researchers found no effects at all (Pea & Kurland, 1984). By the time the researchers compiled their data, however, the negative findings came as little surprise. Observations of the children as they interacted with Logo and with each other showed that very little planning was involved in their programming practices. Thus, there was little reason to expect programming to make children more planful.

As Pea (1983) observed:

> Much more common was on-line programming, in which children defined their goals, and found means to achieve them as they observed the products of their programs unfolding on the screen. Rather than constructing a plan, then implementing it as a program to achieve a well-defined goal, and afterwards running the implemented plan on the computer, children would evolve a goal while writing lines of Logo programming language, run their program, see if they liked the outcome, explore a new goal, and so on . . . In most cases, children preferred to rewrite a program from scratch rather than to suffer through the attention to detail required in figuring out where a program was going awry. As one child put it when asked why she was typing in commands directly rather than writing a program: "It's easier to do it the hard way."

From the children's point of view, Logo was for the most part an interesting classroom activity, although there were certainly differences among the children in their level of interest and in the amount of programming that they learned. But, despite their enthusiasm, they did not explore the more conceptually challenging aspects of Logo in the course of their discovery learning. They were essentially "playing." In Piaget's (1962) terminology, assimilation was dominating accommodation; that in, the goal was assimilated to the procedures rather than the procedures being accommodated to a set goal. Whatever worked became the goal retrospectively.

From the teacher's point of view, the children were engaged in the Logo activity but were not learning to program. Experiments involving the better Logo programmers showed that few had correct understanding of such central concepts as flow of control, conditionals, or recursion (Kurland and Pea, 1983). As time went on, the teachers began to question the discovery-oriented approach to teaching programming. It became clear to them that Logo could not just "happen," but that they, the teachers, had to have a idea of what they wanted the children to get out of the activity: Goals had to be set, activities had to be formulated, and the teachers had to come up with effective ways of getting their ideas across to the children. The teachers themselves wrote a book (Burns and Cook, in press) based on their efforts to make Logo part of their classrooms. Their experiences while attempting to follow the radical child-centered approach advocated by Papert suggests that, in the case of complex symbol systems, the educational activity must be guided by more mature members of the culture.

When an activity is made functional from the teachers' point of view, the children's activity may change. Those who follow Papert's child-centered approach fear that the activity will lose its intrinsic motivation once teachers decide they want to teach programming. This should not be the case if the teacher's role is to guide rather than impose the activity. However, important changes can result when the activity becomes part of the children's schoolwork. For example, children were often observed to work cooperatively while doing Logo. The children's interviews indicated that the relatively high level of cooperative work was a result of the activity's not being seen as part of the official schoolwork (Hawkins, 1983). There is some concern that, even in Bank Street classrooms where a high value is placed on cooperation, children will be less cooperative when the activity is no longer perceived as play and they have to be accountable to a teacher. FLEs must be functional for both teachers and children for education to happen. The coordination and optimization of these functions, however, remains a difficult issue that demands the attention of educators.

Simulating a Function: "The Science Show"

Another illustration of the importance of the teacher in the structuring of a FLE is found in Bank Street's Project in Mathematics and Science Education. Materials developed by the project include a television series, software simulations, and workbooks, all of which emphasize the process and tools of scientific work. I will focus on one aspect of the project in which a FLE is based on a multimedia simulation of a navigation problem. While the content is more specific than is the case with Logo, the use of the content is still conditioned by the teacher's interpretation of its function.

A television series, "The Voyage of the Mimi," tells the story of an expedition to study whales off the New England coast. A group of scientists and their teenaged research assistants charter a schooner captained by an old sailor. Although the boat is old-fashioned, it is equipped with electronic navigation equipment, as well as computers and other sophisticated scientific gear. Thirteen episodes take the expedition through a series of adventures in which the crew learns a lot about the sea, whales, navigation, survival in the wilderness, and each other. In one episode, a bad electrical connection causes several instruments to malfunction. The captain suspects that they have been moving faster than his knotmeter indicates, so he has one of the assistants use the battery-operated radio direction finder to establish their position. The assistant calls down the compass bearings for two beacons while the captain plots the position of the boat on the chart. He finds they are actually much closer to dangerous shoals than he had thought. This episode illustrates a functional environment for navigational equipment, as well as for geometry-related skills concerned with intersecting lines and measurement of angles.

A simulation created as part of this project engages the same skills in a similar FLE. The game Rescue Mission simulates a navigational problem in which the players must determine their own position using a simulated radio direction finder, locate the position of a ship in distress using chart coordinates, and then plot a course toward the ship. A simulated radar screen, binoculars, and compass are also available to indicate the current location of the ship. Children play in teams, each attempting to be the first to get to the distressed ship.

The episode described above was designed to show how navigational instruments and geometrical concepts function in a real problem. It engaged children's interest both because they could identify with the teenaged characters and because of the emotional and dramatic tension of the narrative. The Rescue Mission game builds on the understanding of navigational instruments, and adds the motivation of peer interaction and the fantasy goal of rescue. Together with the print materials -- workbooks and study guides to be used in the classroom -- the show and software provide the basis for FLEs for a number of school-relevant subjects. However, as we saw with Logo, the teacher plays an important role in determining the nature of the software experience.

Char (1983; Char, Hawkins, Wootten, Sheingold & Roberts, 1983) carried out formative research to guide the design of the classroom materials. Working in fourth, fifth, and sixth grade classrooms, she observed the way the teachers used the materials and the children's responses to them. From the children's point of view, the materials were a success. They enjoyed the TV show and were excited by the software simulation. Interviews with the children showed that, after seeing the show and playing the Rescue Mission game, most of them understood the function of the navigational tools and the concepts of plotting positions at the level needed to win the game.

From the teachers' point of view, the results were mixed. The teachers in the study represented a wide range of expertise in their own science and mathematics training and in their use of classroom microcomputers. These teacher differences in training and computer expertise appeared to lead to differences in their interest in and perceptions of the Rescue Mission simulation. Some considered it limited to the function of teaching about navigation, while others founds a variety of uses for it across the whole elementary curriculum. For the latter, the simulation and the navigation unit functioned as a jumping-off place for teaching about geometry, mathematical measurement, estimation, the history of the whaling industry, geography, and literature.

Interestingly, it was the teachers less familiar with computers and the teachers responsible for a wider variety of subjects (i.e., those who taught more that math or science) who found Rescue Mission most useful. In contrast, the science and math specialists, who were also more familiar with computers, were less receptive to the game's long-term use. Char (1983) points out that these teachers used computers primarily for programming instruction and were not accustomed to software that presented specific content. Perhaps as a result, the navigational content seemed to them to comprise the primary educational function of the software. Thus, an important finding from the formative research was the need to make explicit the full educational potential of the simulation to those teachers familiar with computers, as well as to those who are computer-naive.

The formative research on the science show materials clearly indicates the extent to which teachers shape children's exposure to materials through the FLEs they set up. It is not sufficient for software developers to create activities that embed important educational facts and concepts. A computer program per se constitutes a very limited FLE. The program must be interpreted by a user or teacher who understands its significance for a variety of culturally important contexts. Like any tool, a program is most useful in the hands of someone who knows how it can be used.

The Functions of Networking for Children and Teachers

The third project that will help to illustrate the coordination of teachers' and children's goals in FLEs is one that has just begun at Bank Street. However, we can draw on the experience of researchers Margaret Riel and James A. Levin of the University of California, San Diego (UCSD) for examples of how networking can function as a FLE. Networking is a general term for communications systems that link up computers. Most microcomputers, when enhanced with a piece of hardware known as a modem, can send and receive messages, text, and even programs to and from other computers over phone lines. Networking is becoming a popular pastime among young computer users who call up computerized bulletin board systems (BBSs) to read messages from other people, leave messages about topics of interest, and exchange software.

We at Bank Street are interested in finding out if networking can be used as a FLE for writing and communication skills. Can we take advantage of children's strong motivation to communicate with their peers to create environments in which children can practice writing and learn to write better? An experimental FLE at UCSD gives reason to be optimistic. The Computer Chronicles (Riel, 1983) operated between schools in San Diego and Alaska, several of which were located in isolated areas. Children wrote news stories using a word processor, which were then sent to the other participating classrooms. In each site, the children, with their teachers' help, composed a monthly newspaper drawing on both local stories and those coming from distant places. In many cases, children edited the stories that came in "over the wire" just as newspaper reporters would do. In fact, the frequency of editing someone else's work for style and meaning using the word processor was much higher than is of the case when children write their own stories using the same technology (Quinsaat, Levin, Boruta & Newman, 1983). Thus, the production of a newspaper became a FLE that not only encouraged children to write, but also provided a context for the editing and revision of their own work as well as the writing of others.

The Computer Chronicles shows the potential for networking as the basis for a FLE. It also illustrates a feature of FLEs that have been suggested as important by our other examples: the coordination of the goals of children and teachers. From the children's point of view, the activity was interesting because they were able to communicate with peers who lived in interesting and exotic places (Alaska and southern California, depending on your point of view). From the teachers' point of view, the activity provided a context in which children could practice writing and were motivated to edit and revise their work. These goals are not identical, but neither are they in conflict. It was because the teachers wanted an activity that would encourage writing and revision that they set up the newswire idea, thus giving the children a chance to communicate with interesting peers. However, without the specific structuring, it is unlikely that the children would have engaged in editing each other's writing.

Conclusion

Three examples of FLEs have illustrated the importance of the teacher in creating and interpreting children's learning environments. While computer software can play an important role in FLEs as a tool, it should not be expected to carry the whole burden of education. Teachers are needed in order to interpret the tools in terms of classroom goals and the larger culture outside of school. Our examples have al been drawn from elementary schools where the need is especially clear. We suspect that, as children develop, the role of the teacher as interpreter or as someone to present another side of the story is gradually internalized, with the result that the mature college student can be expected to use books and manuals to discover multiple points of view on many subjects. Yet, even mature students require the insights of experts when the subject matter is particularly complex.

Our focus on the teacher is not meant to detract from a concern for the children's point of view. Obviously, a FLE cannot work unless it makes contact with the children's interests and experiences. A well-designed FLE is one that coordinates children's and teachers' points of view so that both the children and the teachers can achieve meaningful goals.

Notes

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Moving Language Around on the Word Processor: Cognitive Operations upon Language

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If it is true that we learn about physical aspects of the world through handling objects, moving them around, it may also be true that we learn about language as a system in part by acting upon it, moving elements around and observing the effects upon meaning. When we write alone, the intuitions about choices of words and structure are private, ephemeral, and often below the level of consciousness. But when we compose and revise with others, linguistic awareness and strategies for problem solving in language are likely to be made public and relatively explicit.

While many students, through direct and vicarious experiences, with or without guided experience in school, have abstracted concepts about the hierarchical relationship of language forms (Hutson, 1977, 1980), about the relationships between oral and written language (Wilkinson, 1981), and about the constructive processes involved in composition (Flower, 1981), some have not completed this process by the time they enter community college. Many students don't seem to think of language as a system, with elements that can be moved about in service of a message; they get "stuck" with the first phrasing that flows from their pen. They resist revision because it's difficult for them to recopy papers. In addition, Levin and Doyle (1983, p. 77) suggest that verbally weak college students' composition is marked by "weakness arising from their apparent inability to 'see' their own work clearly. Their revisions [are] unconstructive or non-existent." Even when these students have knowledge about the social world, this knowledge is too seldom reflected in their composition. The problem is especially great for learning disabled students and students from other cultural backgrounds.

The project described here involved community college students assigned to a developmental writing lab, composing and revising together in small groups on word processors. Text manipulations were discussed, instantly made, and instantly seen on the screen. This writing experience was part of a one-quarter course with emphasis on meaning, feedback, and revision. Students were assigned to the class on the basis of low scores on the English Placement Test. The class was ethnically diverse, including a number of recent immigrants as well as students who had been classified as learning disabled during elementary or secondary school. Reading scores on the Nelson-Denny reading test, administered on the first week of class, were below 7th grade for half the class. Success in the course was required before students could enter other courses in English.

The instructor of the writing class, Diane Thompson, had stripped down the Word Star program to bare essentials so that students could begin using it for composition during the first week of class. Supplementing the tiny screen on the Osborne was a more readily visible monitor placed above the computer. Only 10 function keys were required to move the text display up or down, to insert and delete text, to start or save a file, or to move language elements around. Any other operations needed, but not in the student's repertoire, were performed by the teacher (an infrequent occurrence). The use of word processors allowed revisions (a problem for many disabled learners) to be made with minimal effort, less likelihood of introducing new errors, and production of a clean final copy. Yet if writers use the word processor only to make minor corrections -- a comma in, a comma out, a letter changed here -- the word processor functions only as a rather expensive eraser.

The topics assigned were often designed to provoke vivid discussion, which served as prewriting. Many of the topics were drawn from materials designed by Northern Virginia Community College staff for values clarification discussions (Bizzaro, 1981).

Early in the quarter, students were assigned a topic, Alligator River (see Table 1).

Table 1

THE ALLIGATOR RIVER STORY

Once there was a woman named Abigail who was in love with a man named Douglas. Douglas lived on the shore of a great river. Abigail lived on the opposite shore of the river. To make matters worse, the river which separated these lovers was teeming with (you guessed it) big, hungry alligators.

Anyway, Abigail wanted to cross the river to be with Douglas but (you guessed again) the only bridge had been washed away. Nevertheless, Abigail went to ask Bluto, a riverboat captain, to take her across. Bluto said he'd be glad to help out, providing she would go to bed with him first.

Downhearted, Abigail refused and went to a friend, Charlotte, to talk things over. After all was said and done, Charlotte let it be known she wanted nothing to do with the whole mess.

At this point, Abigail felt her only alternative was to accept Bluto's terms. As these things go, Abigail kept her promise and so did Bluto. After a short ride on the riverboat, Abigail and Douglas were together once again.

Well, with "happily ever after" on her mind, Abigail decided to tell Douglas about her affair. Hearing this, Douglas told her to get lost or something like that.

Rejected, dejected and just generally bummed-out, Abigail turned to Ernest with her sorry story. One thing led to another and Ernest stalked off to beat the tar out of Douglas.

As the sun sets in the West, all we can hear is Abigail's laughter.

Explain your feelings about one individual in this situation.

After whole class discussion, students each wrote individual handwritten responses, and were then formed into groups of 3-5 to discuss their ideas and to type a joint composition at the terminal. At the end of the two-hour period the file for each group was saved, and each student received a printout. At the next meeting the group revised and expanded the joint composition. For the composition discussed here, the group was audiotaped discussing revision. They met a further time for proofreading, using the Grammatik and Spellguard programs as well as their own reading to produce a third draft. The questions to be explored were (1) whether, with the twin supports of group and word processor, students in this high-risk group *would* revise; (2) what *kinds* of revisions they would make -- which language units they would change and what operations they would perform on these units; (3) what *effects* revision would have on the structure of their compositions; and (4) what aspects of *awareness of language structure* students would display in their discussions during group composition and revision on the word processor. Although a considerable file of group and individual compositions and revisions has been developed, and more formal analysis (including computer analysis of length, vocabulary, grammatical features, spelling, etc.) is in progress, the process will be illustrated here with a series of revisions and discussions of one composition by one group.

Description of group composition and revision on the word processor requires an analytic scheme faithful to the conceptualization of language as an object of thought. The notion of "moving language around" (Hutson, 1977, 1980) reflects a cognitive developmental view of the growth of concepts about language. The central notion is that just as we can learn about physical aspects of the world by moving those objects around and noting the effects of the transformation, we can learn about language structure by operating upon language, moving elements around and noting effects upon meaning and the larger structure. Our analytic scheme, then, needed to specify *which units of language* the writers changed and *what operations* they performed upon these units.

The changes from one draft to another were categorized finely in terms of various units, then collapsed into five more global levels -- format or mechanics, letters, words, phrases or sentences (or blocks of more than one sentence inserted within a paragraph), or paragraphs and larger units of text. The operations were categorized as additions, deletions, substitutions (deletion of one element and addition of another), and rearrangement of a given language unit. A matrix of operations by levels of language provided visually salient profiles of revision strategies. This analysis was supplemented by analysis of the structure of various drafts and the changes in structure from one draft to another. Excerpts from group discussion were used to illustrate the problem-solving processes and the variety of linguistic intuitions shared. Examples of explicit linguistic awareness were categorized in the same terms as the levels of language used in revision. (The first draft and second draft for one group are shown in Table 2.)

The group included Matt, 21-year-old white American male, outgoing, Eagle Scout, not always faithful in his assignments; Karen, 19-year-old white American female, disliked writing and wrote little on her own; Jim, 20-year-old white American male, some brain damage and speech impediment, quite conscientious in carrying out exercises and revisions; and El, 28-year-old Egyptian-born housewife, advanced ESL, bright and cooperative. All scored at less than seventh grade level on the Nelson Denney reading test. Their first draft began where the story starter ended. The later draft added explanatory material to the beginning. The revision strategies are summarized in Table 3-A. The revisions were not numerous but half the revisions from draft 1 to draft 2 involved units ranging from phrases to multiple paragraph segments, which seem relatively sophisticated kinds of revisions, seldom seen in earlier compositions. For the proofreading (revisions from draft 2 to draft 3) summarized in Table 3-B, only one quarter of the revisions involved these more complex units, and none were more than a phrase. More attention at this stage went to spacing, spelling, etc. In the summary (Table 3-D) this pattern is compared to the whole class composite for the first assignment of the quarter. The revisions of the earlier composition from draft 1 to draft 2 were primarily "pencil point" revisions dealing with format, mechanics or smaller units of language -- more like the proofreading revisions from draft 2 to draft 3 of this later composition.

The revision from draft 1 to draft 2 on Alligator River made important changes in the structure of the story. As shown in Figure 1, the structure is episodic -- one incident leads to another. The lines indicate which characters are the focus of each episode; for example, on the first draft the line from Douglas to Abigail indicates that she is the object (of his loving). The line stays with Abigail as she leaves. Douglas becomes the focus as he repents, but the focus changes again as Abigail acts upon Ernest, appealing to him. Then Ernest acts upon Douglas, forcefully. In draft 1 the story begins with Douglas' love for Abigail, but immediately she leaves, for reasons that are unclear; it is implied that she had earlier slept with Bluto, but that episode is not tied in and her motivation is not specified. After a few fight scenes, the story has a happily-ever-after ending.

Draft 2 incorporates the actions from draft 1, but develops Douglas' character, provides more description of the setting (which explains why crossing the river was so important) and develops motivation for Abigail's behavior -- mad love and self-sacrifice. The new ending is bittersweet.

The group discussion about these revisions is even more interesting than the outcomes, reflecting awareness of various levels of language and of the need to move language around in order to build a cohesive structure.

Illustrations of Revisions at Various Levels

All of the types of revisions mentioned in discussion of the matrix profile for cognitive operations on language are mentioned in the transcript of the discussion during group composition. Examples of discussions about needed changes in various levels of language are given.

Format or Mechanics. During revisions of the Alligator River story, students seemed to save proof-reading considerations (like spacing twice after a sentence) until the third draft, not presented here. The discussion was a multimodal experience, with students alternately speaking (offering possible wordings or discussing strategy or motivation of the characters, rereading prior text, or restating the text orally as it was being typed in). Words indicate lines entered on the word processor.

- No, I'm trying to move the rest of this paragraph up.

Table 2

DOUGLAS

I really love this girl. After she left I thought the whole situation was over and decided that I was to harsh with Abigail. I guess that I never knew how much Abigail loved me to go through so much just to be with me. Even to stup as low as to go to bed with SCUMBAG Bluto. Of course it would be natural for any human being to get rage about your lover sleeping with someone else.

This whole ordeal led to Abigail running and crying to Ernesdt telling him what a Dirty Rotten nosebleed I was. A little while later that day a load knock interrupted my gourmet supper.I knew that it was my good friend Ernest the alligator feeder.Upon opening the door a extremely large fist encaved my face. After this violence was over I grabed my jacket out of the closet and ran to catch the riverboat. Upon seeing Bluto I thought of how low he stupped to take advantage of Abigail so out of instinct I rage out on Bluto. In other words I kicked his ass. So I made him take me to the othe side. On my way to Abigail I thought of how to apologize. I knocked on her door but there was a slight delay, when she open the door she was very suprised. Without saying a word we started to cry and embraced. After a day or two the whole accident was forgotten.

DOUGLAS

My name is Douglas and I am 31 years old, I know that all women love me because I am very handsome. There is a women that loves me, her name is Abigail and she lives on the other side of the river. This women follows me where ever I go. I know that she loves me enough to do some crazy things even to stup as low as to go to bed with SCUMBAG Bluto.

It all started when the bridge washed out and Abigail and I could not see each other. Without seeing each other for a long period of time Abigail started going crazy. So she took matters upon herself. Bluto an exfriend of mine thought he would used the situation knowing that Abigail would do anything to see me. So he offered her a ride over the river in exchange to spend the night with him.

The day she came over I asked her how she made it over the river full of alligators. She started to cry and explained what had happen. I was furious so I took the ugly stick to her.

I really love this women. After she left I thought the whole situation was over and decided that I was to harsh with Abigail. I guess I never knew how much Abigail loved me to go through so much just to be with me. Of course it would be natural for any human being to get rage about your lover sleeping with someone else.

This whole ordeal led to Abigail running and crying to Ernest telling him what a Dirty Rotten nosebleed I was. A little while later that day a loud knowck interrupted my gourmet supper.I knew that it was my good friend Ernest the alligator feeder.Upon opening the door a extremely large fist encaved my face. After this violence was over I grabed my jacket out of the closet and ran to catch the riverboat. Upon seeing Bluto I thought of how low he stupped to take advantage of Abigail so out of instinct I rage out on Bluto. In other words I kicked his ass. So I made him take me to the other side. On my way to Abigail I thought of how to apologize. I knocked on her door but there was a slight delay, when she open the door she was very surprised. Without saying a word we started to cry and embraced. After a day or two the whole incident was forgotten, but in the back of my mind I still can't trust her.

* *

Table 3
Profiles of Revision Strategies
Cognitive Operations Upon Language

A. Revisions from Draft 1 to Draft 2

	Add	Delete	Substitute	Rearrange
Format/Mechanics			1	
Letters/Affixes	1	1		
Words			1	
Phrases/Sentences/ Blocks	1			1
Paragraphs/Larger Text Units	1			1

B. Revisions from Draft 2 to Draft 3

	Add	Delete	Substitute	Rearrange
Format/Mechanics	3			
Letter/Affixes	3		3	
Words			5	1
Phrases/Sentences/ Blocks	2	2	1	
Paragraphs/Larger Text Units				

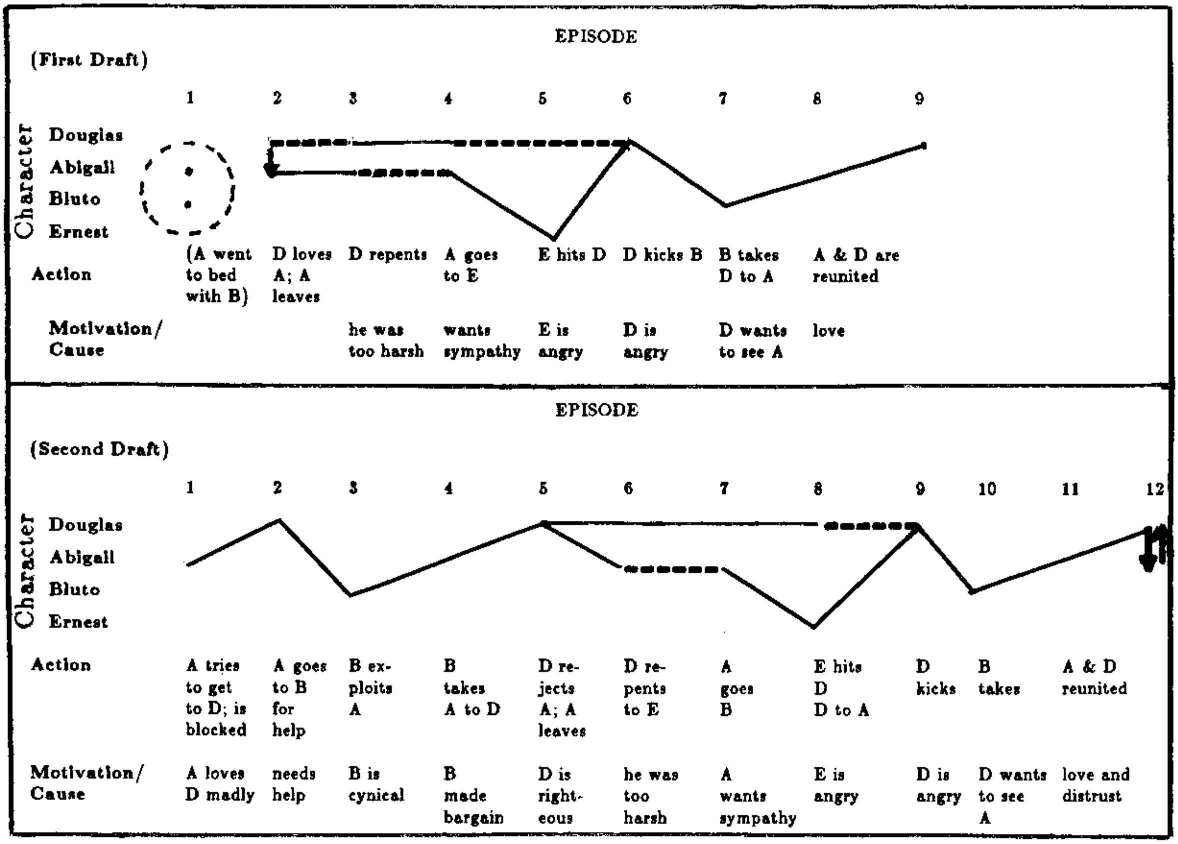
C. Revisions from Draft 1 to Draft 3

	Add	Delete	Substitute	Rearrange
Format/Mechanics	3		1	
Letter/Affixes	4	1	3	
Words			6	1
Prases/Sentences/ Blocks	3	2		1
Paragraphs/Larger Text Units	1			1

D. Summary

Alligator River	Draft 1 to Draft 2	Draft 2 to Draft 3	Draft 1 to Draft 3
Total revisions	8	20	28
% at higher level of language	50%	25%	32%
% rearrangements	25%	5%	11%

Figure 1
Schematic Representation of the Episodic Structure of First and Second Drafts



- Put your cursor under the i.
- Under the i?
- Mmhmm. And control 7.
- Control 7? There we go. There she goes.
- Isn't that good? Whoa!

They did discuss punctuation on the second draft. Although the outcomes were not in all cases correct, discussion may well have raised awareness of punctuation.

- *There's a woman that loves me.*
- *But she lives across the river -- her name's Abigail.*
- (typing) *Her name is . . .*
- Period? Okay, go ahead.
- *Her name is Abigail* is a whole sentence, isn't it?
- Yeah, just put a period in front.
- Okay. (Note that this did not show on the final version. This segment of text was erased, the backup copy of the earlier version was saved but did not include the change.)

Letters or Affixes. In some cases spelling errors were caught as words were entered:

K: *I am very hansome.*
M: *Handsome?*
K: Mmhmm. (You) forgot the *d*.
E: I think there's a *d* in handsome.
M: Where at?
K: After *han*.
M: Okay; *d*; *d*-some.

In another segment one student noticed the unneeded *d* in the spelling of the word *Ernesdt*. The student who has typed in the word said, "I'm glad you caught that. I woulda never caught that."

During this discussion there was relatively little mention of affixes, but at a later session using the computer-checking programs of Grammatik and Spellguard, the computer flagging of possible errors plus the group's re-viewing their text led to some final smoothing (though some errors remained in the third draft after proofreading).

For example, on their printout, the group corrected the spelling of "a women," corrected "he would used," and changed "to get rage about" to "to get enraged about." They left untouched the separation of "where ever" (which the Grammatik program accepts as two words). In changing the phrase "*very* handsome," which the program flagged as containing an overused word, the students substituted (and misspelled) "extremely" as "extremly."

Words. The students sometimes debated the best word to use:

M: *This woman . . .*

K: *This woman . . . would kiss my feet.*

M: This girl. (spelling) *girl.*

K: Well, it has to be a woman, if he's 31.

M: Girl?/Woman; whatever. Girl-woman.

J: Woman.

E: Woman. She wouldn't spend the night with other men.

M: (Continuing typing) *This woman follows me -- everywhere?*

Phrases, Sentences, or Blocks of Sentences. In the first draft, the story ended in tears and kisses. In the final draft the group discussed several times whether to add a phrase that changed the picture considerably. The issue was decided in this segment:

M: Did they get married and live happily ever after?

E: No, cause he can't trust her.

M: I know a lot of marriages where they don't trust each other, but they're still married. (typing) *But in the back of my mind . . .*

E: *I keep asking, how am I going to trust her?*

M: Now let's see, *I still can't trust her.*

After that, one student commented, "That like rounds it all out. I mean that."

The phrase about "stooping low enough" was moved up and incorporated into the new explanatory material added to the beginning, filling in the motivation for Abigail's action (though perhaps providing also the reason for Douglas' later lack of trust).

Paragraphs or Larger Units of Text. The major change from draft 1 to draft 2 was the addition of three paragraphs including one sentence moved in from the earlier draft. When they began work on the revision, the group began by describing Douglas' character more fully, making him more vivid if not more admirable:

K: Okay, like she says, "*she follows me.*" Oh, well, you can make . . . you can . . . Remember we wanted to make him sound like a stud. We have to make it sound like he thinks he's just great.

M: Are we making him that way?

K: Yeah! (laughter)

M: We are?

M: Okay. I didn't know he had that personality. Okay! *She follows me . . .*

Next they developed more fully the motivations for Abigail's actions, weakly developed earlier. They described her as madly in love with Douglas, going crazy to see him, and in the early part of the story they downplayed his feelings for her. Initially the first 1 1/2 paragraphs of new material were marginally connected to the earlier-written final two paragraphs. They recognized the problem:

M: All right, so we need to explain what went on.

K: Yeah, we can say like, okay, *one day . . .*

M: One day Abigail found a way of coming.

K: To the other side.

M: Okay. You want a add it on to this paragraph, right?

K: To that one? Okay, how about "*After the bridge washed out. Abigail found her a way to get across the bridge?*"

K: But you want to let him say, how much he loves her?

M: Well, we're writing about Douglas, though. His feelings. The question is do you want to explain the rest of the story? Cause we got bits and pieces here. Do you want to explain how the bridge washed out and she found a way across there by sleeping with Bluto? Or do you want to keep on saying, you know, how much they love each other?

Observations

These findings suggest (1) the usefulness of conceptualizing and evaluating revisions as cognitive operations upon language and; (2) the usefulness of group composition and revision on the word processor (a situation in which implicit concepts may be made explicit) as a means to enhance student's concepts about units of language, operations upon text, and concepts about the functions of units in a rhetorical structure; and (3) the feasibility of studying group problem solving about language. Although even draft 3, not shown here, contained some errors, the text structure, characterization, motivation, wording, etc., were far more advanced than seen at the beginning of the course (as were certain linguistic variables analyzed more formally elsewhere) and better than frequently seen at the end of a writing course for developmental college students. Changes were also seen in student's individual writing by hand and on the word processor. Revised drafts tended to be longer, fleshing out the skeletal structure developed earlier, while in many classes the compositions turned in are at best skeletal structures.

The fragments of group discussion cited here indicate the range of aspects of language the students as a group considered and the insights they shared, unexpected in high-risk students. The technology made text manipulation easy, public and readable. Schwartz (1983, p. 35) comments that "the machine makes it possible to play and 'tinker' with language." Students were able to see instantly how their changes affected words, tone, viewpoint, and story structure. The group structure made it safe to risk forwarding a tentative idea. Group members also provided alternative viewpoints and "represented intellectual resources for each other" (Cole, 1980, p. 45) as they thought out loud about language.

This group composition setting also provided an intriguing opportunity to study the problem-solving processes that students used while caught up in the act of group composition. These observations support Levin and Kareev's (1980) contention that in many real-world problem-solving situations, people call upon *social* resources.

Because the composition was done by a group, and was thus interactive in more than one sense, it is also possible to examine some of the social dimensions, though they were not stressed in this report. Questions that could be asked include: Are some individuals more successful than others in gaining the floor? How do they gain access? Is perceived expertise differentiated -- does the group listen to one person for spelling, for example, and another for computer control commands, and another for social reality? Who is selected to type in the composition for the group? Does control of the keyboard, even when rotated across individuals, confer extra power to select from the suggestions offered by the group? In some segments here there is clear solicitation of input from the group, and in at least one segment the group is encouraging one member who is brain damaged and lacks confidence but often seems to see the logic of a situation sooner than others.

In group composition and revision on the word processor, the processes of reading, writing, listening, and speaking are fluidly integrated. As the audiotapes reveal, the students repeatedly read portions of their text aloud, discussing possible additions or insertions, watching the text flow onto the screen, and evaluating the developing story. While students with low reading scores often fail to read for meaning or to visualize what they are reading, these students were clearly caught up in their story, seeing characters develop personality, and basing decisions about plot upon character. For instance, this group discussed whether Abigail had been sleeping around, and decided not. Another group, telling the story from Bluto's viewpoint, built up a troubled childhood to develop sympathy for him. For less than able readers this approach may have had the special benefit of allowing their reading and writing to lean on the oral language process.

More formal evaluation (not reported here) suggests that there was marked improvement in both group and individual writing. The very complexity that makes it difficult to apportion credit for such change may add strength to the instructional situation. The salient features included these: time for writing, multiple drafts that allowed writers to see again and to refine their writing, peer feedback at several points, oral-to-written connections, as well as the group composition and the technological facilitation stressed here. The interweaving of these strands may provide redundancy of cues in multiple modes and reinforcement of one learning experience by another, helping high-risk students become more aware and more effective communicators.

Moving language around, direct manipulation of written or oral text as a means of developing or refining concepts about language, seems applicable to unsophisticated adults as well as to children (Hutson, 1982). Concrete external operations upon language, supported by group discussion, may become internalized as more abstract concepts about language units and their interrelationships, their functions in written discourse, and the processes of composition and revision.

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