USER-FRIENDLINESS REVISITED: CHILD-FRIENDLINESS

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A few years ago my three-year-old neighbor would march up to my flat to use my computer, where she wrote books for her grandmother in San Diego. After covering screens full of characters, she would say: "Now, will you make it into paper?" At that point I would save her work and print it. We then folded and stapled the printouts, and she would illustrate the pages of the book for her distant grandmother.

The request, "Now will you make it into paper" impressed me for several reasons. First, it told me how much my little neighbor knew about what was possible to do with the computer. Secondly, it told me what my little neighbor believed to be outside of her range of independent activity. And finally, her request struck me as naturally intelligent as it pointed to the transformative movement of communication across modes and media of communication—from computer to paper/print.

The following paper reports research findings with a group of older children (eight- and nine-year-olds) using computers to make a database of book reviews at a small public alternative[1] elementary school. In particular, it is about *child*-friendliness: how to define this shaded area at the intersection of the design of computer use and literacy, with some specific examples of what constitutes friendliness for little fingers and bubbling energy.

Instrumentality and Agentivity

Current uses of computers in education may be seen as falling into two categories: the instrumental and the agentive (Dretske, 1985; Herrmann, 1992). Agentive applications are anthropomorphic and progenitive. Designed as tutors, drillmasters, and taskmasters, these programs determine such variables of the educational context as subject matter, the paths of knowledge acquisition, and what constitutes successful performance. As such these applications tend to function as independent learning and teaching environments, for example in remedial and adjunct modes (Papert, 1993).

In contrast, instrumental applications are open-ended and protean (Papert, 1980). Designed as *HyperCard* stacks, word processors, databases and communication networks, for example, these programs enable users to perform tasks extrinsic to the machine while they also depend on the action of their users to define and delimit their pedagogical functions. One and a combination of these programs may be used to support and create a variety of collaborative classroom activities.

Examples of instrumental applications include the production of a classroom newspaper, both within one classroom and among classrooms located at distant geographical sites (Barson, 1991; The Copen Family Fund, 1991, 1992); international conversations focused on ecological responsibility (KIDS-91, 1991; KIDS-92, 1992); a yearbook (Thornburg and Allen, 1991); the simulation of an international peace conference on an interdisciplinary basis (ICONS, 1992); inter- and intra-class surveys (Martinelli-Zaun, 1993); a problem-solving center (Reissmann, 1990); and a local tourist brochure (Bruce and Rubin, 1984; 1992).

Thus, the design of instrumental applications, as they both open up possibilities

for innovative classroom activity and depend on this activity for their pedagogical *raison d'être* may be characterized as ontological (Winograd, 1986; Winograd and Flores, 1986).

Designing User-friendliness

The way user-friendliness is designed is driven by an opposing set of concerns in agentive and instrumental applications. In agentive applications the goal of user-friendliness is to make the operation of the machine invisible or "transparent." Friendly agentive programs hide the functions of the machine in such a way that the user can "boot and run" through the program without focusing on the mechanics of how the program runs. In this way the user can focus on the contents of the program, the subject matter, without deploying energy in the direction of machine and program operations.

In contrast, the goal of user-friendliness in the design of instrumental programs is to make explicit the functions of the program. This goal, for example, is operational in the design principle of "WYSIWYG" (What You See Is What You Get, pronounced "WizzyWig") in Macintosh computers and with Windows on DOS machines. Thus, a friendly instrumental program is one where the functions of the machine and the program are clearly and unambiguously communicated to the user so that users can understand and use the functions of the program to further the goals of their activity.

These different concerns underlying the design of user-friendliness in instrumental and agentive applications may further be refined when users are elementary school children. This endeavor, however, is problematic.

A Problematic Situation

The problem of child-friendliness may be seen as twofold. First, how do you define it? And secondly, what are some of its characteristic properties?

Certain current learning theories inform us that learning optimally occurs in spaces that are just a bit beyond the current capacity of the learner (e.g., Griffin and Cole, 1984; Moll, 1990). These spaces, called Zones of Proximal Development (ZOPEDs), place the issue of child-friendliness on a fine line. The fine line lies at the difference between unfriendly program features that lead to a systematic breakdown of activity and those that are unfriendly simply because they are new and fall within the scope of the general unfriendliness of novelty. The question becomes how much of the vast novelty of a program can be broken down into the tolerable bits of novelty that are optimal to the learning process and the features of the program that remain unfriendly to children and bring activity to a needless halt.

For example, my little neighbor's, "Now will you make it into paper?" was a request for me to print her document for her. Her request indicated that this was beyond her ability to work independently. Without seeing her manipulate the printer herself, however, I could not tell which of the operations subsumed by printing—loading paper into the printer, working the interface to command the printer to print, followed by retrieving her work from the printer—were unfriendly and perhaps impossible for her to perform even with direction. I did know from her request that my computer was at least friendly enough for her to be aware of what was possible and to clearly express her current goal.

The issue of child-friendliness lies in a space (the ZOPED) where program features enter the equation of learning and teaching activity as they contribute to create both positive and negative learning experiences. Friendly program features function as nov-

elties that quickly propel children in their goals, providing a positive learning experience. (The delete and arrow keys, for example, are favorite friendly novelties.) In contrast, unfriendly features are visible as repeated and systematic breakdowns in activity. Children systematically stumble over these features and the flow of their activity is unnecessarily interrupted. These features can and need to be fixed.

With child-friendliness thus defined, the next step is to exemplify some of its characteristics. The following study of a class of third/fourth graders using computers points to some of these characteristic patterns of activity.

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Overview of the Study

During three weeks a group of 25 third/fourth graders enrolled at a small public alternative elementary school used one computer (an Apple IIe), one printer (an ImageWriter), and *The Bank Street Writer* to create a database of book reviews. This database of book reviews was created within the context of a larger language arts program where the children were also making video book reviews in the television broadcast style of the *Reading Rainbow*. Thus, some of the computer-mediated book reviews were used as script prompts for the video book reviews. It was also envisioned that this database of book reviews could be used and appended to by future classes of third/fourth graders and perhaps even loaned to the local public library for consultation and expansion there, too.

Procedures

The children read books of their choice each day during Quiet Book Time (QBT). During that time one of their two team teachers was available to help with the reviews and guideline handouts were distributed. After reading their books the children worked at the computer with me, a parent volunteer. Some of them drafted their reviews online while others had prepared handwritten drafts, which they entered. Some of them took computer turns individually. Other children came to work in pairs.

Depending on their prior experience with computers, each child spent one to several hours at the computer working on such tasks as turning the machine on and off; selecting and handling program diskettes; booting the program; entering, reviewing, editing, commenting, and browsing the reviews; saving, retrieving, and printing files; loading the printer with paper; and collecting hard copy off the printer. Over time, five enthusiastic computer users became tutors working on these same tasks with their classmates. Altogether 35 reviews were entered on a storage diskette—our database.

Data Collection

Hard copies and computer files of the children's reviews were collected. As I worked with each of the children I took notes of their activity at the computer. At the conclusion of the project I distributed a small questionnaire designed to elicit information about the children's learning experience: what they had enjoyed, what they would change, and whether they would recommend this kind of activity to other children. I also talked with the children, some of whom I knew quite well since their first kindergarten year at the school.

Analyses

Many different analyses were performed on the collected data. These were performed

within the framework of Soviet activity theory (e.g., Engeström, 1988; Wertsch, 1981). This framework enabled me to focus both on selective aspects of learning and teaching activities, and the interdependency of these aspects. Thus, at one level I looked at reading and writing tasks occurring away from the computer.

In particular I analyzed the kinds of writing functions that were being invoked by the activity of book reviewing. At another level I focused on reading and writing tasks at the computer, looking in particular at how reading and writing at the computer within the book reviewing activity was different from reading and writing off-line. Finally, I focused on the learning and teaching activity cycles that were invoked by the operations of the computer and the program in use.

Findings selected from this third level of analysis constitute the material for this paper. At this level I was focusing on embedded cycles of learning and teaching activity subsumed by computer use and the relationships between this level of activity and the over-arching goal of creating a database of book reviews within the context of a language arts program. To circumscribe the issue of child-friendliness, I looked both at the locus of these embedded cycles of learning and teaching activity (computer use) and the children's behavior at the computer (the children's verbal and non-verbal actions as they were using the computer).

Findings

Fourteen out of twenty-two children responded to the question "What did you learn?" with statements such as "delete"; "printing"; "typing"; "typing with two hands"; "capitalizing with shift key"; "how to use the 'space bar'"; and "how to do the computer." From the children's perspective, much energy tended to be deployed towards the mastery of a new means of productivity. This was also clearly apparent in observations, where the children could be heard asking for help about the operations of the program and the machine. The children could also be seen experimenting with certain features of the program, as well as halted in the flow of their activity towards creating the database of book reviews.

Operations of computer use that invoked cycles of learning and teaching activity were of two kinds: those focused on the interface of the program and those focused on the keyboard. Learning and teaching operations invoked by the use of the interface were those that required help with menus, prompts, and instructions appearing on screen. Keyboard operations were of two kinds: those invoked by the use of the keyboard for typing and those invoked by the use of the keyboard for control over computer function (i.e., use of computer function keys such as the arrow keys, the control/Apple/Reset sequence and shifting for commands over regular keycaps).

For example, the children as novice typists were seen hunting and pecking for keys to enter their reviews. They were seen trying out the small motor coordination required to perform such tasks as booting, shifting, and control key functions. They asked for help with the operations of the interface when they could not decipher the words of the interface. They also asked for help when they could decipher the language of the interface but could not understand what these words meant; that is, when they could not understand what they were supposed to do (e.g., -Clear file- "What does *that* mean?").

In these learning and teaching cycles focused on the operations of the machine and the program in use, the following systematic breakdowns in activity occurred. These are characteristic features of child

unfriendliness and therefore are features that can and need to be fixed to optimize positive learning and teaching activity.

The Keyboard "i"

In the eyes of these children the keyboard "i" (I) not only looked like an "L" (l), it was an "L." Thus, in addition to the difficulties that were experienced finding keys to enter the reviews as a result of being for the most part novice typists, the children systematically confused the keyboard "i" for an "L," and when they did not confuse the keys they simply could not find a keyboard "i."

Telegraphic Discourse

The language of the interface was sometimes incomprehensible for the children, so they could not decipher some of the words. Otherwise, when the words could be deciphered the children sometimes could not understand what the prompts and instructions meant and consequently what they were supposed to do. For example, they experienced no difficulty reading such instructions as "NO DATE SET FOR FILES. ENTER DATE. ENTER DATE IN FORM 5/55/55" but they could not comprehend what the program was instructing them to do. This difficulty arose in part out of the use of telegraphic discourse in the language of the interface. Once these instructions were syntactically expanded into, for example, "There is no date for your file. Type in the date. Type in the date using the model 5/55/55," the children could understand what they were supposed to do. That no month has 55 days, an additional unfriendly element, was less a hindrance once the instructions were in longer form.

Computer Science and English

Embedded in the above example about date-setting there is also language contact (Weinreich, 1974) between computer science and English. Thus, such terms as "Enter" in "Enter date," meaning "Type in the date," were at the root of the difficulties the children had in understanding the program's instructions. Other examples of language contact occur in such instructions as "Clear" in "Clear file," meaning "Do you want a blank screen displayed?" or "Do you want the screen erased?" Another area in which computer science has its effect is the listing of files according to a binary rather than a decimal system (e.g., File 1, File 11, File 12, followed by File 2).

Metalinguistic Terminology

The language of the interface presented metalinguistic words such as "character" meaning "letter, number, punctuation mark and space"; " text" meaning the reviews; and "retrieve" meaning "get" that were beyond the reading level of these third/fourth graders. Thus, these were the kinds of words that children had difficulty deciphering.

Screen Resolution

Fuzzy gray characters tended to generally compound the difficulties of deciphering and reading the language of the interface. The demonstrated beauty and lure of crisp arcade video graphics were features whose absence was sorely missed.

Summary

The keyboard "i," telegraphic discourse, linguistic contact between computer science and English, metalinguistic terminology and the general issue of screen resolution were characteristic features of the language of the interface and the keyboard that created systematic breakdowns in the flow of activity. As such they constitute aspects of computer use that were unfriendly to elementary school children.

Discussion

Fortunately, as Leont'ev (1981) puts it, "It is the fate of operations that they become a function of the machine" (p.64). Although he was referring to thinking processes of novice car drivers, the analogy holds for novice computer users. Just like the novice car driver who initially has to think about the operations of changing gears, novice computer users have to think about the operations of the machine and the workings of the program they are using. With time and use, however, the novice car driver forgets about the operations of changing gears and just thinks about using the car to get someplace. Similarly, over time novice computer users focus their energy on goals that are extrinsic to the functions of the tool they are using.

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The children of this study experienced difficulties with such operations as finding keys; the small motor coordination required to perform such tasks as shifting for capital letters, booting the program, and entering commands; positioning the cursor to the left of the character to edit; and confusing the arrow keys with the space bar. These hurdles of computer operation slowed them down in their goals of creating a database of book reviews.

Over time, however, they mastered certain features of computer use that empowered them at other levels of activity. Once they learned how to use the delete key, they enjoyed watching all the characters disappearing off the screen and consequently thought nothing of extensive rewrites. Similarly, they enjoyed using the arrow keys to zoom up and down files and thus tended to enjoy reading the unfolding texts.

At this operational level of activity, however, there is a fine line between what constitutes child unfriendliness reduced to the general unfriendliness of novelty and unfriendliness leading to the systematic breakdown of activity. In a ZOPED theory of learning, optimal conditions require effortful behavior (i.e., stretches). A tension between current and threshold levels of performance needs to be maintained. This tension is regulated in both inter- and intra-active behavior: intra-active behavior as learners integrate novelty into their own evolving frameworks, and interactive behavior as they communicate with peers and teachers when action is beyond solo performance (e.g., Belyaeva *et al.*, 1989).

The issue of child-friendliness enters this space as design features which have the capacity to both break down the fragile tensions of learning and sustain them. Certain features of computer design such as the keyboard "i," the use of metalinguistic terminology, linguistic imports from computer science, telegraphic discourse, and fuzzy screen resolutions are features that tend to upset the fragile tensions of learning when elementary school children are users. In contrast, the delete key and the arrow keys are features that tend to sustain and even propel the necessary tensions as children quickly learn to couple these manipulations with extrinsic goals such as reading someone else's review and entering another review.

Implications of the Findings

The implications of these findings are twofold. First, there are implications for the design of computer applications where the patterns of systematic breakdown in activity identified above may be considered. Secondly, there are implications for learning

and teaching activity where computers are used in language arts classrooms. Practitioners could use the findings of this study in two ways. First, these findings throw some light on the cognitive processes at work when computers are used in an instrumental mode in a language arts context. This places computer use in a position beyond both the typing arts and programming. It places computer use as a new mediational means of productivity that is interdependent with the language arts context. Secondly, practitioners could consider their own experience and those of their children as rich sources of friendliness issues and thus enter the conversation to revisit the issue and change it in an increasingly friendly direction.

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Notes

[1] This public school was considered an alternative school because the children attending had not been assigned on the basis of their home address and bussing legislation. The children enrolled through a petition for Optional Enrollment (OER process) through which children were admitted on a first-come first-served basis, with a preference given to siblings and providing that the racial balance of the school met with the district guidelines for integration. These children were comparable to their district peers in terms of such variables as cognitive development, gender, and ethnicity.

Such educational practices as individualized and self-paced learning, projects involving children and teachers across grade levels, in-house artists from the community for music and graphic art instruction, the presence of the major cultures of the community in all aspects of the curriculum, and the small size of the school (170 children) might have been among the reasons that prompted parents to petition for the enrollment of their children at this particular public alternative school.