

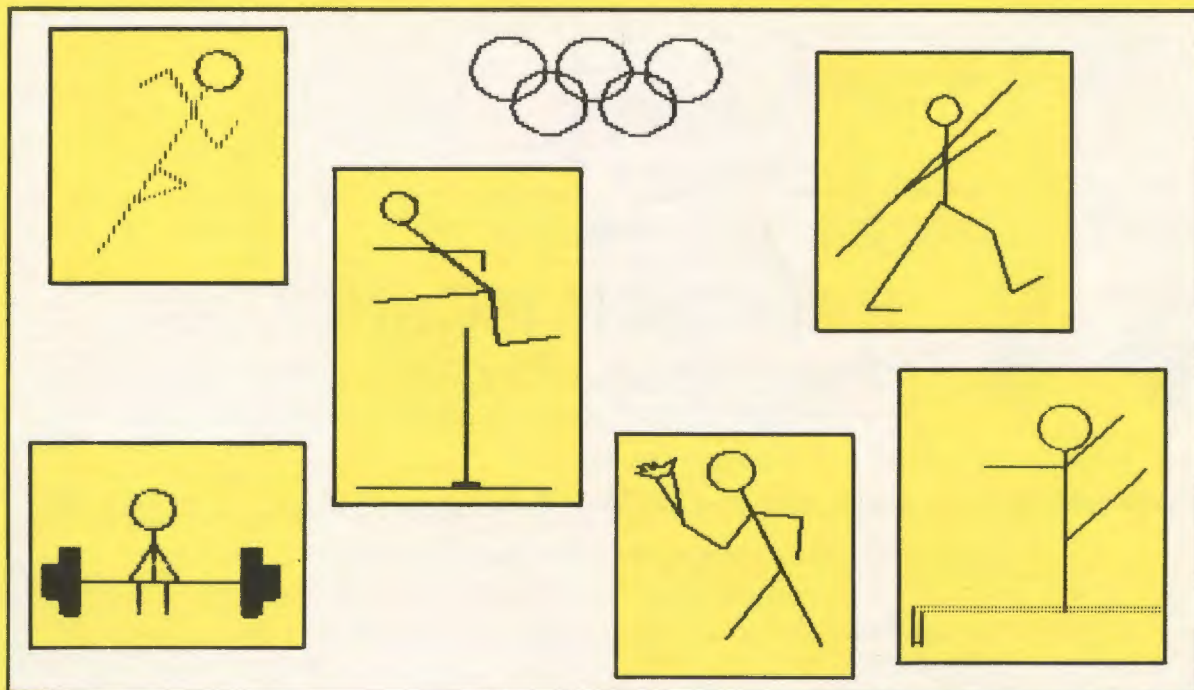
Journal of the ICCE Special Interest Group for Logo-Using Educators



LOGO EXCHANGE

OCTOBER 1988

VOLUME 7 NUMBER 2



International Council for Computers In Education



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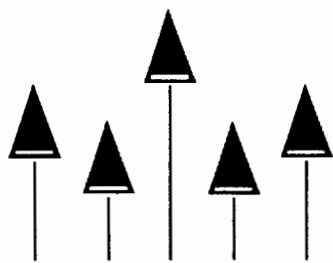
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LOGO EXCHANGE

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Journal of the ICCE Special Interest Group for Logo-Using Educators

October 1988

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From the Editor

Where Are We Going?

I have just spent the better part of a week teaching at Dan and Molly Watt's Logo Institute held this year at Lesley College in Cambridge, Massachusetts. As always, the atmosphere at the Institute was alive with excitement as novices and experts worked together in a rich Logo environment to expand their horizons. In (rare) spare moments, I found myself reflecting on the evolution of Logo over the past several years.

It seems like only yesterday that Logo burst unexpectedly onto the educational scene. We found ourselves reading *Mindstorms* and dreaming of a classroom of tomorrow where Logo was the panacea that would single handedly improve our educational system. Some eight years later, the educational system has not been revolutionized and educators are still looking for solutions.

But something more subtle than a revolution has happened. As hundreds of educators jumped on the Logo "bandwagon," thousands upon thousands of elementary students were exposed to Logo. Many of these young people are now in secondary schools, bringing with them a foundation in Logo programming. A substantial number of these students have enough knowledge of Logo to be able to make use of this skill with very little re-teaching.

Last year, as part of my work with Logo Computer Systems, I attended computers in education conferences all over the United States. As I talked to people in workshops, conference sessions, and over coffee, I gradually became aware of an evolution in attitude towards the use of Logo. No longer is it viewed solely as a "little kids" language. There is a more accepting attitude towards the use of Logo in junior and senior high schools. At almost every conference, I encountered enthusiastic teachers exploring the use of Logo in their junior high, high school and university classrooms.

A part of this growing acceptance of Logo at levels beyond the elementary seems to be the increasing sophistication of newer implementations of Logo. Versions of Logo for the Macintosh open up new horizons for those interested specifically in programming. Such versions offer access to more memory, greater speed, and features such as object oriented programming. Other newer versions such as Logo Writer and Logo Plus, broaden the capabilities of Logo for use in a variety of subject areas. It is now much easier to move beyond turtle graphics. Text and graphics can be combined with relative ease.

In fact, these new Logos seem to be moving more towards becoming broad based productivity tools. No longer is Logo "just" a programming language. The new Logos provide a low level desk top publishing environment, often quite inexpensively. They also have characteristics reminiscent of Hypercard (Lough, Muir). They are flexible and easy to use but there is great power in the underlying Logo programming language.

Another factor affecting the wider acceptance of Logo is the publication of a number of books that present Logo on a more sophisticated level. For example, Brian Harvey's *Computer Science Logo Style* series make it very clear that Logo isn't just for little kids. Paul Goldenberg and Wally Feurzeig's eagerly anticipated book, *Exploring Language with Logo*, allows us to play with grammar. There are certainly many other books both published and promised that address uses of Logo beyond the basics.

These observations, indicate that there are three important factors affecting the future of Logo, especially beyond the elementary level. The first is the growing number of students who have been exposed to Logo at some point in their educational careers. The second is the development of increasingly sophisticated versions of Logo on increasingly sophisticated computer systems. Finally, there is the availability of materials that can help guide us in more advanced uses of Logo. Only time will tell the effect of these two factors on the future, but perhaps we can speculate.

Is it reasonable to assume that Logo will increasingly become the vehicle through which all children will learn about computer programming? Will powerful ideas such as procedurality and debugging be seen as important enough to be included in our school curriculum? If so, is not Logo a logical tool to teach these concepts? Will skill with Logo be encouraged and nurtured so that as students move through school they become more and more proficient with some version of "HyperLogo?" Will secondary teachers be able to assume such knowledge in students? Will materials that make use of Logo in a variety of curriculum areas at all levels be published and then used in schools? Will Logo be built into the "dynabook" computer of the future that will be sitting on every student's desk? Or will the future of Logo take an unexpected turn as new software and hardware come into the picture? What will be the next addition to Glen and Gina Bull's *Journal of Learner Based Tools*? (Bull) And, what will be causing excitement at Dan and Molly's next Logo Institute? Stay tuned! The future is unlikely to be boring!

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Monthly Musings

Incomplete Perceptions by Tom Lough

Remember the story about the three blind people who had encountered various parts of an elephant? One was touching the trunk, another a leg, and the third the tail. Each had an idea about the nature of the beast which was quite different from those of the others!

Certainly one cannot fault the blind people for not recognizing the true nature of the elephant. Their perception of the elephant was incomplete because they were operating with information which was incomplete. Moreover, their perception is likely to remain incomplete, since no one knows everything there is to know about an elephant.

However, they could have done something to reduce the "degree of incompleteness" of their information. For example, they could have moved about and explored other parts of the elephant. They could have interviewed each other in detail to discover common attributes. Actions such as these would have provided additional information, thus helping them to gain a broader perspective of the animal.

Sometimes I am like the blind people. I find myself guilty of acting on incomplete information when, with a little additional effort, I could have obtained access to much more. Even worse, I feel that the information I have is complete (for my purposes) when in reality it usually is not so.

This same mechanism seems to be at work when people are forming their personal answers to the question, "What is Logo?" When teachers are not familiar with the full range of Logo's capabilities, it is easy for them to dismiss it as a computer language just for younger children.

This realization came home to me recently while delivering a Logo workshop to high school physics teachers. During the workshop introduction, I helped the teachers learn more about the artificial intelligence heritage of Logo, and its relationship to Lisp, a powerful and widely used artificial intelligence computer language. Activities during the workshop focused on using Logo in activities directly related to concepts of physics, such as planar motion and electrostatics.

At the beginning of the workshop, the physics teachers appeared mildly interested, since I had indicated that I had used Logo in my physics teaching regularly since 1983. As they proceeded through the activities of the workshop, however, their enthusiasm grew remarkably. By the end of

the scheduled time, many teachers were exclaiming that they had no idea that Logo could do all the things they had done with it, that they did not know it was so powerful, yet so easy to use. They were surprised at the many physics applications, and began generating ideas for applications in other high school subjects they taught.

The foundation for this surprise was their previous incomplete knowledge of Logo. They said that they had always thought of Logo as a computer language just for the elementary grade students, and had no idea that it would be so useful for secondary students.

But let's go beyond the issue of using Logo in secondary schools and think about how parents, administrators, and teachers at all grade levels may have already built their opinions about Logo on incomplete information. Introductory books, one-day workshops, articles about second graders drawing squares all contribute to such an opinion. From what I can sense, this is the situation in many parts of the globe.

How can we encourage these people to take a more complete look at Logo, to get more of "the whole truth" about this fascinating powerful computer language? What can each of us do to make sure others have more complete information about what Logo is and what Logo can do?

I welcome your ideas.

FD 100!

PS: Have you seen any automobile license plates with Logo slogans on them? I am currently collecting such slogans and will incorporate them into a future article. Please send me any that you know about.

Tom Lough
PO Box 5341
Charlottesville, VA 22903

Cover: These Olympic Logo projects were done by Grade Six and Seven students at Pineview Elementary School in Prince George, B.C. Canada. They used Terrapin Logo to complete the projects. Jim Swanson was their Logo teacher.

1. Jamie Hill, grade 6
2. Jamie Hill, grade 6
3. Ryan Martin & Shane Myram, grade 7
4. Jasen Florell, Jason Neumeyer & Faron Muncey, grade 7
5. Scott Ross & Chris Bowler, grade 7
6. Colleen Wanner & Daniela Mogus, grade 7

SIGLogo News

The first general meeting of the ICCE **Special Interest Group for Logo-Using Educators (SIGLogo)** was held in the Batike B Room of the Lowes Anatole Hotel, during the meetings of the National Educational Computing Conference, on Wednesday, 15 June 1988.

The acting officers were in all in attendance: Peter Rawitsch, President; Gary Stager, Vice President; and Theodore Norton, Communications Officer; so was Sharon Yoder, Editor of the *Logo Exchange*. Additionally, thirty-six persons signed the attendance sheet, although the actual number of persons present is likely to have been larger.

The agenda for the meeting was divided into three parts: (1) Welcome by Peter Rawitsch, and discussion of the proposed SIGLogo bylaws. (2) Old Business, including a reading of the membership and financial reports (Theodore Norton); and a report on the *Logo Exchange* (Sharon Yoder). (3) New Business: A discussion of possible projects for 1988-89, prepared and led by Gary Stager.

1. Peter Rawitsch opened the meeting by greeting those present. He introduced the acting members of the SIGLogo Board of Directors (see above). He then submitted the draft copy of the SIGLogo bylaws to the consideration of those present. There followed a lively discussion of the bylaws. Several changes were moved and adopted:

In Article I—Name: following the second sentence, insert the sentence: "The official publication of the special interest group will be the *Logo Exchange*."

In Article II—Purpose: In the first sentence, insert the word "legitimate" just before the word "...language..."

In re Article IV—Officers; Section 1: Election of Officers: Peter Rawitsch proposed that the four officers (President, Vice President, Communications Officer, Treasurer) be elected to two year terms. In re subsection a: Nominations will be submitted by January 1. In re subsection b: the membership will be balloted by April 1. Members will vote by May 30. Changes accepted.

At this point in the meeting, Peter Rawitsch asked for nominees for the vacant post of Treasurer. Frank Matthews, of the University of Huston, Texas, volunteered, and was approved by acclamation. (Frank can be reached at 1880 White Oak Drive #187, Houston, Texas 77009, 713-864-0768)

2. Theodore Norton read the "SIG Membership and Organization Budget" for 1988. This covered both membership and finances. Current membership in SIGLogo is estimated at 2,853 making SIGLogo is now the largest SIG in the ICCE.

Sharon Yoder reported on her editorship of the *Logo Exchange*. She commented on her assumption of editorial responsibilities, after *LX* was acquired by the ICCE. She noted changes on the journal's staff for the next year: the

departure of Robs Muir, and the additions of Lesley Thyberg and Dan Watt. She indicated that *LX* would start the new academic year on schedule. She stressed that *LX* has an ongoing need for cover art as well as articles. Tom Lough congratulated Sharon for a difficult job well done. His thanks were warmly seconded by those present.

3. Gary Stager led the last part of the meeting, on the following preannounced topics: conference co-sponsorship; children's conference; Logo Learning Month; electronic bulletin board; position papers; other ideas from SIGLogo members. The following summary covers some highlights of this discussion.

Gary Stager discussed the founding of the SIGLogo, the value of ICCE affiliation, and the recent Great Lakes Logo meeting. At the latter, participants discussed regional chapters and national conferences—do we need them? Gary thought so. He is also involved in the planning of NECC '89

Suggestions for children's computer conference were put forward. Should it be a Logo conference, or a computer conference sponsored by SIGLogo? The possibility of children's telecommunications between conferences was addressed.

Tom Lough observed that there were no future plans for another MIT conference.

Several of those present spoke to the issue of telecommunications. Ricky Carter proposed the creation of a subcommittee on telecommunications. Gary Stager raised the issue of Logo bulletin boards. Tom Lough volunteered to chair the subcommittee.

Other topics that were raised included: Sponsorship of a Logo Learning Month; creation of a Logo Room; the need for a general discussion on how Logo is to be taught; and a Logo Idea Exchange.

Sharon Yoder raised the possibility of a special Conference Issue of *LX*, much like the conference issue of *The Computing Teacher*. Tom Lough observed that work needs to go forward on a Logo Language Standard.

Dan Watt spoke to his concern with microworld development and exchange. Should we set up a Board of Editors for microworlds? He emphasized the importance of documentation standards. Sharon Yoder affirmed that ICCE would be interested in hearing more about these proposals.

International Logo activities were discussed, together with various Logo trips abroad, international communications, and a Logo Academy.

The meeting was brought to an informal close.

Theodore Norton, Communications Officer
3 Pine Tree Circle, Pelham, MA 01002

Logo Ideas

A Logo Message Center by Eadie Adamson

One of the first events of the school year for many of us is something called "Parents' Night" or "Parent Evening" or "Open House." Last year I wanted to do something to encourage parents to visit the new computer lab in our school. Since the evening is planned as a method of communication between parents and teachers about the curriculum in general, I thought that a little experiment in communication using LogoWriter might be fun. I invited the parents to come to the lab and leave a "secret" message on the computer for their child, a message which would be printed and delivered as a surprise the next day. It seemed a perfect way to show off LogoWriter.

The program itself (see listing below) was extremely simple. Since I had a clear idea of what I wanted it to do, it took a very short time to write. Starting instructions are given on the screen. The program is invoked by typing WRITE and pressing Return. Then the program guides the user through the stages of leaving a message. When completed, the message is stored on a separate page so that each child can have several messages. Finally, the program returns to the main message page, ready for the next correspondent.

Since this particular Parents' Night involved only fourth, fifth and sixth grade parents I set up one computer for each grade so that the messages would not have to be sorted. I was not prepared for the huge success of this idea! Our lab is directly across from the library where the main reception was being held. When I arrived in the lab, the room was already jammed with parents waiting their turn to leave a message. More people were in the lab than in the library! They were fascinated by the idea of leaving a message and had turned the room into a mini-version of a Logo class, with the "experts" helping out those having difficulty. People were having a wonderful time sharing their momentary successes. I sat down with one very nervous father who confessed to me that this was the first time he had even touched a computer! Parents discovered the importance of following directions carefully, since there was no elaborate error-trapping included. I was amused to hear some accusing the computer or the program of being "stupid" when something went wrong, not unlike the reaction of many beginning students!

I have refined the MESSAGES program slightly since last year by breaking one long procedure into a more readable series of shorter procedures. This year I will have more computers running the program so that there is less time to

wait. Last year several parents came back a number of times before they had a chance to leave their message. In addition, I have worked out a second procedure which prints all the message pages on the disk automatically. Since we are using French LogoWriter with the sixth grade, I will probably set up a French message center also.

The MESSAGES idea could transfer to classroom use or could be used as a mini-lesson in writing and communication. One class could write messages for another class. The classes could also retrieve their own messages and write replies. This could serve as preparation for an online penpal project.

Technical notes on the MESSAGE CENTER:

Since we use LogoWriter 2.0 for the Apple, I took advantage of being able to LOCK the message page itself. If you don't yet have this version, you can write a STARTUP procedure which prints a welcome and beginning instructions on the screen. Any procedure named STARTUP on a LogoWriter page will be automatically run as soon as the page is accessed, so your instructions will appear each time someone goes to the MESSAGES page.

Here is the initial screen I set up on my MESSAGES page:

```

locked-----Messages-----
This is the LogoWriter message center.
To leave a message:
      Type WRITE.  Press RETURN.
FOLLOW DIRECTIONS AT THE BOTTOM OF THE
SCREEN CAREFULLY!

LogoWriter will collect your message
and your name.  When you finish you'll
see LogoWriter save your message and
then return to this page.

```

When someone types WRITE, GETNAME, the first subprocedure, asks for the first and last name of the person to be sent the message. The last name will later be used as the page name for storing the student's messages.

GETMESSAGE does several things: clears the screen (remember it's a locked page, so any changes will not be saved on the page), moves to the top of the page, begins the letter with "Dear" and the first name, moves the cursor down, tabs and waits for the person to type the message. When

Logo Ideas -- continued

Return is pressed, the person is asked to give the name to be signed on the letter. "Love," and then the person's name is printed on the page.

SAVEMESSAGE clears the text from the screen so that it appears to the user that the message is being moved to another page. Actually all the information has been stored in the variables NAME, MESSAGE, and FROM. SAVEMESSAGE then checks whether a message has already been left for that person:

```
IFELSE MEMBER? LAST :NAME PAGELIST
```

If so, it gets that page which was named with the last name.

```
GETPAGE LAST :NAME
```

If this is a new person, SAVEMESSAGE gets a new page and names it with the last name.

```
NEWPAGE NAMEPAGE LAST :NAME
```

I didn't need to check for duplicate last names, since I used separate computers for each class. It might be a good challenge for you to add that feature!

SAVEMESSAGE hides the turtle, then moves to the bottom of the page and prints a blank line. This ensures that the messages will be saved in order. If a message already exists, the second message goes under the first, at the bottom of the page. On a new page the bottom of the page is the same as the top since there is no text on the new page. SAVEMESSAGE then uses the information collected to put a letter on the page, leaves a blank line and a few stars as end markers, and moves back to the MESSAGES page for the next writer.

Printing the Messages

Printing all those messages could be a long and tedious task. How could one procedure be instructed to move from page to page, printing each page as it moves along? Recursion doesn't seem to help us much here. One's first thought might be to use multiple GETPAGE commands, followed by SSPACE PRINTTEXT80. That will work, but there's an easier way (of course!)

Remember that if a procedure is to go from page to page, performing tasks as it goes along, all the necessary information must be contained in that procedure or its subprocedures. If a subprocedure is called from the procedure, it must be present on the page or somewhere in memory as a tool procedure.

The problem then is this: How can you get a list of pages, run through them in order, print each page and then move to the next page, all from just one procedure? In

addition, how can you eliminate the pages you don't want to print (e.g., the MESSAGES page, the PRINT page if you make it a separate page, the HELP page if you left that on the disk)? Think about the problem a bit before you read on!

I named my printing procedure PRT. Though short, it's a little complex because everything must be contained in this single procedure in order for it to move from page to page and continue running.

First, store the PAGELIST in the global variable, PAGES. Store the COUNT of the pages as HOWMANY.

```
NAME PAGELIST "PAGES
NAME COUNT :PAGES "HOWMANY
```

Next you need to repeat this process HOWMANY times to print all of the pages, but you want to check each page name **before** it is printed. If it's one you don't want, you want to eliminate it and move on to the next page. Which page are you concerned about each time? The FIRST of the list stored in PAGES.

Our REPEAT begins this way:

```
IF EQUAL? FIRST :PAGES "MESSAGES
[NAME BUTFIRST :PAGES "PAGES]
```

This eliminates printing the MESSAGES page.

I stored my printing procedure on another page, which meant I had to be sure that page was not printed as well. You don't *need* to do that and in fact it is better not to, but I also wanted to be sure that everything worked before I combined things:

```
IF EQUAL? FIRST :PAGES "PRINT
[NAME BUTFIRST :PAGES "PAGES]
```

Any other pages to be skipped need to be checked and eliminated in a similar fashion in this part of the PRT procedure.

One last check was necessary to eliminate an error message and is similar to the kind of stop rule needed in many recursive procedures. We know we are cutting out at least one page from the list of pages already counted. The list of pages will be empty before REPEAT :HOWMANY has finished. Here's what to say:

```
IF EQUAL? COUNT :PAGES 0 [STOP]
```

Now having passed all these tests on the first REPEAT :HOWMANY, my procedure needed to be told to get the page:

```
GETPAGE FIRST :PAGES
```


To make it easier to distribute messages later, I wanted to put the last name at the top of the page. The FIRST of the list in PAGES will be a last name, the name of the page, so the commands look like this:

```
TOP
PRINT FIRST :PAGES
PRINT []
```

Next, print!

```
SSPACE
PRINTTEXT80
```

I also needed to eliminate the page just printed from the list, so that the last part of REPEAT :HOWMANY reads:

```
NAME BUTFIRST :PAGES "PAGES
```

The REPEAT :HOWMANY line will continue until there are no more page names stored in PAGES.

I hope you have fun with this project too. Just remember, if you decide to try it at a Parents' Night, to be prepared to be swamped with people anxious to try it out. Have as many computers available as possible. Put signs on the computers to sort out the groups if necessary.

The MESSAGE CENTER procedures:

```
TO WRITE
GETNAME
GETMESSAGE
GETSIGNATURE
SAVEMESSAGE
END
```

```
TO GETNAME
CC
CT
TYPE [Please type the FIRST and LAST NAME of]
TYPE CHAR 13
TYPE [the person to receive this message.]
TYPE CHAR 13
TYPE [Press RETURN after the name.]
TYPE CHAR 13
NAME READLISTCC "NAME
END
```

```
TO GETMESSAGE
TYPE [Now type your message. DO NOT PRESS RETURN UNTIL YOU ARE FINISHED!]
TYPE CHAR 13
PRINT (SENTENCE "Dear WORD FIRST :NAME ", )
PRINT "
TAB
NAME READLIST "MESSAGE
END
```

```
TO GETSIGNATURE
TYPE [Now type your name (Ex: Mom or Dad) and press RETURN.]
```

```
TYPE CHAR 13
PRINT "
REPEAT 3 [TAB]
PRINT "Love,\
PRINT "
REPEAT 3 [TAB]
NAME READLIST "FROM
END

TO SAVEMESSAGE
CC
CT
IFELSE MEMBER? LAST :NAME PAGELIST
[GETPAGE LAST :NAME] [NEWPAGE NAMEPAGE LAST :NAME]
HT
BOTTOM
PRINT []
PRINT (SENTENCE "Dear WORD FIRST :NAME ", )
PRINT []
TAB PRINT :MESSAGE
PRINT []
REPEAT 3 [TAB]
INSERT "Love,
REPEAT 2 [PRINT []]
REPEAT 3 [TAB]
PRINT FIRST :FROM
PRINT []
REPEAT 3 [TAB]
PRINT [* * * * *]
CC
GETPAGE "MESSAGES
END
```

The Printing Procedure:

```
TO PRT
NAME PAGELIST "PAGES
NAME COUNT :PAGES "HOWMANY
REPEAT :HOWMANY
[IF EQUAL? FIRST :PAGES "MESSAGES
[NAME BUTFIRST :PAGES "PAGES]
IF EQUAL? FIRST :PAGES "MESSAGE.BU
[NAME BUTFIRST :PAGES "PAGES]
IF EQUAL? FIRST :PAGES "PRINT
[NAME BUTFIRST :PAGES "PAGES]
IF EQUAL? COUNT :PAGES 0 [STOP]
GETPAGE FIRST :PAGES
TOP
PRINT FIRST :PAGES
PRINT []
SSPACE
PRINTTEXT80
NAME BUTFIRST :PAGES "PAGES ]
END
```

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Stager's Stuff

A Microful of Monkeys by Gary Stager

At the 1987 West Coast Logo Conference Seymour Papert shared a discussion he had at Project Headlight at Boston's Hennigan School. Dr. Papert and his associates mused at how unfortunate it was that the kids go home at 3 PM and the computers sit around alone all night with nothing to do. Since computers can't play baseball or watch cartoons, it doesn't seem fair that the students have to do homework and the computers get to goof off. What kind of homework can we devise to keep our school microcomputers off the street?

One such idea suggested by Dr. Papert was based on the familiar tale, "if there were an infinite number of monkeys, sitting at an infinite number of typewriters - they would eventually type the complete works of Shakespeare." This hypothesis would be nearly impossible to prove due to the low probability of Shakespeare's work being recreated at random. In fact, two of the goals of the Logo project featured in this article are to explore probability and randomness.

Using a few simple Logo procedures we are able to create a laboratory for experimenting with word formation, probability, randomness, spelling, and vocabulary. Analytic pursuits like science and math become inseparable from language. We will use the scientific method for our journey into the world of linguistics, the science of language. In an NLXUAL Challenges article by Robs Muir the author convincingly articulates this idea:

What is science anyway?...Let me propose that science can be done in any part of the curriculum. Science isn't just a subject such as chemistry or physics; science is a method of inquiry that transcends curricular boundaries. It is just that we are unaccustomed to doing science in an English class. (Muir 1986)

In order to make our experimental data manageable we should severely restrict the goal of our experiment. Instead of waiting the centuries necessary to recreate Macbeth randomly, our goal will be for Logo to create the word "CAT" by random selection. Even the odds of creating the word "CAT" are 1 in 17,576 (26³). If it takes only one second to randomly create a three-letter word, it could take five hours or more for the word "CAT" to appear. That's a lot of homework for our poor micro!

Our Laboratory

This entire project will run in any version of Logo. (Replace INSERT with TYPE and in Apple or IBM Logo, replace EQUAL? with EQUALP.)

Experiment # 1

The CREATE.WORDS procedure is our monkey, the beaker in which we stir the elements in our experiment.

```
TO CREATE.WORDS :COUNT
MAKE "NEW.WORD
  (WORD LETTER LETTER LETTER)
IF EQUAL? :NEW.WORD "CAT
  [PRINT SENTENCE :NEW.WORD :COUNT
  STOP]
INSERT WORD :NEW.WORD CHAR 32
CREATE.WORDS :COUNT + 1
END

TO LETTER
OUTPUT PICK [A B C D E F G H I J K L
            M N O P Q R S T U V W X Y Z]
END

TO PICK :THING
OUTPUT ITEM
  (1 + RANDOM (COUNT :THING)) :THING
END
```

The procedure takes a numerical input, usually the number 1, creates a random word from our collection of elements (letters) and checks to see if the word created is the word "CAT." If the word created is "cat", the user is told how many tries it took to create "CAT" and the procedure stops. If "CAT" is not formed, the word that was created is printed and the experiment continues.

LETTER randomly outputs one of the letters contained in the list. The list in LETTER represents our experimental pool. The PICK procedure has been used in numerous other Logo projects and articles. As you may remember, PICK takes a word or list as input and randomly outputs an item in that word or list.

The Goal of Our Experiment

The goal of our experiment is relatively simple -- to make the CREATE.WORDS procedure "smarter." This means two things.

1. The word CAT will be created in fewer tries.
2. More of the other words, while still randomly generated, will look less like gibberish and more English or English-like.

Throughout the remainder of this article I will suggest ways to modify the rules for creating new words and improve the sample of letters Logo chooses from. We will begin with the simplest of rules and pool of letters and incrementally make our experiment more personal and sophisticated.

Experiment #1: Getting Started

In this experiment, students should be encouraged to record the number of random words created and the number of English words they find in the results. Experiment #1 creates some pretty strange looking words. What was the last time you saw a word beginning with QZ? I found that my students and I were constantly looking up words in the dictionary that appeared to be orthographically¹ plausible. In the process we were able to improve our vocabulary.

How can we avoid awkward combinations of letters? In my results from Experiment #1, Logo created 80 words and 2 of them were English words. 2 out of 80 represents 2.5% of all words generated were recognizable English words (coincidentally, men's names.) What was your experimental result? What was your class average? Were your results close to the class average? Why not graph the class results? How about a contest to see who can find the most real words in their sample of 1000 words?

Type CREATE.WORDS 1 to begin the experiment. In this experiment three-letter words are randomly assembled by randomly chosen letters of the alphabet. The following is a sample of the results I achieved.

Results of Experiment #1

CDS JSW YLC GDO DLI AZE IKC QNJ WNA PKC BOJ
 CEM ZEJ HJJ WMR WYI JUG EWB JOI ZOY IVW PVH
 SEZ FXR DHB BEF QZU AWW ORQ JSF AHD **DOM** LYU
 OOI ZSG NNI YLP OQI PBV MHM IEV RYO KKJ THH
 GUW UPX AQB MXI DLG BRE TMN YHT EWM BTN WAI
 AGR PNL RME SBZ POG PCC MCJ MLO QZQ AXI VCE
 VIV GLP OZL IDQ WGR VST MLB MEK **DON** MGW WDE
 BDE PZG CKR

NOTE: Due to space limitations I have taken some liberties with including the results of my experiments. The English words, including proper nouns, generated are in bold; commonly recognized initials are in bold and italicized; abbreviations are underlined. Where I had to truncate my experimental results I tacked on some more of the other "real" words which were created.

Experiment #2: Vanna Speaks:

The Wheel of Fortune Theory

While exploring this microworld with some fifth graders I asked, "How can we improve the quality ("Englishness") of the words created by the CREATE.WORDS procedure without getting rid of the infrequently used letters, such as Q, X, Z?" As a hint I asked, "How do you improve your chances of winning the lottery?" Some kids suggested that you would buy more tickets. We can increase our chances of generating better words without removing any other letters from our sample by adding what the kids called

the "Wheel of Fortune Letters" to the list in the LETTER procedure. I have added the Wheel of Fortune Letters (a e i o u l m n r s t) to the LETTER procedure in small letters so that we can observe how they are used in our new words. You may even wish to add two extra sets of vowels to the LETTER procedure. As you can see in the following example, approximately 9% of the words created in Experiment #2 were English words. Note how many proper nouns and common abbreviations appeared.

Modify the LETTER procedure as follows:

```
TO LETTER
OUTPUT PICK [ A B C D E F G H I J K L
             M N O P Q R S T U V W X Y Z
             a e i o u l m n r s t ]
END
```

Results of Experiment #2

mUi ssN orV PYm DnD aQl oYU VGO TTr lCU RYo
 laV Kol iYt CXT NSo ZUH **mOe** QYE EeT JtF **Nat**
 tLO lAF oPM riP NQa rDF BmA **MOQ** **oFF** MYn Cll
 QWW mZM iET EHJ Itl moa lLJ sZi JW's AE's Hom
 asm Rlo WnX Kln iis sON JiY GTs Krn ZrP oOV
 Qlt QiX Alr MQL eLl toF lAC sFi **MeG** AVS UUs
 AHI miP Wer oli DQe GiS AnH lBs RLH sKe mnV
 RLO ORC QFN FoM aPa nYi iYs ZYe UiQ DZa **Aaa**
 oae rUA **Alt** Rws **ReP** rXJ iZV oer FHi ZtF **nET**
 OoA oVN ELs APS **One** WoQ FLn MBB enS CXW Hrt
 HBL **LOG** mDn eSH aHT onT Mie PCD lrs **IBM** iTi
 iZG **err** PsA iMa CGV INA DQn BKe **rUN** mmo LZz
 YnD HGa imL ota **BeV** aVK omp rLA JHo mWZ ...
 miD **MAI** *oas Doa sat nOt siD YAM ten neO saP AIM GoV DIV*
 ReV ...

Throughout this activity our "junior linguists" or "word scientists" should be encouraged to experiment, take risks, explore, and make hypotheses. My hypothesis is that we can create many more "good" words by imposing the rule that the three-letter words be assembled in consonant-vowel-consonant format. My hunch wasn't bad. The percentage of English words created in proportion to the number of words generated has risen to 16%.

Seymour Papert heard chuckles from the conference audience when he recounted the story of how he and some students at Project Headlight were waiting for the word "CAT" to be created and suddenly the word "DOG" appeared. Dr. Papert said that everyone watching the computer sighed a breath of relief because they felt as if they were getting closer. In my experiment (below) the word "DOG" also appeared. While it's impossible to count on "DOG" being generated, it is fascinating to ask students the question, "If DOG was the next word created would we be any closer to CAT being created?" The discussion that will undoubtedly follow will challenge the students' understanding of

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their own thinking processes and may even lead to a discussion of such superstitions as, a "lucky day", or "I'm on a roll."

Experiment #3

Change the following line in CREATE.WORDS:

```
MAKE "NEW.WORD
      (WORD LETTER LETTER LETTER)
```

to:

```
MAKE "NEW.WORD
      (WORD CONSONANT VOWEL CONSONANT)
```

Add the following two procedures:

```
TO VOWEL
  OUTPUT PICK [A E I O U]
END
```

```
TO CONSONANT
  OUTPUT PICK [B C D F G H J K L M N P
              Q R S T V W X Y Z]
END
```

and type CREATE.WORDS 1

Results of Experiment #3

```
TUK QEH CAC HEN DOD QEX FEC NIM LIS
QOW YAR HOL KAF HUT PIZ CIY BOG YIM LUN BOC
NEN PEV GUD GAS RUQ JID QIH DEK REL FIQ DID
CAK LAP WIM MEX QUT LEH COH HUB VOL MEM VEB
REW BEY BUG KIG PIF DOG KAV ZEW SOR QUB LAW
NEB KIK RIH SOJ QUR TIG ZOM GOF DUR HEV RUZ
KOY BON XUX ZUB WEK DAM XUP WUZ WAC NIM XIX
LOH ZIC TAN MIB VEX YID QEN JAC LOS FUC WOY
ZUN FEQ JAC RAX CEX HUS WIV SOS XOT XOM GOX
YUP HOF DIV DOH LOS MAR SAC PEC LAQ DEL ROX
DAG BES DAF QIP BOR BEK WIR TUC FOH MIN KUQ
LUD QIR YUQ JOP NUR POG KIR SEY ROB ZIK
TUT YIZ TEN PUZ GUS JEF KIB GEY FOX ... GAP TIN
HEN HON SAT PAM DIM PIT MIT RAG JON TOM FAD ROM FAN POW
VAT GEL VOW PAC DAN KIM MAD WIN TAD JIM RUG RIG CAP RAY
GOT DAB HIT NAY PEN HUB FOB FIT GUN DIP MEN SUB DOM BUN
LAG FUR BUY PUD DAY PIN DAN GUM GAS DIG TAP BIC TED LET
MOM YEN RIP SIP PAT HOT YES COW BIG MAY HEP SAD WAS JON
TOM FAD ROM FAN POW JAY
```

Experiment #4: A Bridge Between Language and Mathematics

In Experiment #4 we will substantially reduce our letter pool so that we can shift our focus from orthography, spelling, and vocabulary to averages, probability, and combinatorics. We will once again use the same CREATE.WORDS procedure as we did in Experiments #1-3. This time however, our pool of letters in LETTER will be restricted to [C A T].

```
TO LETTER
  OUTPUT PICK [ C A T ]
END
```

Type REPEAT 1000 [CREATE.WORDS 1 PRINT []] to observe how our data behaves since the pool of letters has been reduced. Notice the range of experimental results which appear - from 2 tries to 91.

Results of Experiment #4

```
TTC TTC ATA ACC ACT TTT AAA TCA AAA TCT TCT
AAA TTT TTC TAC CCT CCC TTC TTT ACT TAT CCT
ACT ATA TTA ACC ACA TAA CCA CAT 30
TAA CAT 2
CTC CAT 2
CCC AAA TAC ATA AAA CTC ACT CTC ATA AAT ACC
CCC AAA TCT ATT CAA CAT 17
TCA CAC ACA CTA ATC CTC CAC CAA CTC CCC ATC
AAT AAC CTT TAC TAA TTA CCA ACC ATT TCC TCA
CCA CCA ATC CAA AAC AAT CCC AAA TAA TAC AAC
AAA ATT CTA TTC AAT AAT CTT CAC AAA CCT CAC
CCA AAA AAC CCA CCT CTT CTT ATT CCA CAA AAC
TCC TCA CTA CTC CTT ACA ATC ACA CAC ACT ACT
TAA CTA TCT ACT TCT ACC CTA ACC CTA TTA TCA
ATC AAA TAT TAC TAT TCA AAA ACT TAT TAC TCC
TTA TTA CAT 91...
```

Collecting and Analyzing Data

Given a set of three letters, [C A T], how many possible permutations of these letters are possible? Mathematics teaches us that there are $3 \times 3 \times 3$ or 27 possible unique combinations of the three letters. If you are like me and don't trust mathematicians you can use Logo to find out how many actual possibilities there are. Too often mathematics and mathematicians ask how many words can be created rather than show what those words actually are. By teaching Logo to add each newly created word to a list, we can count the number of possibilities and study what those words are by allowing the CREATE.WORDS procedure to run for a significant period of time. Eventually, three letters have to be assembled in every possible way.

Let's use Logo to help us collect and interpret the results of our experiment.

Change the CREATE.WORDS procedure to:

```
TO CREATE.WORDS :COUNT
  MAKE "NEW.WORD
    (WORD LETTER LETTER LETTER)
  IF NOT MEMBER?
    :NEW.WORD :POSSIBLE.WORDS
  [MAKE "POSSIBLE.WORDS
    LPUT :NEW.WORD :POSSIBLE.WORDS]
```

```
IF EQUAL? :NEW.WORD "CAT
  [PRINT SENTENCE
   :NEW.WORD :COUNT STOP]
INSERT WORD :NEW.WORD CHAR 32
CREATE.WORDS :COUNT + 1
END
```

Add the following new superprocedure:

```
TO POSSIBLE
MAKE "POSSIBLE.WORDS [ ]
CREATE.WORDS 1
END
```

1. Type POSSIBLE to begin.
2. After a minute or two stop the procedure with your equivalent of CTRL-G or ⌘-S.
3. Type SHOW :POSSIBLE.WORDS to see the words that can be possibly created by CREATE.WORDS.
4. Type SHOW COUNT :POSSIBLE.WORDS to see how many possible combinations of words created by our experiment. Did Logo tell you that there are 27 possible permutations?

Suggestions for Further Inquires

1. Run one of the experiments (or your own) over night and dump the created words to a dribble file or printer.
2. To save time, paper, and disk space modify the CREATE.WORDS procedure so that the randomly created words are not printed. All the procedure needs to do is record how many trials were necessary for "CAT" (or your word) to be generated:

```
TO START.EXPERIMENT
MAKE "TRIALS [ ]
REPEAT 9999 [ CREATE.WORDS 1 ]
END
```

```
TO CREATE.WORDS :COUNT
MAKE "NEW.WORD
(WORD LETTER LETTER LETTER)
IF EQUAL? :NEW.WORD "CAT
  [ MAKE "TRIALS
    LPUT :COUNT :TRIALS STOP ]
CREATE.WORDS :COUNT + 1
END
```

```
TO AVERAGE :LIST
OUTPUT (SUM :LIST 0) / (COUNT :LIST)
END
```

```
TO SUM :LIST :TOTAL
IF EMPTY? :LIST [OUTPUT :TOTAL ]
OUTPUT SUM (BUTFIRST :LIST)
(:TOTAL + FIRST :LIST)
END
```

The following line will display the average number of trials necessary to generate "CAT":

```
SHOW AVERAGE :TRIALS
```

3. Change the rules for creating words by making the CREATE.WORDS procedure "smarter" so that letters can not be used twice in a word or awkward combinations of letters don't occur.
4. Modify the CREATE.WORDS procedure to generate words with more than three letters.
5. Graph the number of trials or the ratio of English words to words created.

Send me examples of how you and your students modified these experiments.

Footnote

¹ Orthography is the term used to describe how a word is spelled. By looking at a word's spelling we are often able to determine if the word is a "real" word. Every language has distinctive rules of orthography.

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The Emerald Isle Shines Again

The 1988 International Computer Problem Solving Contest Elementary Logo Results by Donald T. Piele

In 1986, an Elementary Logo Division was added to the International Computer Problem Solving Contest (ICPSC). Last year, we expanded the Logo contest to include the same three age groups used in the Open Division: Elementary (grades 4-6), Junior (grades 7-9) and Senior (grades 10-12). On the last Saturday in April, teams gather at local contest sites and attempt to solve five problems in two hours using Logo. This year an estimated 1,000 students from the United States and a few foreign countries participated in the Logo Division. This month, the results of the Elementary Logo Division are presented. The problems from last spring's contest will appear in next month's *LX*. The Junior and Elementary divisions will be presented in coming months.

Elementary Division Winners (Logo)

One of the great pleasures associated with the International Computer Problem Solving Contest is researching background information about the winning teams. Each year, I ask the top team's contest director or advisor to send me information that I can use when I write about the results for publication. The stuff I get is fascinating. I am amazed how often the winning team is made up of students who *don't* spend all of their waking hours in front of a computer. Most have a wide range of interests outside the world of computing. No one, in recent memory, typifies this breadth of interest better than this year's winning team in the Elementary Logo Division. Her name is Anne Chazarreta, age 12, from Scoil an Spioraid Naoimh School, Bishopstown, Cork, Ireland. Yes, the winning team consisted of only one girl! And it is the second year in a row that an Irish team took top honors.

Instead of piecing together a story about Anne, I would like to share with you the full letter I received from Michael D. Moynihan, Chairman of the Computer Education Society of Ireland. He writes,

There was great excitement in Scoil an Spioraid Naoimh when it was learned that Anne Chazarreta was ranked first in the world in the 1988 International Computer Problem Solving Contest (Elementary Logo Division). This prestigious contest is organized annually by the University of Wisconsin-Parkside and is open to children of the same age group all over the world. Anne is the first

person from Cork to win. Indeed it is worth noting that for the second year running an Irish child has won (John Farragher from Limerick was the 1987 winner).

Anne is the only child of Jose and Philomena Chazarreta of Woodbrook, Bishopstown. Her parents are justly proud of her achievement. Her school Principal, Mrs Joan Toomey and class teacher Mrs Mary Fleming are equally proud of the honour that her achievement bestows on the school. Mrs Fleming describes Anne as a gentle unassuming person who is most co-operative in school and achieves a lot in her own quiet way. She is also a perfectionist with an excellent logical mind.

For the past few years experimental courses in LOGO for mathematically talented children have been conducted at various centers throughout Ireland. These courses are co-ordinated by Dr. Sean Close, Mathematics Department, St. Patrick's College of Education, Drumcondra, Dublin. The Cork center is at Colaiste an Spioraid Naoimh, Bishopstown and is directed by Declan Donovan and myself. Anne was one of our students.

Throughout the twenty week course Anne proved herself to be one of the more able students and quickly came to grips with Logo and displayed problem solving skills which amazed even her tutors. In April, she was ready to enter the ICPSC at the Cork site sponsored by the Computer Education Society of Ireland (CESI). Anne solved all five problems in one and a half hours and spent the remaining time testing her solutions. We knew that she had solved them all correctly, but we did not expect to be so highly ranked.

Anne's other main interests are music and reading. She has been learning to play the piano for four years and also likes to play the guitar. She also was a member of the Irish National Children's Choir in 1987. Anne enjoys reading the classics and was recently taken by Joan Lingard's novels about the Northern Ireland situation and the Protestant vs. Catholic clashes. An all-rounder, in April Anne was presented a special award by the Lord Mayor of Cork for an essay on her environment. She has had her own computer (a BBC Micro) at home since Christmas 1986.

Anne is in her final few months in Primary school. In September, she commences her Second