THE ROLE OF MICROCOMPUTERS IN EXPERIMENTAL PARAPSYCHOLOGY

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For almost thirty years, sporadic interest has been shown in the use of digital computers in parapsychology, mainly for their potential in implementing fully automated experiments. For the most part, the computers in question were large, costly machines of limited availability; moreover, they were not designed for ease of use. Thus their utilization in experimental parapsychology was far from a routine matter. Even when the size and cost of computing equipment was significantly reduced and minicomputers began finding their way into laboratories, including a few parapsychology laboratories, these basic limitations persisted. Despite some rather interesting work that was done, as described by Richard Broughton,[2] parapsychologists generally lacked ready access to computer equipment or the expertise to use it effectively.

This situation began to change somewhat, starting about a dozen years ago, with the availability of tiny inexpensive microprocessor chips that could be housed in experimental equipment. The potential value of such devices in parapsychological investigations has been demonstrated by the pioneering work of Helmut Schmidt. By using such microprocessor chips, Schmidt developed self-contained, secure units capable of generating truly random numbers and of recording data automatically.[9,10] Moreover, he has shown how to use this equipment in wonderfully clever ways. Using these tools Schmidt has gone far beyond simple psi testing and has boldly raised new conceptual issues: consider, for example, his early work with prerecorded targets[11] and subsequent attempts to develop empirical tests of observational theories.[1] These Schmidt machines have also been used to address some of the fundamental issues related to scientific acceptance of parapsychology: e.g., they have been used to assess the role of experimenters in eliciting psi (as in the experiment[8] that gave birth to the "Edinburgh split"); and they are a central feature in one plan for a direct assault on the problem of repeatability, involving the development of fully portable experiments.[12] Furthermore, Schmidt has dealt in part with the problem of availability of computers by literally placing his boxes in the hands of parapsychologists.

However, despite the tantalizing possibilities arising from the use of special microprocessor devices, there are certain limitations inherent in this approach. For one thing, the microprocessors used in such Schmidt machines are set up to perform a single task and, by design, are not accessible to the user. Thus, in at least one sense, parapsychologists have limited access to this equipment as well. In any case, there is a fundamental lack of flexibility built in that has disadvantages which should become more clear as our story unfolds.

The world of computing has changed dramatically within the past five years with the advent of low-cost, powerful microcomputers that are versatile and easy to use. The potential value of such small, accessible computers for experimental parapsychology is, for me, simply staggering. In what follows, an attempt will be made to delineate some of the specific ways in which these friendly micros can be of service in the parapsychology laboratory.

Actually, the uses of microcomputers in parapsychology are so varied that any serious attempt at classification would soon grow tedious. Rather than risk terminal bordom by sketching a moderately comprehensive list of possibilities, I will try to provide an assortment of specific examples suggested by my own limited experience in this field. One obvious way in which microcomputers can be of value in experimental work in any scientific area is in extending the range of experiments that can be performed. This will be an implicit theme in much of what follows even when not expressly stated; hopefully, the examples will speak for themselves.

As will become evident, microcomputers can serve parapsychology as powerful tools in a variety of rather different roles. Some of these roles are familiar to most of us and have been discussed at length in the past; I will try not to repeat what has been said better elsewhere—or at least not dwell on it. In particular, I will try to provide some fresh examples, along with a few old favorites that I find especially exciting. There is also one old chestnut that should be dealt with as soon as possible.

Perhaps the most obvious role of the computer in parapsychological research is in establishing various forms of security. It is certainly the case that microcomputers can be used effectively in helping to ensure what might be termed methodological security. That is, they can be invaluable in guarding against sensory leakage, in providing automatic data recording, in minimizing manual handling of data prior to analysis, and so on. To some extent, computers can also be useful in attempts to establish a more absolute form of security; e.g., security against deliberate deception by subjects, outright experimenter fraud, or even selective reporting of results. But there definitely seem to be practical

limitations as to what can be accomplished here; I see no prospect for computers providing the key to designing an absolutely "foolproof" experiment. The search for such an experiment is probably a futile endeavor; it is, moreover, an endeavor that appears to misconstrue the basic tenets of the scientific method. In any case, in terms of the present discussion, it certainly misses the mark; the most significant potential applications of microcomputers in parapsychology have little to do with absolute security—as we shall see.

Apart from their role as Security Guards, how else can microcomputers be useful in parapsychology? Well, for one thing there are situations that simply cry out for the availability of a computer, where the experiment would be barely feasible if not outright impossible without a computer to assist in the collection and analysis of data. An excellent illustration of just such a situation was provided by Richard Broughton[2] in the first study he described: for each of more than fifty subjects in that experiment, hundreds of precisely timed tones were presented and hundreds of response times taken, measured in milliseconds. This simply could not have been carried out without computer assistance. Similar examples can be found in other parapsychological work involving the monitoring of physiological functions; the sheer mass of data as well as the possibility of administering precisely controlled stimuli make the use of a computer highly desirable.

Actually, once a computer is interfaced with physiological monitoring devices, a whole range of new possibilities suggest themselves. For example, the computer can be programmed so that psi trials are conducted only when specified physiological conditions are met; or comparisons can be made between performance on a psi task during periods when physiological conditions were met and when they were not met. This last approach can be used to test the effectivenss of potentially psi-conducive states, such as relaxation. E.g., do people generally perform better on psi tasks when in a relaxed state and if so for what types of tasks is this the case?

Another example is provided by some of the work of Honorton and Tremmel[6] relating psi to volitional control in a biofeedback task. Here the behavior of a hidden random event generator (REG) was examined during periods when a subject was attempting to influence his production of alpha waves; the output of the REG deviated significantly from chance on those trials when the subject was successful in influencing his EEG, but not on other trials. Actually, this particular experiment did not make use of a microcomputer and results on the REG were observed and recorded by an experimenter who was aware at all times of the subject's EEG performance. Thus, in trying to interpret these results, some at-

tempt should be made to assess the role of an actively involved experimenter. One way to do this would be to repeat the experiment under conditions in which the experimenter played a far less active role; indeed it is possible for the experimental sessions to be run under microcomputer control in the virtual absence of the experimenter. Plans for such a computerized replication are being developed by Honorton and Varvoglis. Another experiment of a somewhat similar nature, performed by Varvoglis and myself,[16] involved (among other things) comparison of a psi task and a biofeedback task. Here the subject received computer-controlled visual feedback representing the degree of success in influencing either their brainwaves or a random generator, with both experimenter and subject remaining blind as to the true source of the feedback at any given time; only the computer knew.

These last examples suggest another class of experiments in which the computer plays an undeniably central role; namely, those in which the entire experimental session is completely controlled by the computer. There are various purposes that are served by such computer-controlled experimental procedures, quite apart from the methodological security they afford. As indicated above, there are situations in which it is important that the experimenter remain blind as to the momentary outcome or even the phase of the experiment actually in progress at any given time; indeed, situations arise in which it is important that everyone connected with the experiment remain equally in the dark, so that traditional means of sharing awareness and responsibility among several co-investigators are inadequate. In a different vein, as Richard Broughton illustrated so well, computer-controlled procedures can be employed to humanize experiments by relieving the experimenter of other obligations, leaving him free to attend to the psychological needs of the subject. Such procedures can also be used, of course, to minimize the role of the experimenter altogether—or to test it.

Yet another reason for designing computer-controlled experimental procedures arises from an attempt to develop self-contained, portable and (hopefully) repeatable experiments. A self-contained experiment of this sort would be completely embodied in a software package which could then be distributed on magnetic media (e.g., floppy disks) to a team of investigators. Each member of the team would thus be able to conduct precisely the same experiment, under virtually the same experimental conditions. This idea is similar in many respects to Schmidt's proposal for dealing with the problem of replication, but one important difference is that instead of distributing hardware (physical devices that perform a single experimental task) here we distribute packages of software (computer programs that can be executed by a multipurpose mi-

crocomputer). The key difference is one of flexibility; the extent and importance of this flexibility will be elaborated on in what follows. In any case, it seems hard to overestimate the importance of such an automated approach in tackling the problem of replicability; this alone would provide powerful justification for the development of self-contained computer-controlled experiments. Of course, these experiments would have to be good ones, ones that obtained reliable results; I'll have more to say on this subsequently. Another major requirement for such computer-controlled experiments is that they really be portable; this demands that a team of experimenters have compatible computer equipment, preferably equipment that is readily available to most parapsychology laboratories. Just how feasible is this?

Actually, this is the area in which microcomputers demonstrate their real strength; not only are they inexpensive, but the more suitable systems (such as the Apple II—for which I may at times appear to be doing commercial advertising) are sufficiently flexible and well-supported by software that their cost is abundantly justified by the many different laboratory functions they can fulfill.

There are standard software packages available for the Apple computer, for example, that can perform interactive data base management. Ultimately, this can be invaluable in surveying the research literature; the catch, of course, is that first someone has to survey the current literature in order to set up the data base. Lest this prospect seem empty or circular, just think for a moment of the advantages of having the results of a literature survey available on a microcomputer data base. For one thing, this way of storing information is very flexible; new results can be added as they appear. Here is a literature survey that need never be outdated; it grows without growing old; it matures. Moreover, information in such a data base is far more readily accessible than when published in any journal; the data base can be searched automatically to reveal all items which satisfy a specified set of conditions. It took me a while to realize the full significance of this capability (perhaps I haven't yet), but I finally began to get the message when a certain parapsychologist who shall go nameless (his laboratory is located in Princeton) took me by the arm and showed me how he could manipulate his new data base for the Ganzfeld literature. "Let's have all the studies involving unselected subjects with a duration time of at least 20 minutes that yielded a p-value of less than .05 on the main effect," he said, punching a few buttons. And there they were, displayed on the screen. Hitting a few more keys let us examine whatever else these experiments had in common. And at this point I finally began to see why he had been so insistent on the ultimate promise of such interactive data bases of para-

psychology. They can be used to help sharpen hypotheses; to help identify antecedent conditions necessary for obtaining an effect; to help decide just what experiments should be done. In short, they can provide invaluable assistance in pursuing a scientific approach with maximal effectiveness.

I have no doubt that the prototypical parapsychological investigator of the future will make extensive use of such data bases. I also believe that he will access these data bases using a microcomputer and that this same computer will be used in a multitude of ways in the routine conduct of research. Stretch your imagination a bit and see if you find this future scenario plausible. Our parapsychologist protagonist has just completed the design of a new incisive experiment, after having his sensibilities heightened by a long series of sessions with his data base management package. Naturally, he has designed a brilliant computer-controlled experiment which, after several long months of programming and debugging, actually works. He now performs a preliminary check on his random generator, by having the computer generate and test one million control trials at night, wile he sleeps. Then after collecting some preliminary experimental data (which, incidentally, took twice as long as he had anticipated) he is ready to perform an extensive series of statistical analyses. But this part is easy, since he designed the study to interface smoothly with the standard super-duper statistical packages available for his microcomputer. He also examines the data graphically, using an excellent scientific plotting package. After scrutinizing the results and making a few modifications, his self-contained experiment is now ready to roll. When the work is completed, he will use the computer to prepare the final paper describing the results; by loading in a terrific word-processing package he finds that this takes only half as long as anticipated. (Naturally he uses the extra time to improve his typing skills via a handy tutorial program available for his computer that provides practice drills tailored to the keys he is found to be weak on.) Over the weekend he plays with next year's budget and draws up several tentative grant proposals using the powerful business-oriented software packages that make it almost fun. When he tires of this, he loads some arcade games into the computer for a little well-earned recreation.

That's the scenario. I don't know how plausible it seems to you, but the most implausible thing about it for me is that it's set in the future. The capabilities for doing all these things are available NOW; indeed, a few parapsychologists are doing them now. Lord knows what they will be doing five years from now!

Perhaps at this point it is worth reiterating my contention that the most significant applications of microcomputers in parapsychology have

little to do with a search for absolute security and foolproof experiments. The examples presented thus far should make it abundantly clear that microcomputers can offer a great deal beyond the role of Security Guard. Still, it should be realized that in many ways we have barely scratched the surface. There is simply a tremendous variety of easy-to-use software packages currently available (at least for the Apple computer). These software packages greatly enhance the power of the basic machine and in some cases have immediate impact for research in parapsychology. An entirely analogous situation exists in terms of hardware devices. Ready-to-use, off-the-shelf peripheral equipment is available for the Apple II system, for example, that will serve a variety of laboratory needs. A few illustrations should suffice to indicate the considerable potential for parapsychological research.

For example, equipment is currently available, in a device called a micromodem, that connects computers to standard telephone lines, thus making it possible for microcomputers to communicate readily with one another and with larger computers as well. This makes it easy for independent investigators to share information contained in a common data base, or to participate in joint computer-oriented research. An excellent example of this last is provided by the possibility of doing some simple distance studies. Using micromodems, which have automatic telephone answering capabilities, it is not difficult to design an experiment in which the same psi task can be presented to a subject by the microcomputer in the next room or by a sister micro across the country, with there being no discernible difference in the outward appearance of the task to either the subject or the experimenter. Thus it becomes easy to conduct long-distance PK experiments[14] in which psychological inhibitions related to the perceived difficulty of the long-range task are eliminated, since the subject need never know that long distances were involved and the experimenter can remain blind as to whether indeed they were in any given session.

There are numerous other ways in which special equipment can be of significant value, often in enhancing things that can be done otherwise; but sometimes a little extra means a lot. As indicated earlier, computer-controlled experiments designed to be portable really should be good ones, capable of producing results with a high degree of reliability. Thus every effort must be made to create experiments which are as "psi conducive" as possible. There are many approaches that can be taken to enhance the effectiveness of an experimental procedure. One technique is to attempt to incorporate ingredients which will favorably influence the subject; that is, which will serve to induce the kinds of physical and mental states that have appeared to be psi-conducive in other studies.

Another technique[13] is to attempt to develop a particularly effective set of target materials or an especially attractive task. In both of these approaches it is possible to capitalize on the lovely color graphics capabilities of small computers such as the Apple. These can be used in developing graphics displays that are interesting and pleasant to watch; sometimes they are engrossing, even hypnotic. These can be used as rewards for successful performance in psi tasks, as well as in induction techniques and target materials.

The capabilities for graphic display can be augmented considerably by interfacing the computer with video equipment; several different sorts of peripheral devices for doing this are presently available. Charles Honorton has begun some work along these lines that seems worth describing. One item he has used is a digitizer that enables the computer to store digital versions of images supplied by a simple video camera that plugs into the computer. This makes it very easy to create personalized target materials for use in computer-controlled psi tasks; for example, a target pool could include one or more digitized pictures of the subject or of people (or objects) meaningful to him. A better illustration of the effective use of such personalized targets is provided by the following task: the subject is shown a 5 by 5 grid on the video screen, and is informed that his personalized target is hiding behind one of the squares in the grid. A partial hit (selecting the proper row or column) will produce a colorful and musical display; a direct hit will also result in the display of the digitized target picture—he has found it!Subject response to this simple task has been very enthusiastic. Personal digitized pictures may also prove quite effective when used with sender/receiver pairs in telepathy protocols. For example, a digitized picture of the receiver can be periodically shown to the sender on a video screen used to display the target material to be "transmitted." Or, more interestingly, pictures of both sender and receiver can be used as part of a mutual induction procedure in which sender and receiver view the same displays on separate video screens. The digitized pictures of both participants can be displayed alternately with increasing frequency and, ultimately, can convey the impression of merging into a single entity. This could be incorporated into a larger induction procedure involving simultaneous viewing, by sender and receiver, of relaxation instructions and suggestions to "merge," accompanied by computer-generated graphics displays designed to provide commonality of experience and produce a relaxed, receptive state. Work is in progress on an induction procedure of this latter sort to be used in conjunction with target materials presented on videotape. Standard peripheral devices now exist which can bring videotape equipment under microcomputer control. This opens the door

to a lot of exciting possibilities for vivid target materials, including some with powerful emotional impact. (Perhaps someone out there would be interested in having the computer monitor the autonomic responses of a receiver during periods when the sender was viewing several videotape segments ranging from soothing nature scenes to a violent assassination attempt. Then again, perhaps not.) In any case, once adequate experience has been gained with the effectiveness of various sorts of videotape segments as targets, it will be possible to develop a standard target pool of such segments which can be randomly accessed by the computer. This could be a highly important component in an effective portable experiment.

Another approach to the search for portable computer-controlled experiments involves the development of a battery of psi games.[4,5,7] This approach has much to recommend it. The tasks themselves can be novel, interesting and thoroughly absorbing; and they can be administered in a pleasant, relaxed atmosphere free of the constraints of mundane reality. Presumably this in itself should contribute to the desired goal of creating a psi-conducive experimental situation, but there are additional reasons for pursuing such an approach. For example, in 1980 the Atari company, manufacturers of arcade games, conducted a market research survey which showed that 86 percent of the U.S. population between the ages of 13 and 20 had played some type of video arcade game and it was estimated that Americans were spending $2.5 billion a year on such games—mostly in quarters.[15] That's a lot of quarters. For reasons that will become clear, this reminds me of some remarks that Robert Morris made a few years ago in commenting on the possible advantages of using successful college athletes as subjects in psi experiments, especially in training programs attempting to develop psi abilities. His point was that, as a group, such athletes were accustomed to spending long hours in developing their special abilities and engaging successfully in competition had provided them with confidence and a certain emotional equilibrium; negative feedback resulting from temporary failure did not overwhelm them, nor were they thrown off balance by the positive feedback associated with strong momentary success. He argued that it was just this sort of discipline and emotional equilibrium that seems important in developing consistent psi performance. This makes a good deal of sense and it appears to me that, in addition to successful athletes, there is another natural source of potentially good psi subjects with similar traits; namely, arcade game buffs. There must be a lot of them out there; somebody is spending all those quarters. It would be well worth developing some challenging psi-games designed to appeal to this audience.

Naturally, arcade-type games will not have the same appeal for everyone; so it is important to develop a wide variety of game-like psi tasks. Indeed, it is desirable to have a battery of tasks available, even for use with a single individual. There are several reasons for this, the most obvious being the desire for novelty of task to avoid a decline in performance attributable to boredom. Another rationale for having a variety of tasks available was recently provided by Diana Robinson,[8] who offers an interesting line of argument indicating that in order to obtain subject motivation without a psi-inhibitory arousal, it may be wise to contribute to the subjects' sense of perceived control and autonomy by providing them with an element of choice in experimental tasks. She plans to investigate whether offering such an element of choice is indeed psi-conducive. Perhaps something of this sort can be done using a battery of psi games, since the same underlying psi task (from the viewpoint of the computer) may be presented to subjects in many different forms. Thus, subjects can be offered an apparent choice while the experimenter still maintains a direct basis for comparison of performance. This capability for presenting the same underlying task in many guises may also be helpful in taking a closer look at the infamous Decline Effect, by attempting to investigate the extent to which a decline in psi performance may be attributable to various factors such as some sort of "psi-fatigue," or to boredom and loss of attention, or perhaps to habituation resulting in a different mode of mental processing.

Yet another reason for having available a wide variety of computer-controlled psi-tasks, game-like or not, involves the long-term development of a data base that would contain information on the performance of a large number of subjects in an assortment of psi tasks, along with contemporaneous information on moods, personality traits and whatever else can be obtained in an inoffensive and unobtrusive manner as part of an overall interaction of subjects with the computer. Perhaps, ultimately, a number of profiles can be constructed from this data base that could be used in instructing the computer to administer certain types of tasks to subjects displaying certain characteristics under certain circumstances. If such an approach were even moderately successful, it could provide a powerful technique for psi-optimization as well as affording potential insight into the phenomena. Thus it certainly seems worth a try. Clearly, the development of such a large scale data base is a major project and would probably require the continuing cooperative efforts of several laboratories gathering such data as a matter of course during all their computer-administered experiments.

This last idea is certainly in the realm of speculation, but it does suggest that widespread use of microcomputers might be instrumental

in helping to establish circumstances under which teams of independent investigators regularly worked together in pursuing a systematic program of research. That in itself would be a significant contribution to the development of parapsychology as a main-stream science. If one reads between the lines in the examples that have been paraded by, it should be clear that there are ways in which microcomputers can be used in mounting fresh assaults on virtually all the major problems in the field. Whether or not such computer-related approaches are ultimately successful in making progress on these formidable obstacles, the fact remains that important issues can now be addressed directly in new ways. This alone makes the microcomputer an essential methodological tool for the contemporary parapsychology laboratory.

I hope that my enthusiasm has not colored my remarks with the brush of a crusader or an evangelist. There is no need for me to preach to parapsychologists of a coming microcomputer revolution; indeed, there is even no need for such a revolution; it has already occurred! Microcomputers are here now and are gaining increasing public attention in the mass media—and parapsychologists seem to be a bit ahead of the masses. One might suppose that the way things are going we won't have long to wait before the first software package of microcomputer psi tasks is available; indeed, it has already been out for months!It was developed for the Apple computer by Gary Heseltine and his associates at SURF and was available in February, 1981. This software package was designed to be used with a hardware device: an electronic random generator which plugs into the Apple. Such an REG device has been available since early 1981 from Dick Bierman of the Research Institute for Psi Phenomena and Physics, who now also offers a package of statistical programs especially designed for the needs of parapsychologists (that is, parapsychologists with Apple computers). At some point soon, another REG board for the Apple, designed by Edwin May, will be available from Chuck Honorton at the Psychophysical Research Laboratories, where plans are also afoot for the development of a software package of psi games.

Thus things are already starting to happen; indeed, have been happening for awhile. A quick scan of the papers and research briefs presented at the Parapsychological Association convention held in 1981 at Syracuse University, revealed that 16 percent of the results being reported involved explicit use of small computers. (Actually, the percentage is quite a bit higher if we restrict attention to papers and briefs presenting new experimental work.) I expect that this proportion will increase sharply in the next few years. A workshop was also held at the Syracuse meeting during which the Psi Apple Users Group was born; it is currently being nursed by Richard Broughton at FRNM. More than

a few parapsychologists now have Apple computers; that number should increase dramatically. No parapsychology lab should be without one, or two . . . or more.

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DISCUSSION

STANFORD: One facet of computers in psi research that is, I think, implicit in the two papers on computers that we have heard here, but hasn't really been focused on, is the matter of putting the raw data from all of our experiments into some kind of computer-accessible form.

There are many occasions on which some of us develop hypotheses that don't require us to set up a new experiment and test eighty subjects to get the data. The answer may be right there in dozens of old experiments. It is particularly interesting because if the data are in old experiments, where the experimenters didn't have our hypotheses, it is at least conceivable that there might be less chance of an experimenter effect. Of particular attraction for me are the hypnosis experiments of which there are perhaps two dozen in the literature. Most of them used forced-choice tasks. We could find out whether there are clear decreases in the patterning of the responses, fewer rational and/or sequential constraints when a person is under hypnosis than when this is not the case. All that information would be available very quickly if we had access to that kind of data base. J.B. Rhine talked all the time about going back into old data to find traces of psi. We don't have the capacity to do this yet, but I hope it might be developed in the near future.

I say a loud mental amen to Richard Broughton's remark that when we're doing work on computers, we mustn't forget about the importance of carefully planning our experiments. I'm willing to add a couple of other caveats to that. While I'm all for computers and very much wish I had one, I would suggest that our selection of problems for research should not depend upon the availability of a computer. If we find a good research problem, even if it's not immediately amenable to the computerized approach, I don't think we ought to ignore that problem. The developments within the field ought to tell us which problems to study, not what computer programs are convenient or even whether the study might or might not easily be computerized. Now a word about the tendency to use programs because they are readily available. It's true that we need replication, but let's not start to run in the same kind of methodological ruts that we sometimes did, I think, back in the past. Those are basically the warnings that I wanted to express. I think most of the computer people will readily agree.

McCARTHY: Sounds pretty good to me. I have one comment about storing the raw data from experiments. To some extent this might be better done on a larger computer. It might be good to have such a base of raw data residing in a central facility just so long as there were opportunities provided for ready access of that data base from remote locations. This is possible with the existing equipment.

BROUGHTON: It would be rather difficult to get large amounts of data into the microcomputers, but they could be teamed up with a central location which can store large amounts of data. We've made some attempts in this direction so that not only could the micros be used to tie into our computer and get out the information rather quickly, but in-

dividual labs that are producing data can ship the information to a centralized location as well. The big advantage, really, and it's been mooted at the Parapsychological Association meetings for some time by people like Charley Tart, is that we would have some kind of centralized data base for sharing. It's never really gotten off the ground because there's been nobody willing to take on the responsibility for getting all that data together. A centralized computer could serve as a focus without adding a lot of work to the centralized computer facilities, if the micros shipped the data in in certain ways and took it out in other ways. So it is quite feasible. I don't think it's too far off and I'm all for it. I hope your ideas come to fruition very quickly.

SCHECHTER: We have been reminded that the sophistication of the tool doesn't substitute for good design and careful thought. Some experiences of my own suggest an aspect of this that I think worth bringing up. In my years in psychology labs, I've gone from hand-run experiments to electro-mechanical automation to plug-in solid-state gadgetry to, most recently, microprocessors. Similarly, my statistical analysis tools have gone from a slide rule and hand adding machine to a pocket calculator that added, subtracted, multiplied and divided, to a fancy pocket calculator, to computer programs. Each time I've made an increase in sophistication, I've noticed two things. One is that I could now do many of the things that I'd seen as too complex or time-consuming before. The other is that I began by getting sucked in by the sophistication, doing things that were far more complicated than necessary. How good the tools are for us depends on what we do with them—and they're so much fun to play with that if we don't really watch what we're doing, we can find the sophistication more interesting than the real active uses.

MCCARTHY: I remember last year when Chuck Honorton presented his paper about computer fantasy games, he made a comment about a warning that Larry LeShan had given to him—"Watch out! These computers will take over the lab!" I'd be interested in hearing what Chuck's feelings are at this point. I think that there was a time in the past year when playing with the computer may have been more attractive to him than doing parapsychological research. I don't think that's the case now. Maybe Chuck has something to add to this.

HONORTON: I'm very glad to have had LeShan's warning. It has haunted me. A certain degree of enthusiasm is necessary in order to learn enough to effectively use computers. The degree to which they are useful to us will I think soon be known. They're like typewriters. No one who writes—except for those who dictate—would be without a typewriter. The small computers are getting to that point now. They are multifaceted. They're easy to use. They are a necessary part of what

we're doing. They can help us, but they are not going to solve all of our problems. Another aspect of microcomputers is their potential for helping us create a consensus within parapsychology. We need to develop a basis for conceptual agreement within the field. We don't really have to worry about the external critics. They are documenting their own incompetence. But if the field is going to advance we must be able to agree on fundamentals. We must operate from a common methodology, an empirically coherent and viable common framework. These computers provide the basis for a common methodology. Our experimental designs can, now, be described in a common and very precise language, the language of the computer. Experiments can be shared and documented as never before. Studies can be done that were previously not feasible. Experimental tasks can be presented in attractive and motivating ways. All of this serves to increase effective communication, greater understanding of one another's work, assessment of replicability and moves us toward greater consensus.

EDGE: Don McCarthy and Chuck Honorton referred to the distribution of software. If there were success in one lab, you would want to distribute the software to another lab and the presumption is that you would have essentially the same experimental conditions. I have already volunteered my lab for this sort of procedure and I still continue to do so. The matter, however, is more complicated, if I am correct in the "field approach" that I discussed in my paper. There's going to be a fundamental difference in lab conditions in one respect. For instance, Richard Broughton at Edinburgh is a different person from Richard Broughton at FRNM. That is, he really can only be defined as an experimenter within certain relationships, within a particular field and if the field changes, Richard Broughton changes. It is not as if there's one object (the software) that is transferred from one location to another location. I'm not talking about just personality differences. It seems to me that there would be a fundamental sense in which even this diskette becomes a different diskette at my lab from Chuck Honorton's lab. That is not to say that we should not exchange programs; it's just to say that the process of exchange itself becomes part of the experimental situation which should be investigated, also.

MCCARTHY: An attempt has been made in some of these packages to include instructions for the experiment and everything else related to it, right in the software package. But I'm inclined to think that there really is something important to this point that cannot be embodied in the software package entirely. For example, in the cab on the way here this morning, Ramakrishna Rao was commenting on some pleasant experiences he had participating in some of these computer-controlled

experiments at Chuck Honorton's lab yesterday. The comment that struck me the most was that the thing that was so important to him was the way in which he was treated by the people in the lab, the attention that he got and the care and interest they displayed in how he was doing and what was going on. So I think this is a factor that definitely cannot be overlooked. Earlier in Hoyt Edge's paper he said "We have to observe the experimenters in their laboratories and the ways that they interact with their subjects." There is a use for video equipment here, to actually make video tapes of some experiments in their full entirety starting from the time the subject walks in the door. You then can see how some of these experimenters really work. I was amazed at one of the PA conventions when Helmut Schmidt brought one of his little boxes along and I saw the way in which he interacted with his subjects in participating and using the box. His written reports certainly describe the way in which he tries to get the subjects involved, but those written descriptions are very pale imitations, at best, of actually seeing Helmut Schmidt at work. I could easily see that he could put a box in the hands of someone who just does not do anywhere near the same kinds of things that he does in motivating and supporting the subject. So I think a lot more attention has to be given to this. Certainly this is one aspect where commonality among laboratories is important. If there really is going to be an attempt at interlaboratory replication, a lot more effort has to be made to really send people around to different laboratories. Maybe some of this is already done, but I think it has to be done much more openly. We must realize that there's a lot to be picked up from being in a laboratory and seeing how the experiment actually is performed, rather than just reading about the procedure.

EDGE: Further: if a person would come into my lab, he's likely to ask "who's Edge?" But if he comes into the lab at FRNM it would be different. That kind of relationship involving expectations is not just how the individual experimenter interrelates with the subject. That is a whole parameter there that needs to be examined.

MCCARTHY: One thing that attracted us to some of the computer psi games is that they can be so vivid and engrossing that maybe they can overcome some of these kinds of differences. Once the subject really gets into an attractive, interesting, exciting game-like situation—if it's sufficiently vivid—maybe some of these other effects can be washed out.

LESHAN: I'd like to raise another question about the whole use of computers and that is: How do they make us think about psi? We have a really terrible and most tragic history in academic and clinical psychology. It should make us think carefully in parapsychology. When we got a new tool, it made us think about human beings in a new way

because the tool was so useful, so effective, so attractive. We had, for example, in the early part of this century, a wonderful tool to study rats with—rats. It was a wonderful tool. We began to study human beings with the techniques we developed to study rats and presently we began to find a marvelous thing. There was nothing in human behavior that wasn't rat-like. We then developed another tool and this was the projective tests to study human beings. They were designed to study pathology and we found, to our amazement, there's nothing about human behavior that's not pathological. Nobody has ever seen a situation where a psychiatrist sent somebody for testing to a psychologist, where the psychologist has not returned the test report: "This person is sick." A witch might have survived the dunking test, but no modern man ever survives the pathology test. The tool that we use—that we become accustomed to, that we have in our labs, that we feel good about, that's powerful—shapes our thinking about the subject tremendously. This is a problem. Eddington once told the story of how he was walking along the beach and he saw two fishermen fighting bitterly. He asked what the fight was about. One said there were only large fish in the sea and the other said there were only small fish in the sea. Eddington, of course, asked "What size nets are you using?" And the question I want to raise—and I really have no idea of the answer—is: With the modern computer, how does it make us think about psi? What is it adapted to study about psi? How does it shape our thinking?

MCCARTHY: I certainly have no answer to that, but I do have some good feelings about using these small computers. In a certain sense there are sinister implications if you start running rats in mazes and that's the instrument you use to investigate human behavior. The kind of behavior and the kind of inferences you would draw out of people, reflect the characteristics of your tool. If that is, indeed, the case, I do have some very good feelings about small computers. They are often described as dream machines and I don't think I can put into words the real enthusiasm I feel for this equipment. There are wonderful things that I always wished that I could do and now, with these fantastic tools, I can do them; and at times can do things so much better than I ever could have imagined. In a sense they can expand our human potential. If, indeed, the quality of the instrument affects the response that we evoke from subjects, then I repeat that I feel pretty good about using small computers in this line of research.

STANFORD: Several speakers have addressed the problems of social interaction in psi experiments and how the use of computers may not fully eliminate that as an important factor. I certainly concur with those remarks. I really hope that we will not abandon the idea of someday doing serious empirical work on subject and experimenter interaction,

the study of social interaction in an experimental context. We talk about this all the time. It's very difficult research. We don't do it because it's so difficult. We also don't do it because very few of us have any training in social psychology or interactional psychology. Perhaps we can best capitalize on what we have in working for replicability with computers, if we can look at this more systematically.

Finally, let me make one more point with regard to computers and the success of psi experiments. I have sometimes done studies which were quite complex. The target arrangements and other aspects of the ESP tasks were so complex that it was impossible to give subjects feedback at the end of the session. I must say, although this is purely a subjective impression, that my research has turned in far more evidence of psi when subjects have had immediate feedback at the end of the session than when they did not. The computer, of course, makes it possible in almost every setting we can imagine to give subjects immediate feedback in a very understandable way. I believe that that factor alone could be extremely important in increasing replicability because the incentive value for the success at a psi task undoubtedly diminishes with time as subjects get away from the experiment. Even if you send them a feedback letter three months later, I don't think it has that impact of telling a subject right then and there that he really did well and the experimenter is happy.

MCCARTHY: It certainly is the case that computers can contribute a lot to this line of research despite the obvious strong emotional component. I think this is a good approach. I think it has tremendous potential, but again it should not be pursued to the exclusion of other approaches. It needs to be supplemented by other approaches, especially social interaction studies, maybe a lot of other things, too. I'd just like to echo the comment that Richard Broughton made, that computers are not going to solve all the problems of the field and they don't deal with everything, but there's an awful lot they can do.

HONORTON: We must, of course, avoid the trap of becoming the slave of our tools. As with any other tool, the computer can narrow our perspective or expand it. I can do things now that I have wanted to do for many years, but couldn't because of the amount of manual work involved, the processing speed required etc., in terms of delivering feedback, measuring concomitant internal processes etc. Now, it still remains to be seen whether these "dream machines," as Don McCarthy calls them, will do for us what a few dollars worth of ping-pong balls and some view-master slides, for example, have done. I think we all will feel happier about our enthusiasm for computers when we have a little bit more assurance on this question.