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The Journal of Parapsychology, Vol. 60, June 1996

SECURITY MEASURES IN AN AUTOMATED GANZFELD SYSTEM

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ABSTRACT: The past success rate of the automated ganzfeld system has brought with it both praise and criticisms from experimenters and critics alike. Researchers associated with the Koestler Chair of Parapsychology at the University of Edinburgh have designed an automated ganzfeld system oriented toward evaluating and addressing these problems. This new, improved approach to security measures within the ganzfeld setting is described in some detail, with recommendations for future improvements in automated ganzfeld settings.

As parapsychological testing procedures produce successful results, they attract increasingly sophisticated levels of criticism, including criticism of their security aspects. Safeguards against fraud or deviation from protocol are often challenged with regard to researchers as well as participants.

This is especially true for protocols that involve very few individuals already regarded as talented, such as special sender-receiver pairs, as well as protocols that focus on producing dramatic effects, such as macro-PK. Many parapsychologists deliberately choose to avoid gifted individuals, or special subjects, because they wish to escape the suggestions of fraud that would be likely to follow positive results. As Morris (1986) has argued, protocols that emphasize one or a few participants and produce dramatic effects are regarded as ideal by those who wish to avoid the noise and uncertainty produced by weak results. It is unfortunate, however, that such dramatic effects are also attractive to the media and are thus regarded as ideal for the pseudopsychic, or someone intending to cheat if given the opportunity.

In general, the more participants there are in a study, the less likely it is that deception has occurred, because one would need to posit increasingly complex collusion among different individuals. In addition, the

The Koestler Chair of Parapsychology would like to gratefully acknowledge Science Applications International Corporation, the American Society for Psychical Research, the Parapsychology Foundation, and the Society for Psychical Research for financial support of personnel and equipment germane to this project. This paper draws from a paper presented at the 1994 Parapsychological Association Convention in Amsterdam, Holland.

motivation of a pseudopsychic to cheat is decreased when there is less opportunity to become famous by doing so, as in studies that use many participants and do not focus on individual results (Morris, 1986). Process-oriented research also militates against deception, because the internal patterns of results would need to be produced fraudulently as well (but see Wiseman & Morris, 1995, for a description of strategies that pseudopsychics can use to produce patterns in results). With larger population samples, such possibilities for deception become increasingly unlikely unless the participants are all drawn from the same tightly knit group. However, many investigators may not have the necessary resources to conduct larger studies, or they may not be able to locate enough participants capable of producing the strong and consistent psi that would be desired for effective process-oriented research. Thus, it is important to employ procedures designed to minimize the likelihood of participant fraud.

A second area of security addressed here concerns precautions against experimenter bias or deviation from intended procedure. This is a serious consideration primarily for protocols that employ a single experimenter and where intentional experimenter bias would likely pass unnoticed by others connected with the study, both colleagues and participants. Intentional experimenter bias is of less concern when there are procedures involving co-experimenters, when different sessions are conducted by different experimenters, and when independent researchers have also found evidence for the effect in question. When considering intentional experimenter bias, one should note that motivation can go in both directions. Experimenters may wish to get good results to keep a program alive or to obtain more funding and prestige, especially if they are persuaded that the effect is really there, although it is "shy" and currently eludes detection. On the other hand, some researchers may be motivated to produce chance results since they would then be regarded by many mainstream researchers and the media as excellent scientists who are doing a fair evaluation of the phenomena but are using methodologically superior procedures, and who are providing an important public service in a difficult area. Individual researchers may find their motives questioned and may come under suspicion of fraud, regardless of their results.

Given the possibility of attribution of intentional experimenter bias or procedural deviation, ideally one would wish to employ procedures that eliminate these, without constraining the procedures to those that have no real ecological validity and little likelihood for success. If a procedure's virtues could easily be made obvious to all potential critics, yet not seem intrusive to participants, all involved would feel more confident that whatever results emerged would not lead to unfounded

accusations. In practice such perfection can only be approximated. The most effective solution, in parapsychology as well as other research, is natural replication and extension, with many participants and researchers involved. But it is also important and useful to have procedures as well safeguarded as possible even at early stages, for several reasons: (a) as a sign of general competence; (b) to minimize unfair criticisms; (c) to help all involved feel comfortable with the results at various stages of the study; (d) to provide conditions that will not need to be altered substantially in later stages, following reasonable criticism of earlier studies; (e) to discourage fraudulent individuals from participating and wasting researchers' valuable time; (f) to encourage others to feel confident in replication attempts; and (g) to encourage potential sources of funding to feel confident that their funds will be intelligently used.

For the remainder of the paper the automated ganzfeld system currently in use at the University of Edinburgh is described to show attempts that have been made to confront these issues using a procedure that has received considerable praise as well as criticism in the course of its development.

Development of the Automated Ganzfeld System

The automated ganzfeld system of the Koestler Chair of Parapsychology at the University of Edinburgh was developed as a means of replicating and extending the successful ganzfeld research at Psychophysical Research Laboratories (PRL). A more detailed description of the automated ganzfeld system used at PRL can be found in Honorton et al. (1990). The PRL system was the brainchild of several people, with Rick Berger primarily responsible for the design of the hardware and software of the system, and many others involved with its development at various stages.

The Edinburgh automated system is designed to be used as a free-response testing system under a variety of experimental designs, including automated ganzfeld research. It is a computer-based system that provides automatic data recording, highly effective shielding against sensory cues, and resistance to both subject bias and intentional experimenter bias. The program is run on a 33MHz 80386DX computer, equipped with a 210 MB fixed disk, 8 MB DRAM, four RS 232 serial ports, an 80387 numeric coprocessor, a super VGA monitor, and a printer. The target presentation system involves two PC/VCR's, both frame-accurate NTSC video cassette recorders equipped with an RS 232 serial interface. All VCR functions are controlled by computer software and video, audio, and computer graphics are routed to the appropriate rooms (sender, receiver, or experimenter) through computer control. Other equipment includes three NTSC video monitors (one each for the receiver, sender, and experimenter); two stereo cassette tape recorders (one for the mentation and judging, and one for playing relaxation instructions and white noise); two microphones (clip-on for the receiver, hand-held for the experimenter); two four-channel stereo mixers; two stereo audio amplifiers; three headphones (one each for the receiver, sender, and experimenter); one red incandescent bulb and flexipose lamp; and an audio cassette tape with 15 minutes of relaxation instructions and 30 minutes of white noise.

The program itself runs under a combination of Microsoft Quick Basic 4.5 and Windows 3.1/DOS 5, and it is passworded; unless the experimenter has knowledge of the correct password he or she cannot run the program. The program produces a datafile during each session which is stored to both the hard drive and a floppy disk and is sent for immediate printout to the printer at the conclusion of the session. All target presentations, VCR video and audio signals, and computer graphics are computer-controlled.

The system at Edinburgh was originally conceived and initially programmed by Charles Honorton. It was redesigned, after Honorton's tragic and untimely death, by Dean Radin and Robin Taylor to improve security features and sensory shielding, and it was initially programmed and documented by Dean Radin. For a description of research using an early version of this system at Edinburgh, see Morris, Taylor, Cunningham, and McAlpine (1993). Additional security features and sensory shielding have been implemented by Kathy Dalton, who also performed the necessary upgrading of programming and documentation. Consultations with Richard Wiseman were of great help throughout in improving security measures. Bob Morris and Deborah Delanoy were involved conceptually throughout system development. During the course of this process, additional persons with computer security expertise were occasionally consulted.

The resultant automated system can easily be tailored to produce a variety of different experimental conditions and to explore those that work best either in general or for specific participant populations. It can also be used to vary conditions in accordance with the design of process-oriented studies, and it was recently used in a study to evaluate the role of the sender in the ganzfeld (Morris, Dalton, Delanoy, & Watt, 1995).

The security measures presented here address the issues and concerns of automated ganzfeld procedures using video tape presentation systems. Future ganzfeld systems that use digitized target systems may resolve some of the problems regarding sensory cues from equipment, which we will discuss later in this paper; whether such systems would introduce new concerns remains to be seen. Thus, we have confined ourselves to addressing the issues raised by the type of automated ganzfeld systems currently found in many parapsychological laboratories.

Laboratory Layout

The video ganzfeld laboratory consists of four rooms, shown in Figure 1 and labelled RECEIVER, EXPT, VIDEO, and SENDER.

Receiver's Room

The receiver's room has double camden walls as specified in the guidelines from the official manual of the British Broadcasting Corporation (*Guide to Acoustic Practice*, 1990); it is also double-doored and partially electromagnetically and acoustically insulated. It attenuates airborne sounds between the receiver's and sender's rooms by a minimum of 60 dB and a maximum of 100 dB over the audio spectrum (50 Hz to 8000 Hz). These audio checks were performed by building engineer specialists from Heriot-Watt University using the Nortronics Sound Measuring System. The procedure for doing such checks generally involves having a well-calibrated source of sound at one site and monitors in several locations within the recording site. Sounds at various specified frequencies and loudness are then generated systematically at whatever site might be expected to be the source of unwanted noise (the sender's room in our case). At the same time, the sound level is monitored at whatever site is to be shielded from the unwanted noise (the receiver's room and the experimental suite in general, in our case). For more detailed information on this test equipment and the results, see MacKenzie (1992), available from the authors. The receiver's room is double-floored to provide vibration attenuation; however, some very low frequency vibrations can be felt inside the receiver's room if people in the experimenter's room jump up and down, and faint noises can also be heard. When the receiver is wearing the headphones, listening to white noise, and sitting in the reclining chair (i.e., in ganzfeld stimulation), his or her ability to hear any airborne sounds or vibrations originating in the experimental suite is substantially reduced. Essentially no sound or vibration that originated from the sender's room could be heard or felt in the receiver's room unless it was of such strength as to be noticed throughout the entire building. The two rooms are on two different floors and have no common walls.

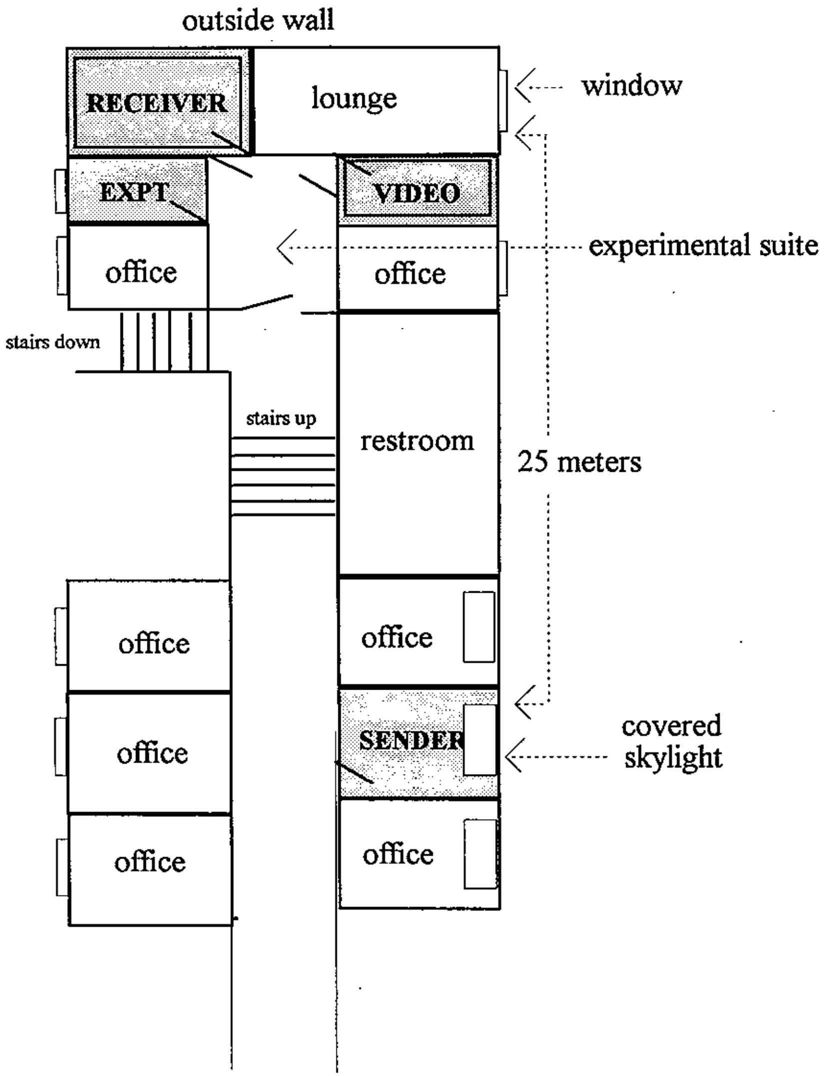


Figure 1. Laboratory layout.

Experimenter's Room

The experimenter's room is adjacent to the receiver's. It contains the computer that controls the audio/video target presentation, audio mixing equipment, and other assorted audio/video hardware (shown in detail in Figure 2).

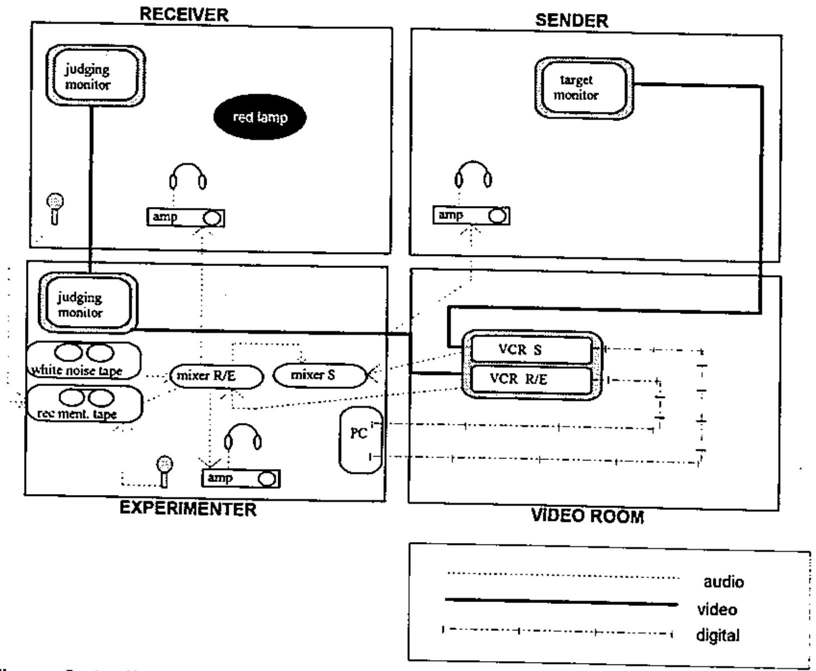


Figure 2. Audio, video, and digital communications layout. This design isolates the audio and video (a/v) paths for the sender and the receiver/experimenter to avoid introducing sensory cues. The only direct connection between the sender's and the receiver's a/v systems is the output of the audio mixer into the input of the sender's audio mixer.

Video Room

The video room is double camden walled, has double doors, is partially electromagnetically and acoustically insulated, and contains the target presentation system. This system consists of two PC-VCRs, which are computer-controlled NTSC-format video tape recorder/players. One PC-VCR is used only to send the target clip to the sender; the other is used only to play the four judging clips to the receiver. No sound from the VCRs can be detected outside the room when the doors are closed.

Experimental Suite

The above three rooms are housed within the experimental suite, a self-contained unit of six rooms plus a central foyer. The additional three rooms include a lounge area where participants can be entertained and can relax with experimenters and senders before and after the ganzfeld session itself. The offices on either side of the entrance to the experimental suite, on the inside, are occupied by laboratory members.

Sender's Room

The sender is placed in a room located outside the experimental suite about 25 meters away, through four doors and up a flight of stairs from the receiver. The sender's room is not acoustically or electromagnetically shielded. The TV monitor which conveys the target material in the sender's room is positioned in the far corner away from the door, with a 5-foot partition between it and the door, effectively shielding against any extraneous light or color coming from the monitor being viewed through any cracks around or under the door. The sound amplifier is similarly positioned, and all sounds to the room are conveyed through the headphones. This ensures that no airborne sounds or vibrations can be heard outside of the sender's room through the area around the door. Thus, anyone standing or lying outside the sender's room door cannot see or hear the display to the sender. The skylight pictured in the sender's room is completely covered by an opaque dark green window shade. Additionally, new locks have been installed on the sender's door, and only research personnel actively involved in the ongoing studies have access to the keys. The offices to each side of this room are occupied by members of the parapsychology unit.

Ganzfeld Procedural Stages

A flow chart (see the Appendix) is included to help visualize the stages involved in the basic automated ganzfeld procedure. A brief outline of that procedure is as follows:

The computer program is initiated and the datafile for that session started shortly before the participant arrives. The computer saves the session data to the hard drive throughout the session, and also to a floppy disk at the conclusion of the judging sequence.

After his or her arrival, the receiver is taken to the receiver's room and prepared for the session with the appropriate adjustments made to audio and light levels. The receiver's room door is then shut, and the sender is escorted to the sender's room. The sender's TV is turned on, and the sender adjusts the audio when the relaxation tape begins. The door to the sender's room is locked from the inside by the sender, and an electronic sensing device on the door is automatically activated if the door is opened. The experimenter returns to the experimental suite, conducts an audio check with the receiver, and then initiates the relaxation period for sender and receiver by beginning the relaxation tape and signalling the computer to begin timing this period.

At the end of this timed period, the computer signals the experimenter to begin the sending period. The experimenter then fades down the sender's relaxation audio tape, signals the computer to begin the sending period, starts the mentation tape recorder, and prepares to take down the receiver's mentation.

At completion of the sending/mentation period, the computer signals the experimenter to fade out the white noise to the receiver and to review the session mentation with him or her. After review, the receiver then takes off the eye shields and prepares to review the four target possibilities. After reviewing the four possible targets, the receiver ranks and rates them according to the correspondence of his or her imagery to each target. When the judging sequence is completed, the computer saves the data and then instructs the sender to return to the receiver's room and reveal the target. Session data are then sent to the printer for multiple printout, and the experimenter is prompted to close out the session.

Security Measures

The automated ganzfeld procedure developed at PRL is widely recognized as one of the soundest methodologies in parapsychology. However, it has not been without its criticisms. Naturally, any replication attempt of complex studies, such as those carried out at the PRL laboratories, must take into account the advantages and disadvantages encountered in those studies and, while capitalizing on the former, must attempt to eliminate or minimize the latter. We have attempted to evaluate these criticisms in our own work at the Koestler Chair, and we will address them here. The main criticisms of the earlier automated ganzfeld work (e.g., Morris et al., 1993; Wiseman, Smith, & Kornbrot, 1994) were that there might have been: (1) possible subliminal sound leakage to the receiver through inadequate electronic component isolation; (2) repeated playing of the target tape during sending, which might alter it physically such as to provide a subtle cue; (3) sounds from the VCR, which might provide cues to the experimenter about which clip was being played as target; (4) sound leakage from the sender's room to the experimenter, which might provide cues if senders are noisy; (5) the possibility of a complex electronic signalling system between sender and receiver; and (6) deliberate experimenter bias. Our responses are as follows:

Criticism 1: There might be subliminal sound leakage to the receiver. The audio systems as well as the video systems are electronically isolated from each other. The only direct connection between the sender's and the receiver's audio or video systems is the output of the audio mixer into the output of the sender's audio mixer (see Figure 2). The technicians from the Electronics/Audio-Visual Department at the University of Edinburgh have electronically checked all such connections, following recommended procedures (all sound levels at upper limit), and have verified electronically that no such leakage exists in our facility. Checks should be conducted prior to the beginning of ganzfeld studies and again at approximately the midway point to verify continued security. In general, it is important to ensure that any electronic system that links various components within an environment is in fact functioning as it should. Faulty connections, inadequately shielded adjacent cables, inadequately isolated electronic components, components that drift outside of specified parameters, and other such problems can produce bias of information in the system. Even if this leakage is so minimal that it would be extremely unlikely to be having an effect, that remote possibility can still be enough to raise concerns, especially from those who regard genuine psi effects as even more unlikely (e.g., Wiseman et al., 1994; Humphrey, 1995). Thorough testing of the system, ideally during the course of the study as well as initially, can thus prevent considerable debate at later stages.

Criticism 2: Repeated playing of the target tape during sending might alter it physically such as to provide a subtle cue. Although this would not be a problem with a digitized target presentation system, many labs currently use a video-tape-based ganzfeld system. Our system utilizes two separate tapes for sending and judging; they are housed in two separate PC/VCRs and are totally under computer control.

Criticism 3: Sounds from the VCR might provide sensory cues to the experimenter about which clip was being played as target, thus allowing the experimenter to guess the sender's target clip. Two separate VCRs are used and are sensorially isolated in a separate room away from the experimenter. The theoretical cue may work as follows: It is possible, although unlikely, that by hearing the sender's VCR rewinding or fast-forwarding the video tape before it begins to play, the experimenter might get a hint about which target pool, and possibly which specific target clip, the VCR is playing. Such a cue would obviously bias the experimenter toward certain targets or a particular target. The experimenter might then inadvertently transfer this bias to the receiver during the judging process, and this is clearly unacceptable.

Note that this sensory cue is possible only if: (a) The experimenter is familiar with the locations of the target pools on the video tape; (b) the experimenter knows the order of the clips within each pool; (c) the experimenter pays attention to how long the VCR rewinds or fast-forwards, or perhaps notices the video tape counter; and (d) the video tape always begins from the same location (e.g., it always rewinds to the beginning of the tape at the beginning of each session).

To eliminate these potential cues in our facility, we have taken the following steps in our procedure. The VCRs have been placed in a separate nonadjoining, sound-attenuated room in the experimental suite, behind two doors. Research personnel have confirmed that video tape movement sounds cannot be heard in the experimental suite anteroom or in the experimenter's room even by people not wearing headphones (which the experimenter wears during the session), and even when the experimenter's door is not closed (which it is throughout ganzfeld sessions). The digital tape counters have been completely blocked from view from inside the housing of the VCR by inserting an opaque cardboard cover and completely covering this with black electrical tape, which effectively removes any possibility of accessing control of the VCR through the remote control. The front control panels are inaccessible, being enclosed by the metal housing unit for the VCRs. The video clips themselves are all exactly 1 minute long within a fraction of a second, eliminating any cueing from the length of time clips are played, even if they could be heard. The order of the clips within each target pool is fixed by the recorded order on the video tape, but the order in which they are played during the judging process is always freshly randomized for each session. Thus, even experimenters who are familiar with the order on the video tape will not know the actual target sequence within each pool. The sender video tape is never rewound to the beginning of the tape, but starts up where the tape stopped at the end of the last session. Research personnel confirmed that no sound can be heard from the video room, and the computer program is written to ensure that no timing cues (e.g., tape rewind times) are available to the experimenter. Thus, the experimenter cannot receive any information regarding tape movement, including where rewind begins or ends. In addition, an opaque cover has been inserted inside the metal cover of the VCR itself, covering all digital information regarding tape characteristics. The receiver and sender video tapes are locked into the two VCRs via the specially designed metal housing unit, with a uniquely numbered brittle plastic security tab, thus eliminating the possibility that a confederate might surreptitiously retrieve one or both of the tapes and tamper with them.

In general, it is important to consider all sources of information that might be linked to the target at the various stages of its generation, storage, and display, including any blind judging situation. We need to ensure that none of those sources of leakage are available to the receiver or to anyone with whom the receiver has contact at crucial stages of the experiment. The use of automated equipment can effectively eliminate many such sources of leakage, but unfortunately it can also create new sources. As equipment capabilities evolve and sophisticated equipment becomes cheaper, various sources of information at any given stage may be eliminated. For instance, the use of CD recorders in our current system would eliminate some of the cueing possibilities from the standard VCRs used now. We would use them in any future system we constructed, but even they would need to be evaluated carefully to ensure that they themselves do not introduce new sources of leakage. In short, any system that manages a target must have all its components evaluated to assess the extent to which they may provide a direct or indirect link to the receiver.

Criticism 4: Sound leakage from the target room to the experimenter might provide cues if senders are noisy. As was noted in the description of both the experimenter's and the sender's rooms, these rooms are separated by some distance (approximately 25 meters) and by a small flight of stairs and three closed doors, two of which are locked throughout the session. In addition, we have had our facilities acoustically evaluated (sound attenuation between the sender's room and the foyer of the experimental suite was above 55dB from 125Hz on up, and presumably higher for the experimental room itself when the door is closed). This evaluation confirmed that even without headphones on, our experimenters could not hear shouts from the sender's room. In addition, there is an electrical sensing system connected to the door of the sender's room that was designed to detect the opening of the door by activating a flashing red light in the experimenter's room. Consequently, if the sender left the room during the experiment, the experimenter would instantly be alerted. As an added precaution, the door into the experimental foyer is kept locked during sessions. In recent studies (Morris et al., 1995), only laboratory staff were used as senders, and all of them knew that they were to be quiet. Additionally, the computer instructs the sender, in two different places in the program, to silently send the target or encourage the receiver with regard to it. Written instructions for the sender are in the target room, and they include instructions to silently send the target. In general, it is important to remember that senders may use strategies that can produce additional information, such as showing emotion verbally and physically, acting out scenes, responding to any real-time feedback they may receive from hearing the receiver's responses and judging, and so on. Such a possibility is reduced by using as senders staff members who know the characteristics of the system. But many receivers may feel more comfortable with senders with whom they already have a sense of rapport, and exploration of sender/receiver rapport is an important research topic in itself. Thus, sensory shielding from sender to receiver or to anyone linked to the receiver should be very thorough, more than might casually appear to be the case to the participant.

Criticism 5: There could be a complex electronic signalling system between sender and receiver. We consulted with several security firms in our attempts to evaluate and address this problem. They confirmed that, although we could conceivably do a great deal to prevent and detect known signalling systems, given the present state of technology it would be extremely expensive to guard against all available types of signalling systems. Furthermore, whereas the signalling system could be very simple (e.g., the sender, hearing the receiver's mentation, gives a tap when the receiver is doing well), the technology of such signalling systems is rapidly expanding, and any detection systems for electronic signalling devices would necessarily require continuous and expensive upgrading. Using only laboratory staff as senders is one way of addressing this situation. There remains the possibility of a fixed monitoring system in the sender's room, or monitoring of the sender's room by an accomplice outside of the room. Attempts can be made to shield against or to detect electronic transmission systems, to monitor transmissions within a certain range, or to monitor any attempt to produce raps (e.g., to an outside wall). Our present physical circumstances make these types of signalling systems unlikely because the room is periodically inspected and we monitor the environment during sessions for strangers. The layout of the sender's room is designed to prevent anyone from standing or lying outside of the door to receive any visual or auditory information about the target clip. Additionally, such signalling systems involve the cooperation of the receiver. Since we currently use each receiver for only one session, any deliberate fraud by receivers must involve several people.

In general, deliberate fraud between sender and receiver in terms of complex signalling systems is very difficult to eliminate, especially if we posit that the sender is prepared to spend a fair amount of money and has access to expertise. It is probably safest not to draw any strong inferences from results from only one sender/receiver team if their data are not supported by data from other teams. Steps to make communication between sender and receiver difficult include: extensive inspecting of sender and receiver environments ideally in nonobtrusive ways; electronic monitoring of the environment throughout a wide frequency range; shielding of the receiver's room (this is expensive if a wide range of frequencies is involved); use of many receiver/sender pairs; and use of senders drawn from the research team. As outlined in recent papers (Dalton, Morris, Delanoy, Radin, Taylor, & Wiseman, 1994; Morris et al., 1995), we opted for the last option as our best safeguard, in addition to environmental monitoring and shielding. Of course, this would not preclude deception by the experimental team itself, which we address next.

Criticism 6: There might be deliberate experimenter bias. In a recent paper (Dalton et al., 1994), we advocated the use of multiple experimenters in any automated ganzfeld experiment. We used three main experimenters and four senders. All of the experimenters participated as needed in the role of sender, as did one other laboratory staff member. Thus, each session had two members of the experimental team involved. The automated ganzfeld program records session data, not only to the hard drive, but also to floppy disk. This disk was stored in a secure location by one of the experimenters and produced before each trial. Immediately after each session, as soon as the computer recorded the session as completed, multiple copies of the session datafile were printed out. It should be noted that no feedback is given regarding the target until the computer stores the judging data to disk. Each experimenter receives one of these session records, and one is included in the session file which, along with the audio-taped subject mentation, is placed in the unit's security cabinet. (For more detail on the security precautions involved in accessing the parapsychology unit's security cabinet, see Delanoy, Watt, Morris, & Wiseman, 1993.) The session records on computer disk are compared to printouts in the experimenters' possession for discrepancies before any data are analyzed. A minimum of two experimenters is required to sign off on the handwritten record of the participant target ratings, which is then included in the subject file with the computer printout.

Intentional experimenter bias can be made difficult and risky, but in principle it is still possible with this experimental set-up. For example, a specific experimenter could substitute a rigged program that would respond to his or her name and allow that person to select or know the target. The substituted program could be removed afterward, and these actions could all be masked by modifying the time stamp on the program revisions. Unfortunately, once one considers the possibility of deliberate experimenter fraud, it is difficult to guard against all the options available to someone who is highly motivated and has access to good resources and expertise. In our case we made the option sufficiently difficult that deliberate fraud would run a high risk of being detected. The experiment was monitored both by having a second experimenter and by having coexperimenters as senders who were able to observe the interactions between the experimenter and the receiver. It is important to have the experimental sessions themselves recorded so that blind judges can later evaluate whether the experimenters influenced the receivers at any stage, including the judging. We could have employed other available computer security safeguards, but anyone having a certain level of computer expertise can generally find ways to circumvent them, and their usage can unnecessarily complicate the experimenter's task. The research team has included procedures that make it more difficult and risky for an individual researcher working on his or her own to engage in fraud (see Delanoy et al., 1993). However, these procedures are not insurmountable and become progressively easier if more and more researchers join in the "collusion." We have used multiple experimenters, and we have adopted a protocol that makes it harder to engage in fraud; but ultimately our results will stand or fall as "worthwhile findings" with independent replication. Such replication is fortunately well underway for ganzfeld work.

In addition to the above security measures, we also conducted a global randomness certification test on the target-generating system. This test consisted of extracting the target generating instructions from

the controlling program and embedding them in a program that generated a large number of autoganzfeld targets in the range of 1–72. In the pre-series test 53,000 trials were generated, and chi-square tests revealed no consistent departures from the expected uniform distribution. Periodic randomness checks also took place at irregular intervals and were conducted not only by the experimenters in the parapsychology unit but also by specialists in Artificial Intelligence and Computer Engineering in the Psychology Department, with no evidence of departures from expectation. The interpretation of the selected target output by the program was checked by running a series of mini-trials, using the program to generate requests for targets and conditions and verifying these as above. Thus, both randomness checks and program interpretation were found to be within specified parameters. The program itself places a new call for the target information during each session (after the receiver is in the ganzfeld stimulation); this is generated fresh at that time and is not stored. Further details on any aspect of this system are available upon request.

Discussion

In our efforts to set up appropriate automated ganzfeld procedures from which to attempt replication of the PRL's successful series of ganzfeld trials, we feel that we were moderately successful. Obviously, ganzfeld systems and their particular designs will vary from lab to lab. This description of the Koestler Chair facility is in no way to be construed as the perfect design for all automated ganzfeld systems, but we hope that the precautions we have outlined here will aid in the continued development of such systems.

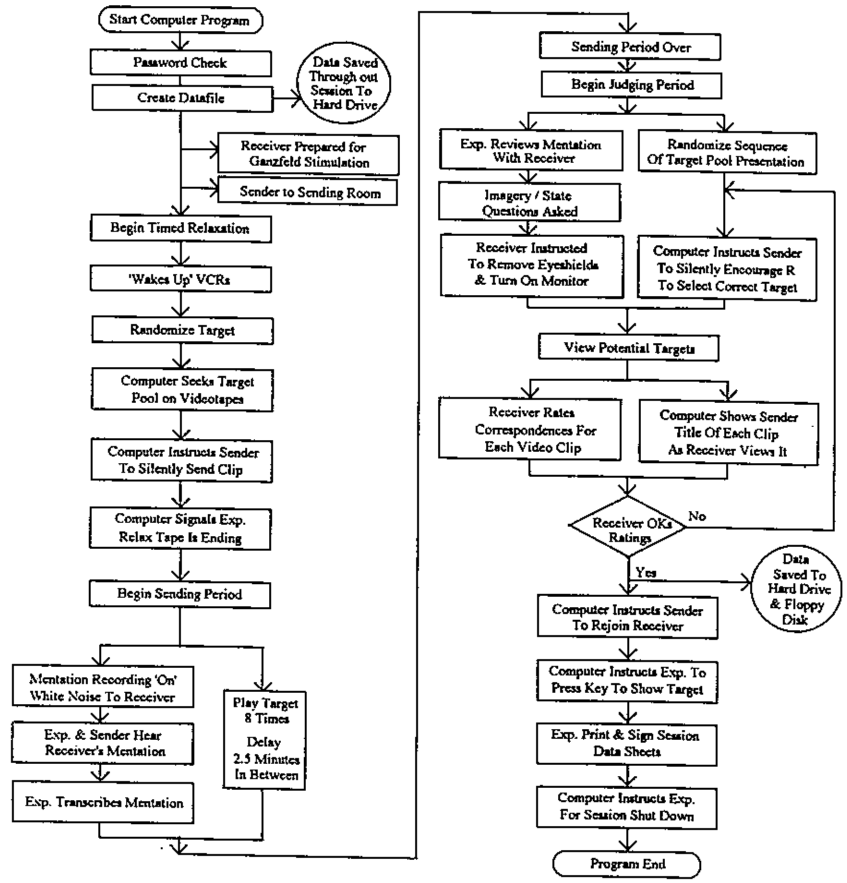
Although currently the electromagnetic shielding on the receiver's room is not completely adequate to shield out the full range of electronic signalling equipment, we feel that electromagnetic shielding of the receiver's room is necessary in order to reduce the possibility that readily available electronic signalling systems may be used. In addition, in laboratories where the sender is not located within the direct sight of the experimenter, installation of surveillance cameras, hidden or otherwise, in hallways and in appropriate sending and receiving rooms make it possible for experimenters to monitor these areas without physically being present. However, the psychological drawbacks to such cameras, which may give participants the feeling that "big brother" is "watching" them and make them feel uncomfortable and self-conscious, has led current experimenters at the Koestler Chair to rely instead on door-mounted signalling systems and monitoring of the environment by lab members during experiments. Honorton himself cautioned against the use of cameras inside the sender and receiver rooms (C. Honorton, personal communication, 1992). In addition, in situations in which sound leakage from the sender's room is possible and the sender has been asked to remain silent throughout the session, the use of a voice-activated tape recorder in the sender's room would indicate whether senders verbalized aloud during sending.

Given that we have experimenter effects in parapsychology as in other sciences, additional effort can be made to explore differences between those experimenters who are successful and those who are unsuccessful (e.g., Schlitz, 1986; Schmeidler & Maher, 1981) with an eye toward identifying talented experimenters and appropriate experimenter training techniques. It is also important to identify procedures that are more resistant to experimenter effects as well as participants who may be less affected by differences among experimenters.

It is our view that the physical environment in which the ganzfeld takes place must be held as constant and secure as possible to aid in our understanding of psi phenomena. We acknowledge that there is no such thing as a single absolutely fraud-proof experiment, and we would not claim otherwise. However, it is vital that experimental protocol that provides a high measure of security be coupled with the type of warm, encouraging, and friendly environment that psi seems to demand. In this way all parties concerned can proceed comfortably with the business of doing research and learning from each session.

Appendix

Flow Chart Of Edinburgh Automated Ganzfeld Program



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