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PSI COMMUNICATION IN THE GANZFELD

EXPERIMENTS WITH AN AUTOMATED TESTING SYSTEM AND A COMPARISON WITH A META-ANALYSIS OF EARLIER STUDIES

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ABSTRACT: A computer-controlled testing system was used in 11 experiments on ganzfeld psi communication. The automated ganzfeld system controls target selection and presentation, subjects' blind-judging, and data recording and storage. Videotaped targets included video segments (dynamic targets) as well as single images (static targets). Two hundred and forty-one volunteer subjects completed 355 psi ganzfeld sessions. The subjects, on a blind basis, correctly identified randomly selected and remotely viewed targets to a statistically significant degree, $z = 3.89$, $p = .00005$. Study outcomes were homogeneous across the 11 series and eight different experimenters. Performance on dynamic targets was highly significant, $z = 4.62$, $p = .0000019$, as was the difference between dynamic and static targets, $p = .002$. Suggestively stronger performance occurred with friends than with unacquainted sender/receiver pairs, $p = .0635$. The automated ganzfeld study outcomes are compared with a meta-analysis of 28 earlier ganzfeld studies. The two data sets are consistent on four dimensions: overall success rate, impact of dynamic and static targets, effect of sender/receiver acquaintance, and prior ganzfeld experience. The combined z for all 39 studies is 7.53, $p = 9 \times 10^{-14}$.

Research on psi communication in the ganzfeld developed as the result of earlier research suggesting that psi functioning is frequently associated with internal attention states brought about

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through dreaming, hypnosis, meditation, and similar naturally occurring or artificially induced states (Braud, 1978; Honorton, 1977). This generalization, based on converging evidence from spontaneous case studies, clinical observations, and experimental studies, led to the development of a low-level descriptive model of psi functioning, according to which, internal attention states facilitate psi detection by attenuating sensory and somatic stimuli that normally mask weaker psi input (Honorton, 1977, 1978). This "noise-reduction" model thus identified sensory deprivation as a key to the frequent association between psi communication and internal attention states, and the ganzfeld procedure was developed specifically to test the impact of perceptual isolation on psi performance.

Fifteen years have passed since the initial reports of psi communication in the ganzfeld (Braud, Wood, & Braud, 1975; Honorton & Harper, 1974; Parker, 1975). Dozens of additional psi ganzfeld studies have appeared since then, and the success of the paradigm has triggered substantial critical interest. Indeed, there is at least one critical review or commentary for every ganzfeld study reporting significant evidence of psi communication (Akers, 1984; Alcock, 1986; Blackmore, 1980, 1987; Child, 1986; Druckman & Swets, 1988; Harley & Matthews, 1987; Harris & Rosenthal, 1988; Honorton, 1979, 1983, 1985; Hövelmann, 1986; Hyman, 1983, 1985, 1988; Hyman & Honorton, 1986; Kennedy, 1979; McClenon, 1986; Palmer, 1986; Palmer, Honorton, & Utts, 1989; Parker & Wiklund, 1987; Rosenthal, 1986; Sargent, 1987; Scott, 1986; Stanford, 1984, 1986; Stokes, 1986; Utts, 1986).

Of the many controversies spanning the history of parapsychological inquiry, the psi ganzfeld domain is unique in three respects. First, the central issue involves the replicability of a theoretically based technique rather than the special abilities of exceptional individuals (Honorton, 1977). Second, meta-analytic techniques have been used to assess statistical significance, effect size, and potential threats to validity (Harris & Rosenthal, 1988; Honorton, 1985; Hyman, 1985, 1988; Rosenthal, 1986). Third, investigators and critics have agreed on specific guidelines for the conduct and evaluation of future psi ganzfeld research (Hyman & Honorton, 1986).

The Automated Ganzfeld Testing System

Psi ganzfeld experiments typically involve four participants. The subject (or receiver, R) attempts to gain target-relevant imagery while in the ganzfeld; following the ganzfeld/imagery period, R

tries—on a blind basis—to identify the actual target from among four possibilities. A physically isolated sender (Se) views the target and attempts to communicate salient aspects of it to R. Two experimenters (Es) are usually required. One E manages R, elicits R's verbal report of ganzfeld imagery (mentation), and supervises R's blind judging of the target and decoys; a second E supervises Se, and randomly selects and records the target.

We developed an automated ganzfeld testing system ("autoganzfeld") to eliminate potential methodological problems that were identified in earlier ganzfeld studies (Honorton, 1979; Hyman & Honorton, 1986; Kennedy, 1979) and to explore factors associated with successful performance. The system provides computer control of target selection and presentation, blind judging, subject feedback, and data recording and storage (Berger & Honorton, 1986). A computer-controlled videocassette recorder (VCR) accesses and automatically presents target stimuli to Se. A second E is required only for assistance in target selection The system includes an experimental design module through which E specifies the sample size and status of a new series.

The system was designed to enable further assessment of factors identified with successful performance in earlier ganzfeld studies. Differences in target type and sender/receiver acquaintance seem to be particularly important. Significantly better performance occurred in studies using dynamic rather than static targets. Dynamic targets contain multiple images reinforcing a central theme, whereas static targets contain a single image. Also, studies permitting subjects to have friends as their senders yielded significantly superior performance compared to those requiring subjects to work with laboratory senders. (See "Comparison of Study Outcomes with Ganzfeld Meta-Analysis" in the Results section.)

The autoganzfeld system uses both dynamic and static targets. The dynamic targets are excerpts from films; static targets include art work and photographs. Receivers may, if they choose, bring friends or family members to serve as their senders; a session setup module registers the sender type and other session information.

In this report, we present the results of the 11 autoganzfeld series conducted between the inauguration of the experiments in February, 1983, and September, 1989, when funding problems required suspension of the PRL research program.[1] We focus on

[1] This article conforms to the reporting guidelines recommended by Hyman and Honorton (1986). Because of the size of this database, however, it is not practical to

(1) evidence for psi in the autoganzfeld situation, (2) the impact of dynamic versus static targets, (3) the effects of sender/receiver acquaintance, (4) the impact of prior psi ganzfeld experience, and (5) a comparison of these four factors with the outcomes of earlier nonautomated psi ganzfeld experiments. Our findings on demographic, psychological, and target factors will be presented in later reports.

Subjects

The participants are 100 men and 141 women ranging in age from 17 to 74 years (mean = 37.3, *SD* = 11.8). This is a well-educated group; the mean formal education is 15.6 years (*SD* = 2.0).

Our primary sources of recruitment include referrals from colleagues (24%), media presentations concerning PRL research (23%), friends or acquaintances of PRL staff (20%), and referrals from other participants (18%).

Belief in psi is strong in this population. On a seven-point scale where "1" indicates strong disbelief and "7" indicates strong belief in psi, the mean is 6.20 (*SD* = 1.03); only two participants rated their belief in psi below the midpoint of the scale. Personal experiences suggestive of psi were reported by 88% of the subjects; 80% reported ostensible telepathic experiences. Eighty percent of the participants have had some training in meditation or other techniques involving internal focus of attention.

Participant Orientation

Initial contact. New participants receive an information pack before their first session. The information pack includes a 55-item personal history survey (Participant Information Form [PIF]; Psychophysical Research Laboratories, 1983), Form F of the Myers-Briggs Type Indicator (MBTI; Briggs & Myers, 1957), general information about the research program, and directions for reaching PRL. Participants usually return the completed questionnaires before their first session. However, if new participants are scheduled on short notice, they either complete the questionnaires at PRL or, in a few cases, at home after the session.

include the data in an appendix to the report. Instead, we will supply the data to qualified investigators in a Lotus-compatible, MS-DOS computer disk file. There is a small fee to cover materials and mailing. Address inquiries to the *Journal.*

Whenever possible, new participants are encouraged to come in for a preliminary orientation session, prior to their first PRL ganzfeld session. The orientation serves as a "get acquainted" session for participants and the PRL staff, and introduces participants to the PRL program and facility. Participants who avail themselves of this option generally complete the MBTI and PIF questionnaires during the orientation session. We inform new participants that they may bring a friend or family member to serve as their sender. When a participant chooses not to do so, a PRL staff member serves as sender. We encourage participants to reschedule their session rather than feel they must come in to "fulfill an obligation" if they are not feeling well.

Session orientation. We greet participants at the door when they arrive and attempt to create a friendly and informal social atmosphere. Coffee, tea, and soft drinks are available. E and other staff members engage in conversation with R during this period. When a laboratory sender is used, time is taken for sender and receiver to become acquainted.

If the participant is a novice, we describe the rationale and background of the ganzfeld research, and we seek to create positive expectations concerning R's ability to identify the target. This information is tailored to our perception of the needs of the individual participant, but it generally includes four elements: (1) a brief review of experimental, clinical, and spontaneous case trends indicating that ESP is more readily detected during internal attention states such as dreaming, hypnosis, and meditation (Honorton, 1977), (2) the notion that these states all involve physical relaxation and functional sensory deprivation, suggesting that weak ESP impressions may be more readily detected when perceptual and somatic noise is reduced, (3) the development of the ganzfeld technique to test this noise-reduction hypothesis, and (4) the long-term success of the ganzfeld technique as a means of facilitating psi communication in unselected subjects.

We encourage "goal orientation" and discourage excessive "task orientation" during the session; this is especially emphasized with participants who appear to be anxious or overly concerned about their ability to succeed in the ganzfeld task. We discourage participants from analyzing their mentation during the session, and tell them that they will have an opportunity to analyze their mentation during the judging procedure. They are encouraged to adopt the role of an outside observer of their mental processes during the ganzfeld. Again, this is emphasized with those who appear anxious

about their performance; they are advised to relax, follow the taped instructions, and to simply allow the procedure to work. We inform participants that they may experience various types of correspondence between their mentation and the target; they are told that they may experience direct, literal correspondences to the target, but that they should also be prepared for correspondences involving distortions or transformations of the target content, cognitive associations, and similarities in emotional tone. Finally, we orient new participants to where Se and E will be located during the session.

METHOD

Layout and Equipment

R and Se are sequestered in nonadjacent, sound-isolated and electrically shielded rooms. Both rooms are copper-screened, and are 14 ft apart on opposite sides of E's monitoring room, which provides the only access. R and Se remain isolated in their respective rooms until R completes the blind-judging procedure.

R's room is an Industrial Acoustics Corp., IAC 1205A Sound-Isolation Room, consisting of two 4-inch sheetrock-filled steel panels. The two panels are separated by a 4-inch air space, for a total thickness of one foot.

The inside walls and ceiling of Se's room are covered with 4-inch Sonex™ acoustical material, similar to that used in commercial broadcast studios. A free-standing Sonex-covered plywood barrier (5 ft wide by 8 ft high) positioned inside the sender's room, between Se's chair and the acoustical door, blocks sound transmission through the door frame. Figure 1 shows the floor plan of the experimental rooms.

E occupies a console housing the computer system and other equipment. The computer is an Apple II Plus with two disk drives, a printer, and an expansion chassis. The computer peripherals include a real-time clock, a noise-based random number generator (RNG), a Cavri Interactive Video Interface™, an Apple game paddle, and a fan. Other equipment includes a color TV monitor, the VCR used to access and display targets, and three electrically isolated audiocassette recorders. One audiocassette recorder presents audio stimuli (prerecorded relaxation exercises, session instructions, and white noise). Another plays background music during the experimental setup. The third records R's ganzfeld mentation and

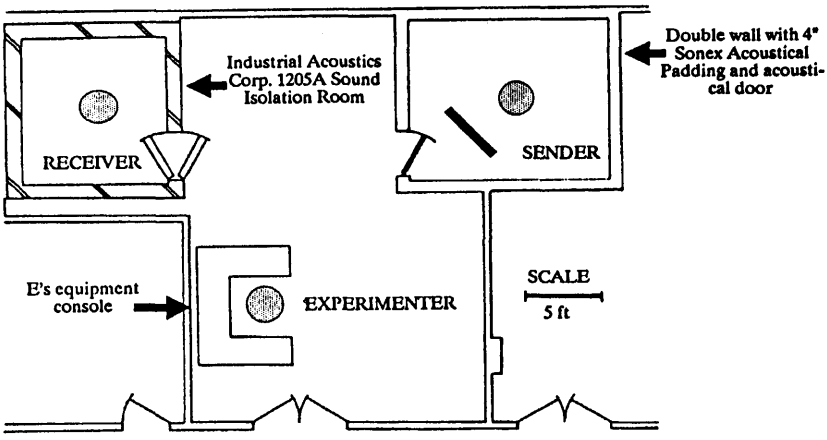

Figure 1. Floor plan of experimental suite.

judging period associations. There is two-way intercom communication between E and R. One-way audio communication from R to Se allows Se to listen to R's ganzfeld mentation.

Receiver Preparation

R sits in a comfortable reclining chair in the IAC room. Se keeps R company while E prepares R for visual and auditory ganzfeld stimulation. Translucent hemispheres are taped over R's eyes with Micropore™ tape. Headphones are placed over R's ears. A clip-on microphone is fastened to R's collar. A 600-watt red-filtered floodlight, located approximately 6 ft in front of R's face, is adjusted in intensity until R reports a comfortable, shadow-free, homogeneous visual field. White noise level is similarly adjusted; R is informed that the white noise should be as loud as possible without being annoying or uncomfortable. The ganzfeld light and white noise intensity are adjusted from E's console after R and Se are sequestered in their respective rooms.

Sender Preparation

Se sits in a comfortable reclining chair in the sender's room. Se faces a color TV monitor, wearing headphones. During the session, Se can hear R's mentation report through one headphone; if dy-

namic targets are used, Se hears the target audio channel through the other headphone.

Series Manager Setup Procedures

E accesses the autoganzfeld computer program through the *Series Manager* software. *Series Manager* is a password-protected, menu-driven control program. It provides the only means through which an experimenter may specify parameters for the series design, register new participants in the series, set up a session, and run a session. The *Series Manager* menu is accessed through entry of a private (and nonechoing) password.

Series design. A valid series design must exist before sessions can be run in an experimental series. This is done through the *Series Manager* "design" module. The design module prompts E to specify the type of series (pilot, screening, or formal), the number of participants, the maximum number of trials per participant, the total number of trials per series, and the series name. There is no provision for changing the series design once it is accepted by E. Design parameters are saved in a disk file; they are passed to the experimental program at the beginning of the session.

Participant registration. When R is new to a series, E accesses "Participant Registration" from the *Series Manager* menu before the session. E is prompted to enter R's name and identification number. The module verifies that the maximum number of participants specified in the design is not exceeded. (An error message appears if an attempt is made to register more participants than are specified in the design; then, control is returned to the *Series Manager* menu.)

Session setup. E then selects "Session Setup" from the *Series Manager* menu. E is prompted to enter R's name and the program verifies that R has not already completed the maximum number of trials specified in the design module. (An error message appears if a participant has completed the number of sessions allowed for the series or has not been properly registered; control is then returned to the *Series Manager* menu.) E enters Se's name and the sender type: lab, lab friend, or friend. *Lab senders* are PRL staff members whose acquaintance with the participant is limited to the experiment. *Lab friend* refers to PRL staff senders who have some social acquaintance with R outside the laboratory. *Friend senders* are friends or family members of the participant. Finally, E enters the ganzfeld light and noise intensity levels and his or her initials. E then leaves

the monitoring room while another PRL staff person supervises target selection.

Targets

The system uses short video segments (*dynamic targets*) and still pictures (*static targets*) as targets. Dynamic targets include excerpts from motion pictures, documentaries, and cartoons. Static targets include art prints, photographs, and magazine advertisements.

There are 160 targets, arranged in judging sets of four dynamic or four static targets. The sets were constructed to minimize similarities among targets within a set. The targets are recorded on four one-half-inch VHS format videocassettes; each videocassette contains 10 target sets (5 dynamic and 5 static). A signal recorded on an audio track of each videocassette allows computer access of the targets. Target display time—to Se during each sending period and to R during the judging period—is approximately one minute; blank space added to briefer targets insures that the VCR remains in play mode for the same length of time for all targets.

Preview packs. The video display format of the autoganzfeld targets does not permit simultaneous viewing of the entire target set during the judging procedure as is done in many nonautomated ganzfeld studies. Each target set is therefore accompanied by a preview pack containing brief excerpts of all four targets in the set; this gives R a general impression of the range of target possibilities. R views the preview pack at the beginning of the judging procedure; it runs approximately 30 sec.

Target Selection

The target selector (TS) is a PRL staff member who has no contact with either E or R until after the blind-judging procedure. TS is needed to load the videocassette containing the target into the VCR. TS is informed which of the four videocassettes contains the target, but remains blind to the target's identity. If Se is a staff member, Se serves this role; otherwise, a staff member not involved in the session serves as TS. (In the latter case, Se and R are sequestered in their respective rooms before TS enters the monitoring room.)

The *Series Manager* program prompts TS to press a key on the computer keyboard. A program call to the hardware RNG obtains the target value (a number between 1 and 160) and stores it in com-

puter memory.[2] The program determines the target set and videocassette number from the target value. The videocassette number is displayed on the monitor, and TS is prompted to insert it into the VCR. The program verifies that the correct videocassette has been inserted and clears the monitor screen; if the videocassette is not correct, an error message prompts TS to insert the correct videocassette.

TS places a cardboard cover over the VCR's front panel to conceal the digital counters and VU meters. Finally, TS leaves the monitoring room with the three remaining videocassettes, knocking three times on the monitoring room door as a signal for E to return.

Relaxation Exercises and Ganzfeld Instructions

R and Se undergo a 14-min prerecorded relaxation exercise before the mentation/sending period. This provides a unique shared experience for R and Se before the ESP task. The relaxation exercise includes progressive relaxation exercises and autogenic phrases (Jacobson, 1929; Shultz, 1950). Ganzfeld instructions are recorded after the relaxation exercise. The instructions and relaxation exercise are delivered in a slow, soothing but confident manner with ocean sounds in the background. The style of presentation is similar to a hypnotic induction procedure. The ganzfeld instructions to R, which are also heard by Se, are as follows:

> During this experiment we want you to think out loud. Report all of the images, thoughts, and feelings that pass through your mind. Do not cling to any of them. Just observe them as they go by. At some point during the session, we will send you the target information. Do not try to anticipate or conjure up this information. Just give yourself the suggestion, right now—in the form of making a wish—that the information will appear in consciousness at the appropriate time. Keep your eyes open as much as possible during the session and allow your consciousness to flow through the sound you will hear through the headphones. One of us will be monitoring you in the other room. Now get as comfortable as possible, release all conscious hold of your body, and allow it to relax completely. As soon as you begin observing your mental processes, start thinking out loud. Continue to share your thoughts, images, and feelings with us throughout the session.

[2] An exception occurs in the two target comparison series (Series 301 and 302). See pp. 112–113.

Mentation/Sending Procedures

Receiver mentation report. After the relaxation exercise and instructions, R listens to the white noise through headphones for 30 minutes. R reports whatever thoughts, images, and feelings occur in the ganzfeld. The mentation report is monitored by E and Se from their respective rooms. The mentation report is tape recorded, and E takes detailed notes for review from R prior to judging.

Target presentation and sender procedures. A Cavri Video Interface automates computer access and control of targets from a JVC BR-6400U VCR. An electronic video switcher selectively routes the video output (VCR or computer text mode) to three color TV monitors, one each for E, R, and Se. E's and R's monitors remain in computer text mode until the judging period. During each of the six sending periods, Se's TV monitor is switched from computer text to VCR mode.

At the beginning of each sending period, Se's monitor displays the prompt, "Silently communicate the contents and meaning of the target to [R's first name]." Se views the target and attempts to communicate its contents to R. Se mentally reinforces R for target-related associations and mentally discourages R when the mentation is unrelated to the target.

Judging Procedure

After the mentation period, E turns off the ganzfeld light and reads back R's mentation from the session notes. R remains in ganzfeld during the mentation review to minimize any abrupt shift in state. E's and R's TV monitors are switched into VCR mode by the computer, which also prompts Se to "Silently direct [R's first name] to select the target that you saw." Se's TV monitor remains blank (computer mode) during this period.

R removes the eye covers and views the preview pack. From their respective rooms, R and E then view the four potential targets (the actual target and three decoys), which are presented in one of four random sequences. R, viewing each candidate, associates to the item as though it were the actual target, describing perceived similarities between the item and the ganzfeld mentation. While R associates to each candidate, E points out potential correspondences that R may have overlooked.[3] R views any of the target candidates as often as desired before proceeding to the judging task.

[3] This applies to Pilot Series 3, Novice Series 103–105, and to Experienced Series

A 40-point rating scale then appears on R's TV monitor. The scale is labelled 0% on the left and 100% on the right. Using a computer-game paddle to move a pointer horizontally across the rating scale, R indicates the degree of similarity between his ganzfeld mentation and each potential target. E and Se view R's ratings on their monitors. The program checks for ties, and, if they occur, R re-rates the four candidates to obtain unique ratings for each. The program then converts R's ratings into ranks. A rank of 1 is assigned to the candidate R believes has the strongest similarity to his ganzfeld mentation; a rank of 4 is given to the candidate R believes is least like his ganzfeld experience.

Feedback and Post-Session Procedures

After R finishes judging, Se leaves the sender's room and enters R's room with E. Se reveals the actual target, which the computer automatically displays on R's TV monitor. The session data are written to a floppy disk file.

Following feedback, E is prompted to backup the series data disk. The target videocassette is then automatically wound to a position near the center of the videocassette (frame 50,000). E selects "Analysis" from the *Series Manager* menu and obtains a hardcopy printout of the session data file. The printout includes: the file name, R's name and ID number, series type, session number, Se's name, E's initials, date and start time, target number, target position in the set, R's target ranking, the standardized target rating (z score), target judging sequence, target name, target type and set number, sender type, light and white noise levels, finish time, and optional experimenter's comments. The printout is attached to E's notes on R's mentation and placed in a ring binder containing all such information for the series. The audio tape of the session is similarly filed.

Experimenters

Eight Es contributed to the autoganzfeld database. Honorton, one of the originators of the psi ganzfeld technique, has conducted psi ganzfeld experiments over a 16-year period. Derr and Varvoglis

201 and 302. It does not apply to the earlier series (Pilot Series 1–2; Novice Series 101–102; or Experienced Series 301). This practice was initiated because participants frequently failed to identify obvious correspondences between their mentation and target elements.

worked with Honorton at Maimonides Medical Center and were trained by him. Berger is primarily responsible for the technical implementation of the autoganzfeld system. He trained Honorton, Derr, Varvoglis, and Schechter in its use. Honorton trained Quant, Ferrari, and Schlitz in the use of the autoganzfeld system.[4]

Experimental Series

Altogether, 241 participants contributed 355 sessions in 11 series. To fully address the issue of selective reporting, we include every session completed from the inauguration of the experiments in February, 1983, to September, 1989, when the PRL facility was closed. Thus, this database has no "file-drawer" problem (Rosenthal, 1984).

The studies include three pilot series and eight formal series. Five of the formal series were single-session studies with novice participants. The remaining three formal series involved experienced participants.

Pilot Series

Series 1. This initial pilot series was conducted during the development and testing of the autoganzfeld system. It served to test system operation, to detect and correct programming errors, and to fine-tune session timing functions. Nineteen subjects contributed 22 sessions as Rs. Seven, including PRL staff members, had prior experience as Rs in nonautomated ganzfeld studies at Maimonides Medical Center. The remaining 12 Rs were novices with no prior ganzfeld experience. Series sample size was not specified in advance; the series continued until we were satisfied that the system was operating reliably.

Series 2. This pilot series was designed by Berger in an attempt to avert potential displacement effects and subject judging problems by having E rather than R serve as judge. R received feedback only to the actual target. Four participants contributed to this series. Nine of the planned 50 sessions were completed before Berger's departure from PRL when this series was discontinued.

[4] Berger, Schechter, and Varvoglis have doctorate degrees in psychology. Quant holds a masters degree in counselling psychology, and Ferrari has a bachelors degree in psychology. Schlitz has conducted independent ganzfeld and remote-viewing research in other laboratories and has a masters degree in anthropology.

Series 3. This pilot series was a practice series for participants who completed the allotted number of sessions in ongoing formal series but who wanted additional ganzfeld experience. This series also includes several demonstration sessions when TV film crews were present and provided receiver experience for new PRL staff. The sample size was not preset.

Novice ("First-Timers") Series

The identification of characteristics associated with successful initial performance was a major goal of the PRL ganzfeld project (Honorton & Schechter, 1987). Except for Series 105, each novice series includes 50 ganzfeld novices, that is, participants with no prior ganzfeld experience. Each novice contributed a single ganzfeld session. Most novices had not participated in *any* psi experiment prior to the novice series.

Series 101. This is the first novice series.

Series 102. Beginning with this series, R was prompted after the mentation period to estimate the number of minutes since the end of the relaxation/instructions tape.

Series 103. Starting with this series, Rs were given the option of having no sender (i.e., "clairvoyance" condition). Only four participants opted to have no sender.

Series 104. A visiting scientist (Marilyn Schlitz) served as E in seven sessions and as Se in six sessions with subjects from The Juilliard School in New York.

Series 105. This series was started to accommodate the overflow of Juilliard students from Series 104. The sample size was set to 25. Six sessions were completed at the time the PRL program was suspended. (There were 20 Juilliard students altogether. Sixteen were in Series 104 and four were in Series 105.)

Experienced Subjects Series

Series 201. This series involved especially promising subjects. The number of trials was set to 20. Seven sessions by three Rs were completed at the time the PRL program was suspended.

Series 301. This series compared dynamic and static targets. Sample size was set to 50 sessions. Twenty-five experienced subjects each contributed two sessions. The autoganzfeld program was modified for this series so that each R would have one session with dy-

namic targets and one session with static targets. Subjects were informed of this only after completing both sessions.

Series 302. This series used a single dynamic target set (Set 20). In earlier series, Target 77 ("Tidal Wave Engulfing Ancient City") had an especially strong success rate while Target 79 ("High-Speed Sex Trio") had never been correctly identified. We made two program modifications for this series. The target selection ("Randomize") routine was modified to select only targets in Set 20, and the VCR tape-centering routine was modified to wind the videotape to a randomly selected position between frame numbers 85,000 and 95,000. The second modification insured that E could not be cued, perhaps unconsciously, by the time required to wind the tape from its initial position to the target location.

The study involved experienced Rs who had no prior experience with Set 20. Each R contributed one session. Participants were unaware of the purpose of the study or that it was limited to one target set. The design called for the series to continue until 15 sessions were completed with each of the two targets of interest. Twenty-five sessions were completed when the PRL program was suspended.

Statistical Analysis

Except for two pilot series, series sample sizes were specified in advance. Our primary hypothesis was that the observed success rate—the proportion of correctly identified targets—would reliably exceed the null hypothesis expectation of .25. To test this hypothesis, we calculated the exact binomial probability for the observed number of direct hits (ranks of 1) with $p = .25$ and $q = .75$. On the basis of the overwhelmingly positive outcomes of earlier studies, we preset alpha to .05, one-tailed.

We also tested two secondary hypotheses, based on patterns of success in earlier psi ganzfeld research. These are: (1) that dynamic targets are significantly superior to static targets, and (2) that performance is significantly enhanced when the sender is a friend of R, compared to when R and Se are not acquainted. We initially planned to test these hypotheses by chi-square tests, a trial-based analysis. However, a consultant (Dr. Robert Rosenthal) suggested that a t test using the series as the unit would be a more powerful test of these hypotheses, and we have followed his recommendation. The remaining analyses are exploratory.[5]

[5] The statistical analyses in this report were performed using SYSTAT (Wilkin-

TABLE 1
OUTCOME BY SERIES

Series	Series type	*N* subjects	*N* trials	Hits		Effect size	
				N	%	(*h*)	*z*
1	Pilot	19	22	8	36	.25	.99
2	Pilot	4	9	3	33	.18	.25
3	Pilot	25	36	10	28	.07	.22
101	Novice	50	50	12	24	−.02	−.30
102	Novice	50	50	18	36	.24	1.60
103	Novice	50	50	15	30	.11	.67
104	Novice	50	50	18	36	.24	1.60
105	Novice	6	6	4	67	.87	1.78
201	Experienced	3	7	3	43	.38	.69
301	Experienced	25	50	15	30	.11	.67
302	Experienced	25	25	16	64	.81	3.93
	Overall	241	355	122	34	.20	3.89

Note. The *z* scores are based on the exact binomial probability with $p = .25$ and $q = .75$.

RESULTS

Overall Success Rate

Ganzfeld hit rate. There were 241 participants, who contributed 355 autoganzfeld sessions. The 122 direct hits (34.4%) yield an exact binomial p of .00005 ($z = 3.89$). The effect size, Cohen's h (Cohen, 1977), is .20. The 95% confidence interval (CI) is a hit rate from 30% to 39%. Because this level of accuracy would occur about one time in 20,000 by chance, we reject the null hypothesis. (See Table 1.)

Success rate by series. Of the 11 series, 10 yield positive outcomes. The mean series effect size is .29, $SD = .29$, $t\,(10) = 3.32$.

Homogeneity of effect sizes. Traditionally, psi investigators have been preoccupied by whether there is a significant nonzero effect. An equally important issue, however, is the size of the effect. There is a growing tendency among behavioral scientists to define replicability in terms of the homogeneity of effect sizes (Hedges, 1987;

son, 1988). When t tests are reported on samples with unequal variances, they are calculated using the separate variances within groups for the error and degrees of freedom following Brownlee (1965). Combined zs are based on Stouffer's method (Rosenthal, 1984). Unless otherwise specified, p levels are one-tailed.

TABLE 2
OUTCOME BY EXPERIMENTER

Experimenter	*N* trials	Hits		Effect size (*h*)
		N	%	
Quant	106	38	36	.24
Honorton	72	27	38	.29
Berger	53	18	34	.20
Derr	45	12	27	.05
Varvoglis	43	11	26	.03
Schechter	14	5	36	.23
Ferrari	15	9	60	.72
Schlitz	7	2	29	.08

Rosenthal, 1986; Utts, 1986). Two or more studies are replicates of one another if their effect sizes are homogeneous. We assess the homogeneity of effect sizes across the 11 series by performing a chi-square homogeneity test comparing the effect size for each series with the weighted mean effect size (Hedges, 1981; Rosenthal, 1984). The formula is:

$$\chi^2(k - 1) = \sum_{i=1}^{k} N_i(h_i - \bar{h})^2,$$

where k is the number of studies, N_i is the sample size of the ith study, and the weighted mean effect size is:

$$\bar{h} = \frac{\sum_{i=1}^{k} N_i h_i}{\sum_{i=1}^{k} N_i}.$$

The test shows that the series effect sizes are not significantly nonhomogeneous: $\chi^2 = 16.25$, 10 *df*, $p = .093$.

Homogeneity of Outcome by Experimenter

Eight Es contributed to the autoganzfeld database. (See Table 2.) All eight experimenters have positive effect sizes. A chi-square homogeneity test, using the mean effect sizes for each E weighted by sample size, indicates that the results are homogeneous across experimenters: $\chi^2 = 7.13$, 7 *df*, $p = .415$.

TABLE 3
GANZFELD SUCCESS IN RELATION TO NUMBER OF SESSIONS

	No. of sessions as receiver			
	1	2	3	4 +
N subjects	183	23	24	11
N trials	183	46	72	54
Hits	53	19	31	19
% Hits	29	41	43	35
Effect size (*h*)	.09	.34	.38	.22

Subject-Based Analysis

Seventy-six percent of the participants (N = 183) contributed a single session as R. Fifty-eight Rs contributed multiple sessions. Participants with multiple sessions either had direct hits or strongly suggestive target mentation correspondences in their first session. (See Table 3.)

Success rate by subjects. To test the consistency of ganzfeld performance across participants, we use the standardized ratings of the target and decoys (Stanford's z scores; Stanford & Sargent, 1983) as the dependent variable. Stanford zs are averaged for participants with multiple sessions. Direct hits and Stanford zs are highly correlated. In this database, N (353) is .776. The mean Stanford z for the 241 participants is .21 (SD = 1.04), and t (240) = 3.22 (p = .00073). The 95% CI is a Stanford z from .08 to .35. The effect size (Cohen's d; Cohen, 1977) is .21. (The effect size for subjects is nearly identical to the trial-based effect size, h = .20.) Thus, there is a general tendency for participants to give higher ratings to the actual target than to the decoys, and the significance of these experiments is not attributable to exceptional performance by a few outstanding subjects.

Dynamic Versus Static Targets

The success rate for dynamic targets is highly significant. There are 190 dynamic target sessions and 77 direct hits (40%, h = .32; exact binomial $p = 1.9 \times 10^{-6}$, z = 4.62). The hit rate for static targets is not significant (165 trials, 45 hits, 27%, h = .05, p = .276, z = .59). Using the series effect size as the outcome variable and target type as the predictor variable, the point-biserial correlation (r_p) between ganzfeld performance and target type is .663, t (17) =

TABLE 4
SENDER/RECEIVER PAIRING

	Sender as:		
	Lab	Lab friend	Friend
N trials	140	66	145
N hits	46	24	52
% Hits	33	36	36
Effect size (*h*)	.18	.24	.24
z	2.01	1.93	2.83
p	.023	.026	.0023

3.65, $p = .002$.[6] The 95% CI for dynamic targets is a hit rate from 34% to 47%. The CI for static targets is from 21% to 34%. Thus, our hypothesis concerning the superiority of dynamic targets is strongly supported.

Sender/Receiver Pairing

Receivers are more successful with friends than with laboratory senders, although the difference is not statistically significant. The number of sessions in this analysis is 351 because four subjects opted to have no sender. The best performance occurs with friend senders. Sessions with laboratory senders, although significant, have the lowest success rate. (See Table 4.)

Using series effect sizes as the unit of analysis and sender type as the predictor variable (combining lab friend and friends), r_p is .363, $t(17) = 1.61$, $p = .0635$.[7] The 95% CI for sessions with friends is a hit rate from 33.3% to 47%. For lab senders, the CI is from 18.3% to 41.8%. Thus, although the effect of sender type is not statistically significant, there is a trend toward better results with friends.

[6] Separate effect sizes were obtained for the dynamic and static target sessions of each series. Since Series 302 used dynamic targets only, the analysis is based on 11 dynamic target effect sizes and 8 static target effect sizes; two static target series (105 and 201) had extremely small sample sizes (2 and 3 sessions, respectively). A similar procedure is used in the analyses of sender/receiver pairing and experienced versus novice subjects.

[7] Three series involving laboratory senders were eliminated from this analysis because of extremely small sample sizes. These include Series 2 ($n = 2$), Series 105 ($n = 2$), and Series 201 ($n = 1$). Thus, the point biserial correlation is based on 11 series with friends and 8 series with laboratory senders.

Ganzfeld Experience

Two hundred and eighteen participants had their first experience as ganzfeld receivers in the autoganzfeld series. (This includes the 5 Novice Series 101–105 and 12 novices in Series 1.) For all but 24 (11%), their initial autoganzfeld session provided their first experience as participant in any parapsychological research. Of the 218 novices, 71 (32.5%, $h = .17$) correctly identified their target (exact binomial $p = .0073$, $z = 2.44$).

Participants with some ganzfeld experience contributed 137 trials and 51 hits (37%, $h = .26$, $p = .001$, $z = 3.09$). When series effect sizes are used as the unit of analysis and prior ganzfeld experience is used as the predictor variable, r_p is .078, t (10) = 0.25, $p = .41$. The 95% CI for novices is a hit rate from 25.5% to 49.5%. The CI for experienced participants is from 29% to 50%.

Participation by PRL Laboratory Staff

For completeness, we report the contribution of laboratory staff as subjects in this database. PRL staff members contributed 12 sessions as R. These sessions yield 3 hits (exact binomial $p = .50$; $h = .00$).

White Noise and Ganzfeld Illumination Levels

The mean white noise level (in arbitrary units of 0–7.5) is 2.97 ($SD = 1.77$). As measured from the headphones, the mean noise level is approximately 68 dB. The mean light intensity (arbitrary units of 0–100) is 73.8 ($SD = 26.1$). Preferred noise and light intensity levels are highly correlated: $r = .569$, t (353) = 12.99.

Neither noise nor light intensity is significantly related to ganzfeld performance. The point-biserial correlation between hits and noise level is $-.026$, t (353) = -0.48, $p = .631$, two tailed. For light intensity, r_p is $-.040$, t (353) = -0.76, $p = .449$, two tailed.

Randomness Tests

The adequacy of randomization was a major source of disagreement in two meta-analytic reviews of earlier psi ganzfeld research (Honorton, 1985; Hyman, 1985). In this section we document the

adequacy of our randomization procedure according to guidelines agreed on by Hyman and Honorton (1986).

Global Tests of Random Number Generator

Full-range frequency analysis. As described earlier, autoganzfeld targets are selected through a program call to the RNG for values within the target range (1–160). The number of experimental sessions ($N = 355$) is too small to assess the RNG output distribution for the full range, so we performed a large-scale control series to test the distribution of values. Twelve control samples were collected. These included five samples with 156,000 trials, six samples with 1,560 trials, and one sample of 1,560,000 trials. The 12 resulting chi-square values were compared to a chi-square distribution with 155 *df*, using the Kolmogorov-Smirnov (KS) one-sample test. The KS test yields a two-tailed $p = .577$, indicating that the RNG used in these experiments provides a uniform distribution of values throughout the full target range.[8]

Test of frequency distribution for Set 20. We used a single target set (Set 20) in Series 302. We repeated the frequency analysis in a 40,000-trial control sample, restricting target selection to the four target values within Set 20 (Targets 77–80). A chi-square test of the distribution of targets within Set 20 shows that the RNG produces a uniform distribution of the target values within the set: $\chi^2 = 3.19$, 3 *df*, $p = .363$.

Tests of the Experimental RNG Usage

Each autoganzfeld session required two RNG calls. An RNG call at the beginning of the session determined the target; another, made before the judging procedure, determined the order in which the target and decoys were presented for judging.

Distribution of targets in the experiment. A chi-square test of the distribution of values within the target sets shows that the targets were selected uniformly from among the four possibilities within each set; χ^2 with 3 *df* is 0.86, $p = .835$.

Distribution of judging order. A chi-square test of the judging order indicates that the targets were uniformly distributed among the four possible judging sequences: the χ^2 with 3 *df* is 1.85, $p = .604$.

[8] One of the preview pack elements for Set 6, containing Targets 21–24, was damaged. This required filtering the RNG calls in the experiment and control tests to bypass the damaged portion of the videotape, leaving the targets in Pool 6 unused. Thus, for the full-range analyses reported here, there are 155 *df* rather than 159.

Summary

The randomness tests demonstrate that the RNG used for target selection in these experiments provides an adequate source of random numbers and was functioning properly during the experiments.

Examples of Target-Mentation Correspondences

In this section, we present some examples of correspondences between targets and ganzfeld mentation. Although conclusions cannot be drawn from qualitative data, this material should not be ignored. It constitutes the raw data on which the objective statistical evidence is based, and may provide important insights concerning the underlying process. These examples are excerpts from sessions of subjects' ganzfeld mentation reports, identified by them during the blind judging procedure as providing their basis for rating the target.

Target 90, Static: Dali's "Christ Crucified."
Series 1. Participant ID: 77. Rank = 1. z score = 1.67.

> "... I think of guides, like spirit guides, leading me and I come into like a court with a king. It's quiet.... It's like heaven. The king is something like Jesus. Woman. Now I'm just sort of summersaulting through heaven.... Brooding.... Aztecs, the Sun God.... High priest.... Fear.... Graves. Woman. Prayer.... Funeral.... Dark. Death.... Souls.... Ten Commandments. Moses...."

Target 77, Dynamic: Tidal wave engulfing ancient city. From "The Clash of the Titans," a film based on Greek mythology. A huge tidal wave crashes into the shore. The scene shifts to a center courtyard of an ancient Greek city; there is a statue in the center, and buildings with Greek columns around the periphery. People are running to escape consumption by the tidal wave. Water rushes through the buildings, destroying the columns and the statue; people scurry through a stone tunnel, just ahead of the engulfing water; debris floats through the water.
Series: 1. Participant ID: 87. Rank = 1. z score = 1.42.

> "... The city of Bath comes to mind. The Romans. The reconstruction of the baths through archaeology. The Parthenon. Also getting sort of buildings like Stonehenge but sort of a cross between Stonehenge and the Parthenon. The Byzantine Empire. The Gates of Thunder. The

Holy See. Tables floating about.... The number 7 very clearly. That just popped out of nowhere. It reminds me a bit of one of the first *Clash* albums, however. The Clash, *"Two Sevens"* I think it was called, I'm not sure...." [The target was number 77.]

Series 302. Participant ID: 267. Rank = 1. z score = 2.00.

"...A big storm over New York City. I'm assuming it's New York City. No, it's San Francisco.... A big storm and danger. It looks so beautiful but I'm getting the sense of danger from it.... It's a storm. An earthquake...."

Target 63, Dynamic: Horses. From the film, "The Lathe of Heaven." An overhead view of five horses galloping in a snow storm. The camera zooms in on the horses as they gallop through the snow. The scene shifts to a close-up of a single horse trotting in a grassy meadow, first at normal speed, then in slow-motion. The scene shifts again; the same horse trotting slowly through empty city streets.
Series: 101. Participant ID: 92. Rank = 1. z score = 1.25.

"...I keep going to the mountains.... It's snowing.... Moving again, this time to the left, spinning to the left.... Spinning. Like on a carousel, horses. Horses on a carousel, a circus...."

Target 46, Dynamic: Collapsing Bridge. Newsreel footage of the collapse of a bridge the 1940s. The bridge is swaying back and forth and up and down. Light posts are swaying. The bridge collapses from the center into the water.
Series: 101. Participant ID: 135. Rank = 1. z score = 1.94.

"...Something, some vertical object bending or swaying, almost something swaying in the wind.... Some thin, vertical object, bending to the left.... Some kind of ladder-like structure but it seems to be almost blowing in the wind. Almost like a ladder-like bridge over some kind of chasm that's waving in the wind. This is not vertical this is horizontal.... A bridge, a drawbridge over something. It's like one of those old English type bridges that opens up from either side. The middle part comes up. I see it opening. It's opening. There was a flash of an old English stone bridge but then back to this one that's opening. The bridge is lifting, both sides now. Now both sides are straight up. Now it's closing again. It's closing, it's coming down, it's closed. Arc, images of arcs, arcs, bridges. Passageways, many arcs. Bridges with many arcs....

Target 137, Static: "Working on a Watermelon Farm." This painting shows a black man with his back to the picture; his suspenders form a V-shape

around his shoulders. A dog is in front of the man; there are watermelons between the dog and the man. The man faces a dirt path with watermelon patches on either side. On the left side, another man pushes a wheelbarrow filled with huge watermelons.
Series: 101. Participant ID: 105. Rank = 2. z score = 0.98.

> "...a small lamb, very soft, outside. Small, playful.... I see a 'V' shape.... An apple.... I see a kitchen towel with a picture on it. Apple seeds or a fruit cut in half showing the seeds. A tomato or an apple. The fruit was red on the outside.... I thought of watermelon as in a watermelon basket. Thinking of kids playing on a beach. Little kids playing with balls that are bigger than they are and buckets that are three-quarters their size.... I had a thought of going through a tunnel, not the kind of tunnel you see on Earth but the type of tunnel described when someone dies."

Target 64, Dynamic: 1920s Car Sinking. From the film "Ghost Story." The scene depicts the murder of a young blonde woman by three young men in the 1920s. The men are all wearing suits; one of the men is wearing a fedora hat that is turned up in the back. The men push an old car into a lake. The camera shifts between close-ups of their facial expressions, and the car, as it slowly sinks into the water. The woman's face and hand appear in the car's large rectangular rear window; she silently screams out for help. The car disappears beneath the water as the sequence ends.
Series: 102. Participant ID: 154. Rank = 1. z score = 1.45.

> "...Girl with a haircut.... Blond hair.... A car.... The back of someone's head.... Someone running to the right.... Someone on the right in a brown suit...and a fedora hat turned up very much in the back.... Fedora, trench coat, dark tie.... A tire of a car. The car's going to the left. An old movie.... I'm picturing an Edward G. Robinson movie.... Big roundish car like 1940's. Those scenes from the back window. Bumping once in a while up and down looking through the back window you could see that it was probably a big screen in back of the car and the car's standing still actually.... I think it's a movie I saw. They're being shot at and shooting at the window and then the girl gets shot.... Girl with the blonde haircut.... Someone walking in a suit, brown suit.... It's the 1940's again, 30's maybe. Except it looks like it's in color. Something red, blood...blood on someone's lap.... A dead person all of a sudden.... A big mouth opened. Yelling, but no sound.... Two people running near a train.... Dressed in 1920 type suits with balloony pants, like knickers.... A big, old-fashioned white car with a flat top. 1920's, 30's...."

Target 107, Static: Stained-Glass Madonna with Child. This is a stained-glass window depicting the Virgin Mary and Christ child.

Series: 102. Participant ID: 183. Rank = 2. z score = 0.61.

> "Some kind of a house, structure.... Some kind of wall or building. Something with the sky in the background. Thinking of a bell. A bell structure. Something with a hole with the light coming through the hole.... Like a stained glass window like you see in churches."

Target 19, Static: Flying Eagle. An eagle with outstretched wings is about to land on a perch; its claws are extended. The eagle's head is white and its wings and body are black.
Series: 104. Participant ID: 316. Rank = 1. z score = 2.00.

> "... A black bird. I see a dark shape of a black bird with a very pointed beak with his wings down.... Almost needle-like beak.... Something that would fly or is flying... like a big parrot with long feathers on a perch. Lots of feathers, tail feathers, long, long, long.... Flying, a big huge, huge eagle. The wings of an eagle spread out.... The head of an eagle. White head and dark feathers.... The bottom of a bird...."

Target 144, Dynamic: Hell. From the film "Altered States." This sequence depicts a psychedelic experience. Everything is tinted red. The rapidly shifting scenes include: A man screaming; many people in the midst of fire and smoke; a man screaming in an isolation tank; people in agony; a large sun with a corona around it; a mass crucifixion; people jumping off a precipice, in the midst of fire, smoke, and molten lava; spiraling crucifixes. There is a close-up of a lizard's head, slowly opening its mouth, at the end of the sequence.
Series: 104. Participant ID: 321. Rank = 1. z score = 1.49.

> "... I just see a big 'X'. A big 'X'.... I see a tunnel in front of me. It's like a tunnel of smog or a tunnel of smoke. I'm going down it.... I'm going down it at a pretty fast speed.... I still see the color red, red, red, red, red, red, red, red.... Ah, suddenly the sun.... The kind of cartoon sun you see when you can see each pointy spike around the sphere.... I stepped on a piece of glass and there's a bit of blood coming out of my foot.... A lizard, with a big, big, big head...."

Target 148, Static. Three Unusual Planes. Three small aircraft flying in formation. The planes are white and have swept-back wings; their landing-gear is extended. A winding road is visible below.
Series: 104. Participant ID: 322. Rank = 2. z score = 0.39.

> "... A jet plane.... A 747 on the way to Greece. Blue skies. Sounds like it's going higher.... I think I'm back on the plane again. I never used to be afraid of flying until recently.... They need better insulated jets, soundproof like these rooms. They could use these comfortable seats, too. And the leg room. The service isn't bad either.... Still can't get the

feeling of being in an airplane out of my mind. Flying over Greenland and Iceland when I went to England.... Feels like we're going higher and higher.... Descending. It seems we're descending.... Big airplanes flying over with people like me staring down.... Flying around in a piece of tin.... Feel like I'm getting a G-force. Maybe I am taking off. Sure feels like it. Feels like we're going straight up.... I always feel like when I'm on the plane going home, I just hope that plane makes it past the Rocky Mountains...."

Target 10, Static: Santa and Coke. This is a Coca-Cola Christmas ad from the 1950s, showing Santa Claus holding a Coke bottle in his left hand; three buttons are visible on Santa's suit. Behind Santa and to his left, is a large bottle cap with the Coca-Cola logo leaning against an ornamented Christmas tree.
Series: 104. Participant ID: 332. Rank = 1. z score = 1.14.

"... There's a man with a dark beard and he's got a sharp face.... There's another man with a beard. Now there's green and white and he's in bushes and he's sort of colonial. He looks like Robin Hood and he's wearing a hat.... I can see him from behind. I can see his hat and he has a sack over his shoulder.... Window ledge is looking down and there's a billboard that says 'Coca-Cola' on it.... There's a snowman again and it's got a carrot for a nose and three black buttons coming down the front.... There's a white beard again. There's a man with a white beard.... There's an old man with a beard...."

Target 70, Dynamic: Dancing in NY City Streets. From the film "The Wiz." The span of yellow-paved bridge over a body of water and automobile traffic is visible in the opening scene; the New York City skyline is in the background. A hot-air balloon flies overhead. The scene shifts as Dorothy (Diana Ross), her dog Toto, the Lion, Tin Man, and Scarecrow dance along the bridge; one of the bridge's supporting arches is behind them. The Chrysler Building is in the background. At the end of the sequence, the characters dance in front of a painted backdrop of an old-fashioned building.
Series: 105. Participant ID: 336. Rank = 1. z score = 1.40.

"Big colorful hot air balloons.... White brick wall.... Ocean.... People walking before my eyes. Several people.... A dog. Hot air balloon.... a nightclub singer.... Back of a woman's head, short curly hair.... Water.... Balloon, big balloon.... Yellow.... Very tall building. Looking down at a city. Leaving a city, going up.... Faces. An arc.... Water.... A woman's face.... Cars, freeway.... A rock-n-roll star chanting.... Architecture. A jester's hat.... geometrical figures, designs. ... Yellow chocolate bar. Water. Going down into water, deep down.... Man with long golden hair and sun glasses.... The Bay, San Francisco

Bay. A lion.... Highways.... Lion, see a lion.... Tornado.... Balloon.... Face mask.... City.... Leaning Tower of Pisa.... Long hallway, doorway.... Long road. Long, long desert road...."

Target 22, Dynamic: Spiders. From the documentary "Life on Earth." A spider is weaving its web. The spider's long legs spring up and down repeatedly, weaving strands of the web. The body of the spider is constantly in motion, and bounces up and down. A close-up shows one of the veins of the web being stretched out by the spider. Various views of the web.
Series: 301. Participant ID: 146. Rank = 2. z score = 0.65.

"...Now visual patterns more like a spider web and the color. And then like the form of the veins of a windmill....Something like a spider web again. A spider web. A pattern that instead of a spider web it looks like basket weaving....An image of the way some children were able to do something like flying when I was a child though I never had one. It was a—forgotten what it was called—a pogo stick or a jump stick, something in which you jumped up and down and you could hop quite a distance by doing so....I have kinesthetic images all over as in vigorous motion expressed in flying or jumping on this sort of spring stick that I mentioned....Vigorous motion. It's as though I were trying to combine relaxation with participating in an image of something very vigorous....I really feel carried away by these images of vigorous activity without being able to localize this activity as to what it is...."

Target 108, Static: Two fire eaters. A young fire eater, in the foreground, facing to the right of the picture, blows a huge flame out of his mouth. In the background there is another fire eater. A group of people are watching on the left side of the picture.
Series: 301. Participant ID: 146. Rank = 1. z score = 1.71.

"...I keep having images of flames now and then....The sound reminds me of flames too....I find flames again....In these new images the fire takes on a very menacing meaning....Rather mountainous sticking up of bare rocks just as though they had come from a recently formed volcano. Volcanos of course get back to the fire, extreme heat. I had an image of a volcano with molten lava inside the crater. Molten lava running down the side of the volcano....Cold. Written out there behind the visual field and thinking how it contrasts with my images of flames. Although my images of flames didn't actually include much real feeling of heat. I didn't have any imagery of heat in connection with the flames. Just abstract thought of flames....Now I think of the water as a way of putting out flames. Suddenly, I was biting my lip. Biting my lip as though lips had something to do with the imagery and I see lips out in front of me....And the lips I see are bright red, reminding me of the flame imagery earlier. And then a bright heart such as Valentine's

candy in the shape of a heart. The cinnamon flavored candies that I remember as a child having at Valentine's. Red color.... This red as in the cinnamon candy is a deep very intense red. And similarly for the flames. And now I see the word 'red'...."

Target 94, Dynamic: Hang Gliders. The sequence shows a skier on a V-shaped hang glider. The skier soars high up above snow-covered mountains and a pine forest. At the end, the skier lands on a mountain slope and skis away. The sequence is accompanied by Pachelbel's Canon.
Series: 301. Participant ID: 188. Rank = 1. z score = 1.26.

"...Some kind of 'V' shape, like an open book.... I get some mountain.... Some kind of bird with a long wing.... The shape of an upside down 'V'.... Ski, something about skiing came to me.... Some kind of a body like an oval shape of a body with wings on top of it in a 'V' shape. Another 'V' like a wing shape.... Something with wings.... Again the shape of an umbrella came into my mind. A butterfly shape...."

Target 80, Dynamic: Bugs Bunny in Space. In this cartoon, there is a close-up of the lower part of a cigar-shaped rocketship and the supports holding it up. The rocket assembly slides over to the launching pad, directly above Bugs Bunny's underground patch. The scene shifts to the underground patch, as Bugs Bunny climbs up the ladder leading out of his patch. Unknowingly, he climbs up through the interior of the rocketship. The rocket's supports pull away and then it takes off into space. The rocket's nose cone spins as Bugs Bunny appears through the top and he sees the Earth recede rapidly in the distance. As the sequence ends, Bugs Bunny is hit in the belly by a comet.
Series: 302. Participant ID: 292. Rank = 1. z score = 1.48.

"...Space craft.... The solar system. The underside of a helicopter or a submarine or some kind of fish that you're seeing from underneath.... Sort of being underneath it. Sort of being underneath it.... A very strange image like a cartoon character, animated character. With his mouth open kind of.... Like a hypodermic needle or a candle or this shaft like thing with the a pointed top again.... missiles flying.... An aerial perspective.... I'm just kind of editing here I think. I'm really hoping all this rocketship kind of imagery isn't because of the noise. I feel like I'm in a rocketship or something.... That image of the ship going into the belly of the mother ship...."

Comparison of Study Outcomes with Ganzfeld Meta-Analysis

In this section, we compare the automated ganzfeld study outcomes with the results of earlier ganzfeld studies, summarized in a

TABLE 5
COMPARISON OF OVERALL PERFORMANCE IN AUTOMATED GANZFELD AND META-ANALYSIS DATA SETS

Outcome variable	Database	*N* studies	Mean	*SD*	*t*	*df*	*p*
z scores	Meta-analysis	28	1.25	1.57	0.33	25	.748
	Autoganzfeld	11	1.10	1.14			
Effect sizes (*h*)	Meta-analysis	28	.28	.46	0.14	28	.892
	Autoganzfeld	11	.29	.29			

Note. The *p* values are two-tailed.

meta-analysis (Honorton, 1985). We compare the two databases on four dimensions: (1) overall success rate, (2) dynamic versus static targets, (3) sender/receiver pairing, and (4) novice versus experienced subjects.

Overall Success Rate

To assess the consistency of results, we compare the 11 autoganzfeld series to the 28 studies in a meta-analysis of earlier ganzfeld studies (Honorton, 1985, Table A1, p. 84), using direct hits as the dependent variable. The outcomes of the two data sets are consistent. Both display a predominance of positive outcomes: 23 of the 28 studies in the meta-analysis (82%) and 10 of the 11 autoganzfeld series (91%) yield positive *z* scores. The mean autoganzfeld *z* scores and effect sizes are very similar to those in the meta-analysis. (See Table 5.)

Combined Estimates of Ganzfeld Success Rate

Because the *z* scores and effect sizes for the automated ganzfeld are consistent with the original set of 28 studies in the meta-analysis, a better estimate of their true population values may be obtained by combining them. Positive outcomes were obtained in 33 of the 39 studies (85%); the 95% CI is from 69% to 99%. Table 6 shows a stem-and-leaf frequency plot of the *z* scores (Tukey, 1977). Unlike other methods of displaying frequency distributions, the stem-and-leaf plot retains the numerical data precisely. (Turned on its side, the stem-and-leaf plot becomes a conventional histogram.) Each number includes a stem and one or more leaves. For example, the stem 1 is followed by leaves of 6,6,6,7,7,7, representing *z* scores of 1.6,1.6,1.6,1.7,1.7,1.7. In the display, the letter "H" identifies the

TABLE 6
DISTRIBUTION OF *z* SCORES

Stem		Leaf			
			Minimum *z*	=	−1.97
−1.		97	Lower hinge	=	0.25
−0.		85	Median *z*	=	0.92
−0.		33	Mean *z*	=	1.28
0.	H	222224	Upper hinge	=	2.08
0.	M	6667777999	Maximum *z*	=	4.02
1.		666777	*SD*	=	1.44
2.	H	011	Skewness (g_1)	=	0.05
2.		8	Kurtosis (g_2)	=	−0.37
3.		01124	Combined (Stouffer) *z*	=	7.53
3.		9			
4.		0			

upper and lower hinges of the distribution, and "M" identifies its median. The *z*'s range from −1.97 to 4.02 (mean *z* = 1.21, *SD* = 1.45), and the 95% CI is a *z* from .76 to 1.66.

The combined *z* for the 39 studies is 7.53 ($p = 9 \times 10^{-14}$). Rosenthal's (1984) file-drawer statistic indicates that 778 additional studies with *z* scores averaging zero would be required to reduce the significance of the combined ganzfeld database to nonsignificance; that is a ratio of 19 unknown studies for every known study.

A stem-and-leaf display of the effect sizes is shown in Table 7. The effect sizes range from −.93 to 1.44 (mean *h* = .28, *SD* = .41). The two most extreme values on both sides of the distribution are outliers. The 95% CI is an *h* between .15 and .41; the equivalent hit rate is from 31.5% to 44.5%.

Dynamic Versus Static Targets

The use of video sequences as targets is a novel feature of the autoganzfeld database. However, a comparable difference in target type exists in the earlier ganzfeld studies. Of the 28 direct hits studies in the meta-analysis, 9 studies (by three independent investigators) used *View Master* stereoscopic slide reels as targets (Honorton, 1985, Studies 7–8, 16–19, 21, 38–39). Static targets (single pictures or slides) were used in the remaining 19 studies by seven independent investigators (Studies 1, 2, 4, 10–13, 23–31, 33–34, 41–42). Like the autoganzfeld video sequences, *View Master* targets present a variety of images reinforcing a central target theme.

TABLE 7
DISTRIBUTION OF EFFECT SIZES (COHEN'S *h*)

Stem	Leaf			
−.9	3			
−.4	0			
OUTSIDE VALUES				
		Minimum *h*	=	−0.93
−.3	1	Lower hinge	=	0.10
−.1	0	Median *h*	=	0.25
−.0	51	Mean *h*	=	0.28
.0	7779	Upper hinge	=	0.41
.1	H 002888	Maximum *h*	=	1.44
.2	M 1334	*SD*	=	0.41
.3	11144777	Skewness (g_1)	=	0.28
.4	H 01113	Kurtosis (g_2)	=	2.49
.5	7			
.7	3			
.8	17			
OUTSIDE VALUES				
1.3	3			
1.4	4			

To compare the relative impact of dynamic and static targets in the autoganzfeld and meta-analysis, we obtained point-biserial correlations for each data set using target type (static or dynamic) as the predictor variable and the series effect size, Cohen's *h*, as the outcome variable. We test the difference between the two correlations using Cohen's *q* (Cohen, 1977). Dynamic targets yield significantly larger effect sizes in both data sets. For the meta-analysis, r_p is .409, t (26) = 2.28, p = .015; and for the autoganzfeld, as reported above, r_p is .663. The two correlations are not significantly different (q = .36; z = 1.14). Therefore, we combine the two data sets to obtain a better estimate of the relationship between effect size and target type: r_p = .439, t (45) = 3.28, p = .002. The 95% CIs are 24% to 36% for static targets and 38% to 55% for dynamic targets. Thus, the cumulative evidence strongly indicates that dynamic targets are more accurately retrieved than static targets.

Sender/Receiver Pairing

A similar analysis compares the effects of sender/receiver pairing in the two databases. Studies in the meta-analysis did not routinely

provide detailed breakdowns regarding sender/receiver pairing. Sender/receiver pairing in the meta-analysis can only be coded according to whether subjects could bring friends to serve as their sender or were restricted to laboratory senders. In 17 studies, by six independent investigators, subjects were free to bring friends (Honorton, 1985, Studies 1–2, 4, 7–8, 16, 23–28, 30, 33–34, 38–39). Laboratory-assigned senders were used exclusively in the remaining 8 studies, by four independent investigators (Studies 10–12, 18–19, 21, 29, 41). (Three studies using clairvoyance procedures and no senders are excluded from this analysis.) For the autoganzfeld studies, we calculated separate effect sizes for each series by sender type (combining lab friend and friend for comparability with the meta-analysis). In the meta-analysis, r_p (23) is .403; larger effect sizes occurred in studies where friends could serve as sender ($t = 2.11$, $p = .023$). For the autoganzfeld, as reported above, r_p is .363, in the same direction. The two correlations are very similar ($q = .05$; $z = 0.14$) and are combined to give a better estimate of the relationship between sender/receiver pairing and ganzfeld study outcome: $r_p = .38$, t (42) = 2.66, $p = .0055$. The 95% CIs are 20% to 34% for unacquainted sender/receiver pairs and 34.1% to 49.2% for friends. Thus, the sender/receiver relationship does have a significant impact on performance.

Effect of Prior Ganzfeld Experience

The meta-analysis includes 14 studies, by nine independent investigators, in which novices are used exclusively (Honorton, 1985, Studies 2, 4, 8, 10–12, 16–18, 23–24, 31, 41–42). Experienced or mixed samples of novice and experienced subjects are used in the remaining 14 studies, by four different investigators (Studies 1, 7, 19, 21, 25–30, 33–34, 38–39). Studies using experienced subjects were more successful than those limited to novices; the point-biserial correlation between level of experience and effect size is .229, t (26) = 1.20, $p = .12$. For the autoganzfeld studies, as reported above, r_p is .078. The two correlations do not differ significantly ($q = .155$; $z = 0.40$), and the combined r_p is .194, t (38) = 1.22, $p = .105$. The respective 95% CIs are 24.5% to 44.5% for novices and 35.5% to 48% for experienced subjects.

The 95% CIs for these comparative analyses are shown graphically in Figure 2. The bottom two rows are CIs for the overall hit rates in the meta-analysis and autoganzfeld, respectively. The next

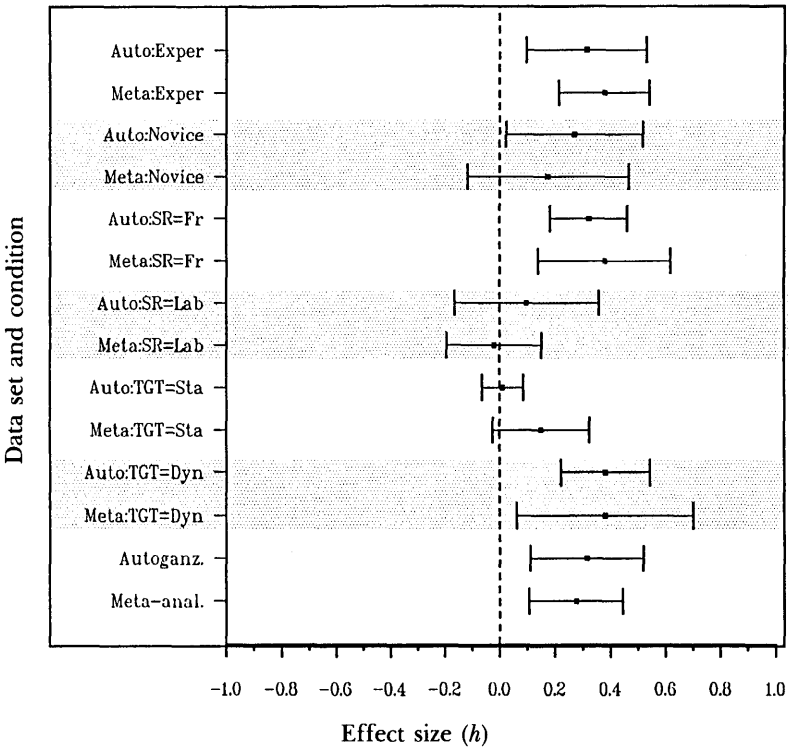

Figure 2. Comparison of autoganzfeld and meta-analysis 95% confidence limits. Abbreviations are defined as follows: Meta = meta-analysis studies, Auto = automated ganzfeld studies, Dyn = dynamic targets, Sta = static targets, Lab = laboratory senders, Fr = sender is friend or acquaintance of receiver, Novice = no prior ganzfeld experience, Exper = prior ganzfeld experience.

two rows give the CIs for dynamic targets in the two data sets, and so on.

Discussion

We now consider various rival hypotheses that might account for the experimental outcomes, and the degree to which the automated ganzfeld experiments, viewed in conjunction with the earlier psi

ganzfeld studies, constitute evidence for psi communication. Finally, we consider directions for future research suggested by these findings.

Rival Hypotheses

Sensory Cues. Only Se knows the identity of the target until R finishes the automated judging procedure. If Se is not a PRL staff member, a staff member not otherwise involved in the session supervises target selection. In either case, the target selector knows only which videocassette contains the target. The target selector leaves the monitoring room with the remaining three target tapes after knocking three times on the monitoring room door, signalling E to return. Since the target selector only knows the videocassette number, variations in knocking cannot communicate any useful information to E. The cardboard cover over the VCR eliminates any visual cues to E regarding the position of the videotape or the activity of the VU meters (which are active when the target is dynamic and has a soundtrack).

Sensory transmission from Se to R during the ganzfeld session is eliminated by having R and Se in separate, sound-attenuated rooms. If either participant leaves their room before R's ratings have been registered in the computer, the session is unconditionally aborted.

The videotape target display system prevents potential handling cues during the judging procedure. Computer registration of R's target ratings and automated feedback after the session prevents the possibility of cheating by Se during feedback, raised by Hyman (1985).

After about 80% of the sessions were completed, it was becoming clear that our hypothesis concerning the superiority of dynamic targets over static targets was receiving substantial confirmation. Because dynamic targets contain auditory as well as visual information, we conducted a supplementary test to assess the possibility of auditory leakage from the VCR soundtrack to R. With the VCR audio set to normal amplification, no auditory signal could be detected through R's headphones, with or without white noise. When an external amplifier was added between the VCR and R's headphones and with the white noise turned completely off, the soundtrack could sometimes be faintly detected. It is unlikely that subjects could have detected any target audio signal with the normal VCR amplification and white noise; as we have reported, there is no correlation between ganzfeld success rate and white noise level in these exper-

iments. Nevertheless, to totally exclude any possibility of subliminal cueing, we modified the equipment. Additional testing confirmed that this modification effectively eliminated all leakage. This was formally confirmed by an audio spectrum analysis, covering the frequency domain between 475 Hz and 15.2 kHz. The critical question, of course, is whether performance on dynamic targets diminished after this modification. The answer is no; in fact, performance improved. Before the modification, the direct hit rate on dynamic targets was 38% (150 trials, 57 hits, $h = .28$, exact binomial $p = .00029$, $z = 3.44$); the 95% CI was from 31% to 45%. Following the modification, the direct hit rate was 50% (40 trials, 20 hits, $h = .52$, exact binomial $p = .00057$, $z = 3.25$) with a 95% CI from 37% to 63%. The direct hit rate for all targets—static and dynamic—after the modification was 44% (64 trials, 28 hits, $h = .39$, exact binomial $p = .00082$, $z = 3.15$).

Randomization. As Hyman and Honorton (1986, p. 357) have pointed out, "Because ganzfeld experiments involve only one target selection per session..., the ganzfeld investigator can restrict his or her attention to a frequency analysis allowing assessment of the degree to which targets occur with equal probability." We have documented both the general adequacy of the RNG used for target selection and its proper functioning during the experiment.

Data selection. Except for two pilot studies, the number of participants and trials were specified in advance for each series. The pilot or formal status of each series was similarly specified in advance and recorded on disk before beginning the series. We have reported all trials, including pilot and ongoing series, using the automated ganzfeld system. Thus, there is no "file-drawer" problem in this database.

Psi ganzfeld success rate is similar for pilot and formal sessions. The proportion of hits for the 66 pilot sessions is .32 ($h = .16$, $p = .129$, $z = 1.13$). For the 289 formal sessions, the proportion correct is .35 ($h = .22$, $p = .0001$, $z = 3.71$). The difference is not significant: $\chi^2 = 0.11$, 1 *df*, $p = .734$.

If we assume that the remaining trials in the three unfinished series would yield only chance results, these series would still be statistically significant (exact binomial $p = .009$, $z = 2.36$). This would reduce the overall z for all 11 series from 3.89 to 3.61. Thus, inclusion of the three incomplete studies does not pose an optional stopping problem.

Multiple analysis. Informal examination of recent issues of several American Psychological Association journals suggests that correction

for multiple comparisons is not a common practice in more conventional areas of psychological inquiry. Nevertheless, half of Hyman's (1985) 50-page critique of earlier psi ganzfeld research focused on issues related to multiple testing. In the present case, advance specification of the primary hypothesis and method of analysis prevents problems involving multiple analysis or multiple indices in our test of the overall psi ganzfeld effect. Our direct hits analysis is actually *less* significant than either the sum of ranks method ($z = 4.04$, $p = 2.7 \times 10^{-5}$) or Stanford's z scores ($t = 4.53$, 354 *df*, $p = 4.1 \times 10^{-6}$).

In addition to the primary hypothesis, however, we also tested two secondary hypotheses concerning the impact of target type and sender/receiver pairing on psi performance, and we have presented several purely exploratory analyses as well. Our Results section includes 15 significance tests involving psi performance as the dependent variable, and the p values cited are not adjusted for multiple comparisons. Of the 15 significance tests, 9 are associated with $p < .05$. The Bonferroni multiple comparisons procedure provides a conservative method of adjusting the alpha level when several simultaneous tests of significance are performed (Holland & Copenhaver, 1988; Hyman & Honorton, 1986; Rosenthal & Rubin, 1984). When the Bonferroni adjustment is applied, six of the nine individually significant outcomes remain significant; these are: the overall hit rate, the subject-based analysis using Stanford z scores, the difference between dynamic and static targets, the dynamic target hit rate, and the hit rate for experienced subjects.

Although the relationship between psi performance and sender type is not independently significant in the autoganzfeld, the correlation coefficient of .363 is close to that observed in the meta-analysis ($r = .403$), and the combined result is significant. The cumulative evidence, therefore, does support the conclusion that the sender/receiver relationship is a significant moderator of ganzfeld psi performance.

Security. Given the large number of subjects and the significance of the outcome using subjects as the unit of analysis, subject deception is not a plausible explanation. The automated ganzfeld protocol has been examined by several dozen parapsychologists and behavioral researchers from other fields, including well-known critics of parapsychology. Many have participated as subjects, senders, or observers. All have expressed satisfaction with our handling of security issues and controls.

In addition, two experts on the simulation of psi ability have examined the autoganzfeld system and protocol. Ford Kross has been

a professional mentalist for over 20 years. He is the author of many articles in mentalist periodicals and has served as Secretary/Treasurer of the Psychic Entertainers Association. Mr. Kross has provided us with the following statement: "In my professional capacity as a mentalist, I have reviewed Psychophysical Research Laboratories' automated ganzfeld system and found it to provide excellent security against deception by subjects" (personal communication, May, 1989). We have received similar comments from Daryl Bem, Professor of Psychology at Cornell University. Professor Bem is well known for his research in social and personality psychology. He is also a member of the Psychic Entertainers Association and has performed for many years as a mentalist. He visited PRL for several days and was a subject in Series 101.

The issue of investigator integrity can only be conclusively addressed through independent replications. It is, however, worth drawing attention to the 13 sessions in which a visiting scientist, Marilyn J. Schlitz, served as either experimenter (N = 7, 29% hits, h = .08) or sender (N = 6, 67% hits, h = .36). Altogether, these sessions yielded 6 direct hits (N = 13, 46.2% hits, h = .45). This effect size is more than twice as large as that for the database as a whole.

Status of the Evidence for Psi Communication in the Ganzfeld

The automated ganzfeld studies satisfy the methodological guidelines recommended by Hyman and Honorton (1986). The results are statistically significant. The effect size is homogeneous across 11 experimental series and eight different experimenters. Moreover, the autoganzfeld results are consistent with the outcomes of the earlier, nonautomated ganzfeld studies; the combined z of 7.53 would be expected to arise by chance less than one time in 9 trillion.

We have shown that, contrary to the assertions of certain critics (Druckman & Swets, 1988, p. 175), the ganzfeld psi effect exhibits "consistent and lawful patterns of covariation found in other areas of inquiry." The automated ganzfeld studies display the same patterns of relationships between psi performance and target type, sender/receiver acquaintance, and prior testing experience found in earlier ganzfeld studies, and the magnitude of these relationships is consistent across the two data sets. The impact of target type and sender/receiver acquaintance is also consistent with patterns in spontaneous case studies, linking ostensible psi experiences to emotionally significant events and persons. These findings cannot be ex-

plained by conventional theories of coincidence (Diaconis & Mosteller, 1989).

Hyman and Honorton (1986) have stated,

> ... the best way to resolve the [ganzfeld] controversy ... is to await the outcome of future ganzfeld experiments. These experiments, ideally, will be carried out in such a way as to circumvent the file-drawer problem, problems of multiple analysis, and the various defects in randomization, statistical application, and documentation pointed out by Hyman. If a variety of parapsychologists and other investigators continue to obtain significant results under these conditions, then the existence of a genuine communications anomaly will have been demonstrated. (pp. 353–354)

We have presented a series of experiments that satisfy these guidelines. Although no single investigator or laboratory can satisfy the requirement of independent replication, the automated ganzfeld studies are quite consistent with the earlier studies. On the basis of the cumulative evidence, we conclude that the ganzfeld effect represents a genuine communications anomaly. This conclusion will either be strengthened or weakened by additional independent replications, but there is no longer any justification for the claim made by some critics that the existing evidence does not warrant serious attention by the scientific community.

Recommendations for Future Research

Recent psi ganzfeld research has necessarily focused on methodological issues arising from the ganzfeld controversy. It is essential that future studies comply with the methodological standards agreed on by researchers and critics. Yet it is equally imperative that serious attention be given to conditions associated with successful outcomes.

Small to medium effect sizes characterize many research findings in the biomedical and social sciences (e.g., Cohen, 1977; Rosenthal, 1984). Rosenthal (1986) and Utts (1986) make a strong case for more careful consideration of the magnitude of effect in the design and analysis of future ganzfeld studies. The automated ganzfeld studies show a success rate slightly in excess of 34%. Utts's (1986) power analysis shows that for an effect of this size, the investigator has only about one chance in three of obtaining a statistically significant result in a 50-trial experiment. Even with 100 trials—an unusually large sample size in ganzfeld research—the probability of a significant outcome is only about .5.

We urge ganzfeld investigators to use dynamic targets and to design their studies to allow subjects to have the option to have friends or acquaintances as their senders. The similarity of the autoganzfeld and meta-analysis data sets strongly indicates that these factors are important moderators of psi ganzfeld performance. If our estimate of the impact of dynamic and static targets is accurate, a 50-session series using dynamic targets has approximately an 84% chance of yielding a significant outcome. A comparable series with static targets has only about one chance in five of achieving significance.

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