ASSESSING POSSIBLE SENDER-TO-EXPERIMENTER ACOUSTIC LEAKAGE IN THE PRL AUTOGANZFELD

Richard Wiseman, Matthew Smith & Diana Kornbrot

Department of Psychology

University of Hertfordshire

College Lane

Hatfield

Hertfordshire

AL10 9AB

United Kingdom

ABSTRACT

Bem and Honorton (1994) have recently presented data that appears to support the existence of extra-sensory perception (ESP). A major part of their argument rests upon a set of parapsychology experiments known as the 'autoganzfeld' studies. In these studies one participant (a sender) attempted to psychically communicate the contents of a film clip (the target) to a second participant (the receiver). This paper presents a critical reappraisal of these studies. It first describes the studies and then outlines a normal (i.e., non-psi) mechanism that could potentially account for their results. The paper notes that it was vital that the experimenter was acoustically isolated from the sender, but that this may not have been the case. Although senders were instructed to remain silent, there is no guarantee that they followed this instruction. The measures taken to acoustically isolate the sender may not have prevented subliminal sounds reaching the experimenter. The paper then discusses some of the evidence relating to whether this potential artifact actually occurred. Finally, the paper outlines the need for increased methodological and reporting improvements in future work of this type.

INTRODUCTION

Bem and Honorton (1994) have recently presented data that appears to support the existence of psi0. This data is based on a set of parapsychology experiments known as the ganzfeld studies.

The initial section of Bem and Honorton's paper summarised a debate between sceptical psychologist Ray Hyman and parapsychologist Charles Honorton

(Hyman, 1985; Honorton, 1985). This debate centred around meta-analyses of 42 ganzfeld studies that had been published up until the mid-1980's. Hyman argued that these studies did not constitute evidence for psi. Honorton argued the opposite. Following this debate, Hyman and Honorton co-authored a 'joint communiqué' (Hyman & Honorton, 1986), in which they set out their main areas of agreement and disagreement. They noted:

We continue to differ over the degree to which the effect constitutes evidence for psi, but we agree that the final verdict awaits the outcome of future experiments conducted by a broader range of investigators and according to more stringent standards. (p. 351).

Hyman and Honorton then outlined these stringent standards, describing methodological and reporting recommendations for future ganzfeld studies. Several leading parapsychologists commented favourably on these recommendations (see the invited commentaries directly following Hyman & Honorton, 1986).

Bem and Honorton then discussed a later set of semi-automated ganzfeld experiments (the 'autoganzfeld studies'). These studies were designed to overcome all the methodological problems identified in the joint communiqué, and were originally reported in a major parapsychological journal (Honorton, Berger, Varvoglis, Quant, Derr, Schechter & Ferrari, 1990). Bem and Honorton were clearly impressed with the methodology of these studies and presented them as role models for future work in this area.

The Hyman/Honorton joint communiqué also provided guidelines on documentation, noting that:

...we believe that readers (including research analysts and prospective replicators) should be able to reconstruct the author's procedures from the descriptions provided in the experimental report. Although this is not common practice in science generally, we believe it is important in areas such as parapsychology where routine replicability cannot be taken for granted. More detailed exposition of methods and procedures should serve not only to aid evaluation of research quality, but also to increase the likelihood that other investigators would be able to replicate the original investigator's results successfully. (Hyman & Honorton, 1986, p.360).

Bem and Honorton believed that Honorton et al (1990) achieved this goal:

Because Honorton and his colleagues have complied with the Hyman-Honorton specification that experimental reports be sufficiently complete to permit others to reconstruct the investigator's procedures, readers who wish to know more details than we provide here are likely to find whatever they need to know in the archival publication of these studies in the Journal of Parapsychology (Honorton et al, 1990). (Bem & Honorton, 1994, p.9).

Hyman (1994) was asked to comment on the procedure and results of Honorton's autoganzfeld studies. Hyman commended 'Honorton and his colleagues (1990) for creating a protocol that eliminates most of the flaws that plagued the original ganzfeld experiments', but noted that (i) the results of the studies were inconsistent with the previous ganzfeld database and (ii) challenged the validity of the randomisation procedure used in the experiment. Bem (1994) argued against both of these notions.

There have clearly been improvements in the methodology and reporting of successive ganzfeld experiments. Unfortunately, this has not been the case for the criticism aimed at these, and other, parapsychological experiments. Although some critics' remarks have been responsible and constructive (including, for example, those of Ray Hyman), the majority have tended to be unfair and of poor quality. Some critics have, for example, dismissed all psi studies on the basis of a few experiments that were poorly designed or obtained negative results. Better controlled studies (especially those that obtained positive results) have been at best ignored and, at worst, had their procedures, controls and results misrepresented1. Palmer (1986) has noted that some critics have offered 'normal' (i.e., non-psi) explanations for parapsychological studies, but have failed to assess the plausibility of these hypotheses. This type of poor quality criticism falls outside accepted scientific standards and does little to help establish whether reported anomalies are real or illusory.

This paper provides an in-depth analysis of one 'normal' hypothesis which could potentially account for the autoganzfeld results. It is hoped that, just as the autoganzfeld studies built upon the shortcomings of past studies, the criticisms described in this paper build upon the errors made by previous psi critics. The authors have taken various steps to help overcome the type of poor quality criticism discussed above. The autoganzfeld studies have been deliberately chosen to avoid protests of 'straw person' rhetoric (i.e., the deliberate avoidance of the best quality evidence). To ensure that the autoganzfeld experimental procedures and controls were accurately represented the authors located all written sources (both published and unpublished) relating to the experiment and obtained testimony from many individuals directly involved in the studies. Whenever appropriate these sources have been cited verbatim and not paraphrased. In addition, earlier versions of this paper were circulated among several leading parapsychologists and sceptics via both an electronic discussion line and conventional mail. The paper was modified on the basis of the considerable amount of resulting feedback and discussion. The paper also offers constructive, rather than destructive, criticism in that it outlines some methodological improvements which could be made in future work of this type. Finally, in line with Palmer's (1986) recommendations, attempts have been made to assess the plausibility of the proposed normal explanations.

This critique has two aims. First, to identify, and apply, some of the guidelines involved in fair and constructive criticism of psi research. The authors are not claiming that the standards shown in this paper represent an ideal. Rather, it is hoped that they build upon some of shortcomings in previous critiques and, in turn, will form a basis for further debate and improvement. Second, the paper outlines some of the methodological weaknesses and the problems in reporting uncovered during assessment of a normal (i.e., non-psi) hypothesis that could provide a potential explanation for the autoganzfeld results.

A BRIEF DESCRIPTION OF THE AUTOGANZFELD STUDIES

The autoganzfeld studies were designed and run by Charles Honorton and his colleagues at the Psychophysical Research Laboratories (PRL) in Princeton, New Jersey.

The autoganzfeld procedure commonly used two participants - a 'sender' and a 'receiver'. These individuals were placed in two separate rooms. The receiver was placed into a state of mild sensory deprivation. Many parapsychologists believe that if psi exists at all it is likely to be a weak signal that is easily masked by internal somatic and external sensory noise (see, e.g., Honorton, 1977). For this reason steps were taken to help the receiver minimise the effects of such noise. They consisted of having the receiver place ping pong ball halves over her/his eyes and then bathing them in red light. This has the effect of creating a homogenous visual field. In addition, the receiver also heard white noise through headphones - creating an undifferentiated auditory field. Finally, the receiver usually engaged in some form of relaxation exercise to minimise any somatic interference. Once the receiver was in this state the sender was repeatedly shown a video clip that had been randomly selected from a pool of 160 clips. The sender had been asked to psychically send this clip to the receiver. The receiver was asked to report all the ideas, images and impressions that came into her/his mind (referred to as 'mentation') during this 'sending period'. The experimenter and sender could both hear the receiver's comments through headphones.

The receiver was then presented with a randomly ordered 'target set', consisting of four video clips (the actual target and three decoys) and asked to rate the amount of correspondence between their mentation and each of these clips. For many of the trials the experimenter assisted the receiver during this 'judging period'. The sender could hear the judging process through headphones. The receiver scored a direct hit if the target receiving the highest rating was the target that had been viewed by the sender. The likelihood of scoring a hit by chance alone was 25%.

The autoganzfeld studies consisted of 11 separate series, with a total of 240 participants providing 354 trials. Each trial was run by one of eight experimenters. The studies started in 1983 and finished in 1989, when the laboratory was forced to close due to lack of funding. At the time of the laboratory's closure many series remained unfinished; however, the results of the trials that had been run up until this point in time are impressive. Overall hitting rate for all trials was 34.5%. This is highly statistically significant. In addition, interesting patterns emerged in the data. Different types of targets seem to have significantly different hit rates. The series had used two types of video clip; dynamic targets consisting of a moving image with accompanying soundtrack, and static targets, consisting of a silent stationary picture. As predicted in advance of the studies, scoring was significantly higher for the dynamic clips than for the static clips. In addition, there was a significant correlation between receivers' introversion/extroversion scores and hitting, with extroverts having a higher hit rate than introverts.

POTENTIAL FOR SENDER-TO-EXPERIMENTER ACOUSTIC LEAKAGE2

Whilst the receiver was in the ganzfeld, (s)he was asked to report any thoughts, feelings and images that came to mind. This 'mentation' was both recorded on audiotape and written down by the experimenter. After the sending period had terminated, the experimenter reminded the receiver of the various ideas and images that (s)he had just mentioned. The experimenter paused between items as they were read back, to encourage the receiver to elaborate or comment on each item3. This occurred for all trials. The receiver then viewed four possible targets and was asked to rate the degree of correspondence between each potential target and his/her mentation. In 165 trials the experimenter interacted with the receiver during this judging process. During these trials the experimenter pointed out potential correspondences between the receiver's mentation and each potential target.

Given that the experimenter played an important role in the judging process, it is vital that (s)he was completely isolated from the target or anybody who knew the target's identity. If this was not the case, (s)he might inadvertently cue the receiver as to the correct target. The potentially large effect that unconscious experimenter cuing can have on psychological experiments has been well documented (see, e.g., Rosenthal, 1976). This cuing could have occurred when the experimenter reminded the receiver of his/her mentation, which occurred for all trials; it may have additionally taken place when the experimenter actively helped the receiver judge the four possible targets, which occurred for 165 of the 345 trials.

For these reasons any possible channel of communication from the sender (who knew the target's identity) to the experimenter could compromise the autoganzfeld results. These two individuals were located in separate, but adjoining, rooms (see Figure 1 [Reproduced, with permission, from Honorton et al, 1990]) so any communication would have been acoustic rather than visual. During the 30 minute sending period both sender and experimenter heard the receiver's ongoing mentation. If some senders vocally rewarded any of the receiver's relatively accurate comments, the experimenter would only have had to unconsciously register the presence (and possibly not even the content) of these noises to know that a certain section of mentation pertained to some aspect of the target. The fact that target sets were 'constructed to minimize similarities among the targets within a set' (Bem & Honorton, 1994, p. 9) would have made it easier for the experimenter to make use of this information. Thus noise leakage during this period would be highly significant. Similarly, the sender heard the judging process; acoustic leakage at this point might have made the experimenter aware of more and/or different noises being made for one target than another.

- - - - - - - - - - -

Figure 1 here

- - - - - - - - - - -

The following sections examine the nature of any noises that could have been produced by some senders and the measures taken to acoustically isolate the experimenter from such sounds.

SENDER NOISE

The sender's voice was not monitored or recorded at any point during the experiment and thus there exists no objective record of the sounds that may have been made by some senders. As a result, one can only speculate as to the possibility of sender noise. It is important to know (i) the instructions that were given to the sender and (ii) the likelihood that these instructions were understood, remembered and obeyed. This section discusses both of these issues.

An earlier version of this paper stated that senders may have been encouraged to be vocally active in response to accurate mentation. This information came from Morris, Taylor, Cunningham and McAlpine (1993). When describing the PRL autoganzfeld they noted:

S's [sender's] were encouraged to be vocally supportive when they heard mentation that was on target. [Emphasis ours]. (p. 180).

A draft of the paper was shown to Rick Berger (one of the original autoganzfeld experimenters) who denied that this was the case, noting (Berger, 20 April, 1994) :

I vaguely remember you [the first author] asking me (while I was in Edinburgh) about whether we allowed them to vocalise during the sending period and I vaguely remember telling you that we did allow it. We DID in fact allow it during the debugging of the program, i.e., during the very early testing of the system. When we first discovered that the experimenter could sometimes hear the sender, we fixed the problem by soundproofing the sender's room [the effectiveness of the sound attenuation is examined more closely in the next section of the paper] and instituting the 'SILENTLY communicate' rule.4

This 'SILENTLY communicate' rule is described in Berger & Honorton (1985). They state that at the beginning of the sending period the sender's monitor displayed the following prompt:

You can adjust the sound level of both the receiver's voice and the target's soundtrack by turning the volume controls on the grey box.

Silently communicate the contents and meaning of the target to (receiver's name).(p. 24).

This 'silently communicate' message is also reported in Honorton et al (1990, p. 109). In addition, the listing of the autoganzfeld computer program (Berger, n.d.) confirms that the above instructions were shown on the sender's monitor prior to target presentation, and that the word 'silently' was flashed on and off to reinforce this aspect of the message. Similarly, Honorton et al (1990, p.109) report that at the start of the judging period the sender's monitor carried the following message:

Silently direct (R's first name) to select the target that you saw' (p. 109).

Again, the word 'silently' was flashed on and off to reinforce this aspect of the message (Berger, n.d.).

There is however, evidence to suggest that the need for silence was not necessarily conveyed to the sender as a rigid requirement. The 1983 PRL Annual Report notes:

...we have sound-attenuated the sender's room, which in our estimation achieves approximately 70dB of attenuation in the auditory frequency range, allowing the sender to become more vocally involved in 'sending' without fear of accidentally giving the experimenter cues to the target (although the senders are still instructed not to vocalize). [Emphasis ours]. (p.46).

(again, the effectiveness of the sound attenuation is examined more closely in the next section of the paper).

In the absence of any evidence that the senders did remain quiet (even if instructed to) it is important to note that there are factors which could have resulted in failure to follow instructions. Some senders (the vast majority of whom were very strong believers in psi5) may not have been able to prevent themselves from becoming excited when hearing accurate mentation and inadvertently given off short but noisy cues of delight or encouragement6. These may have been vocal, or, for example, involved senders stamping their feet on the floor or striking their hands against the arms of the chair. For the same reasons senders may have made more/different noise during the judging of the correct target than the decoy targets. Senders who did occasionally vocalise during these periods may have fallen into the trap of not realising how loud a noise they were making owing to the headphones they were wearing7. All of this may sound speculative, however, there is evidence to suggest that the experimenters themselves were not convinced that all senders would obey the 'silently communicate' instruction. Two reviewers of this paper noted that part of the autoganzfeld protocol specified that trials were to be aborted if the experimenters heard any noises coming from the sender's room8.

So, the detection of noise from the sender's room during 'debugging' trials led to modifications in the sound proofing of this room. The effectiveness of these measures will be discussed in the next section. This is critical given that there is some uncertainty concerning whether all senders continually followed the 'silently communicate' rule.

SENDER-TO-EXPERIMENTER ACOUSTIC ISOLATION

The previous section established that some senders may have produced noise in response to accurate mentation, and/or the judging of the correct target. For this reason attention now focuses on the degree of sender-to-experimenter acoustic isolation.

Impressive measures were taken to isolate the receiver from the sender. The receiver was placed into a specially built, industrial-standard (Industrial Acoustics Corp., 1205A Sound Isolation Room) sound-isolation room (Honorton et al, 1990, p.104-5). In contrast, the measures taken to acoustically isolate sender from experimenter were far less impressive. Whereas the receiver and sender sat in rooms (one of which was acoustically isolated) 14 feet apart, the experimenter sat just 12 feet away from the sender's room, in an acoustically unprotected area (see Figure 1).

There are two types of sound which may have leaked from the sender's room; airborne sound (caused, for example, by senders giving off vocal cues of delight or encouragement) and structure borne sound (caused, for example, by senders stamping their feet on the floor or striking their hands against the arms of the chair). Each will be discussed in turn.

Insulation against air borne sound

Air borne sound could have travelled from sender to experimenter via the following pathways (Parkin, Humphreys & Cowell, 1979).

Direct transmission through the wall separating sender and experimenter

To assess this possibility it is vital to know the precise construction of this wall. Honorton et al (1990, p.105) only provide the briefest description of the sender's room walls, simply noting that they are 'double'. No other published sources provide further details. However, the authors asked Ephraim Schechter about the construction of these walls. Schechter originally (16 May, 1994) noted:

...the walls were frame and wallboard with fibreglass insulation between the inner and outer wallboard panels.

In response to the authors' request for more information Schechter (25 May, 1994) later recalled:

As I remember it, the space between the wall board sheets was filled with some kind of foam-core insulation intended both for thermal insulation and some sound blockage, instead of simple fibreglass, but I'm not as clear about that as about the other details. It would be best to check with someone else who was there at the time -- Rick Berger or Mario Varvoglis might be able to confirm or correct what I recall9.

The authors contacted Berger about this, and received the following reply:

I also have no information on the construction of the sender's room. I'm sure that Chuck [Charles Honorton] knew. I don't know who's alive who knows. Don McCarthy or Ed May may have some details, as I believe that they were given some charge of the PRL stuff after PRL's demise. There may be blueprints or such. (Berger, 26 May, 1994).

The authors then contacted Don McCarthy, Ed May and several other parapsychologists about this matter (via an electronic discussion group). None were able to provide any additional information concerning this aspect of the PRL set-up. The authors are unaware of the existence of any PRL blueprints. In short, it appears to have been a standard type of internal wall used in the American construction industry10(Everest, 1994). It is obvious that the sender's room was certainly not built to the same high specifications as the receiver's room. A properly acoustically isolated room is constructed by building one room inside another, with a sizeable gap between the walls of the inner and outer rooms. This was the case with the receiver's, but not the sender's room.

The sound insulation provided by any wall can alter dramatically if it contains cracks, small holes or any possible air paths. As noted by Parkin, Humphreys & Cowell (1979):

An air path is a sound path, and the smallest hole can reduce insulation performance markedly. The gap around pipework passing through a partition, a door ajar, ill-fitting joints - all contribute to a reduction in sound isolation. A most important aspect of sound insulation, often overlooked, is that the total sound insulation of a composite construction is determined to a large extent by its weakest link....[An]..example of a loss of insulation due to a weakness is a 25mm square hole in plastered 230mm brick wall, 2.5 metres high and 2.5 metres long. The potential 50dB average insulation of the brick wall will be reduced to a real value of approximately 40dB. (p. 142-3)

The sender's room certainly had electrical connections to other parts of the experimental suite. In addition, its wall may have had small cracks, ill fitting joints (with the floor, ceiling and other walls), ventilation and plumbing/lighting connections running through it. No written sources describe these connections or the effect that they might have had on sound insulation. However, in reply to the authors' request for this type of information, Schechter (25 May, 1994) noted:

There was a pair of connector panels on the outside and inside walls, just as there was on the receiver's isolation chamber. Sockets on the inner and outer panels were connected with wires that ran through the insulation on the wall. I THINK all electrical connections into the sender's room were made through this panel, but I am not certain.

Again, although such information is helpful, it is simply not precise enough to accurately calculate the true sound insulation properties of the sender/experimenter wall.

Berger (20 April, 1994, see above) noted that, when the experimenters first discovered that they could sometimes hear the sender, they attempted to soundproof the sender's room. This soundproofing, for the most part, consisted of placing acoustical tiles around the room. Honorton et al (1990) described this set-up, noting that:

The inside walls and the ceiling of the Se's [sender's] room are covered with 4-inch Sonex acoustical material, similar to that used in commercial broadcast studios. (p. 104).

The authors have contacted both the UK supplier (Canford Audio, Tyne & Wear, England), and the US manufacturer (Illbruk USA, Minneapolis, USA), of Sonex tiles. Both companies clearly state that these tiles are designed to stop sound being reflected back into a room, rather than stop it leaking from the room. Engineers informed us that the tiles have a high sound absorbtion coefficient but a very low sound reduction index. Thus almost none of the sender's sounds would be reflected back into the sender's room: Instead, nearly all of it would be transmitted through the tiles to the walls.

Direct transmission through the door/door frame of sender's room to the experimenter

Another possible pathway for leakage involves sound travelling through the sender's door/door frame and into the experimental area.

The sender's room had only a single (versus the receiver's heavy double) door. Honorton et al (1990, p. 105) describe the door as 'acoustical' but provide no further details. Again, no published or unpublished sources present additional information concerning the structure of this door. However, the PRL experimenters contacted by the authors believe that (as part of the measures designed to electrically isolate the room) this door was made, in part, from steel11. Assuming that this was the case, the door would have provided good, although not perfect, protection against sound leakage. It appears, however, that gaps between the door and door frame may have allowed sound to leak from the room. This is reflected by the fact that the experimenters felt it necessary to try to prevent this leakage by placing a special barrier behind the sender's chair. Honorton et al (1990) note that:

A free standing Sonex-covered plywood barrier (5ft 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. [Emphasis ours]. (p. 104).

In addition, it is unclear whether Figure 1 correctly represents the positioning of the Sonex barrier. Schechter (20 May, 1994; 25 May, 1994) has stated that it was positioned nearer (and possibly parallel) to the door. If this were the case it would provide a greater barrier to sound leaking through the door frame, but less protection against sound leaking through the wall directly separating sender and experimenter. Daryl Bem12 has reported that Berger also confirmed this scenario, noting:

...Rick Berger told me that the schematic diagram that appeared in the 1990 [Honorton et al] paper is a bit misleading in that it shows the plywood barrier a bit of a distance from the door when, in fact, it was pressed closely (into the frame, Eph?13) thus providing much better attenuation through the door and frame than would be implied by the diagram.

However, in an electronic mail to the authors Berger (8 June, 1994) later noted:

The last time I was at PRL was around 1986. I can't vouch for the position of the barrier after that time, but prior to that time it was at a 45 degree angle with the door, directly behind the sender's chair. It was a very large and imposing barrier, and I recall about 24" clearance as you walk around it to enter the room.

Schechter (16 May, 1994) has also provided more information about the supposed gaps between door and door frame. He recalled that:

The four inch Sonex on the door fitted tightly against the four-inch Sonex on the walls and the door frame, so that the door had to be firmly pushed shut against the binding of the Sonex surfaces. Even granted that Sonex is a sound absorbent rather than a sound blocking material, the door-to-frame gaps were pretty thoroughly muffled.

The authors asked Schechter how this would have worked on the hinge side of the door. If the two sets of Sonex were so closely connected here the door would either not have opened or, over time, the Sonex would have become crushed. Schechter (31 May, 1994) recalls that the sender's room door may have actually opened outwards (i.e., into the experimenter's area) and thus would not have crushed the Sonex on it's hinge side. However, Schechter was clearly uncertain about this, adding:

IF my memory that the door opened outward is correct, you have the answer to why the Sonex didn't crumple. But I want to hear someone else say that the door opened outward before I trust that memory. It's SO different from the diagram.

All of the other individuals quizzed by the authors recall that the door opened into the sender's room (i.e., in agreement with Figure 1).

Flanking transmission

Flanking transmission refers to any indirect (ie., those not travelling straight through connecting walls and doors) sources of sound propagation from source to receiver room. Parkin, Humphreys & Cowell (1979) note that such leakage can take many possible routes. For example, small amounts of sound could have propagated along the back wall of the sender's room (i.e., the wall opposite the sender's room door) and emerged in the experimenter's area. Likewise, sound could travel along the floor connecting the sender's room to the experimental area.

Ceiling's also act as another possible path for flanking transmission. For example, Smith, Peters & Owen (1982) note that sound travelling over a partition (via a perforated, suspended, ceiling) can reduce the partistion's sound insulation by 10dB or more. This is especially the case when the ceilings contain breaks light fittings or other small holes.

Various steps can be taken to reduce the effects of flanking transmission. Walls and floors can be made to contain structural breaks which reroute/disperse sound away from the receiver room. Ceilings can be constructed from moderately heavy membranes, be airtight, have fewer points of suspension etc. Honorton et al provide no details of the ceiling in either the sender's room or experimenter's area, nor the construction of the wall that ran between the two areas. Again, the authors have been unable to discover any additional information concerning these constructions.

Structure borne sound

The floors of the experimenter's area and sender's room were on the same level (i.e., parts of the same constructions). This is a violation of the normal procedure used to acoustically isolate one area from another. Structure borne sound can travel great distances through most construction materials with only a tiny amount of energy loss. As noted by Everest (1994):

...a slammed door...can cause the structure to vibrate very significantly. These vibrations can travel great distances through solid structure with little loss. With wood, concrete, or brick beams, longitudinal vibrations are attenuated only about 2dB in 100ft. Sound travels in steel about 20 times as far for the same loss! Although joints and cross-bracing members increase the transmission loss, it is still very low in common structural configurations (p. 139).

For these reasons a properly acoustically isolated chamber involves suspending one entire room (with it's own floor) inside another. Estimating the degree that structure borne sound may have carried between the two rooms is difficult, even when one has accurate knowledge of the precise construction of the floor and its coverings. Honorton et al (1990) do not provide any of these details. However, a set of slide photographs showing the PRL set-up revealed that the sender's room was carpeted. Many individuals involved with the experiment have also confirmed that this was the case. This carpet would certainly have helped dampen the effects of structure borne sound. However, the precise amount of insulation between the sender's and experimenter's areas cannot be calculation without far more details of the carpet and floor construction. The authors have been unable to discover this information and so it is almost impossible to discover if any structure borne sound would have been likely to have reached the experimenter.

Assessing sound insulation

None of the published journal articles report any steps taken to explicitly investigate how well the sender was acoustically isolated from the experimenter. However, as noted above, the 1983 PRL Annual Report states that:

...we have sound-attenuated the sender's room, which in our estimation achieves approximately 70dB of attenuation in the auditory frequency range.... (p.46).

No additional details of this testing are provided in this, or any other, PRL Report. Thus, it is difficult to know for certain how this testing was carried out (e.g., the meaning of the phrases 'in our estimation' or 'auditory frequency range') or how 'allowing the sender to become more vocally involved in sending' relates to the issues discussed in the above section concerned with levels of sender noise. The authors asked Schechter about this and received the following reply (Schechter, 20 May, 1994):

I'm not certain what 'in our estimation' means either. I have a memory of somebody -- probably Chuck [Charles Honorton], Rick [Berger] or Mario [Varvoglis]--checking sound transmission with a commercial decibel meter after the Sonex was added, but I don't recall details. I've asked a couple of people but got only equally vague memories, and the folks who have access to Chuck's files haven't found records of these tests. (That may not mean much--Chuck's files are pretty scattered now, some in Edinburgh, some in Durham and possibly some still in New Jersey).

The authors contacted Berger (8 June, 1994), who recalled the following:

My memory (I wish there was documentation) was that we used a Radio Shack [marketed as Tandy in the UK] meter and did various tests like getting people to yell directly behind the door, behind the barrier, etc. We were satisfied from our testing that we were achieving very high attenuation AT THE OUTSIDE of the door. Since our real concern was with the experimenter seated across the room, with headphones on, listening to the amplified voice of the receiver and transcribing everything madly--WE FELT THAT WE HAD COMPLETELY OBVIATED THIS CONCERN. We were not on an unlimited budget. The Sonex cost a lot of money, but was the most cost effective means to produce what we felt was COMPLETE ATTENUATION between sender and experimenter. (I seem to recall we couldn't get ANY readings on the dB meter outside the room, no matter what was going on inside).

There are several well respected and practical ways of measuring the sound insulation between two rooms (see, e.g., Parkin, Humphreys & Cowell, 1979, Chapter 9; Smith, Peters & Owen, 1982, Chapter 5). Briefly, these consist of using various loudspeakers to accurately create the hypothesised sound source. These speakers emit white noise (or a warble tone14) at each frequency and direction of interest. The input to microphones in the source and receiving room are then subtracted from one another to discover the difference in sound pressure levels between the two rooms. This is usually repeated for at least six locations of the microphones for frequencies up to 500Hz and three additional locations for higher frequencies (with further placements being necessary if the difference between the microphone inputs differ by more than 6dB in any one frequency). Honorton et al do not seem to have carried out these types of techniques.

Similar tests can be used to assess the degree of insulation again structure borne sound. These are especially important as there are considerable difficulties involved in estimating the quantity of such transmission theortically. The authors have discovered no record of Honorton et al carrying out such tests.

ESTIMATING SOUND LEAKAGE

Given the dearth of information surrounding the acoustic properties of the sender's room, and the fact that the PRL autoganzfeld set-up has now been dismantled, it is impossible to accurately assess the amount of possible sender-to-experimenter acoustic leakage. The following sections do, however, provide rough estimates of maximum and minimum leakage15.

Estimating air borne leakage16

Estimating sender noise

Sound tests carried out by the authors established the intensity and dominant frequencies made by an individual saying 'Yes' in a jubilant, but controlled, manner. These tests revealed that between 70-75dB's of noise was created, spread fairly equally over the 125Hz to 4kHz frequency range. Assuming that the sender had his/her back to the free standing barrier (Schechter, 20 May, 1994) and that the Sonex provided perfect absorbtion of all sounds across these frequencies (a conservative estimate), there are two routes by which sound might travel from the sender to the wall located on his/her right. First, some sound would have travelled directly from the sender to the wall. Second, the large TV monitor (20 inches) situated approximately five feet in front of the sender (Schechter, 25 May, 1994) would have reflected additional sound back to the wall. It was therefore estimated that the Sonex padding on this wall would receive between 70dB (minimum leakage estimate) and 75dB (maximum leakage estimate) of noise spread evenly across the 125Hz to 4kHz frequency range.

Acoustic tiles

As noted above, the acoustic padding on the wall and barrier would have prevented only a small amount of the senders' sound travelling through to the wall. Badi (1994) and the sound engineers at Illbruck USA (manufacturers of Sonex tiles) estimate that the padding would have a maximum sound reduction index of between 2dB (maximum leakage estimate) to 5dB (minimum leakage estimate) across the frequencies of interest.

Sender's room wall

As noted in the previous section, the authors are uncertain as to the construction of the sender's room walls. For this reason, calculations for each of the possible standard types of 'double' wall will be given. Everest (1994) notes that a 'double' wall could have had a sound transmission class17 (STC) of either 43dB (no fibreglass filling), 55dB (3.5 inches of fibreglass filling) or 58dB (9.5 inches of fibreglass filling). These figures are used within the minimum leakage estimates. However, these figures are determined under well controlled laboratory conditions (i.e., using walls with no cracks, small holes, no flanking transmission from other walls and ceiling etc). In reality, the sound insulation provided by the walls can be much less. For these reasons, the maximum leakage estimates uses reduced figures of 36dB (no filling), 48dB (3.5 inches fibreglass filling) and 51dB (9.5 inches fibreglass filling).

Sound loss to experimenter

Any noise emerging from the sender's room would have to travel from the outside of the wall to the experimenter (a distance of approximately 12ft). It was assumed that this distance would cause a loss of between 3dB (maximum leakage estimates) and 9dB (minimum leakage estimates).

From Figure 1 it may appear that the experimenter's console would have obstructed the path of such a sound. However, this cannot be determined with any great sense of certainty. Schechter (20 May, 1994) has noted that his discussions with individuals involved in the PRL autoganzfeld indicated:

...different memories of whether there was an open straight-line path from the sender's room walls to the experimenters chair or whether the path was blocked by the experimenter's console.

For this reason the possible effects of the console have been excluded from the analyses.

Tables 1 & 2 present maximum and minium leakage estimates respectively. Maximum leakage estimates range from 36dB (air filled wall), 24dB (wall filled with 3.5 inches of fibreglass) and 21dB (wall filled with 9.5 inches of fibreglass). Minium leakage estimates range from 14dB (air filled wall), 2dB (wall filled with 9.5 inches of fibreglass) to -1dB (wall filled with 9.5 inches of fibreglass).

Estimating structure borne sound leakage

Parkin, Humphreys and Cowell (1979) note that theoreticl estimation of structure borne sounds is extremely complex and that the magnitude and effects of such sounds are usually determined in field settings. For these reasons they have been excluded from the present analyses.

EXPERIMENTER DETECTION AND UTILISATION OF SOUNDS

To estimate whether the levels of sender sound might be unconsciously detected/utilised by the experimenter, it is necessary to estimate (i) the amount of noise which would have masked such a signal and (ii) the signal to noise ratio currently thought be involved in auditory subliminal perception. Each of these issues will be discussed in turn.

Estimating masking noise

There were two types of noise which would have helped mask any signals emerging from the sender's room. First, the experimenter was wearing 'light' headphones (i.e., those resting on, as opposed to in or around the ear [Schechter, 3 June, 1994]). During the sending period these carried the receiver's mentation. During the judging period they carried both the mentation and (for dynamic targets only) a target soundtrack. When the receiver was speaking these would have carried between 50-70dB of noise. In the absence of the receiver's comments this figure would fall to between 30-40dB of noise. In addition, the experimenter's console contained some equipment (e.g., an Apple II Plus computer, a fan and a videocassette recorder [Honorton et al, 1990, p. 104]) which would have produced a certain level of low frequency background noise. Richard Broughton (Institute of Parapsychology, North Carolina, USA) has access to the original PRL equipment and has informed the authors (6 June, 1994) that the set-up currently produces 54-60dBA of noise18. Combining these estimates is far from easy (see Parkin, Humphreys and Cowell, 1979), however, a reasonable figure would be between approximately 50dB (maximum leakage estimate) and 70dB (minimum leakage estimate).

Detection of subliminal auditory stimuli

It is problematic to estimate the signal minus noise (S-N) figure which might mean that the experimenter could have subliminaly detected sender signals. The literature on acoustic subliminal perception is both controversial and equivocal. Some theorists argue that the phenomena has not been demonstrated whilst others argue the opposite. However, a recent review of this literature, Urban (1992) has noted that some studies have obtained positive results even when signals have been masked by as much as 30dB of additional noise (i.e., a S-N ratio of minus 30dB). This figure is based upon auditory subliminal perception research which usually requires individuals to unconsciously register the meaning of a phrase or sentence. In the ganzfeld scenario the experimenter may just have had to register the presence/absence of sender noise and possibly not its content: This may be possible under slightly higher values of masking. Table 3 contains the S-N ratios for maximum and minimum leakage estimates for each type of wall. All of the values in the minimum leakage estimates lay outside of the minus 30dB S-N ratio. All of the maximum leakage estimate lay within this value. In short, if the maximum leakage estimates reflect the actual autoganzfeld set-up it is possible that the experimenter may have been able to subliminally register sounds made by the receiver. If the maximum estimates are valid such detection becomes very improbable.

Utilisation of subliminal stimuli

It is problematic to assess the degree to which any signals, unconsciously detected by the experimenter, could have biased receivers' choice of target during the judging period. A large body of research has demonstrated the potentially large effect that such cuing can have within other types of psychological experiments (see, e.g., Rosenthal, 1976), but no previous work (in either parapsychology or subliminal auditory research) has explicitly tackled how this might work in the ganzfeld scenario. Bem and Honorton believe that at least one study of this type has been undertaken, noting:

...if the experimenter who interacts with the receiver knows the identity of the target, he or she could bias the receiver's similarity ratings in favour of correct identification. Only one study in the database contained this flaw, a study in which subjects actually performed slightly below chance expectation. (p. 7).

The authors contacted Bem and asked for additional information concerning this study. Bem (6 July, 1994) replied, noting that these comments were based upon a study by Palmer & xx (1979). Bem & Honorton have misunderstood the nature of this experiment: Palmer has assured the authors that the experimenter was kept blind to the identity of the target until after the completion of judging (Palmer, xx, 1994). This is also clear from the experimental write-up of the study.

Summary

It is very difficult to establish the plausibility of the 'sender-to-experimenter' leakage hypothesis. This is due to (i) the dearth of accurate information regarding many aspects of the PRL autoganzfeld set-up and (ii) the lack of unequivocal and predictive information within research on acoustics, psychoaccoustics and auditory subliminal perception. However, the analyses presented in these sections have argued that sender-to-experimenter leakage could, under certain conditions, have taken place. These sections have not, however, discussed another important point, namely whether this mechanism would actually account for the autoganzfeld results. This issue is discussed in the following section.

ASSESSING THE ACTUALITY OF SENDER-TO-EXPERIMENTER LEAKAGE

This section discusses some of the evidence, and methodological difficulties, involved in trying to assess whether sender-to-experimenter leakage actually took place in the PRL autoganzfeld.

First, some readers may dismiss the sound leakage as implausible. However, sender-to-experimenter leakage would not have had to happen very often to account for the overall hit rate obtained in the autoganzfeld studies. Bem & Honorton (1994) report an overall hit rate of 34.5% (354 trials, 122 hits). Approximately 88 of these hits would be expected by chance alone. Thus, the effect is caused by approximately 34 additional hits in 266 trials, or 1 hit every 7.8 trials above chance. Thus the sender to experimenter leakage would only have to occur approximately once every eight trials (above chance) to produce the reported main effect.

The likelihood of potential non-psi explanations can also be assessed on the basis of whether they can account for internal effects. The sensory leakage problem, if valid, could help explain many of the patterns in the autoganzfeld database. As noted above, dynamic targets scored significantly higher than static ones. This difference was one of the main experimental hypotheses[19]. Thus experimenters would have entered the studies highly motivated to find a difference between the two types of targets. This hypothesis could have become a self-fulfilling prophecy, with experimenters inadvertently providing more cues during the judging of dynamic, as opposed to the static, targets. In addition, senders may have found dynamic targets more absorbing/exciting than static ones and thus made more noise during the sending/judging of dynamic as opposed to static video clips. The presence of experimenter cuing could also account for why certain groups of receivers (e.g., extroverts, participants from the Julliard School[20]) scored higher than others (e.g., introverts, non-Julliard participants). Perhaps some types of receivers (e.g., those that were more outgoing or socially oriented) were able to elicit more cues from the experimenter, and/or made more effective use of these cues. Finally, the 165 trials in which the experimenter helped with judging obtained significantly higher rankings than the 189 trials in which the receiver judged on his/her own (Mann-Whitney U Test; z[corrected for ties]=-1.94, p[two tailed]=.05). Again, this would be expected if the sensory leakage hypothesis were valid, as interaction during the judging period allows more opportunity for experimenter cuing. However, it should be noted that these patterns are also consistent with psi-type hypotheses[21] and so it is difficult to tease apart normal from paranormal interpretations of the results.

Third, one reviewer of this paper suggested that the likelihood of the leakage hypothesis could be tested by running another autoganzfeld study, but randomly assigning trials to either (i) the old procedure [i.e., one including the possibility of sender leakage] or (ii) a new [and flaw free] procedure. Although the authors strongly support the notion that critics should try to experimentally test their hypotheses, it would be difficult to accurately reconstruct the PRL set-up for various reasons. First, some of the information concerning the physical construction of the PRL is not present in any published sources and cannot be recalled by the autoganzfeld experimenters contacted by the authors. Second, it would prove difficult to match various attributes (e.g., hearing ability, belief in psi, experience in running the autoganzfeld) of any new experimenters and senders with those involved in the original autoganzfeld. The original experimenters (and some participants) could not be used, in part, because they are now aware of the hypotheses being tested. In addition, running a ganzfeld study is very time consuming and requires great dedication. A single ganzfeld session can take between one and three hours, with many trials being needed to have a realistic chance of obtaining a statistically significant result. Also, the ganzfeld procedure needs a relatively large amount of specialised equipment and dedicated laboratory space. Investing time and effort in a possibly inconclusive testing of sender-to-experimenter leakage would be seen by many as a waste of these limited resources.

Finally, the transcripts of the receiver's mentation could be blind judged. Such judging would help remove any influence provided by the experimenter during the judging period. Assuming the data was not contaminated by any additional methodological weaknesses, a significant above chance result would provide tentative evidence against the actuality of sender-to-experimenter leakage; a chance result would provide the opposite. Although such judging would have to be carried out in a very careful way, the authors believe that it could prove both useful and constructive. For these reasons, the authors hope that such judging will be undertaken in the near future, and would be happy to help design and possibly run such an analysis.

DISCUSSION

This paper has argued that there was the potential for sender-to-experimenter acoustic leakage in the PRL autoganzfeld. This analysis has raised many important issues .

First, to assess the possibility of acoustic leakage it was necessary to know exactly how the sender's room was constructed. Unfortunately, the written sources describing the autoganzfeld (e.g., Berger & Honorton, 1985; Honorton et al, 1990; PRL Annual Reports) contained few details about this subject. The Hyman/Honorton joint communiqué recommended that research analysts should be able to reconstruct experimental procedures from the descriptions provided in written reports (Hyman & Honorton, 1986, p.360). The autoganzfeld investigators were in clear agreement with this notion and provided an admirable description of many other aspects of their studies. However, they did not provide enough information about the sender's room. Future research should concentrate on developing strategies which would help parapsychologists provide a more complete, unambiguous and reliable description of their studies. This could involve, for example, learning how best to record the set-up and procedure of these studies using different types of media (e.g., still photographs, videotape, floor plans, etc.). As noted by Hyman & Honorton (1986) such detailed recording is not the norm in science. However, it is important within parapsychology if future analysts (and replicators) are to be able to accurately reconstruct past experiments.

Second, although the written reports did not provide very much information concerning the sender's room, additional details were available from some of the original autoganzfeld experimenters. The information provided by these individuals proved extremely valuable and the authors are indebted to the experimenters for taking the time and trouble to make these details available22. However, the autoganzfeld was constructed over ten years ago and thus it was not surprising that these individuals were unable to clearly recall all of the details needed to fully assess the leakage hypothesis (e.g., the exact materials used in the construction of the sender's room walls, and the methods used to assess the acoustic properties of the room, are still unknown). In addition, these memories often appeared vague and uncertain. For example, when inquiring about the notion that a trial was terminated if any sender noise was heard, Berger noted (8 June, 1994):

I explicitly remember that the protocol was to abort sessions if any noise was heard from the sender. Unfortunately, the only written reference I can find is to aborting sessions if the sender leaves the room prematurely.

Varvoglis (22 May, 1994) noted:

...if the experimenter heard anything resembling 'vocal supportiveness' - like...'Yeah!' or a shout - this would normally considered a breach of protocol, leading to a session abort.

Schechter (26 May, 1994) was less certain, noting:

The published material and annual reports is probably the best written record, and there's little in the ARs that's not also in Berger & Honorton (85) or Honorton et al (1990). E.g., the statement that senders were told not to vocalise is mentioned [in] several places, as I noted in my review [Schechter was sent an earlier version of this paper and asked for comments]. There's also a statement in one or more of these sources that sessions were to be aborted if the sender's room door opened. I did not say in my review that they were to be aborted if the experimenter heard any noise because while some folks have confirmed that memory, I haven't heard from those who had most experience as experimenters.

This situation further emphasises the need for investigators to make accurate records of studies when they happen, rather than having to depend upon their own memories (which are more likely to be influenced by the effects of bias and decay) at a later date.

Third, the information recalled by the experimenters revealed that some of the details in the written sources was inaccurate (e.g., the notion that sender's were encouraged to be vocally supportive when they heard mentation that was on target, and possibly the way in which Honorton et al represented the position and angle of the barrier in the sender's room). Again, this highlights the need for researchers to ensure that information presented in written sources is both accurate and complete. In addition, researchers involved in multi-author studies should perhaps attempt to identify, and comment upon, any discrepancies between the report of a study as agreed upon by all authors, and any summaries of that study presented by other writers.

Fourth, when the reporting deficiencies discussed above were (as far as it was possible) resolved, and the autoganzfeld procedure reconstructed, the potential for sender to experimenter acoustic leakage remained. This was due, in part, to the facts that (i) the acoustical tiles used by Honorton et al would have prevented only a small amount of sound escaping from the room and (ii) the construction of the sender's 'double' wall cannot be established with any great degree of certainty and (iii) the sender's room and experimenters area shared the same floor level. The autoganzfeld experimenters were clearly aware of the potential problems which could be caused by sender-to-experimenter leakage and took some measures to minimise it's occurrence. However, some of these measures do not appear to have been as effective as they may have believed it to be. Again, future researchers should try to eliminate this type of problem occurring. For example, researchers running these types of experiments might find it helpful to have a working knowledge of relevant areas of acoustics, or be prepared to closely interact with acoustical engineers. The acoustics engineers consulted by the authors have suggested that the necessary level of sound isolation would only have been achieved for certain by (i) placing the sender in a purpose built sound isolation chamber (of the type used to house the receiver) or (ii) retaining the sender's room but moving it much further away from the experimenter.

The final section of this paper discussed some of the issues involved in establishing whether the potential sender-to-experimenter leakage actually occurred. It noted that such leakage could account for the reported main and internal effects, but that better evidence for or against the hypothesis would only be gained through further research (e.g., the blind judging of receiver mentation). As such, it should be clearly noted that this paper has outlined the potential for the sender-to-experimenter leakage; it has not established that such an artifact actually occurred. Future analysis of the autoganzfeld data may suggest that this potential artifact did not actually happen. This would not, however, alter the focus of this paper, namely that important lessons should be learnt from the potential for this artifact and the way in which some aspects of the experiment have been reported.

Despite the problems outlined in this paper, the authors believe that the autoganzfeld studies (and the resulting database) represent an impressive achievement. The studies achieved a very high level of methodological sophistication that towers above most previous ganzfeld studies. However, just as the autoganzfeld studies built upon the shortcomings of past studies, so future work should aim to identify, and eradicate, any errors contained in the autoganzfeld studies. Indeed, to a limited extent, this has already started to happen. Discussions with one laboratory currently attempting to replicate the autoganzfeld studies (the Koestler Chair of Parapsychology at Edinburgh University) have resulted in various design modifications (Dalton, Morris, Delanoy, Taylor, Radin & Wiseman, 1994).

Parapsychologists may indeed be starting to corner their elusive quarry. However, future attempts to actually capture their prey will require further improvements in methodology and reporting. It is hoped that these improvements will continue to develop from the type of open and constructive debate currently surrounding the autoganzfeld studies.

ACKNOWLEDGEMENTS

The authors thank Daryl Bem, Kathy Dalton and Richard Broughton for making available the autoganzfeld database. We also grateful for the helpful information kindly provided by those individuals directly involved in the design, set-up and running of the PRL autoganzfeld, including; Rick Berger, Ephraim Schechter, Mario Varvoglis, Ed May and Don McCarthy. Special thanks also to Robert Morris, Katie Moore, Robin Taylor, M.N.M. Badi, Michael Adams, Peter Howell, and Dean Radin for their helpful comments on the work presented in this paper. An earlier version of the paper was circulated on a parapsychological electronic discussion network and modified as a result of feedback received from Daryl Bem, Richard Broughton, John Palmer, Dick Bierman, Charles Tart, Topher Cooper, Brian Josephson and Roger Nelson, Adrian Parker and James Spottiswood. Finally, the first author gratefully acknowledges help given by the late Charles Honorton in conversations about the autoganzfeld. As a result of his untimely death in November 1992, parapsychology has lost one of its most creative and productive experimentalists.

FOOTNOTES

23As noted by the Bem and Honorton (1994) the term 'psi' denotes:

...anomalous process of information or energy transfer, processes like telepathy or other forms of extrasensory perception that are currently unexplained in terms of known physical or biological mechanisms. (p.4).

23See, e.g., Child's (1985) discussion of the way in which some critics ignored, distorted and misrepresented the Maimonides ESP dream experiments.

23Details of the autoganzfeld design, procedure and results discussed in the following sections are derived from various sources. Published sources consisted of Berger and Honorton (1985), Schechter and Honorton (1986), Honorton et al (1990) and Bem and Honorton (1994). Unpublished, but widely available, written sources consisted of the autoganzfeld computer listing (Berger, n.d.), experimenters instructions for the autoganzfeld (attached to the autoganzfeld computer listing, n.d.) and the PRL Annual Reports. Honorton's personal files concerning the PRL autoganzfeld are now scattered between Edinburgh University (Scotland, UK), The Institute for Parapsychology (North

Carolina, USA) and possibly his son (New Jersey, USA). The authors have inspected the first two locations and have been informed that items in the third location should be classified as either destroyed or lost (McCathey, xx). The authors also contacted those individuals directly involved in setting up and running the autoganzfeld studies (see acknowledgements). For this reason, this paper contains a great deal of information from the authors' personal correspondence. This is referenced by the writer's names, followed by the date of the fax, telephone call, letter or electronic mail. The authors are happy to make available copies of all faxes, letters and electronic mails cited. Written permission for each citation has been obtained by the authors and, again, is available on request.

23This information is only to be found in two sheets of paper entitled simply 'Instructions', attached to Berger's (n.d.) listing of the autoganzfeld computer program.

23The information from Morris et al was published in the 1993 conference proceedings of the Parapsychological Association and was clearly mentioned during the paper's oral presentation at that conference. The validity of this information was not questioned by the paper's referees, those attending the conference or anybody subsequent to conference proceedings (Morris, May 1994). This information was apparently based upon conversations between Robert Morris and either Rick Berger, Mario Varvoglis or Charles Honorton (Morris, May 1994), all of which served as experimenters during the PRL autoganzfeld studies. Varvoglis (22 May, 1994) does not recall telling Morris this information. However, Berger (8 June, 1994) noted:

I may very well have told Bob [Morris] or anybody else that sender vocalization was not forbidden in the formal series. This was until I went back and probed my notes, in particular the program listings.

23Honorton et al (1990) notes that:

Belief 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. (p. 102).

23One reviewer of this paper noted that senders might have been equally likely to give off noises of disappointment when the mentation was not on target. The authors believe that sounds of delight were likely to have been louder than sounds of disappointment. If this were not the case the experimenter would need to have subliminally registered the approximate content of the sender's noise, rather than simply its presence/absence.

23Senders' headphones carried the receiver's mentation and, in the case of dynamic targets, soundtracks.

23The authors asked these reviewers to specify the source of this information. Both believed that the autoganzfeld experimenters had stated that this was the case. The authors contacted three of the main experimenters (Rick Berger, Ephraim Schechter and Mario Varvoglis) and asked for further information. All three confirmed that they believed this was the case (see discussion for details), but neither they nor the authors were able to locate any written source that described this aspect of the autoganzfeld protocol. None of these individuals reported aborting any trials for this reason.

23The citation of both of these quotes was requested by Schechter (31 May,1994), who noted:

If you're going to use me as the source, I'd prefer that you give both possibilities for insulation [i.e., fibreglass and some type of 'foam-core' material] and make it clear that I don't claim to recall accurately. It does seem appropriate to stick with the conservative assumption (fibreglass) for the calculations, though [see the acoustic analyses presented later in this paper].

23A 'double wall partition' consists of two separate sheets of 5/8 inch Gypsum board. These are mounted on two separate 2x4 inch plates and the gap between the sheets can be left empty, or filled with varying thicknesses of fibreglass.

23Schechter (31 May, 1994) reports the discussions that he has had with other PRL experimenters concerning this issue. Schechter first thought that the door was an 'ordinary' indoor one (i.e., one obtained from a building contractor, rather than a door especially design and constructed for the room). (Schechter [8 June, 1994] has since asked the authors to note that this was because he 'had not been thinking in terms of electrical shielding'.) Another PRL autoganzfeld experimenter corrected him, noting that (because of the electrical shielding) the door was made, in part, from steel. Berger (8 June, 1994) also recalled that the door was partly steel. Schechter (6 June, 1994) has since added that the term 'acoustical' (used by Honorton et al (1990) describe the sender's door) is:

...commonly used in the US building trades to mean a wood or steel-clad door filled with sound-absorbent extruded foam...The door used was at least steel-clad, as part of the electrical shielding. So, while I still am not SURE (it's an old memory), the 'acoustic' description makes me lean toward the notion that the sender's room door was the foam-filled steel clad type.

23Bem has asked the authors to make it clear that:

...I am serving as a secondary source. I was not an experimenter and am relying on communications with those who were, for my own understanding of the exact experimental setup.

23Bem's message was part of an electronic discussion group. This part of the message is asking Ephraim Schechter for more information about this issue. In a note to the authors Schechter (20 May, 1994) wrote:

The Sonex-covered barrier in the sender's room, by the way, was fairly close to the door rather than directly back of the sender's chair.

In reply to the authors' request for more information, Schechter (25 May, 1994) further added:

My memory doesn't gibe with the diagram. I remember the panel as being parallel to the door. Check with Rick or Mario, though, AND with someone who participated in sessions after I left. Maybe the position was changed sometime after I left.

23A warble tone is a sound whose frequency is continuously varying in a regular manner within fixed limits.

23The figures cited in this section are based upon advice and help from Dr M.N.M. Badi (Department of Mechanical and Aeronautical Engineering, University of Hertfordshire), Michael Adams (Canford Audio), sound engineers at Illbruck USA and Dr Peter Howell (psychoaccoustics specialist, University College London).

23This section assesses the notion that sound may have travelled through the wall directly separating sender from experimenter. Another possible route for leakage involves sound passing through the free standing barrier and out through the 'acoustic' door. In fact, the barrier would reduce sound by between 10-25dB and the door by at least a further 35dB. Thus this route would probably provide a greater reduction in sound than direct passage through the wall. For this reason, and to err on the side of caution, the effects of the barrier and door are ignored in these analyses.

23The STC is a value of the transmission loss (TL) at 500Hz with attenuations of -16dB at 125Hz and +4dB at 4KHz.

23This is higher than most Apple II computers as Honorton's machine is equipped with a 'Kensington System Saver' fan.

23This hypothesis stems from the fact that previous ganzfeld experiments using multiple image targets (e.g., from View Master slide reels) produced significantly higher hit rates than studies using single images as targets.

23Honorton et al wanted to test an artistically gifted set of participants, and thus recruited actors, dancers and musicians from the Julliard school of performing arts in New York.

23For example, experimenter prompting during the judging period:

...was initiated because participants frequently failed to identify obvious correspondences between their mentation and target elements (Honorton et al, 1990, p. 110).

23It should be noted that without this information (i.e., had the authors based their analysis solely on written reports) the conclusions reached would have been far more critical of the autoganzfeld design.

REFERENCES

Badi, M.N.M. (1994). Sound Transmission from the Sender room in parapsychology experiment. Technical Report: University of Hertfordshire.

Bem, D.J., & Honorton, C. (1994). Does psi exist? Replicable evidence for an anomalous process of information transfer. Psychological Bulletin, 115(1), 4-18.

Berger, R.E., & Honorton, C. (1985). An automated psi ganzfeld testing system. Proceedings of the Parapsychological Association 28th Annual Convention, 3-36.

Berger, R.E. (n.d.) Auto-ganzfeld program documentation. Psychophysical Research Laboratories. Princeton, New Jersey.

Everest, F.A. (1994). The Master Handbook of Acoustics. McGraw Hill Inc: PA.

Honorton, C. (1977). Psi and internal attention states. In B.B. Wolman (Ed.) Handbook of parapsychology (pp 435-472). New York: Van Hostrand Reinhold.

Honorton, C. (1985). Meta-analysis of psi ganzfeld research: A response to Hyman. Journal of Parapsychology, 49, 51-92.

Honorton, C., Berger, R.E., Varvoglis, M.P., Quant, M., Derr, P., Schechter, E.I., & Ferrari, D.C. (1990). Psi communication in the ganzfeld: Experiments with an automated testing system and a comparison with a meta-analysis of earlier studies. Journal of Parapsychology, 54, 99-139.

Hyman, R. (1985). The psi ganzfeld experiment: A critical reappraisal. Journal of Parapsychology, 49, 3-49.

Hyman, R. & Honorton, C. (1986). A Joint Communiqué: The Psi Ganzfeld Controversy. Journal of Parapsychology, 50, 351-364.

Moore, B.J. (1982). An Introduction to the Psychology of Hearing. Academic Press: London.

Morris, R.L., Taylor, R., Cunningham, S., & McAlpine, S. (1993). Towards replication and extension of autoganzfeld results. Proceedings of the Parapsychological Association 36th Annual Convention, 177-191.

Rosenthal, R. (1976). Experimenter effects in behavioural research (enlarged edition). Irvington Publishers Inc: NY.

Urban, M.J. (1992). Auditory subliminal stimulation: A re-examination. Perceptual and motor skills, 74(2), 515-541.

Urban, M.J. (1993). Auditory subliminal stimulation: Methods. Perceptual and motor skills, 76(3), 1103-1106.

0As noted by the Bem and Honorton (1994) the term 'psi' denotes:

...anomalous process of information or energy transfer, processes like telepathy or other forms of extrasensory perception that are currently unexplained in terms of known physical or biological mechanisms. (p.4).

1 See, e.g., Child's (1985) discussion of the way in which some critics ignored, distorted and misrepresented the Maimonides ESP dream experiments.

2 Details of the autoganzfeld design, procedure and results discussed in the following sections are derived from various sources. Published sources consisted of Berger and Honorton (1985), Schechter and Honorton (1986), Honorton et al (1990) and Bem and Honorton (1994). Unpublished, but widely available, written sources consisted of the autoganzfeld computer listing (Berger, n.d.), experimenters instructions for the autoganzfeld (attached to the autoganzfeld computer listing, n.d.) and the PRL Annual Reports. Honorton's personal files concerning the PRL autoganzfeld are now scattered between Edinburgh University (Scotland, UK), The Institute for Parapsychology (North Carolina, USA) and possibly his son (New Jersey, USA). The authors have inspected the first two locations and have been informed that items in the third location should be classified as either destroyed or lost (McCathey, xx). The authors also contacted those individuals directly involved in setting up and running the autoganzfeld studies (see acknowledgements). For this reason, this paper contains a great deal of information from the authors' personal correspondence. This is referenced by the writer's names, followed by the date of the fax, telephone call, letter or electronic mail. The authors are happy to make available copies of all faxes, letters and electronic mails cited. Written

permission for each citation has been obtained by the authors and, again, is available on request.

3 This information is only to be found in two sheets of paper entitled simply 'Instructions', attached to Berger's (n.d.) listing of the autoganzfeld computer program.

4 The information from Morris et al was published in the 1993 conference proceedings of the Parapsychological Association and was clearly mentioned during the paper's oral presentation at that conference. The validity of this information was not questioned by the paper's referees, those attending the conference or anybody subsequent to conference proceedings (Morris, May 1994). This information was apparently based upon conversations between Robert Morris and either Rick Berger, Mario Varvoglis or Charles Honorton (Morris, May 1994), all of which served as experimenters during the PRL autoganzfeld studies. Varvoglis (22 May, 1994) does not recall telling Morris this information. However, Berger (8 June, 1994) noted:

I may very well have told Bob [Morris] or anybody else that sender vocalization was not forbidden in the formal series. This was until I went back and probed my notes, in particular the program listings.

5 Honorton et al (1990) notes that:

Belief 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. (p. 102).

6 One reviewer of this paper noted that senders might have been equally likely to give off noises of disappointment when the mentation was not on target. The authors believe that sounds of delight were likely to have been louder than sounds of disappointment. If this were not the case the experimenter would need to have subliminally registered the approximate content of the sender's noise, rather than simply its presence/absence.

7 Senders' headphones carried the receiver's mentation and, in the case of dynamic targets, soundtracks.

8 The authors asked these reviewers to specify the source of this information. Both believed that the autoganzfeld experimenters had stated that this was the case. The authors contacted three of the main experimenters (Rick Berger, Ephraim Schechter and Mario Varvoglis) and asked for further information. All three confirmed that they believed this was the case (see discussion for details), but neither they nor the authors were able to locate any written source that described this aspect of the autoganzfeld protocol. None of these individuals reported aborting any trials for this reason.

9 The citation of both of these quotes was requested by Schechter (31 May,1994), who noted:

If you're going to use me as the source, I'd prefer that you give both possibilities for insulation [i.e., fibreglass and some type of 'foam-core' material] and make it clear that I don't claim to recall accurately. It does seem appropriate to stick with the conservative assumption (fibreglass) for the calculations, though [see the acoustic analyses presented later in this paper].

10 A 'double wall partition' consists of two separate sheets of 5/8 inch Gypsum board. These are mounted on two separate 2x4 inch plates and the gap between the sheets can be left empty, or filled with varying thicknesses of fibreglass.

11 Schechter (31 May, 1994) reports the discussions that he has had with other PRL experimenters concerning this issue. Schechter first thought that the door was an 'ordinary' indoor one (i.e., one obtained from a building contractor, rather than a door especially design and constructed for the room). (Schechter [8 June, 1994] has since asked the authors to note that this was because he 'had not been thinking in terms of electrical shielding'.) Another PRL autoganzfeld experimenter corrected him, noting that (because of the electrical shielding) the door was made, in part, from steel. Berger (8 June, 1994) also recalled that the door was partly steel. Schechter (6 June, 1994) has since added that the term 'acoustical' (used by Honorton et al (1990) describe the sender's door) is:

...commonly used in the US building trades to mean a wood or steel-clad door filled with sound-absorbent extruded foam...The door used was at least steel-clad, as part of the electrical shielding. So, while I still am not SURE (it's an old memory), the 'acoustic' description makes me lean toward the notion that the sender's room door was the foam-filled steel clad type.

12 Bem has asked the authors to make it clear that:

...I am serving as a secondary source. I was not an experimenter and am relying on communications with those who were, for my own understanding of the exact experimental setup.

13 Bem's message was part of an electronic discussion group. This part of the message is asking Ephraim Schechter for more information about this issue. In a note to the authors Schechter (20 May, 1994) wrote:

The Sonex-covered barrier in the sender's room, by the way, was fairly close to the door rather than directly back of the sender's chair.

In reply to the authors' request for more information, Schechter (25 May, 1994) further added:

My memory doesn't gibe with the diagram. I remember the panel as being parallel to the door. Check with Rick or Mario, though, AND with someone who participated in sessions after I left. Maybe the position was changed sometime after I left.

14 A warble tone is a sound whose frequency is continuously varying in a regular manner within fixed limits.

15 The figures cited in this section are based upon advice and help from Dr M.N.M. Badi (Department of Mechanical and Aeronautical Engineering, University of Hertfordshire), Michael Adams (Canford Audio), sound engineers at Illbruck USA and Dr Peter Howell (psychoaccoustics specialist, University College London).

16 This section assesses the notion that sound may have travelled through the wall directly separating sender from experimenter. Another possible route for leakage involves sound passing through the free standing barrier and out through the 'acoustic' door. In fact, the barrier would reduce sound by between 10-25dB and the door by at least a further 35dB. Thus this route would probably provide a greater reduction in sound than direct passage through the wall. For this reason, and to err on the side of caution, the effects of the barrier and door are ignored in these analyses.

17 The STC is a value of the transmission loss (TL) at 500Hz with attenuations of -16dB at 125Hz and +4dB at 4KHz.

18 This is higher than most Apple II computers as Honorton's machine is equipped with a 'Kensington System Saver' fan.

19 This hypothesis stems from the fact that previous ganzfeld experiments using multiple image targets (e.g., from View Master slide reels) produced significantly higher hit rates than studies using single images as targets.

20 Honorton et al wanted to test an artistically gifted set of participants, and thus recruited actors, dancers and musicians from the Julliard school of performing arts in New York.

21 For example, experimenter prompting during the judging period:

...was initiated because participants frequently failed to identify obvious correspondences between their mentation and target elements (Honorton et al, 1990, p. 110).

22 It should be noted that without this information (i.e., had the authors based their analysis solely on written reports) the conclusions reached would have been far more critical of the autoganzfeld design.