THE PERCEPTION OF EXPRESSIVE MOVEMENT IN MUSIC PERFORMANCE.

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1a- 5g are point-light displays, in order to view these correctly, the viewing monitor contrast control must be turned down and the brightness control turned up so that only the patches of reflective tape are visible on the screen.

All the following examples are in ordinary brightness-contrast settings.

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ABSTRACT

This thesis is an attempt to develop empirical methods which address the issue of body movements in music performance. The closest equivalent work is found in studies which adopt *"ecological"* methods, based on the theoretical approach of J.J. Gibson. Chapters 1 and 2 present this framework together with a review of related literature from a variety of perceptual studies.

Chapter 3 presents four studies which use *"point-light technique"* to illuminate body joints so that pure kinematic information can be presented to observers. The results of these studies demonstrate that kinematics alone provide enough information to distinguish between different expressive manners (deadpan, projected, and exaggerated) and that the movement stimulus provides information equivalent to sound. Systematic reduction of the amount of point-light information shows certain body joints to be more significant than others in conveying performance intention.

Chapter 4 presents five studies which explore quantitative and qualitative aspects of body movement in music performance in an attempt to identify those features of body movement which are expressive. A variety of techniques is used including tracking, the construction of a movement vocabulary and semantic differentials. These studies show that the perception of expressive movements is based on a complex mixture of quantitative and qualitative factors incorporating a flexible repertoire of specific movement types.

Chapter 5 presents the final five studies which explore the constancy of this repertoire of movements over time and across musical styles, and investigate the organisation and origin of these movements. The techniques used in these studies range from semantic differentials to interviews with the performer. These studies show a degree of consistency in the organisation of the expressive movements across repeated performances and in different styles, and reveal that musical structure and the performer's emotional response to it are important determiners of these movements. The performer has partial knowledge of the movements he makes, and even in the context of imaginary performances, shows consistency in their locations and specific character.

The final chapter presents a summary of all the empirical results and develops a framework within which they may be interpreted based on three main ideas: i) a *"centre of moment"* for expressive movements; ii) a flexibly applied repertoire of movements; iii) an interaction between physical, biological and cultural factors in the establishment of this repertoire. The thesis concludes with a brief discussion of further possibilities for research in this area and the broader implications of such investigations.

CHAPTER ONE

1.1 INTRODUCTION

The research in this thesis is a contribution to the psychology of expression in music performance. It is primarily concerned with the visual perception of the performer's movements. With the assumption that the perceiver detects expressive information in movement, this research has two broad aims. First, to investigate what movements are detected as expressive sources; and second to examine how performance movements are organised and to enquire where they originate. The visual component of music perception is chosen because the existing empirical research on musical performance has focused almost exclusively on sound, and in so doing has ignored the fact that the live performance presents the audience with both sound and visual stimuli.

In the study of the aural component of music performance, the term expression has tended to refer to the intentional modifications of a variety of parameters (timing, dynamic, articulation) by players during performance. These modifications have been discussed in terms of their structural and affective effects. In this study, movement expression is considered to be the deliberate modifications of body posture beyond those required purely for the mechanical production of the notes. Because of the role of movement in the production of music, it is realised that the movements of the performance are associated with the production of the sound modifications. Therefore, the research links pure psychological enquiry with music study in an attempt to deepen our understanding of the nature of the visual information in music performance.

Initially, the thesis examines what is perceived in a performance, but as the investigation progresses, the focus shifts to the examination of performance production in order to examine the source of the movements.

Music performance is a sophisticated behaviour, and in an attempt to capture its richness and subtlety, a variety of broadly empirical studies are used. These range from the conventional experiment in which the data are analysed statistically, to individual subject reports. The conventional experiments are used to try to examine particular effects, whereas the subject reports are used to address the more diverse properties of the performance.

1.2 EMPIRICAL WORK ON MUSIC EXPRESSION

From the simplest anecdotes it is known that what differentiates one performer's rendition of a piece of music from another is the individualised interpretation. Coker (1972) believes that such interpretation is bound up in the performer's ability to furnish the pitches, timing and timbral indications of a composition with expressive character. He believes that this character originates in the performer's thoughts about the music and her own emotional and physical state. Support for this opinion can be found in Balliot's treatise on violin technique of 1834 which states that the performer must allow *"personal feeling to show itself supreme"* (cf. Stowell, 1985: 269). Questions about how these feelings are manifested have produced a wide range of empirical studies which have taken a number of viewpoints ranging from social psychology through to motor skills.

At one extreme, Kemp's (1981) investigations into the personalities of musicians indicates that performers tend to display common personality traits of introversion, pathemia (sensitivity and imagination) and intelligence. However, within this personality type, Davies (1978) suggests that social stereotyping heavily influences the player's performing identity and how he or she should behave within the performing context of an orchestra. By asking members of a Glasgow-based symphony orchestra to talk about themselves and their fellow players, Davies found that string players tended to categorize themselves as hard-working, aesthetic and sensitive. Yet the brass players viewed the string players as humourless, overly sensitive wets. Whilst the brass players considered themselves to be honest salt-of-the-earth types, the string players saw them as coarse and loud-mouthed boozers. Davies hypothesises that such opinions may begin to affect players' behaviour to such an extent that new members of the orchestra could fall in with the stereotype: a brass player becoming a heavy boozer, for example. He believes that the stereotyping may originate in the much broader British stereotype of the North/South divide, the equation being that the brass players come from the North and therefore tend to be of working class origin, whereas the string players come from the South and tend to be of middle class origin. Hargreaves (1986) presents many instances of such stereotyping and group influence on the individual musician. He concludes that such social behaviours are empirically unquantifiable, but certainly create important effects on the way in which the performer behaves, and therefore the way in which he or she produces a performance. Indeed, from this personality-based stereotype, Hargreaves (1982) suggests that peer pressure or group influence also affects musical preferences. Therefore it is also possible to conclude that some performers will modify their responses and performing strategies to a piece of music on these grounds.

At the other extreme, the issue has been approached from a motor skills perspective. Shaffer's (1982) investigations demonstrate that in order to organise movement there must be a motor program and that in typing the characteristics of the performance are like a *"finger print"* for how the program is organised. Indeed, he shows that sequences of key presses have definite timing profiles across performances of the same word sequences. He concludes therefore that the movement control program elicits effects on the performance that are inevitable, but which are expressive only of the individual's production of words. In work on expressive piano performance, Shaffer (1984) concludes that some of the timing variations away from the metric pulse of the musical rhythm are the inevitable expression of features of the motor program. However, he goes on to illustrate that there are also other timing profile variations which are flexible in note production. Though these features are themselves integrated into the motor program, these features are seen as timing effects specifically intended to enhance the musical effect. These intentional variations can be increased or diminished but never totally removed. Thus the two elements of motor programming coexist: timing profiles directly related to simple execution and timing deviations for musically enhancing effects.

In line with Shaffer's evidence that the structural element of timing is varied in performance, it is of course essential to recognise that the structural elements of dynamics, intonation and timbre as well as timing are manipulated according to an individual's performance interpretation. When Apel (1972) examines the possible determinants of musical expression, he suggests that it is the musical structure which is the principal underscoring element of the player's modelling of a composition. However to know that structural elements are manipulated does not verify that it is the structure of the music itself which creates either an expressive moment within a performance or an expressive whole. For instance, Nakamura (1987) demonstrates that different performances contain different quantities of dynamic variation which are consciously used and recognised by performers as expressive devices. However, Nakamura's study does not show any specific relationship between musical structure and the dynamic profile that he records. Todd (1985) proposes a generative model to explain how, in timing modification, slowing occurs at significant structural moments in the piece - for example, the phrase boundary and final cadence points. For Todd, an answer to the question of what elicits expressive production of timing is that there is some specific rule relating harmonic structure to rubato in performance.

Studies by Sloboda (1983) have shown that in the performance of the same musical phrases, performers show significant agreement in the position, nature and direction of expressive timing variation. From a study in which performers were asked to play the same sequence of pitches in two different metres, it is apparent that some of the timing variation is related to the performers' production of a performance which emphasises the metre. Indeed in each performance of the two metres, note extensions occurred principally at bar and half bar levels. Thus Sloboda's work again suggests a link between structure and expression.

All the above mentioned empirical enquiries provide a valuable discourse on the nature of what might be defined as the ways in which expression is produced. However, this entire spectrum of work pays little attention to the vital issue of how these elements are detected and used by the perceiver: are they the details which are picked up by the audience? It is evident that without knowledge of what is detected, any investigation of the individual's performance is incomplete, for performance is clearly a communication between performer and audience. Therefore, how are the perceiver's sensibilities affected? Arguments about what causes an interpretation to be unique to the performer seem senseless without some knowledge of whether the manipulated components of the performance are detectable by the audience and some knowledge of what these modifications are detected to be. Sloboda's (1983) study does pay some regard to what the audience detects and indicates that the metre of a piece is evident to the audience from the expressive stresses placed by the performer on the initial beat and half bar beat. This suggests therefore that expressive devices make the musical purpose clearer - in this case the metre. Nakamura (1987) also examined the perceiver's abilities to detect produced modifications, and, his study illustrates that listeners detect dynamic modifications in a performance as explicit performer intentions of emotional effect. In addition to these studies, Clarke (1989) has revealed that listeners are able to perceive timing extensions as small as 20ms to notes with between 100-400ms duration. He also shows that tonal and atonal melodies elicit slightly different judgements: an altered atonal tune is easier to detect than an altered tonal tune; whilst an unaltered tonal tune is easier to detect than an unaltered atonal tune. Clarke proposes that an unaltered tonal performances may be easier to identify because the pattern of rubato fits the structure of the melody and forms a strongly unified and perceptually stable time/pitch organization. Thus as a consequence, the timing changes in the altered tonal melodies become difficult to detect because they tend to become assimilated into the stable perceptual organisation of the neutral melody and its timing organisation. For the atonal piece Clarke suggests (1989: 8) that the pattern of rubato is arbitrarily related to the melody and thus produces a less stable perceptual event. As a consequence of less perceptual stability, when the atonal melody is altered the isolated changes are relatively more conspicuous. Clarke also discovered that the perceptual effect of the extended notes is dependent on note position. Indeed, he remarks that the first timing change (only four notes into the melody) is not easily detected. Thus he concludes that perceivers need to be exposed to the temporal structure for a little more than four notes before they can discern a timing change from the overall rhythm. Therefore Clarke is able to conclude that not only are details of performance expression perceptually available, but that there is a link between certain perceptual effects and features of the musical structure.

The value of the perceptual study is, therefore, that by finding out what features of the music can be detected, a basis from which an understanding of the communicative function of expression can be established. However, despite the importance of such studies, the work developed by Clarke, Sloboda, Nakamura and others forms only a small part of the current research into music, and questions about the extent of the perceptual impact of those elements which production studies have identified remain largely unanswered. All the research discussed so far has focused entirely on the sounds detected in performance, whilst there is a good deal of anecdotal evidence that visual information provides important information about individual interpretation. For instance, again in Balliot's L'Art du violon, the author suggests that different tempi should naturally produce different types of physical execution. Indeed, Balliot remarks that the Adagio tempo results in "*more ample movements*" than the Allegro where notes are "*tossed off*", whereas in Presto there is "*great physical abandon*". Although these points illustrate that movements are essential in production, it is also important to note that live music performance is a social communication, which like any other human encounter, presents the perceiver's visual system with information. Indeed, as perceptual verification of this, Schumann's description of the performances given by Liszt reveals how effective this transmission of expression to the audience through body movement can be. Schumann reports of Liszt's performance:

> "*Within a few seconds tenderness, boldness, exquisiteness, wildness succeed one another; the instrument glows and flashes under the master's hands... he must be heard and seen; for if Liszt played behind a screen, a great deal of poetry would be lost*" (An excerpt taken from R. Schumann's On Music and Musicians quoted in Morgenstern 1956: 155).

Of course, Liszt's performances did not suit everyone's musical taste: Glinka (an excerpt taken from O. Fouque's

Glinka, d'après ses mémoires et sa correspondances quoted in Morgenstern, 1956: 129) referred to him as the *"exaggerator of nuance"*. However, whatever the evaluation of Liszt's style, this example serves to illustrate that body movement provides valuable information about his state of mind and his involvement with the music. The illustration of Liszt in figure 1.1 shows that flourishes of the body are evidently intended to have meaning and communicative force for the audience. Although nowadays there is a diminished enthusiasm for this kind of extrovert performance, professional performers nonetheless talk about *"projecting"* the performance through the body: Baker (1982) claims that a performer can only communicate to the audience if she is prepared to allow the sounds to live and breathe through the body.

Thus it seems that there is a rich source of perceptual information contained in body movements. There are, however, virtually no precedents for an empirical investigation of this aspect of music performance. The fundamental concern of this thesis, therefore, is to explore the perceptual information contained in the visual appearance - that is to say the performer's body movements - of music performances. The particular area of interest is to examine whether a variety of explicit performance interpretations can be distinguished in movement and, if identifiable, to determine what particular features of the movement go towards making each interpretation *"look"* different. What makes different performance interpretations of the same piece particularly interesting is that whilst it is clearly necessary for the performer to obey the instructions of a score, the performer is also expected to have a particular approach to the piece and therefore the presentation of the music. Thus it should be possible to discover what visually distinguishes the different styles of different interpretations.

Liszt appears in his cassock. Haughty smile. Hurricane of applause.

First chords. Turns around to force the audience to pay attention.

Closes his eyes and appears to be playing only for himself.

Pianissimo. St Francis of Assisi converses with the birds. His face is radiant.

Hamlet's self-questioning. Faust's torment. The keys exhale sighs.

Reminiscences: Chopin, George Sand, beautiful youth, fragrances, moonbeams, love.

Dante: the Inferno; the damned and the piano tremble. Feverish agitation. The hurricane breaks down the gates of Hell. – Boom!

He has only played for us – while trifling with us. Applause, shouts and hurrahs!

Figure 1.1: Caricatures of Liszt's performances by Janko (reproduced in Sachs, 1982) taken from **Borsszem Janko**, 1873.

One issue in the study of complex skill is the principle of economy. Focusing on a comparatively simple motor task, Welford (1968) showed that as practice is increased and motor plans are established, so the level of the performance becomes more consistent. This suggests that movement accuracy increases with practice. Indeed with practice, the execution time of an activity from first attempt to high-level practice falls exponentially until it reaches an *"incompressible minimum"*. This suggests that there is conservation of energy expenditure, with movements being reduced to only those required to execute the task. In other words, the skilled practitioner produces the necessary movements in the most economical manner. Turning back to music performance, the photographed performer shown in figure 1.2 illustrates that for the most part in his piano performance the hands are active around the keyboard area, presumably occupied simply with playing the correct notes. However, there is a range of movements which depart from the keyboard and that seem far in excess of any technical motor programming requirement. These movements with their curved traces appear to have a relationship with the notion of achieving *"flow and grace"* - the words used by Balliot to describe the types of actions which affect the performer's sensibilities.

Thus, besides mechanical accuracy in the achievement of the pitches and note sequences of a composition, it appears that there may be some other movement component in the creation of a performance. Perhaps it is these components that are in excess of note execution which create differences between different interpretations of the same music.

Empirically, there is evidence in the general literature on social behaviour that all physical actions reveal important information to the onlooker. Leach (1976) provides the example of the involuntary biological activity of breathing to demonstrate that it is this motion of the body during a breathing cycle which informs the onlooker that a person under observation is alive. If the breathing includes large shoulder heaves the observer can make the additional judgement that the person is having difficulty in

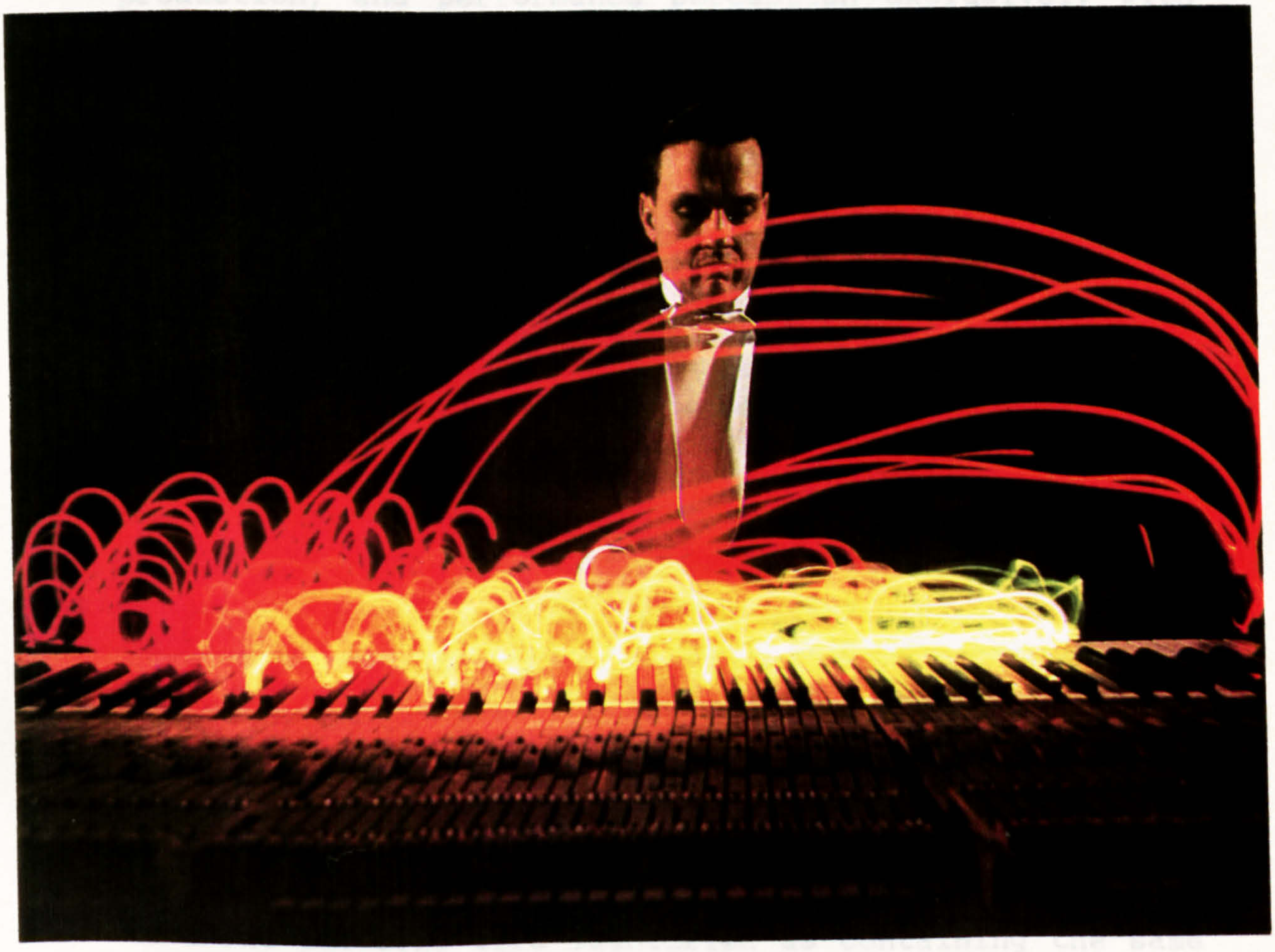


Figure 1.2: The hand movements of a concert pianist traced using light sensors (taken from Miller, 1978: 329).

breathing. McArthur and Baron (1983) propose that all humans have the potential to make quite complex social judgements from this kind of information. For instance, they discuss how it is a visual judgement which the observer depends on when choosing who to walk up to and ask directions from.

In music performance there is of course an intimate link between sound and movement: the player has an idea about how the music should sound and then finds a way of expressing it through the body. However this link has tended to lead to the equation of movement with note production, and performance perception exclusively with sound. Indeed, Shaffer's (1980) reference to the mechanistic speech of people who become deaf shows that a lack of aural feedback curtails the expressive potential of the speaker and provides a good example of the importance of sound perception in order to monitor and maintain expression in sound production. However, work by Clynes (1980) and Clynes and Nettheim (1982) has suggested an equivalence between movements and sounds in their conveyance of sentic form (characteristic dynamic expressive forms of specific emotional qualities). Using seven different hand movements which Clynes and Nettheim (1982) considered to be analogous to seven emotional qualities (anger, hate, grief, love, sex, joy, and reverence) as the visual stimuli, they discovered that Australian and American observers with European heritages and Aboriginals living in the Australian bush could identify the movements with the appropriate emotional qualities. Similarly, single musical sounds which were given amplitude profiles similar to those of the hand movement patterns were identified as containing the same emotional qualities as the pressure movement from which the sound was derived. Thus, there is some indication that movement contains information of the same expressive type as sound. However, whilst Clynes and Nettheim's work is interesting, the foundations of these studies are highly speculative, and there has been very little proper empirical validation of their ideas.

1.3 THE ARGUMENT FOR AN ECOLOGICAL APPROACH

The overriding absence of previous work which tackles the issues of the expressive nature of performance movements has the consequence that there are no established methods for researching the question. The closest equivalent work can be found in the innovative empirical methods of Johansson (1973) and subsequent studies by Cutting and Kozlowski (1977), Kozlowski and Cutting (1977), Cutting, Proffitt and Kozlowski (1978), Barclay, Cutting and Kozlowski (1978), Cutting and Proffitt (1981), Runeson and Frykholm (1983), Frykholm (1983a, b & c), Runeson (1984), Bassilli (1978), Scully (1986), van Wieringen, Boon and Gerritsen (1987), all of whom have investigated the perception of human bodily activities ranging from simple walking and lifting to much more complex activities like gymnastic performance for which judgements about the separate technical and artistic interpretation elements of the performances have been examined. These studies and their methods will be discussed in chapter two. The general theoretical framework for them - the "*ecological approach*" - was originally developed by James Gibson (1966a, 1979) and it is to Gibson's work that our attention must now turn.

Gibson's central theoretical proposal is that information is directly available to the perceiver. That is, perception constitutes some kind of awareness of what is specified in the environment without recourse to a series of constructive stages. Although Gibson argued a case for the direct availability of information in all the senses, his own empirical work and theory focused mainly on vision.

In essence, his approach to vision recognises that light is structured and therefore carries information which is meaningful. The theoretical point of departure is that radiant light from sources like the sun is reflected from the surfaces of the environment and is structured by them. The structure of this ambient optic array is uniquely specific to its source, and is therefore informative about the source - see figure 1.3.

Informational structure specific to the unchanging properties of the environment is invariant under transformations of the optic array and is thus revealed by the transformations:

> *"Continuous optical transformations can yield two kinds of perception at the same time, one of change and one of non-change. The perspective transformation of a rectangle, for example, was always perceived as something rotating and something rectangular. This suggests that the transformation, as such, is one kind of stimulus information for motion and that the invariants under transformation are another kind of stimulus information, for the constant properties of object ... The perception of an object does not depend on a series of percepts, each one an image of the object, that is, perceptions of its forms or perspectives over time. Object perception does not depend on form-perception but on invariant detection. And these invariants are "formless", that is to say, they are not themselves forms"* (Gibson, 1973: 43).

However, the perceiver's capacity to detect that information is not treated as innate. As Gibson states:

> *"The perceptual capacities of the newborn, animal or human, for getting information becomes a matter for investigation. The relative proportions of the unlearned and the learned in perception might be expected to depend on the degree of maturity of the infant at birth, which in turn depends on his species and on the kind of environment the young of his species have been confronted with during evolution"* (Gibson, 1966a: 267).

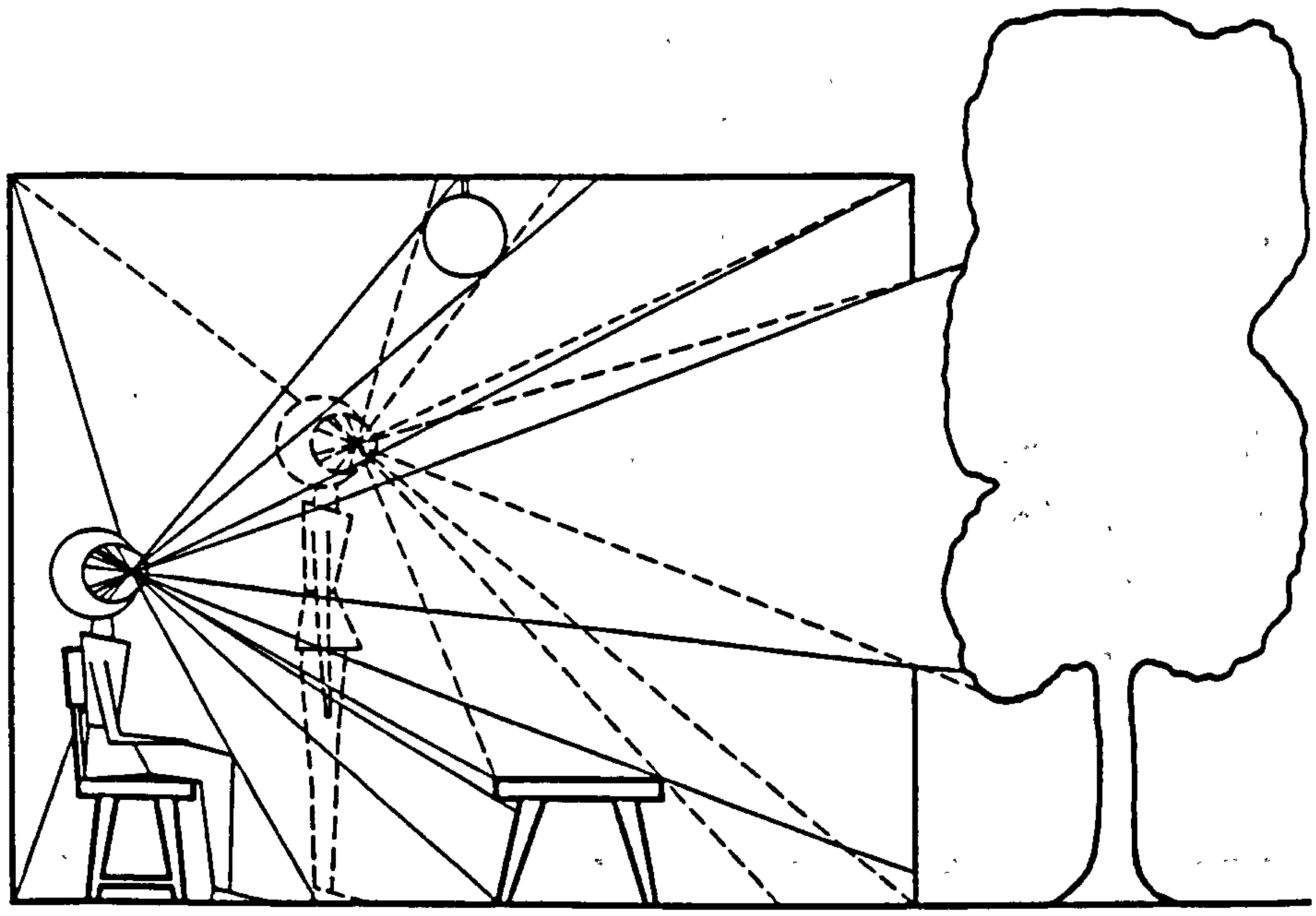


Figure 1.3 The ambient optic array and its change brought about by a locomotor movement of the observer. The thin solid lines indicate the ambient optic array for the seated observer, and the thin dashed lines the altered optic array after standing up and moving forward. The difference between the two arrays is specific to the difference between the points of observation, that is, to the path of locomotion. Note that the whole ambient array is changed, including the portion behind the head. And note that what was previously hidden becomes visible. (Taken from Gibson, 1979: 72.)

This need to "*investigate*" for learning to occur is achieved by "*seeking-out*" with movements of the eyes, head and often the whole body, and responding to the transformations of the environment. As Gibson summarises:

> "*Perception is active not passive. It is exploratory, not merely receptive ... Exploratory movements of the eyes, and even locomotor exploration in surroundings may all be thought of as a search for more information*" (Gibson, 1958: 43).

Gibson coined the term "*ecological*" to emphasize the belief that only a synthesis of the physical, physiological, and evolutionary selective forces on the senses (cf. Reed, 1988: 207) brings about perception. For all empirical studies, such an approach means developing experiments which preserve as many features of the individual's natural behaviour as possible. This is what is meant by the "*ecological validity*" of an experiment.

Although Gibson's approach enjoys increasing support, the central thesis has promoted much debate. Theoretical discourse is essential to the scientific dialectic, but Gibson's ideas have been attacked on account of their radical opposition to the majority approach to perception which is commonly termed "*information processing*". Gibson (cf. Reed, 1988: 223, who refers to notes by Gibson [1965] held in the J.J. Gibson Archives, Cornell University) treats this majority opinion as a misconception and shows a keen interest in presenting his ideas to people who have not invested an interest in the study of psychology at a professional level. In brief, the professional formation for psychologists holds that information is processed for perception through the reception of myriad components of light intensities at the retina which produce meaning only if they advance through a number of stages in which progressively more global and complex patterns of the visual scene are constructed by the perceiver. This approach demands that in empirical studies the investigator looks at relatively isolated details of complex activities in order to determine which light patterns occur at which point in time and at which part of the retina. The approach assumes that the complex behaviour is composed of assemblages of easily distinguishable simple operations. Gibson believes that this ignores the ways in which structures or behaviours are perceived as meaningful wholes or configurations.

An example of this "*information processing*" approach is found in the work of Gregory (1970, 1973, 1974) who proposes that information is processed by the perceiver through mental representation which in turn depends on a store-like memory which is necessary for meaning to be achieved. The ambiguity of information contained in visual illusions is at the core of Gregory's work, and it is from the knowledge that illusions are successful that Gregory maintains that there is only sensation at the retina. In the case of illusions, the sensations on the retina are interpreted by some higher level process as providing evidence for the illusory object, and this principle is generalised to form the basis for non-illusory perception. However, there are several basic problems with these proposals which require attention. Firstly, as Rogers (1985) argues, visual illusions are exceptions, not the perceptions of common experience, and therefore constitute strange examples upon which to base a theory of everyday perception. Secondly, although Gregory proposes that the mind is active in processing the light stimuli so as to construct meaning, it is apparent that in the experiments from which Gregory's theory is derived, the person receiving a range of light intensities at the eye is passive, rather like an onlooker or spectator who is isolated from the events. Common experience informs to the contrary: people usually move around objects in the world in such a way that their properties can be explored, not simply received.

Gregory's view that visual perception starts with unstructured primitive sensations is contradicted by significant evidence of a neurophysiological kind. It has been shown, for instance, that certain retinal cells are responsive to quite complex features of the visual environment. For instance, Barlow (1953) demonstrated that in the frog's eye:

> *"... one finds one particular type of ganglion cell which is most effectively driven by something like a black disc ... this causes a vigorous discharge ... if the [light] stimulus which is optimal for this class of cells is presented to frogs, the behavioral response is often dramatic; they turn towards the disc [which is located somewhere in the field of vision] and make repeated feeding responses consisting of a jump and a snap. The selectivity of the retinal neurons and the frog's reaction when they are selectively stimulated suggest that they are "bug detectors" [the black disc being the experimenter's approximation of an insect]"* (Barlow, 1953: 73).

Here the claim is evidently that light information produces a direct response, not a sensation from which a meaning is constructed. The proposal that there are complex feature detectors is, however, problematic. Indeed, Frisby (1979) points out that we cannot be sure that there is not some kind of primitive processing of the kind Gregory describes going on between the rods and cones of the retina and the ganglion cell which fires. A second problem is the difficulty one has in trying to relate neurophysiological function with experience. Gordon (1989) has focused on this point using the analogy between the experience of colour and the experience of pain:

> *"... colour is, amongst other things an experience; a pain is not only activity in certain sorts of neuron, it hurts. But "redness" and "hurting" are part of our conscious lives. How much we hurt depends on ... other events and experiences which have taken place in the external world...A full description of colour and pain must surely*

take this into account if the true nature of what perception entails is to be identified" (Gordon, 1989: 117).

One theoretical approach which attempts to relate neurophysiological function with the real world is that of Marr (1982). This work uses computer modelling to represent algorithmically cell functions through several staged processes which range from the recovery of edges through light intensity changes to a final memory store which permits the labelling of the object or event in view. As a bottom-up theory, a procession of representations is formed so that the features of the object or event can be defined in order to achieve recognition of the detected object. Maffei and Fiorentini (1977) provide evidence to suggest that Marr's modelling may be equivalent to neurological function. Maffei and Fiorentini show that retinal ganglion cells have different spatial frequency sensitivities, with the highest spatial frequency sensitivity cells occurring in the layer of the striate cortex where the lateral nuclei thalamus fibres terminate. The conclusion they draw from this discovery is that the highest spatial frequency cells provide the narrowest filters for the detection of light gradient variation, whilst the ganglion cells in other layers of the cortex make up the wider light filters. This finding ties in with Marr and Hildreth's (1980) algorithmic demonstration that edge detection can be achieved by a series of filtering operations. The large-scale gradient intensity changes in the image and some small-scale intensity changes are achieved algorithmically by placing negative and positive values adjacently.

This work differs from Gregory's view of visual information in that the model does not operate to eliminate uncertainty by means of filtering and decision making; Marr's view of vision is that the process of seeing is organised in successive stages. However, despite the apparent appeal of Marr's work, he fails to account for features of common experience such as the interactive animal/environment mutuality (Turvey, 1977b). Indeed, in Marr's work the retinal image with an accompanying series of static snapshots held in a short term memory representation known as the 2 1/2 D sketch, prevents any continuous flow of information from the environment to the animal. A computational alternative is found in Clocksin's (1980) work. In this work there is no *"memory store"*, and it shows how the local slant of surfaces is recovered relative to the moving observer. Edges that form the boundaries of surfaces are detected and discriminated between by the use of a continually moving spherical coordinate mathematical formalisation. Whilst Clocksin's model provides a computational alternative to Marr's work, along with Marr's work it demonstrates that there are many computational pathways towards achieving the same functional ends. Bruce and Green (1985: 330-331) state that these variations may have little relationship with real human function. Dreyfus and Dreyfus (1987) pick up this point when they take all information processing advocates to task for their claim that mental processes are a constructed series of rule-based stimulus constraints. Support for their opposition comes in their discussion of the so called "*thinking*" computers and their poor abilities to perform in competitions against humans. They use Arthur Samuels' checker-player program as a case in point. Samuels tried to program heuristic rules of checker masters into the computer, so that the computer would not have to calculate all the chains of possible moves - particularly uncharacteristic of human playing strategy. He found that the program was capable of beating amateurs, but not professionals. Although Samuels continued to bring in professionals for details of their heuristics, he feared that he was reaching "*the point of diminishing returns*" (Dreyfus and Dreyfus, 1987: 22, citing Samuels from details of a Stanford University News Office interview, 1983). He concluded that master checker players were poor at recollecting their own heuristics. Dreyfus and Dreyfus (1987) argue, however, that the only conclusion to draw from Samuels's work is that skill acquisition does not in fact build up from specific cases to more and more abstract and sophisticated ones; rather, with rule knowledge and experience, creativity and daring become possible, and with such creativity comes playing strategy which involves rule bending. In sum, through the experience of playing, the human constantly learns and restructures his own knowledge. As Feigenbaum and McCorduck (1983: 84-85 In: Dreyfus and Dreyfus, 1987: 30) suggest:

> *"A human expert solves problems, all right, but he also explains the results, he learns...Part of learning to be an expert is to understand not merely the letter of the rule but its spirit..he knows when to break the rules, he understands what is relevant to his task and what isn't...Expert systems do not understand these things."*

Thus, their argument would suggest that Marr's approach is incorrect not only because it does not really examine human function, but also because the theory itself is the wrong way to conceive a definition of perception. Using the example of Chomsky's (1972) work in linguistics, Mace (1977) shows that by initially aiming to specify the accomplishments of the language system, and then by gradually limiting the class of plausible mechanisms for perception to those that satisfy the job description, an account can be based in what the system (in this case language) does. This starting point seems more plausible for it is clearly based in common experience. Such an approach is of course the launch pad for Gibson. However, prior to assessing the merits of Gibson's theory in detail, it is first essential to cast more light on why it is that the majority of investigations have been carried out within the framework of information processing theories.

1.4 THE INFORMATION PROCESSING VIEW

As far back as Al Hasan's tenth century discourse on the eye, investigators producing theories of vision based their beliefs on the notion of an image at the retina. By 1604 this notion was discussed by Kepler in terms of a camera obscura. In brief, light radiated from any opaque reflectant surface was supposed to be carried to the pupil as thousands of single divergent rays. Once in the pupil, these divergent rays were to converge on the retina, thus creating a dense set of focus points to constitute an inverted retinal image (see figure 1.4).

Evidently such an image brings complexities of interpretation: the world is solid, mobile and meaningful, yet images produced by cameras are flat, upside-down, and as a result, hard to interpret. The aim of the investigator, therefore, is to find a description of how meaning is attained from a two-dimensional retinal image. This reduction from the three-dimensions of the real world to the two-dimensions of the retinal image is symptomatic of the deepest difficulty of image-based theory. Reed (1982) argues that it was the Cartesian framework which provided an interpretation of the two-dimensional image that was to dominate much subsequent investigation. In brief, Descartes proposed that all existing thoughts were motions of the brain, and thus all awareness was awareness of brain states. Corporeality has its role, but it is a role of pure sensation. That is, mind and body are separate and perception consists of one-to-one correspondences between sensations and mental constructions. This constructivist view is highly problematic for it fails to capture the value and function of objects in the real world. Pastore (1971) demonstrates that by Berkeley's 1709 publication of his essay **Towards a New Theory of Vision**, such one-to-one correspondence was treated as an axiom rather than a possible explanation of visual perception.

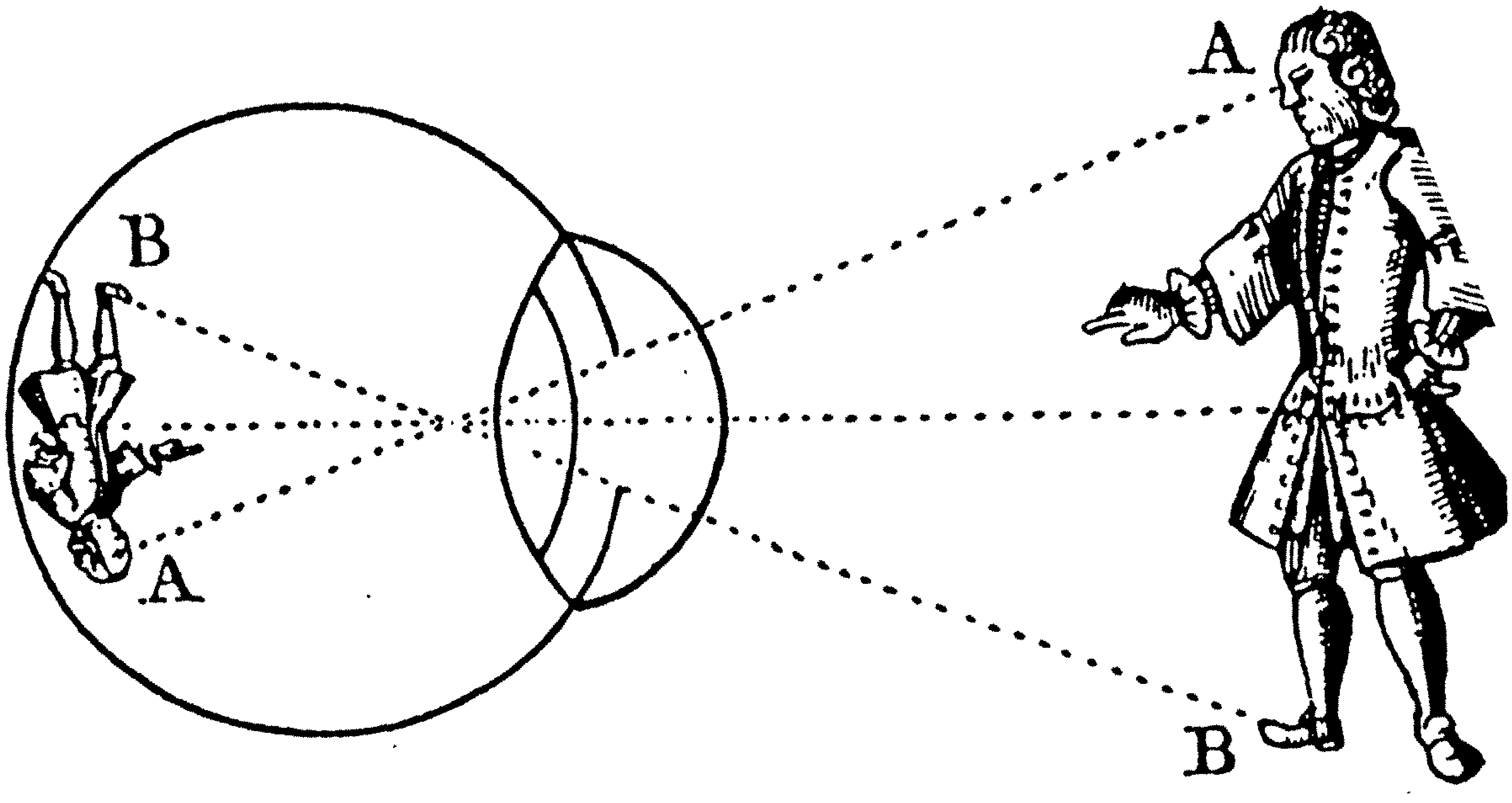


Figure 1.4: The camera obscura view of the image at the ·etina. (This diagram is based on Voltaire's work of 1738 ıd is taken from Pastore, 1971: 91.)

Drawing on Mill's writings of 1842 Pastore shows that Berkeley's proposal:

> *"...remained, almost from its first promulgation, one of the least disputed doctrines in the most disputed and most disputable of all sciences"* (cf. Mill 1842, in Pastore, 1971: 72).

However, the point of particular worth is Mill's additional comment that :

> *"...this is the more remarkable, as no doctrine in mental philosophy is more at variance or more contradictory to the natural prejudices of mankind"*. (ibid).

Mill recognised that unquestioned support for any theory is problematic for it can seriously impair scientific critique and response in theory formation. Ironically, though, Mill chose to ignore the shortcomings of such blind acceptance, for he too followed the Cartesian thread.

Gibson's ecological approach challenges the assumptions of a sensation/perception divide.

It is possible to argue that Gibson's own inspirers (Brunswik, William James, his teacher Holt and the Gestaltists) failed to achieve theoretical success because they could not find an appropriate theoretical framework (cf Gibson's own views 1979: 140) which would eliminate the need for sensation and perception to be treated as separate features. For instance, the Gestaltists' basic innovation - the Gestalt (the whole process or configuration) - which relied on innately operating principles of organization was ultimately rendered void since the Gestaltists persisted in the belief that there was an impoverished input to the visual perception system:

> *"...our vision of any object is a mosaic of stimulation like that of the photographic plate...How can rich effects arise out of*

such poor causes, for clearly the dimensions of our environmental fields are far more numerous than those of the mosaic of the stimulation" (Koffka, 1935, in Michaels and Carello, 1981: 3).

It is essential to note that Gibson's approach is of course not simply a counterbalance to the dominance of the Cartesian doctrine. Indeed, it is possible to see that Gibson's approach had something of its own ecological development: that is, it arose out of a need for a different explanation of perception which Gibson moved towards through the influences of past research and his own development as a theoretician. In Reed's text of 1988 this image is clear: Gibson was a man who spent his life working through ideas at every opportunity - in seminars, with friends and around the family breakfast table. Descriptions of how Gibson never once wrote an academic publication without revising much of its content in a subsequent paper certainly reveal a person intent on getting his ideas together with great care, and highlight the fact that Gibson did not view any of his work as a final formulation: his theoretical developments were all part of a far larger continuum of ideas and understandings.

1.5 THE MAIN PROPOSALS OF GIBSON'S THEORY.

This section presents the main features of Gibson's theory that will be made use of in this thesis. The order in which the features appear is not intended to imply any psychological sequence of processes or priority within Gibson's theory.

1.5.1 THE AMBIENT OPTIC ARRAY

In essence, the ambient optic array is the <u>structured light</u> which reaches the eye: radiant light is reflected from objects in the environment and therefore as the light reaches the eye it is already structured by the objects.

The ambient light does not so much carry as contain information, thus it provides a continuous flow of stimulus energy.

As already discussed (section 1.3), this is the starting point for Gibson's theory, for it emphasises the idea that with structured information in the ambient optic array, the perceiver and the perceived are complementary.

1.5.2 DIRECT PERCEPTION

Hand in hand with the notion of information reaching the eye is the belief that the perceiver seeks out the persistent and changing features of the optic array through active exploration with either whole body movements to alter the looking position, or simply with eye movements. This activity-based way of getting to the information is considered to be direct in that the perceiver does not have to construct any kind of awareness of the world, she detects the structured information: there is an awareness of what is specified in a whole perceptual system. As Gibson states, direct perception is:

> *"...the activity of getting information from the ambient optic array..this is a process of information pickup that involves the exploratory activity of looking around, getting around and looking at things. It is quite different from the supposed activity of getting information from the inputs of the optic nerves"* (Gibson, 1979: 147).

Thus, to see a thing, a place, an event, an animal, or a person is to be in touch with it: it is an "*immediate acquaintance*" (Gibson, 1960) with the world. As a student, Gibson made some notes which encapsulate the essence of direct perception:

> *"If being is perceiving...or if perceiving is being...why has it not occurred to anyone that the equation is really an identity? That*

> *is, being = perceiving. The difference is merely one of words*" (Gibson, 1930, In: Reed, 1988:52, taken from the Gibson Archives at Cornell University).

By proposing that there are perceptual systems to detect information, Gibson does not reject the idea that representations exist; rather, he proposes that representations are mediators of non-environmental information. For instance, Gibson notes (1980: xiii In: Reed, 1988: 307) that humans have developed gestures and vocalisations which are specific to specific groups and particular circumstances. Meaning can only be achieved with some knowledge of the representational code - an example of indirect perception. However, Gibson shows that representations are inextricably bound up in direct perception. For one thing, he points out that social codes have ecological origins; thus for perception, there is a fusion of mediated and direct apprehension because social and historical factors are only part of the human awareness of the gesture or the language. In fact, Gibson shows that direct perception is primary:

> "*Perceiving helps talking, and talking fixes the gains of perceiving. It is true that the adult who talks to a child can educate his attention to certain differences rather than others. It is true that when a child talks to himself he may enhance the tuning of his perception to certain differences rather than others. The range of possible discriminations is inevitable. But this does not imply that the verbal fixing of information distorts the perception of the world...The observer can always observe more properties than he can describe*" (Gibson 1966a: 282).

Integral to the concept of direct perception is, of course, the issue of how the structured information gets picked-up. "*Resonance*" is the term which has been the most debated in this regard.

Gibson (1966a) used the metaphor of a radio which *"resonates"* to the correct frequency of a radio station to describe the perceiver who Gibson believed has an ability to *"tune"* into the information in the structured light. This was a two-sentence statement (cf 1966a: 271) in which Gibson also pointed out that the metaphor was not totally satisfactory because: *"there would have to be a little man to twiddle the knobs"*. In perceptual terms this would mean some sort of mediation between the light information on the retina and cognition, the operation therefore being indirect. However, Gibson pointed out that the human perceiver is a <u>self-tuning</u> system, leading to the issue of what it is that makes the perceiver tune into the correct information. More insight into this question can be found on the very same page as the 1966a resonance reference. Discussing Woodworth's work (1947) on *"reinforcing"*, Gibson states that perceptual systems *"hunt"* until they achieve clarity: the clarity itself being of perceptual value. In accordance with Woodworth's proposal, the process of hunting occurs at two levels: i) the pickup of information *"reinforces"* the exploratory adjustments of the organs that make it possible; and ii) the registering of information *"reinforces"* whatever neural activity is going on in the brain (Gibson, 1966a: 271). This is, therefore, the essence of how Gibson believes the system picks up information.

A study which has both supported the notion of direct pickup and the principle of resonance is Runeson's (1977) work on a *"smart perceptual mechanism"*:- the polar arm planimeter (see figure 1.5 for an illustration of the planimeter). Runeson shows how this device it is able to capture all the characteristics of complex variables of any plane figure, irrespective of shape, simply by tracing the boundary line of a plane figure using an index with a measuring wheel rotating at an angle which is directly proportional to the area of the figure: the proportion of the angle of the measuring wheel permits resonance between the measuring mechanism (the index arm) and the shape being measured. As the perimeter is traced, the measurement of area emerges. Thus, the information is directly available as there is no need to know differences between lengths and sides in order to calculate the area. What makes the example particularly appealing is the fact that it does not perform well at all in measuring lower level properties like length.

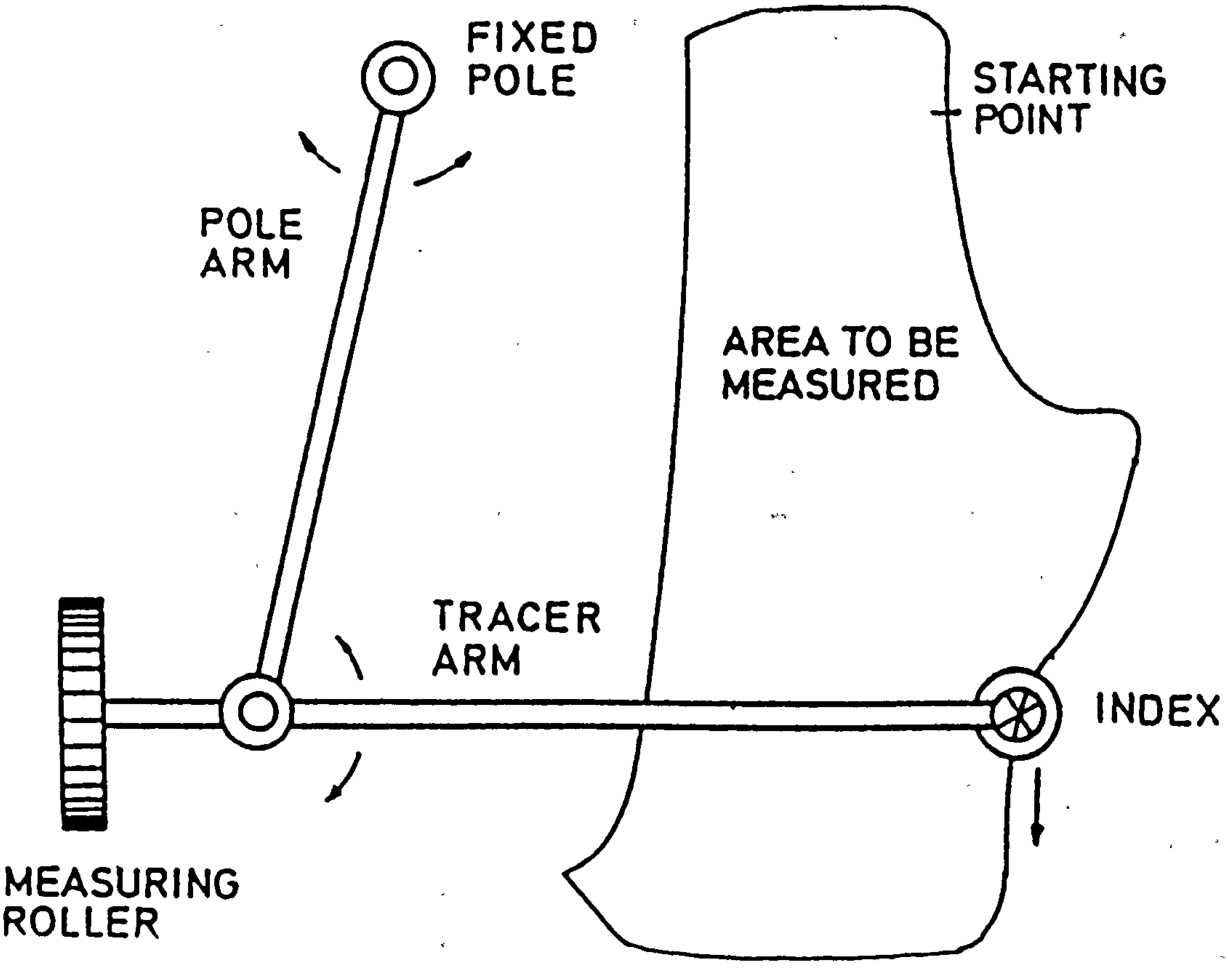


Figure 1.5: The Polar Arm Planimeter, as illustrated by Runeson (1977: 173).

As Michaels and Carello (1981: 67) suggest, it strengthens the case for direct perception to discover that the detection of high-order properties does not need to entail detecting lower-order properties as well. Like the radio, it is the mechanism itself which is constructed to detect the information, and it is the mechanism which has the potential to "*resonate*" with the information with which it is dealing. Like the radio, as Cutting (1982) notes, the planimeter ultimately falls short as a metaphor, for it too depends on the meter dial which needs to be calibrated and read before the area can be known. However, the evidence of the planimeter's abilities is appealing, not least because it illustrates that this mechanism arrives at complex measurements in a simple and direct manner. As Runeson (1977: 174) points out, it seems unlikely in both biological systems and human artefacts that something would be designed to be more complex and cumbersome than necessary.

1.5.3 INVARIANTS AND TRANSFORMATIONS

It has already been mentioned (see section 1.3) that a sample of the optic array from a single point provides a unique view of an environmental layout. Within this layout, there are many occlusion relationships between objects in the environment, so that some parts are hidden by others. However, as soon as the perceiver moves (eye movements or locomotion), the occlusions, and therefore the perspectives, change. Gibson states that <u>invariant structure</u> is whatever optical pattern persists despite the changes of perspective and the changes are what Gibson calls the <u>transformations</u>. Gibson (1966b) refers to the French folk wisdom, *La plus ça change, la plus c'est la même chose* to characterise the meaning of the invariant and the transformation, for it describes how, by actively looking, the persistent features remain. As Gibson (1966b) stresses: "*something becomes different but it is not converted into something else*" (quoted <u>In</u>: Reed and Jones, 1982: 178). A clear illustration of Gibson's ideas is found in his discussion of how a tabletop is detected. The discussion is significant for it also highlights the contrast between Gibson's and the information processing view (1979: 74):

> *"Consider, for example, the age old question of how a rectangular surface like a tabletop can be given sight when presumably all that the eye can see is a large number of forms that are trapeziods and only one form that is rectangular, that one being seen only when the eye is positioned on a line perpendicular to the centre of the surface. The question has never been answered, but it can be reformulated to ask, What are the invariants underlying the transforming perspectives in the array from the tabletop? What specifies the shape of this rigid surface as projected to a moving point of observation? Although the changing angles and proportions of the set of trapezoidal projections are a fact, the unchanging relations among the four angles and the invariant proportions over the set are another fact, equally important, and they uniquely specify the rectangular surface ... We tend to think of each member of the set of trapezoidal projections from a rectangular object as being a form in space. A change is then a transition from one form to another, a transformation. But this habit of thought is misleading. Optical change is not a transition from one form to another but a reversible process. The superficial form becomes different, but the underlying form remains the same. The structure changes in some respects and does not change in others. More exactly, it is variant in some respects and invariant in others."*

In empirical work, Gibson has provided natural environmental examples to show the viability of this concept. For instance, Purdy and Gibson (1955) placed markers in a level grass field up to 350 yards away from observers and then, with the use of mobile markers, got observers to bisect the distance between their feet and the markers in the field. The results showed that all the observers could bisect the distance with accuracy. The conclusion Purdy and Gibson drew was that the observers were detecting the amount of grass texture in the visual angle between the marker and themselves, and they proposed that for the equal amounts of texture there are equal amounts of terrain, and thus, an invariant relation. In additional work (1979: 162 - a discussion of his experiments and their aims) Gibson argued that the terrestrial horizon is invariant in two ways: it never moves irrespective of the point of observation; and it is the point to which all other motions have reference. Sedgwick (1973) provided the first major work to identify a specific invariant optic array relation between the horizon and all objects on the ground plane. Indeed, Sedgwick showed that there is a *"horizon ratio relation"*, that is, all terrestrial objects of the same height are cut by the horizon in the same ratio, no matter what the angular size of the object might be (Gibson, 1979: 164). For instance, (see figure 1.6) a row of telegraph poles 20 feet high viewed from a point five feet above the ground will be intersected in the ratio 5/20 or 1/4 whatever the poles' distance from the observer (Rogers, 1985).

Whilst Gibson acknowledges Sedgwick's work, he points out that it deals with only one possible type of invariant (height relation) and as there must be more complex layouts, there must be more complex ratios (Gibson, 1979: 164) to be discovered. Implicit in Gibson's view is the idea that invariants are many and complex, and in the majority of cases, not easily identifiable. Indeed, whilst Gibson (1979) defines four different kinds of visual invariant (those that underlie changes of illumination; those that underlie changes of points of observation; those that underlie overlapping samples and finally, those that underlie local disturbances of structure) he also carefully points out that the specific invariants are *"as yet unknown"*. This is because the invariants are *"formless"* in that they are not a pattern of stimulation, but rather a higher-order property of the pattern of stimulation (Gibson, 1979: 178). Gibson (1970) argues that to try to find where this formless invariant lies is an irrelevancy:

the most important feature of the invariant is that it shows that there is a direct relationship between the observer and the environment. Therefore, Gibson believes that the enquirer must find a means of developing the concept of the invariant rather than the possible location of the invariant.

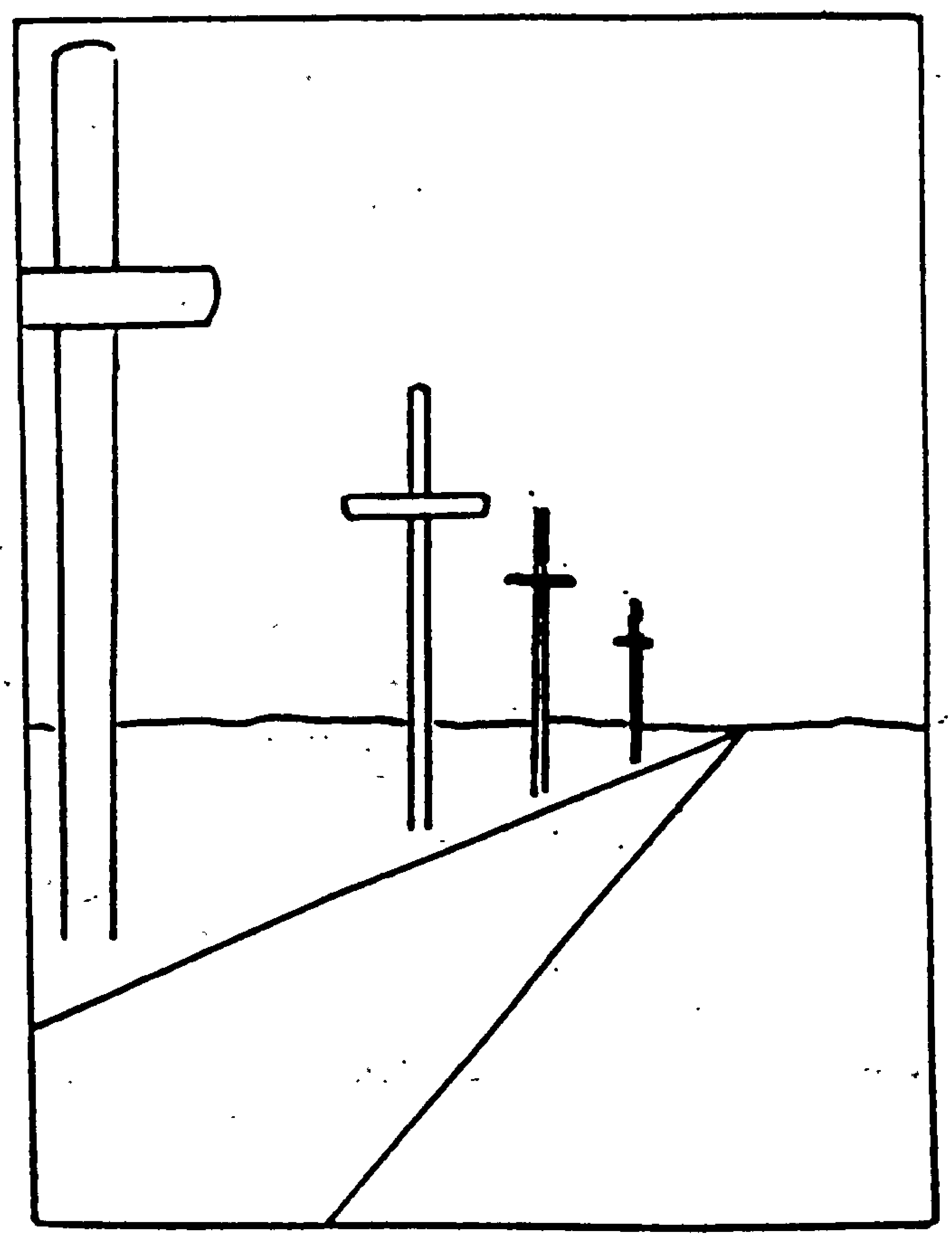


Figure 1.6 The horizon's invariant height relation (Taken from Rogers, 1985: 24).

Without doubt, invariants and transformations are useful concepts in that they provide a solution to the problem that although the stimulus information is altered by movement and occlusion, what is specified remains constant. The difficulty of getting at the invariant is perhaps given an emphasis by researchers opposed to Gibson's ideas (Ullman, 1980; Marr, 1982) because of a history of research based on asking <u>how</u> something must be the case, rather than demonstrating that something <u>is</u> the case.

1.5.4 AFFORDANCES

Gibson defines affordances as follows:

> *"Roughly, the affordances of things are what they furnish, for good or ill, that is, what they <u>afford</u> the observer"* (Gibson, 1979: 127).

Cutting (1982) views this concept as an ideological master-stroke, for, in effect, to perceive an affordance is to perceive meaning. This meaning is the *"value-rich ecology"* of an object, or an environment and provides a complimentarity with the perceiver. Gibson (1979: 127) provides an example which clearly illustrates this relationship:

> *"If a terrestrial surface is nearly horizontal (instead of slanted), nearly flat (instead of convex or concave), and sufficiently extended (relative to the size of the animal) and if its substance is rigid (relative to the weight of the animal), then the surface affords support. It is a surface of support, and we can call it a substratum, ground or floor. It is stand-on-able, permitting an upright posture for quadrupeds and bipeds. It is therefore walk-on-able and run-over-able. It is not sink-into-able like a surface of water or a swamp, that is, not for heavy terrestrial animals. Support for water bugs is different."*

Therefore, each animal has its own <u>niche</u> in relation to which the affordances from different events or objects are established. Thus, for different species or individuals the affordances of the same objects or events will differ.

Critics like Bruce and Green (1985) and Gordon (1989) believe the concept to be appealing in principle, but unconvincing upon examination. They view the concept to be ultimately empty for beyond the notion that the object in the environment offers up its "*demand character*", there does not seem to be any constraint on what constitutes that character. The example Bruce and Green cite is that there are thousands of possible uses for a piece of paper, and they argue that there is nothing to assist the perceiver's decision about which of the thousands of possible meanings the paper should afford. However, it seems that Bruce and Green miss Gibson's line of argument, for despite the fact that paper has thousands of uses, equally, it does <u>not</u> have a myriad of other uses. For instance, paper cannot be used like a stone to chip or break. Also, they seem to ignore Gibson's explanation that the circumstances of the paper's presentation to the perceiver provide natural constraints on what the paper may afford. Additionally, Gibson notes that the perceiver's own knowledge of paper and its uses - the perceiver's sensitivity or <u>attunement</u> to the object - affects what the object may mean. (This latter point accounts for why the same objects afford different properties to different people.)

Gibson has said that "*attunement*" is dependent on experience which is achieved by the "*education of attention*". In essence, to educate one's attention is to refine the ability to discriminate through practice (Gibson and Gibson, 1955). An instance of this can be found in Gibson and Gibson's observation that people were able to discriminate wines simply through repeated tasting: there was no need for anyone to teach the subtle differences between the flavours. This suggests that (in the case of vision):

> *"The progress of learning is from indefinite to definite, not from sensation to perception. We do not learn to have percepts, but to differentiate them. It is in this sense that we learn to see"* (Gibson, 1950: 222).

This means, as was pointed out in section 1.5.2, that direct perception is the basis of extracting affordances even in the cultural environment. Gibson's opinion is clear: the root of a culturally developed environment is the natural environment which is modified to change what it affords, but this is not artificial and distinct from the natural environment: it is the same environment. As Gibson (1966a) explains:

> *"The cultural environment...is often divided into two parts, "material" and "non-material" culture. This is a seriously misleading distinction, for it seems to imply that language, art, music, law and religion are immaterial, insubstantial, or intangible, whereas tools, shelters, clothes, vehicles, and books are not. Symbols are taken to be profoundly different from things. But let us be clear on this. There have to be modes of stimulation, or ways of conveying information, for any individual to perceive anything, however abstract. He must be sensitive to stimuli no matter how universal or finespun the things he apprehends. No symbol exists except as it is realized in sound, projected light, mechanical contact or the like. All knowledge rests on sensitivity"* (Gibson, 1966a: 26).

1.5.4 THE LINK BETWEEN PERCEPTION AND ACTION

An affordance does not only offer up meaning, however, it also provides a motive for action. As Gibson states:

> *"An affordance...points two ways, to the environment and to the observer. So does the information to specify an affordance. But it does not in the least imply separate realms of consciousness and matter, a psychophysical*

dualism. It says only that the information to specify the utilities of the environment is accompanied by information to specify the observer himself, his body, his legs, hands and mouth. This is only to reemphasize that exteroception is accompanied by proprioception - that to perceive the world is to coperceive oneself. This is wholly inconsistent with dualism in any form, either mind-matter dualism or mind-body dualism. The awareness of the world and of one's complementary relations to the world are not separable.

The child begins, no doubt, by perceiving the affordances of things for her, and for her own personal behaviours. She walks and sits and grasps relative to her own legs and body and hands" (Gibson, 1979: 141).

Therefore, the meaning of events in the environment does not directly <u>cause</u> action, but gives the perceiver an idea of what is possible. There are two kinds of potential action which are part of the perceptual process: exploratory action and performatory action. Exploratory action is controlled by a search for the affordances of the environment and performatory action is then the response to those affordances controlled by the perception of them (cf Gibson, 1974).

In the case of locomotion in ambient light, Gibson, quite naturally, stresses the role of vision. However, his ecological approach stresses that all the senses are capable of detecting invariants and transformations, and therefore that all are involved in consequent motor adjustment. The full potential of the perceptual systems and their potential action effects is shown in figure 1.7.

When locomoting, Gibson, Olum and Rosenblatt (1955) discovered that the ambient optic array <u>outflows</u> specify "*approach to*" and optic array <u>inflow</u> specifies "*retreat from*" (this can be seen below in figure 1.8). These motion perspectives were found to provide vital information about time-to-contact. This information was found in the nested magnification of the obstacle in the environment from which progressively finer details keep emerging as the observer approaches the obstacle until these magnifications reach an optimal degree for contact which varies according to what the obstacle affords (Gibson, 1979: 231).

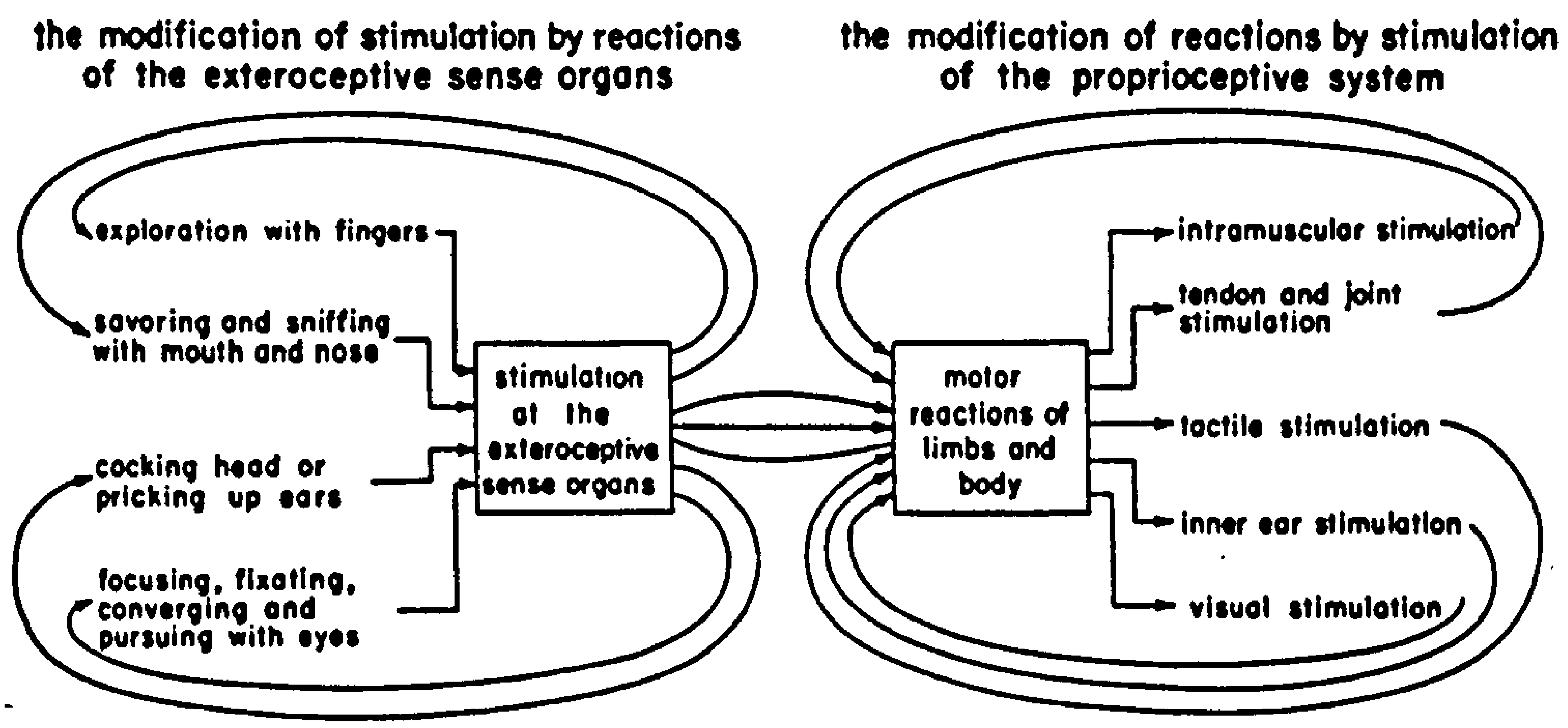
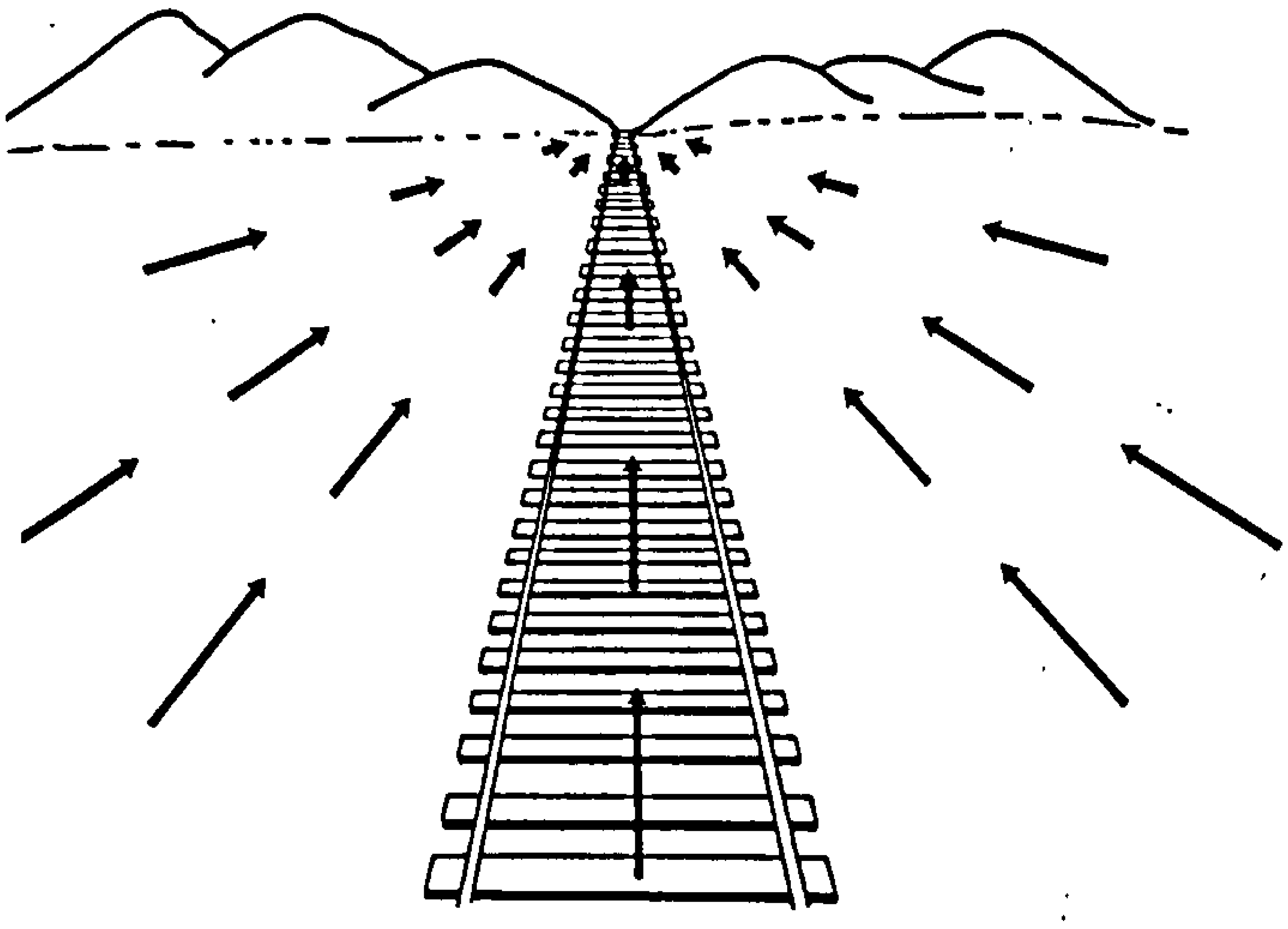


Figure 1.7: Showing what Gibson called the feedback loops for exploring stimulation and those for controlling behaviour (reproduced from Gibson, 1963 In: Reed and Jones: 367). The angular lines represent physical action; the curved lines represent neural action.

A



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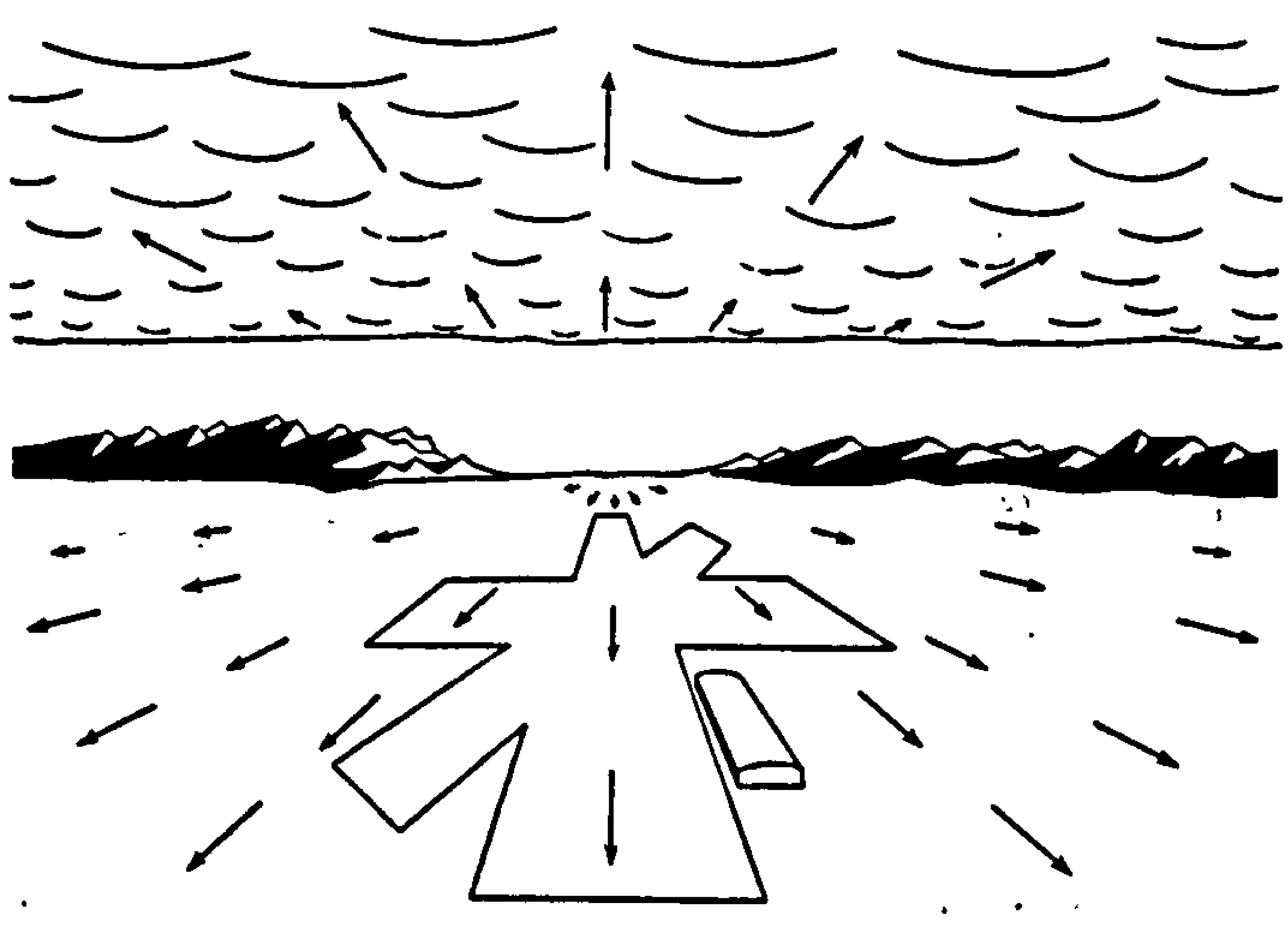


Figure 1.8: showing a) inflow of the optic array as a person sits on the roof of a train, facing backwards; b) outflow of the optic array as a pilot lands an aeroplane. (Both illustrations are taken from Bruce and Green, 1985: 196.)

A post-doctoral research fellow of Gibson's, David Lee, took up these ideas and developed an integrated theory of relations between perception and action in the 1970s. Lee's example of the time-to-contact diving of the gannet provides a useful example of his findings. Lee (1980) showed how the gannet can dive into the sea for fish from heights which vary from 30m down to just 3m, concluding that it is infeasible that the dive is simply a stereotyped act with the wings programmed to fold an invariant time after the start of the dive (Lee, 1980: 287). He points out that even if an information-processing computation of hovering height and pre-determined wing folding prior to contact with the surface of the water were theoretically plausible (an argument used by motor behaviourists Biguer, Prablanc and Jeannerod, 1984), the computation is thrown awry with the introduction of a simple gust of wind. Undoubtedly there would be a lot of accidents if such a variable as wind speed could not be adequately accounted for. In a film analysis, Lee shows that the birds vary their wing folding speed in accordance with their rate of acceleration, and therefore seem to be visually dependent on the visual information of the kind Gibson proposed. The dives are finely judged with no margin for error - wing folding occurring 300-400ms prior to impact. Another particularly interesting study by Lee which is worth mentioning is the investigation of long-jumpers (Lee, Lishman and Thomson, 1982), for here the study looks at highly trained long-jumpers who have detailed locomotor programs in which stride size and speed are rehearsed. In stride-by-stride measurements of several performances by different jumpers, it was discovered that although the early part of the run-up to the launch board was virtually identical on each occasion (and therefore consistent with the motor program), in the final few strides, stepping variations were found to occur on each approach. Therefore, despite the program, visual information about time-to-contact was guiding the action.

Although this work clearly provided support for Gibson's own account of time-to-contact and the link between perception and action, Reed (1988: 297) has shown that Gibson was sceptical of Lee's position because theoretically his calculations for time-to-contact took a mechanistic approach to action; Gibson insisted that it was the analysis of the function of a behaviour that was important, not an analysis of its detailed component parts. Indeed, Reed (1988) refers to an unpublished essay Gibson began writing on The Varieties of Human Movement in which Gibson states:

> "*The laws of mechanics constrain animal movements but do not describe them...Locomotions are what may be called achievements not movements. An act is a set and sequence of movements of bodily members that achieves a new relation between the whole body and the environment. Various different bodily movements (and different sequences) are equivalent for the same act*" (In: Reed, 1988: 298 taken from the Gibson Archives, Cornell University).

The theory of affordances provides the basis for Gibson's understanding of actions as achievements in that: i) affordances provide possibilities for action; ii) thus, actions are elicited in response to those possibilities; iii) therefore, the actions are achievements. However, Good (1987) suggests that this view of activity in perception is not fully reconciled within the theory of affordances, for as Costall (1981) points out, perception and action are often concurrent:

> "*... the perceptual systems are a part-system of a larger system; perception is often concurrent with our activities, rather than a preliminary phase. The point is, surely, that we perceive that a surface affords walking in the very activity...the essential point of the theory of affordances is that our primary way of coming to know objects is in our practical dealings with them*" (Costall, 1981 In: Good, 1987: 18).

This is an important point and shows the efforts being made to produce a broader foundation from which Gibson's ideas can develop. It also shows that when Gibson ceased writing, his ideas with regard to action were in that developmental stage he spoke about when he referred to his pre-1961 work on ecological optics. However, in general theory terms, Gibson became more radical in his opinions about perceptual systems, and it seems that he was certainly beginning to take an even more extreme position about action. Although Lee has maintained his rather more traditional approach to investigating the visual control of action, his studies have in no way diminished the case they argue for the ecological approach; it is simply that Lee's methods use the tools of a more established ideology.

With this point in mind, it must be stated that this exposition of Gibson's theory has not be undertaken to argue a theoretical case, rather it has been undertaken to illustrate Gibson's basic theoretical position and the empirical strategies which have resulted. Psychologists who are sympathetic to Gibson's theory demand more precision and more detail, and are increasingly involved in developing the theory to deal with the many issues of the psychological debate. Indeed, Gibson laid the foundations for a new psychology (something he recognises in his 1979 text), and those interested in his approach are now involved in developing the potential of his ideas. An example of this development is the work being done within social psychology.

In its general theoretical approach, Gibson's work focuses mainly on individualistic perception: that is, the perception of the natural world by single organisms. It is evident that the social situation is a central perceptual concern especially in light of Gibsons' notion of the active perceiver. Social perception is particularly pertinent to this thesis given the social nature of musical performance.

1.6 ECOLOGICAL SOCIAL PERCEPTION

> *"An understanding of life with one's fellow creatures depends on an adequate description of what these creatures offer and then on an analysis of how these offerings are perceived"* (Gibson, 1979: 42).

In accordance with Gibson's general theoretical approach, the understanding referred to in the quotation above is based on ecological optics and its concomitant invariants, affordances, attunements and actions which are in both the natural and the cultural environment (see above sections 1.5.2 and 1.5.4). Thus, besides having the potential to detect a common world and act in it in accordance with specific social behaviours, similarly *"attuned"* individuals have the potential to extract similar kinds of information, whilst individuals of different social or cultural groups potentially extract different kinds of information. Indeed, Gibson, writing about social perception in an unpublished paper (1941 In: Reed 1988: 65-66, taken from the Gibson Archives, Cornell University) flirted with the notion of direct and indirect perception:

> *"The scientific fact is that the "proper", ethical, moral modes of behaviour - that behaviour which conforms to a social code - become part of the self (are "internalized") and thus become the effective motives of the socialized adult. Codified behaviour is behaviour of the individual."*

In the perception of others, Gibson acknowledged that there is often a simultaneous giving as well as a receiving of information:

> *"What the other animal affords the observer is not only behaviour but also social interaction. As one moves so does the other, the one sequence of action being suited to the other in the kind of behavioural loop. All social interaction is of this sort - sexual, maternal, competitive, cooperative -*

> *or it may be social grooming, play and even human conversation*" (Gibson, 1979: 42).

So there is evidence that Gibson was aware of what an ecological theory of social perception involved. Indeed, as a teacher of social psychology at Smith College in the 1930s, Gibson's lecture plan to talk about "*values as the objective aspect of human motivations (economic, sexual, social, ethical, aesthetic values)*" was a precursor to the development of the concept of the affordance (Reed, 1988: 55, taken from the Gibson Archive, Cornell University).

A formalised ecological social perception theory has been proposed by McArthur and Baron (1983) which draws on Gibson's general beliefs. However, rather like Lee's work, McArthur and Baron (1983) and more recently Zebrowitz - formerly McArthur - (1990) do not abandon the use of more established psychological tools.

In brief, they claim that ecological social perception theory has four "*hallmarks*": i) with the focus on active perception and action, species survival and the goal attainment of individuals can be accounted for; ii) through affordances, it is possible to integrate the *perceiver and the target effects of social behaviour* iii) the structured information in the environment "*implies a perceiver whose perceptions are informed by an active interaction with the social environment*" (Zebrowitz, 1990: 178) iv) "*attunements*" place social perceptions "*into the life of a whole human being with a personal history and a social context*" (ibid).

Zebrowitz (1990) provides examples of the applications of these "*hallmarks*" in her discussion of the general contents of social perception and the three specific areas of impression formation, emotion perception and causal attribution. For the general contents of social perception she shows that affordances provide:

> *"...a common denominator that can accommodate perceiver variations in the frequency of different kinds of person descriptors. Specifically, the effects of perceiver culture, gender, and age on person descriptors may reflect variations in the categories that communicate adaptively significant affordances"* (Zebrowitz, 1990: 180).

An example of this is that human traits relating to dominance which are stressed in young children's behaviour may communicate who is fun to be with, whilst older children's emphasis on prosocial behaviours may communicate the same affordance (Zebrowitz refers to Livesley and Bromley's (1973) research on the different trait preferences).

For Zebrowitz, the affordance concept also offers answers to questions about impression formation:

> *"Rather than reflecting qualities of the perceiver or the perceived [as traditionally thought], impressions may reflect the affordances of the perceived and the perceiver. And, although it is difficult if not impossible to find a criterion for validating perceived traits, behavioural evidence can validate perceived affordances. If someone is perceived to afford domination, one can determine the accuracy of this perception by ascertaining whether that person can indeed be dominated by the perceiver. However, if someone is perceived as dominant, then any instance of dominating or not dominating can neither confirm or disconfirm this trait ascription"* (Zebrowitz, 1990: 181).

As she proposes, therefore, affordances may provide a way to resolve problems related to understanding the accuracy of impressions. Indeed, she develops this point further when she suggests that if social perceptions serve adaptive functions it could be that misperceptions reflect the overgeneralisation of some highly adaptive perceptual attunement, and this would have major implications for how stereotypical impressions are formed. She provides the following example:

> *"...the impression that leadership qualities are lacking in adults who are babyfaced, short, or fat may reflect the overgeneralisation of the very adaptive impression that such qualities are lacking in short and chubby babies. Other erroneous impressions may similarly reflect the overgeneralisation of adaptive attunements that , on average, yield accurate perceptions rather than reflecting fundamentally flawed social perception processes, as has often been assumed"* (Zebrowitz, 1990: 181)

Thus, she suggests that the application of affordances and attunements may provide a more comprehensive account of stereotypical impression formation.

The affordance concept is also potentially useful in emotion perception. As Zebrowitz states:

> *"...emotion expressions may be viewed as specifying social affordances such as "approach me" or "avoid me" or help me" rather than simply as "happy" or "angry" or "afraid". Indeed, emotions are associated with specific states of action readiness ...[and] a fearful or angry face not only signals that the environment affords danger but also facilitates appropriate adaptive actions by the perceiver..."* (Zebrowitz, 1990: 182).

Thus, for her, the concept of a social affordance is able to provide an account of the perception of an expression and the resulting perceiver action. Zebrowitz also suggests that the affordance may add to the discussion of causal explanations for social events. Indeed, she suggests that it may prove more profitable to focus on the mutuality of the animal and the environment, rather than looking at the individual person and environment separately for the information related to cause. This would mean that the interactive influence of the person and the environment on behaviour would be studied rather than the individual components of the potential sources of influence.

Zebrowitz (1990) also points out that Gibson's concept of the ambient optic array indicates that dynamic information is potentially very important to both impression formation and causal attributions since changing and moving information (by sound, vision, smell and touch) forms the basis of perception. This is a particularly important concept, especially since much of the established ideology in social perception has depended on static information. For instance, Ekman and Friesen's (1975) research on facial expression depends on photographs as stimulus materials, and work on the perception of emotion in vocal qualities is based on static qualities such as the average pitch and loudness (Burns and Beier, 1973). Although both these research examples have produced consensus judgement responses by observers and listeners, it could be that the information in the static display is highly impoverished in comparison with naturally dynamic information. Indeed, Zebrowitz (1990) believes that the maintenance of the "*ecological validity*" of the dynamic stimulus information is the way ahead for all psychological investigations.

The significance of the dynamic display is underscored by Gibson himself whose sole empirical foray into what may be offered to the perceiver in the social perception situation (in collaboration with Anne Pick, 1963) deals with looking behaviour. The experiment presented a real face to face social encounter between an observer and a trained looker who changed the direction of her "*look*" on 21 occasions (seven directions of look in three head positions) by looking at marks on a wall directly behind the observer's head. The observer was asked to report whether she was being looked at directly or indirectly by the looker. Gibson and Pick found that the acuity of the looking perception was independent of head position. They concluded that this demonstration illustrated the possibility of separating the ocular expression of the direction of attention from the head position and noted that:

> *"The ability to read the eyes seems as good as the ability to read fine print on an acuity-chart.."*(Gibson and Pick, 1963: 394).

Hence not only is fine perceptual information available to the observer, but it is extremely accurate information. Gibson and Pick propose that there is indeed a relational stimulus-variable for the perception of *"looking"* - an important indication that even minute disturbances in the layout of light can lead to the detection of subtle invariants. In their discussion, the experimenters show that they are interested in the qualitative vocabulary that is used to describe different kinds of looking: a glance, a stare, and a gaze. Indeed, the concept of the affordance of an expression is hinted at in Gibson and Pick's comment that:

> *"A person can be said to look directly, or askance, overtly or covertly, boldly or bashfully, sternly or mildly, critically or kindly, or even unseeingly"* (Gibson and Pick, 1963: 386).

This methodology and the questions asked in this experiment are important not least because they suggest that body movements reveal intentions and that the qualitative aspects of these movements are articulated in ordinary vocabulary.

There are many indications that an ecological social psychology has a strong potential case. It would be naive to assume that Gibson's views were final formulations and it cannot be denied that there are some aspects of his research which need to be developed to strengthen the argument for a general as well as a social application (for instance, Good (1987) underscores that Gibson never mentioned activities which are not exploratory, and never tried to account for them in his theory). However, since he actively sought to renew and discuss his ideas, and since he quite categorically stated that his ideas were not to "*shackle*" the researcher interested in the ecological approach, it seems quite logical that researchers interested in developing his ideas should do so. Baron and McArthur (1983) continue to stress some of the more standard approaches of "*information processing*". For instance, they believe that the constructivism of "*information processing*" stresses the internal organisation and structuring of social information in a useful manner, whilst the ecological approach favours the links between the person and the environment, and the organisation and structure that is provided in the external stimulus information. Thus, they favour a merging of ideas from both theoretical camps. Ultimately this may prove to be the most productive way forward in terms of theoretical development. What is most important for this thesis, however, is that the ecological framework offers a sensitive and rich framework for empirical enquiry and as the Gibson and Pick (1963) study shows, there seems to be a lot of potential for the theory in its account of the expressive intentions manifested in body movements.

Perhaps the best way to summarize the work discussed in this chapter is to say that in the selection of "*ecological approaches*" initiated by Gibson, all the work discussed has identified the important need for a new view of the world. Gibson's information-based as opposed to sensation-based perception is certainly a radical approach and though his methods are not as "*thorough*" as Marr's or as "*fanciful*" as Gregory's, the questions he raised for all investigators of perception were vital. As Reed (1988: 313) states:

> *"James Gibson's most enduring achievement was to show that the study of perception could be both scientific and realistic. Ever since the scientific revolution, the study of perception has been crippled by the belief*

> *that we cannot see the meaningful things surrounding us, that what we see are mere images of the world or, worse, merely fleeting sensations that are caused to appear in our consciousness by the ultimately unknowable machinations of the outside world ... From the beginning, Gibson challenged the basic assumptions of this unfortunate heritage. It is typical of Gibson's working style that he was the first to understand and push beyond the limits of his own critique ... Gibson felt he was merely showing the way to a new range of problems and issues, not presenting a settled and complete theory."*

In order to examine these potentials further, it is necessary to turn to empirical investigations on person perception which are conceived within the ecological framework to assess the various paradigms and the relevance of the work for the study of musical performance.

CHAPTER TWO

2.1 EMPIRICAL EVIDENCE IN SUPPORT OF ECOLOGICAL SOCIAL PERCEPTION.

Chapter 1 outlined Gibson's theory and its methodological implications. With particular reference to work examining the visual perception of human performance, this chapter deals with some ecological literature in order to explore paradigms which are relevant to the examination of the visual perception of music performance.

One of the most significant experimental methods which implements the use of dynamic stimulus material comes from Johansson (1973). Although Johansson's aim was to investigate the geometric structures of body motion patterns, he conceded that the method he employed produced results that were highly convincing for a case which argued against the sensation-perception divide (Johansson, 1973: 202). Johansson's methods, therefore, supported a case for direct perception, though this was not their explicit intention.

The methodology which was crucial to Johansson's (1973) enquiry involved two variations on a technique which has become known as "*point-light technique*". In the first version, Johansson attached small light bulbs to the major body joints (shoulder, elbow, wrist, hip, knee and ankle) of an assistant who was dressed in tight-fitting dark clothes and who walked across a darkened studio. The walking was filmed and was found to give a recording of the motion tracks of the different joints without revealing any traces of the background or the body contour (Johansson, 1973: 202). However, the transformer to power the bulbs and wires attached from it to the bulbs were cumbersome and unless the walker took a rectilinear path to the camera, not all the bulbs could be seen on film. Therefore, a second version was developed initially using tiny patches of glass-bead retroflective tape, and later ribbons of the material attached around the body joints. Once the ribbons were attached, the walker was flood-lit by two spotlights mounted very close to the lens of a camera so that the light hitting the reflective ribbons was reflected back into the camera. The result was to create an extremely high brightness contrast between the ribbons and the background. Once filmed, this version was viewed by adjusting the brightness and contrast control of the playback monitor to yield a supercontrast between the ribbons and the background. The result was that only the ribbons could be seen on the monitor.

In the experiment, Johansson demonstrated that when the joint motions of the walker were shown to observers the activity could be detected. Furthermore, all kinds of locomotion could be detected: walking, running, dancing in twos, climbing, cycling and various types of gymnastic motion. He also demonstrated that in walking not all the joints were necessary for the activity to be detected. In a further study (1976), Johansson went on to demonstrate that only 200ms of exposure to dynamic joint activity in point-light display was necessary for the correct perception of the action. He also demonstrated that if the video image is frozen (that is, if the points of light do not move) observers see a random scattering of dots on a screen, not a human figure.

As mentioned above, Johansson's interest was in the geometric structures of the body motion patterns. His study led him to the conclusion that perception of the moving displays was consistent with perceptual vector analysis in which the configuration of moving points of light has a common motion component in the horizontal direction in which the walker is moving. Against this, slight undulatory motions are made in the shoulders and hips, while against these, the knee describes a pendular motion from which a further pendular motion is described in the ankle. Thus the dynamic configuration is resolved into a set of hierarchical relative motions of rigid limb segments. It is significant that Johansson drew conclusions from his point-light study that were in agreement with the way in which Gibson conceived dynamic visual stimuli. That is, dynamic visual stimuli are the basis of perception and there are constantly transforming yet coherent patterns in the joint motions which reveal human walking. The fact that only 200ms of information is necessary from any part of the step cycle of the walker suggested that there is something in the overall pattern of the movement which specifies this percept, rather than just one feature of the movement.

Because it removed all surface adornments and features of the body, Johansson's point-light technique meant that he could prove that the perception of the shape or form of the human body need not be based on the shapes and forms of the image at the retina. In pursuit of Gibson's theory, it was a way to examine the invariants which specified human movement.

A series of studies with a knowledge of Johansson's findings and an interest in Gibson's belief in invariants was undertaken by Cutting and his co-workers Kozlowski, Proffitt and Barclay (Cutting and Kozlowski, 1977; Kozlowski and Cutting, 1977; Barclay, Cutting and Kozlowski, 1978; Kozlowski and Cutting, 1978; Cutting, Proffitt and Kozlowski, 1978; Cutting and Proffitt, 1981 and Cutting, 1982). Beginning with a general exploration into what kind of information could be detected in a point-light walker, Cutting and Kozlowski (1977) found that the specific identity of the walker could be discovered. They showed that six undergraduates who were of similar heights, weights and who lived in the same housing, could detect themselves and their friends when shown the point-light stimuli. This result suggested that some very fine perceptual information about the quality of walking could be differentiated in the display. Kozlowski and Cutting (1977) pursued this finding by examining just one feature of person identity, gender. Using both static and dynamic displays, they found that 2 seconds of dynamic display were essential to identify the gender of a subject (enough time to see two step cycles). These studies were repeated using different observers and walkers to produce the same results (Barclay, Cutting and Kozlowski, 1978). Because the experimenters noticed that the women walkers tended to swing their arms more and that they also tended to walk more quickly than men, they hypothesised that arm swing might be a possible cue for gender. However, Kozlowski and Cutting (1977) and Kozlowski and Cutting (1978) demonstrated that any joint lights, including the ankles alone, provided enough information, to determine gender. This evidence suggested therefore that gender information is distributed throughout the dynamic display.

In a systematic study Cutting, Proffitt and Kozlowski (1978) went on to show that men have proportionally broader shoulders and women have larger hips, though, since the walkers in all the experiments had walked in side profile it was impossible that this ratio difference was the critical invariant. However, in side profile the observer was being exposed to information about body torsion. They noted that in rightside walking profile there was a point within the step cycle where:

> *"the right leg is forward and both feet are on the ground, the right hip is forward and the right shoulder is back. Both joints move counterclockwise along the path of an ellipse so that the next time both feet are on the ground, with the weight equally distributed, the right shoulder is forward and the right hip is back..[there is] an oscillation back and forth of the hips and the shoulders... if the shoulder difference is greater than the inverse difference in hip widths - and it is- then one can derive a measure of the various hip and shoulder swings from the visual display"* [see figure 2.1] (Cutting and Proffitt, 1981: 257).

The difference between the angles shown in figure 2.1 reflects the amount of torsion, and hence reflects gender.

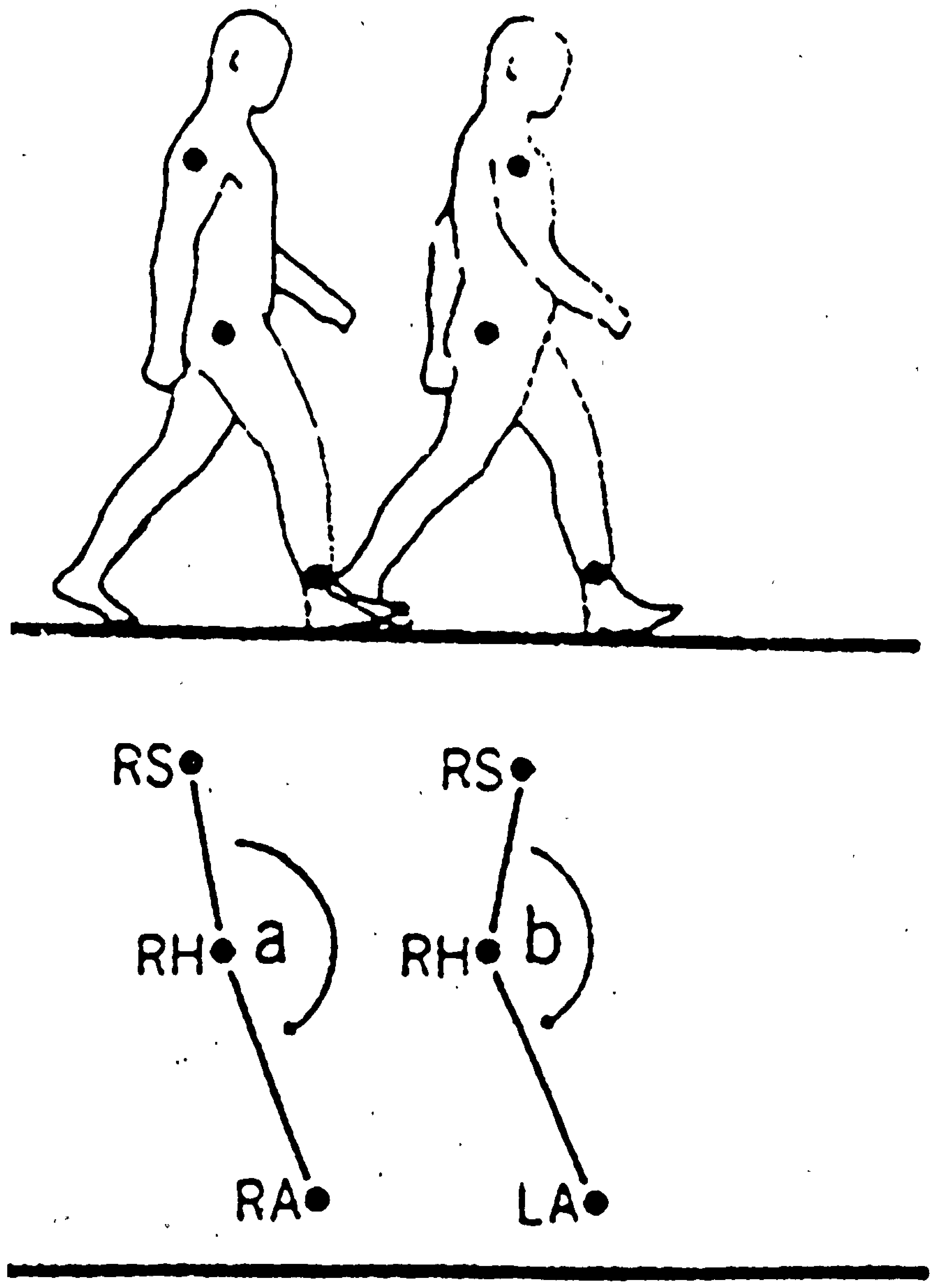


Figure 2.1: showing that torque in the torso can be measured by subtracting angle B from angle A. The larger difference results indicate males and the smaller difference results indicate females. (RS = right shoulder; RH = right hip; RA = right ankle; LA = left ankle.) The diagram is taken from Cutting and Proffitt, 1981: 257.

However, Cutting, Proffitt and Kozlowski (1978) had one female walker in their study who did not swing her arms at all, therefore, she had no difference between her two angular measurements, and as a consequence was identified as male by nearly 50% of the observers. Furthermore, they felt that they had found evidence which could give information about walking only, rather than all dynamic activities. Therefore, realising that dynamic symmetry is key to locomotion (that is, as one arm swings forward, the other swings back; as one leg swings forward, the other swings back; crossing limbs working in phase synchrony; ipsilateral limbs working in opposition), they examined ways of finding the planes of symmetry within the body and tried to discover a common intersecting point for these planes. They realised that there must be a point within the walker around which everything moves which had to be in the torso. They noted that as the torso has the general shape of an isosceles trapezoid, oscillating as a flat torsion spring, it is possible to:

> *"derive stress lines across the diagonals of the torso. These intersect at a point that we call the <u>center of moment</u>, a reference around which all movement in all parts in the body has regular geometric relations"* (Cutting and Proffitt, 1981: 260).

Figure 2.2 shows this intersection point or *"center of moment"*. It is important to note that it is the centre point for the distribution of movement, not mass, the centre of gravity being quite different. Its relative location is determined by knowing only the relative widths of the hips and the shoulders.

This discussion of how Cutting, Proffitt and Kozlowski (1978) arrived at their conclusion illustrates that invariants are elusive. However, the investigation reveals that invariants are feasible concepts.

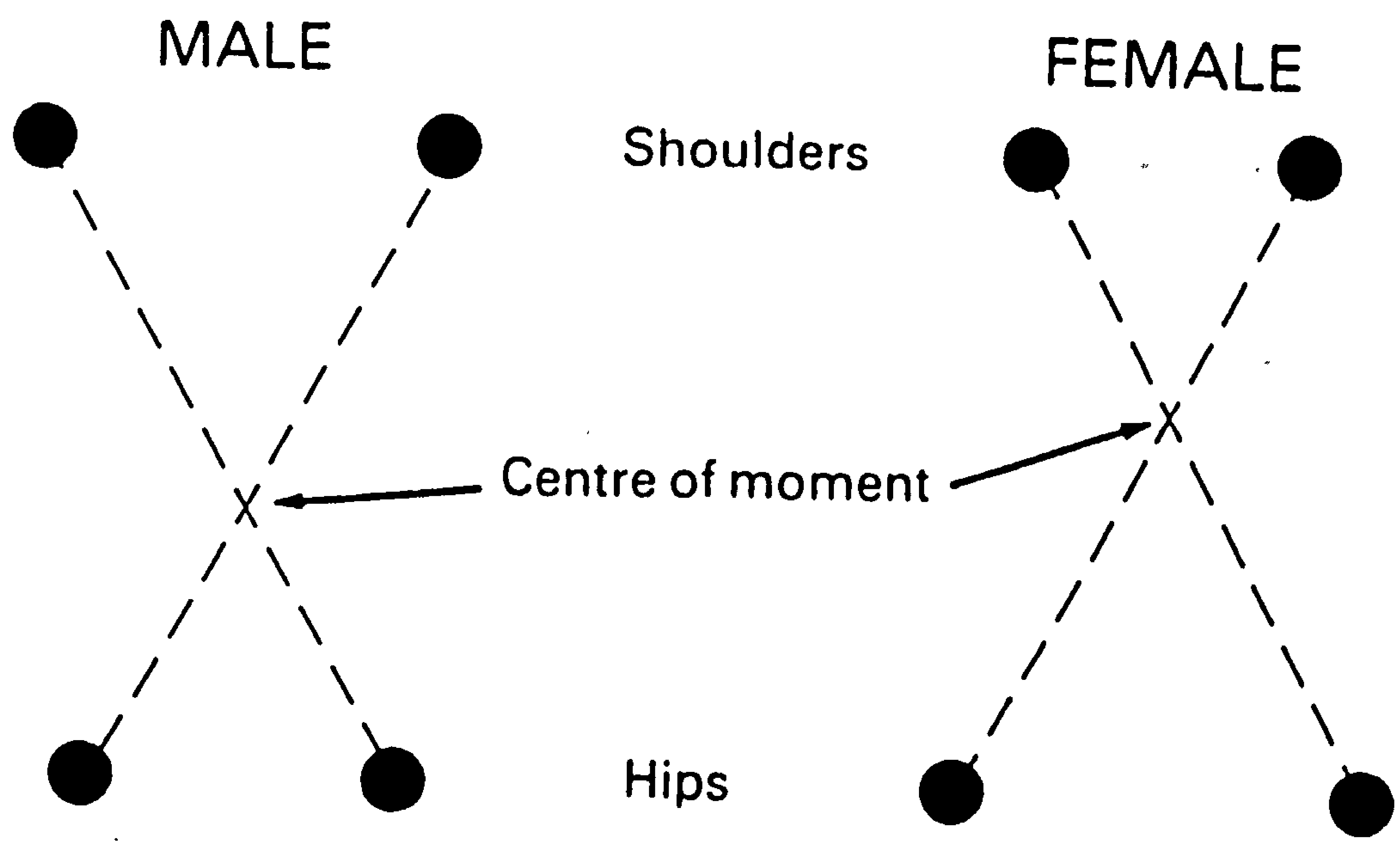


Figure 2.2: showing the schematic representation of the torsos of a male and a female. In general males have slightly wider shoulders and narrower hips than females. The intersection of stress lines across the diagonals of the torso is the *"center of moment"*. Note that this point is not the centre of gravity. (Taken from Cutting and Proffitt, 1981: 259.)

Furthermore, although the center of moment is possibly only one of many invariants detected in the determination of individuals and their *"styles"* of movement, Cutting's (1978a) use of computer point-light simulations to manipulate the geometric balances between limbs and the centre of moment highlights that this single invariant is enough to perceive gender: perceivers consistently ascribe maleness to a low centre of moment, and femaleness to a high centre of moment.

Further research by Cutting and Proffitt (1981) has demonstrated that the concept of a centre of moment is useful not only for gender, but also for describing the invariants in ageing faces, and even the night sky. In his research on faces, Cutting (1978b) derived a point for the best transformation of a face to both younger and older profiles working from a standard young adult profile. The region he identified about which all the changes were to occur was the foramen magnum, the skull/spinal column intersection point. This work was a development of research by Pittenger and Shaw (1975) which began by arguing that the perception of any event has two components: the detection of invariant information specifying the nature of the change involved, or the *"transformational"* invariant, and the detection of invariant information specifying the structure which undergoes that change, or the *"structural"* invariant. With this modification to Gibson's notion of an invariant, their research tested the extent to which perceived changes in age level are captured in strain transformation information - that is, the changing strain imposed on the bones of the skull by stresses produced by growth of softer elastic tissues (cf Bruce and Green, 1985: 310). They discovered that strain change preserves enough *"structural invariants"* to permit the identification of the head despite the remodelling or *"transformational invariants"* produced by ageing.

In addition to the centre of moment work, Cutting and Proffitt (1981) have argued that it is possible to construct a "*grammar*" for event perception which gives an account of why the perceptual system selects one description of an event from the infinitely large set of possibilities. In brief, they suggest that observers "*parse out*" different components from the dynamic visual information presented in the changing visual scene. Figure 2.3 shows that according to the proposed grammar, the first division is made between the event and the ground against which it occurs. Cutting and Proffitt (1981: 265) cite the example of a walker being extracted from the visual scene with the residual information becoming the ground. The event is parsed into figural and action components. The action component is action relative to the observer (the person travelling over the ground), and the figural component is the movements of the figure relative to itself (the swinging of the walker's arms and legs). If the figure contains component structures, a hierarchical set of centres of moment can be abstracted. Each centre of moment provides a reference point from which the motion and the topography of the component structure can be described (see figure 2.4 for a description of a walker).

Although this approach shares far more in common with Johansson's work than Gibson's description of motion and how motion is perceived, it provides a bridge between Gibson's and Johansson's ideas, for it suggests that there are dynamic "*nested*" dependencies (not that far removed from Gibson's idea of nested events in the environment). The major claim of Cutting and his co-workers is that invariants are of varying levels of perceptual importance, which is different from Gibson who argues for "*formlessness*".

A second valuable contribution towards consolidating an understanding of the type of information specified in human movement is found in work by Runeson and his co-worker

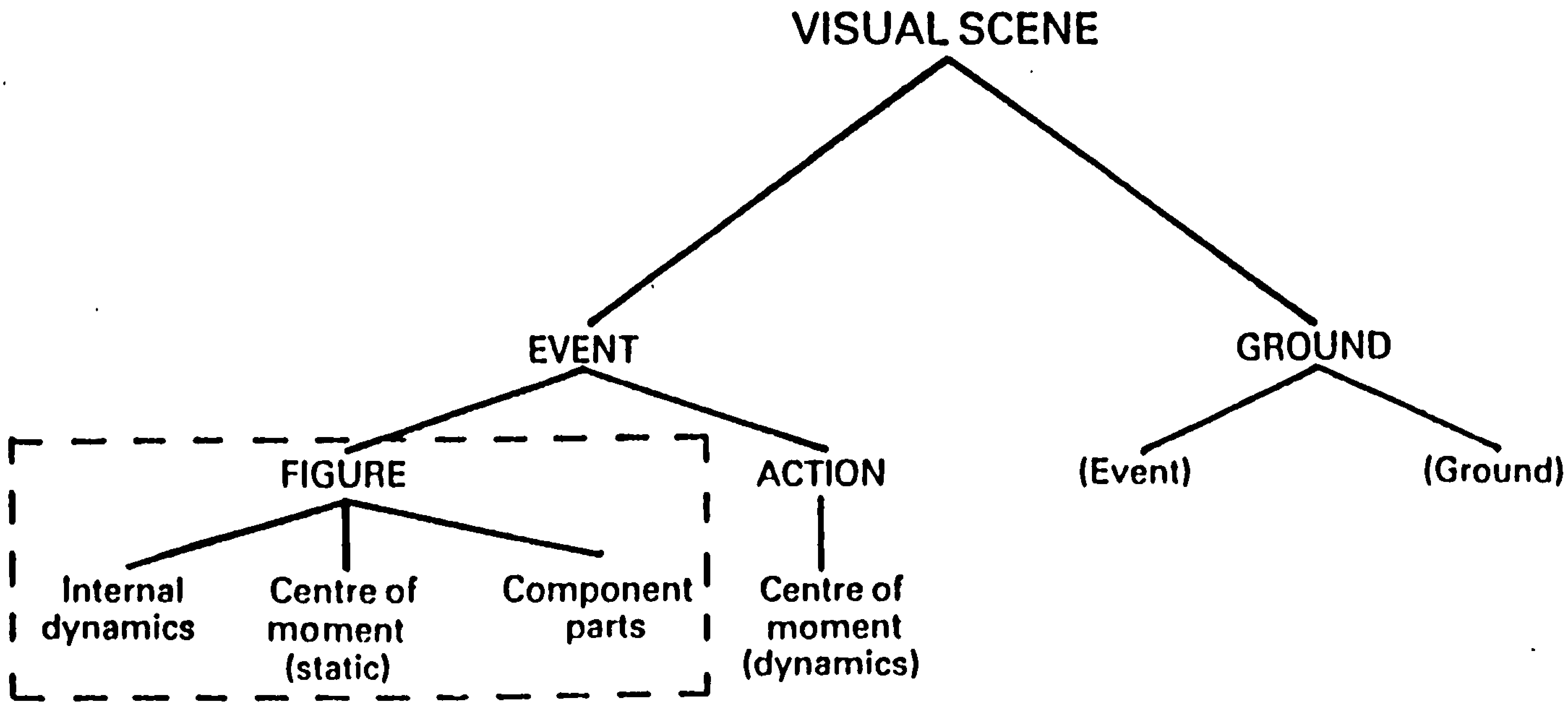


Figure 2.3: A grammar for event perception. A visual scene can be divided into an event and a background. The event consists of a figure and its action. (An adaptation of Cutting and Proffitt's model, taken from Bruce and Green, 1985: 296).

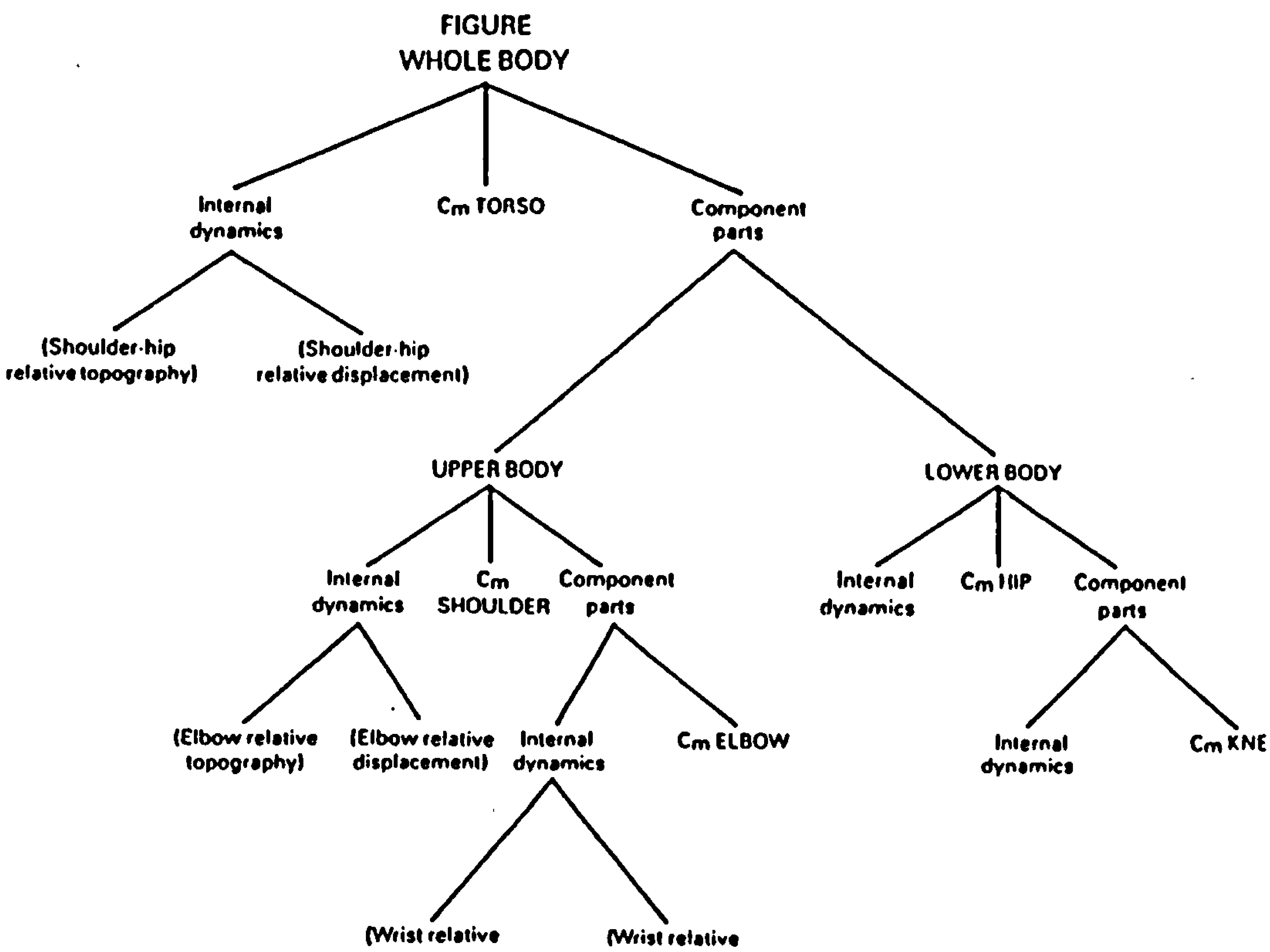


Figure 2.4: An expansion of figure 2.3, this figure shows how a moving human figure can be broken down into a hierarchical set of components, each with its center of moment, internal dynamics and component parts. Adapted from Cutting and Proffitt by Bruce and Green (1985: 297).

Frykholm (Runeson and Frykholm, 1983; Frykholm, 1983a, 1983b, 1983c; and Runeson, 1984). Runeson and Frykholm (1983) showed that when a person dressed in point-lights (all joints and a reflective ribbon attached around the head) is involved in complex continuous activities (walking and running, standing on and jumping down from a chair, lifting a wooden box, picking up and throwing a blackboard eraser) gender is detectable. However, if the actors do the same complex activities while trying to: i) emphasise their gender or ii) deceive their observers about gender, both gender and deception are detected by the onlooker. These results suggest that gender information is based on features of movement over which people have no voluntary control, since when actors manipulate controllable features of their kinematics to express a deceptive intention, these expressions are detectable as being unnatural.

In the same series of studies, Runeson and Frykholm (1983) showed that if a point-light actor lifts a box (depicted by point-light patches at its corner) the observer viewing the point-light playback can not only detect the activity, but also the weight being lifted and how much this weight differs from the lifter's expectation about the box's weight. To be able to lift the box, the lifter produces reactive forces large enough relative to the static forces and weight of the box to pick it up. If the weight is not known to the lifter in advance of grabbing and lifting, postural adjustments concerning the expectation of the weight are made as the lifter grabs the box, and then as the lift begins to occur, further adjustments are made until the body is properly adjusted to the weight. Hence, as Runeson and Frykholm (1983: 590) note, a covert mental disposition becomes optically specified when it enters the observers visual scene as a dynamic factor: both the lifter's expectation and the real weight are specified. Additionally, when lifters who were in fact lifting an empty box which weighed 4kg were asked to try to deceive their onlookers into believing that they were lifting a light (6.5kg), a medium (11.5 kg) and a heavy (19 kg) box, it was discovered that there were two distinct things to be seen: the real weight and the performer's attempt to give the impression of a different weight. Thus, there was a perceived difference between intention and reality: the onlookers perceived that the actor was pretending to lift a heavy weight, for instance.

Another interesting indication of the kind of perceptual information contained in kinematics was shown within the same series of studies (1983), when point-light actors were asked to throw a sandbag various distances. The observers could not see the bag's trajectory, landing or indeed the bag itself. The recordings were made at a right-angled corridor intersection with the camera 5m inside one of the corridors with the throwing range extending into the other corridor, therefore, all the target locations were outside of the camera range. The throwers walked to a fixed point and threw their bag aiming at one of 6 target distances: 1.75m, 3m, 4.25m, 5.5m, 6.75m, and 8m. The results showed that observers were very accurate at judging how far the bag had been thrown. Thus it was concluded that there was:

> *"Nothing short of an inclusive visual attunement to the kinematics-to-dynamics relations in human actions..."* (Runeson and Frykholm, 1983: 600).

In sum, these studies illustrated that both invisible external sources and internal sources influence movements in such a way that the information is detectable by observers. These results are subsumed in Runeson and Frykholm's proposal of a principle of the kinematic specification of dynamics (K.S.D.): *"...movements specify the causal factors of events"* (Runeson and Frykholm, 1983: 585). That is, the occurring kinematic pattern is specific to the conditions that generated it.

Runeson (1984) discusses a specific social formulation for the K.S.D. principle. He argues that since kinematics reveal permanent and transitory information (invariants and transformations) about the person and what she is doing, very complex information should be specified in the movements for the repertoire of executable body movements correlate with variables (cognitive, emotional and personality) in the condition of the person. This is a major proposition in the study of expressions and other inner states, for it rejects the idea that social perception is based entirely on cultural convention and learning and that there is no firm unmediated information available. Runeson (1984) accounts for variations in the abilities of individuals to judge these invariants and transformations through Gibson's notions of "*perceptual learning*" and "*attunement*". Also, he accounts for the successful social deceptions by the principle of "*attentional focus*". Take the instance of a magician who makes a person disappear. Evidently there are alternative stimuli, the true and the false; the true is that the person is concealed and the false is that the person has disappeared. Therefore, if only the false is attended to the deception is successful. Runeson concludes that this ecological proposal is a complete way to account for the meaning of human movement, as he states:

> "*Our movements are like a river. They provide a steady flow of information about our true conditions. Expressive movements are like eddies and bubbles with which we adorn the surface. As perceivers we can attend to either the actual properties of a person or to the communicative expressions. To be at the theatre would then be like travelling on a raft carried by the river; although we know very well that the river is actually flowing, that the theatre has a true place in space and time, and that the actors are real people with true characteristics, all that matters for a while is the movement stirred within the framework of the flowing river or theatre*" (Runeson, 1984: 64).

Hence, like McArthur and Baron (1983) and Zebrowitz (1990), Runeson's studies advance the theoretical case for an ecological social perception. Moreover, however, Runeson with Frykholm, Johansson and Cutting and his co-workers illustrate that the reductionist approach of getting subjects to perform only parts of natural activities, or worse still using still photographic displays as stimulus materials for observations about human activity, may leave out vital information about the subject. The ecological studies highlight the fact that social encounters and physical activities that are specially acted for the laboratory set-up must be treated with extreme caution, for they are bound to contain both the true and acted information. Thus these studies reinforce the importance of the ecological validity of empirical investigations.

Even finer perceptual evidence supporting the notion of the moving stimulus for the perception of inner intentions has been provided by Bassilli (1978), again using the point-light technique. His work was concerned with the perception of emotion in the face. Although his studies do not deal with joint kinematics, they show that the dynamic information from points of light on the face is sufficient to identify different expressions. Bassilli used both ordinary displays and point-light displays in his studies. In the first of two studies, he covered his four actors' eyelids, face and teeth with black make-up and asked them to keep their eyes closed throughout the recordings. Then, he evenly placed approximately 100 white spots of 8mm diameter over the entire surface of the face. He asked his actors to carry out two separate acts. The first was to make continuous grimaces which were then shown to the observers in either continuous motion, or as seven still shots (taken arbitrarily from the moving display). The second act was to make moving expressions of the following expressions: happiness, sadness, surprise, interest, disgust, fear and anger; these were shown to observers in either the continuous displays, or static shots. In order to check whether the observers would respond to any non-rigid movement of an oval shape as if it were a face, Bassilli also introduced two conditions in which the face was replaced by a piece of foam rubber which was either continually twisted around a vertical axis, or compressed. In free response to the question: *What did you see?,* Bassilli discovered that i) none of the observers perceived the foam to be a human face; ii) the moving displays elicited more accurate responses than the static displays; iii) emotions could be distinguished from grimaces. In the second of the two studies, Bassilli compared ordinary displays and point-light displays from the six emotional expressions and asked observers to determine which emotion was being shown in either of the displays. The results indicated that both the point-light information alone and the ordinary display produced equally accurate results. This indicated therefore that dynamic information was a principal perceptual source for emotion. By using four different subjects, Bassilli discovered that the movement patterns for each emotion were similar between subjects. Indeed, in a paper written in 1979, Bassilli formalised his findings in a demonstration that (for instance) happiness comprised an upward displacement of each side of the mouth and sadness had a slight upward displacement of the chin area and an inward and upward movement of the eyebrows. This work clearly argues a good case for the ecological approach to social perception in that it demonstrates that even the subtlest of kinematic information can convey complex information in a direct manner.

Despite the relative perceptual subtlety involved in picking up the information contained in the studies already discussed, there has been a lack of work examining artistic activities in which there are intentions of an expressive nature which have to be contained within the constrained movements of a physical technique - as is the case in musical performance.

2.2 SOCIAL PERCEPTION OF ARTISTIC PERFORMANCES.

The ecological literature on the perception of artistic movement is scanty. However, of recent work, Scully's (1986) study of gymnastic performance is particularly noteworthy for three reasons: i) it examines whether performance technique and aesthetic quality are co-specified in the kinematic displays; ii) it examines the different abilities of different groups of observers (experienced and naive); and finally, iii) it compares the point-light technique with ordinary illumination to examine the effectiveness of the two different stimuli.

In the study, gymnasts wore point-light ribbons attached around all major joints and the head, and point-light patches on the fingers and toes. All the gymnasts performed the same balance beam routine (30 seconds duration) of 11 set movements which included: leaps, turns, hops, splits and a handstand. Three groups of observers with different levels of judging experience (a minimum of 5 years as official judges; 2 years experience as official judges; no former experience of watching gymnastic performance) watched the performances on video in both point-light and ordinary illumination conditions. The two official judge groups were given their official guideline rating criteria for technical execution. The naive judges were given a ten point rating scale and were told that the qualified judges had awarded mean scores of 9.15 to the highest standard performance, 8.15 to the mediocre and 6.95 to the poor performance. Therefore they were to use this information as their guide. For aesthetic quality, all groups used the official guidelines for "*general impression of performance*" and rated the performances on a 7 point scale (1 being no aesthetic appeal and 7 being the highest aesthetic quality). The guidelines advised that the performance was considered in terms of the "*beauty of movement, the beauty of presentation, inner execution, elegance, carriage and* *posture*" (Scully, 1986: 190).

Scully found that all three groups of observers rated technical quality similarly. However, she discovered that for the two groups of experienced judges their ratings of aesthetic quality differed from their ratings for technical quality, whilst the naive judges rated aesthetic quality very similarly to technical quality. Scully's conclusions were that naive judges saw the two components as being synonymous. The most experienced judges awarded scores for both components which indicated that they perceived high technical quality and high aesthetic quality to be related, but that they were separable components of the performance. The less experienced judges showed the greatest difference between their scores for technique and aesthetic appearance. Scully concluded that the less experienced judges were not linking high technical execution with high aesthetic quality. These findings led her to argue that observer experience affected the pick-up of information related to aesthetic quality. The relationship between the high-level technical execution and high aesthetic quality was explained in terms of the structural invariants and the transformations associated with them containing both forms of movement technique and aesthetic quality information.

In addition to the examination of judging experience, Scully found that the mode of stimulus presentation (point-light or full illumination) had no effect on the results for technical performance. For aesthetic performance, however, the highly experienced judges' scores showed lower correlations between the technical and aesthetic components in normal illumination than in point-light display. This led Scully to conclude that the additional information of the normal condition may have provided further information about aesthetic quality. This point clearly refutes Runeson proposal that all inner intentions and expressions are revealed in kinematics. On the other hand, however, it can be argued that the point-lights bring the aesthetic information more clearly into relief without the additional factors of body shape and appearance (a point Cutting (1982) makes about the kinematic displays in general), and it could be that the lower correlations in normal illumination between aesthetic quality and technique reflect the more ambiguous information in the normal display.

Work which has gone some way towards testing Scully's findings has been the study of dance phrases by van Wieringen, Boon and Gerritsen (1987). Using both point-light displays (ribbons attached to shoulders, elbows, wrists, knees, ankles, waist and head and patches attached to the fingertips and toes) and normal illumination, the experimenters used 17 videoed dance phrases of the same female dancer as the test stimuli. Students from non-art backgrounds, art backgrounds and dance backgrounds acted as observers. Sixteen 7-point bipolar scales based on Osgood, Suci and Tannenbaum's (1957) measurement of meaning in semantic differentials were derived from adjectives commonly used to describe dance performances in journalistic analyses of performances and were used to rate the relative expressivity of each dance phrase. These scales were refinements of a previous study examining the expressive qualities of dance photographs (van Wieringen, van der Veer, van der Meulen and Ader, 1982), and the experimenters had already discovered that the bipolar scales were fairly reliable instruments for measuring connotations of posture in dance. In contrast to Scully, the results showed that there were no differences between the point-light and normal illumination results in the assessment of expressive quality.

Whilst the point-light display has proved to be a vital tool for Johansson, Cutting and his co-workers, Bassilli and Runeson and Frykholm, it is important to note that there has been some concern (cf. Good, 1987) about the ecological validity of the technique because it uses film as its stimulus. There are three objections to this: i) it leads to the observer being passive; ii) it can be argued that it is not sufficiently ecological because film can be considered to be an indirect perceptual source; iii) it does not show the actor against the background of the environment. The conflicting results of Runeson and van Wieringen et al.'s studies reveal there is some possibility that the full display may provide other perceptual information. Good has dealt with the problem of the passive perceiver by developing interactive point-lights. This involves the actor-perceivers in wearing the point-light ribbons and each viewing simultaneously the kinematic information of the other on a monitor which faces them. This technique has permitted Good to examine the degree of social coordination of action which can be achieved with kinematic information alone, though he has found difficulty in finding *"realistic"* tasks which can be examined in these unusual conditions. Thus, point-light technique may have certain serious limitations.

2.3 MOVEMENTS IN MUSIC PERFORMANCES

The visual perception of music performance, as stated in chapter 1, has not been researched. However, work by Clayton (1985) provides evidence that visual information in the form of co-performers movements has a contributory effect to the production of a performance. Indeed, in a series of different performance conditions (co-performers in physical proximity but with no conductor; co-performers separated from each other without a conductor; co-performers with a conductor and in close physical proximity; co-performers with a conductor but separated from each other) Clayton demonstrated that physical proximity between co-performers is a crucial factor in the production of cogent performance timing.

A study which explicitly investigates the movements of music performances is Winold, Thelen and Ulrich's (1990) work on coordination and control in the bow arm movements of cellists. This study has gone some way towards explaining some of the produced differences and similarities of movements in performances. By studying five cellists' performances of fragments by Schubert and Brahms with similar bowing patterns played at different tempi, Winold et al. discovered that consistent patterns of bow changes were produced. However, measurements collected from infrared light sensors attached at the shoulder, elbow, wrist and knuckle of the bowing arm, with an additional sensor at the bottom end of the bow (the frog) showed that the elbow and wrist were more variable in stroke duration and amplitude than the bow, and more constrained in fast than slow playing. This suggested that there was a subtle interaction between the arm segments in the production of bowing timing, and led the experimenters to conclude that the performer focuses on the hand holding the bow, rather than at levels of joints or particular muscles.

Articulation patterns (the lag between reversals of the joints) were found to be greater in the Schubert than the Brahms. This was particularly noticeable at one point in the Schubert where there was a whip-like action in the elbow at the initiation of a three-note group. Winold et al. speculated that this pattern used this pulsed burst to provide a musical accent. To investigate these results in more detail, Winold et al. undertook a second study in which five different performers were asked to play the same sequence of notes, only on this occasion the tempo demands were far less precise, the performers being asked (in their own time) to scale up the speed of the Brahms to the slowest speed of the Schubert (which had originally been faster than the Brahms) and to scale down the slowest speed of the Schubert to the original speed of the Brahms.

The results revealed that in these conditions where the musical demands were not specific, the cellists were much more individually variable in their articulation patterns, though the patterns of interjoint coordination were consistent across the performances and the overall patterns of velocity changes at the bow were consistent within the performers. This led the experimenters to conclude that within the general mechanical and energetic constraints of movements, there is considerable leeway for assembling a kinematic chain. The physical intensity differences revealed in the timing changes in the articulation patterns to produce different pulses of acceleration to accented as opposed to unaccented notes were powerful contributors in the production of the performances. Therefore, it seemed that the articulation reflected performance intentions, rather than some mechanical factor associated with the reproduction of the notes.

As a consequence of these results, the experimenters suggested that the well-used musical training method of making performers rehearse technique and interpretation separately is a weak method, for in certain ways, the two elements appeared to be inseparable. According to the findings, it is the intention which guides the intimate shape of the mechanical production of the notes. Furthermore, since it was discovered that the body coordination for playing slowly was different from the coordination for playing fast, the practice method of learning and repeatedly practising fast passages slowly seems dubious for it could be that there is a qualitatively different movement pattern at the two tempi.

2.4 CONCLUSIONS

The studies reviewed in this chapter have demonstrated 4 important features of the perception of complex movements: i) kinematic information alone is all that is necessary to convey information about the activities and the performer's expectations and intentions when performing the actions;

ii) since the kinematic stimulus must be dynamic, there is some information in the overall pattern of movement which specifies it (very little exposure to the stimulus is necessary for accurate perceptions to be made), though the investigation of cello bowing has indicated that some parts of the kinematic display may not be as useful as others (the shoulder contained little information); iii) it is possible to identify at least some features or invariants of the kinematics which inform about specific kinds of information (for instance, the information specifying gender); iv) for highly skilled movements like gymnastic performance the perceiver has to be *"perceptually attuned"* in order to detect the full range of perceptual information specified in the kinematic display.

Individually, the aims of each study described in this chapter have been disparate and have ranged from a desire to discover invariants to more simply illustrating that the information available is invariant and under transformation. However, with the findings shown above and the prospect of examining the movements of a music performance in mind, it is essential that the following chapters of this thesis begin with an aim which is more basic than any of those described in this chapter: to discover what information is contained in the movements of a music performance. Since Cutting and his co-workers have made major strides towards beginning to identify the *"formless"* invariant, it seems that any investigation considering what information is conveyed to the observer should also address the issue of where this information originates. Thus, an emergent second aim will be to ask this latter question.

This chapter has highlighted the empirical benefits of point-light displays, and from Winold et al.'s studies, it seems likely that for music performance, point-light displays should provide information about both the technique and the intentions of the performer. In order to retain the ecological validity of empirical work, it is important to compliment point-light investigations with natural display work. Also, van Wieringen et al.'s study along with Scully's use of the bipolar rating scales for aesthetic quality have illustrated the difficulty involved in extracting details about the observers' perceptions of the artistic and emotional qualities of performances. Nonetheless, they have identified measurement techniques which seem to provide useful data. Therefore, many of these techniques will be adopted in the subsequent empirical investigations.

CHAPTER THREE

3.1 INTRODUCTION

As a starting point for the empirical investigations of this thesis, this chapter reports a number of studies intended to determine whether observers can detect different intentions from the visual information of a music performance. The work described uses the kinematic information contained in point-light displays. Scully (1986) demonstrated that kinematics have the potential to reveal information about artistic as well as technical performance. Informal preliminary observations showed that in point-light display videos of three trombonists and two pianists the players could be identified playing their instruments as opposed to a variety of other non-perambulatory tasks (for example, picking up an object, and, brushing their teeth). The question remained, however, whether the intentional details of a music performance could be revealed in kinematics.

3.2 THE PILOT STUDY

3.2.1 INTRODUCTION

This initial investigation was undertaken primarily to assess whether different musical interpretations can be detected from kinematics. In Good's (1986) investigation of the kinematic information specifying social encounters he used <u>acted</u> social encounters for his observation data but feared that the observers detected the acted out encounters as unrealistic. Therefore, in this study, performers were asked to play with three specific, genuinely performable different intentions underlying their performances. One of these was consistent with a public performance - the *"projected"* performance - and the other two (*"deadpan"* and *"exaggerated"*) were equivalent to teaching methods. In the deadpan performance, the performer was asked to produce the music in a purely technical manner. This device is used by teachers to encourage students to focus on the technical aspects of performance. In the second, the performer was asked to play as if in a recital, and finally in the third "*exaggerated*" instance, the performer was asked to play the piece in such a way that all aspects of the music's expressive features would be overstated. This teaching device is commonly used to encourage an awareness of the music's expressive features. No specific instructions were given about how to achieve these differences since the instructions were viewed as a simple method to get the performers to approach the music with different intentions, and to see if any detectable differences in movement occurred. Since music is essentially an aural phenomenon, a second aim was introduced to explore the contributions of sound and vision in the detection of the performance intentions. As a preliminary attempt to tackle this issue, two different versions of the recordings of the performers were used: one normal sound and vision, and one in which observers saw only the visual information without sound. Thirdly, a number of different instrumentalists were used in the study in order to examine a variety of physical postures.

The methods of Scully (1986) and Runeson (1984) were central to the formulation of this experiment, and since both Scully and Runeson examined the nature of perceptual "*attunement*" by comparing the perceptual data collected from expert and naive viewers, it was decided to consider - as a secondary issue - whether experts (trained musicians) extract more information from the performances than non-musicians.

3.2.2 METHOD

Subjects

Five experienced performers (3 males, 2 females) undertaking postgraduate music studies and five non-musician trainee journalists (2 males, 3 females) all students at City University participated as observers in this investigation. (The mean age of the observers was 26.5 years.)

Stimuli and Apparatus

Stimulus production followed Johansson's (1973) point-light displays in the use of reflective ribbons, two high-powered theatre lights, video camera and recorder, playback and monitor. Five undergraduate performance majors (mean age of 21.2 years) played excerpts from the solo instrumental repertoire. The players represented a range of physical stances associated with different types of solo performance, these were:

a) Right-side, profile sitting - 2 male pianists
b) Full frontal sitting - 1 female cellist
c) Right-side, semi-profile standing - 1 female violinist
d) Full-frontal standing - 1 male trombonist

Each performer played a solo instrumental excerpt which lasted between 100 - 180 seconds. As a complete rendition of a solo piece or a movement from a concerto would be too long for test presentations, the performers were asked to perform excerpts that would not exceed the arbitrarily chosen duration of 3 minutes. The choice of excerpt was made by the performer. The excerpts selected were from:

Pianist opening, Nocturne in F minor, Op.55, No.1,	Chopin.
Pianist opening, Vallee d'Obermann,	Liszt.
Cellist opening, Prelude in C major, Suite No.3,	Bach.
Violinist opening, Partita No. 3 in E major,	Bach.
Trombonist entry, 1st mvt., Concerto d'Hiver,	Milhaud.

The five soloists wore tight-fitting black tracksuits with strips of reflective tape (3cm wide) attached around the head, elbows, wrists, knees, and ankles and on each hip and shoulder and the centre of the chest. Because of the variation in the stances, the tapes were attached to the sides of the limbs for the pianists and were placed on the front of the limbs for the cellist, violinist and trombonist (see figure 3.1 for examples). The performers were placed in front of a black, non-reflective backcloth with the theatre lights set close to the video camera. The apparatus was at a distance of 4 metres from the soloist so that the entire body was in the camera shot (see figure 3.2).

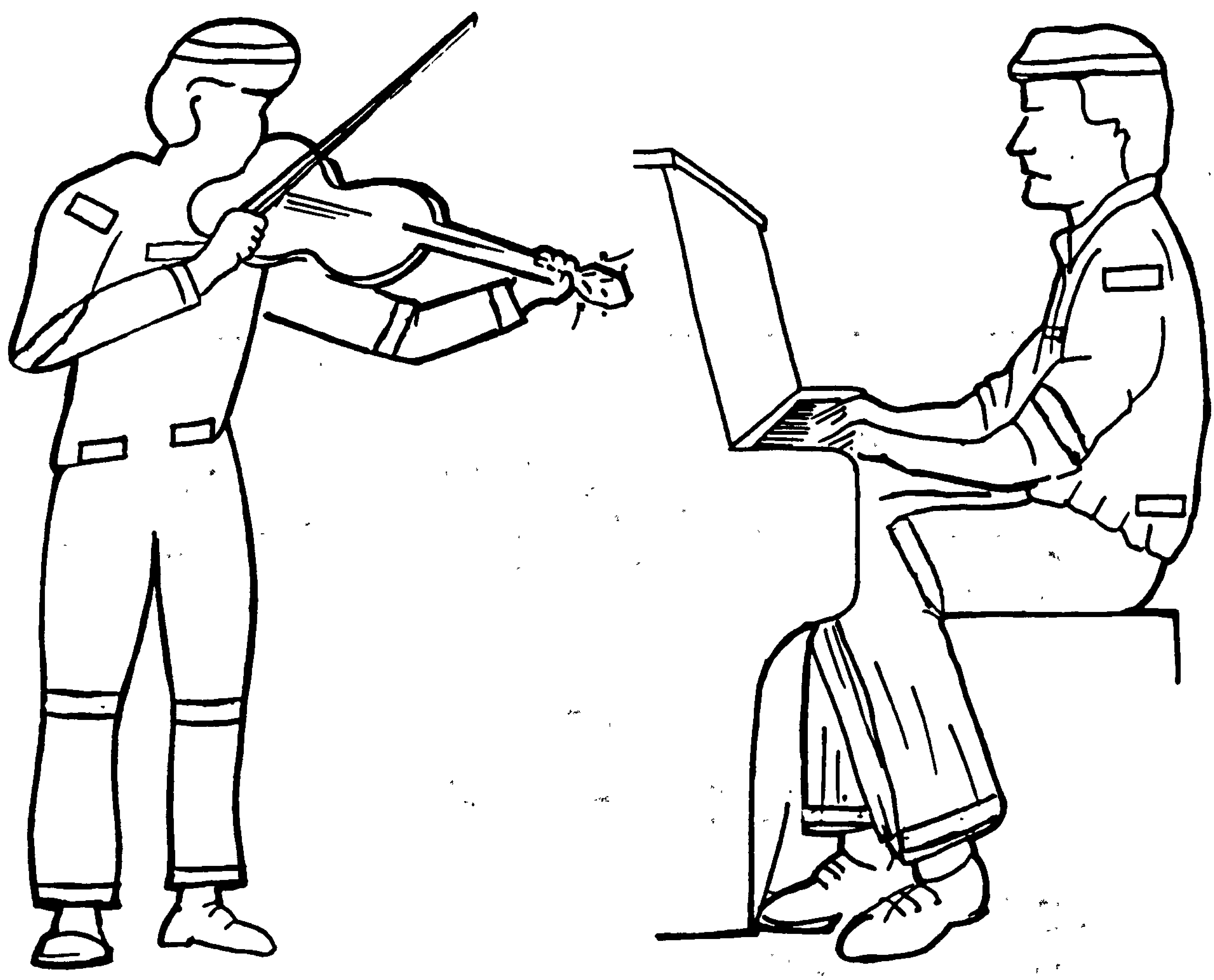


Figure 3.1 showing examples of distributions of the point-light bands.

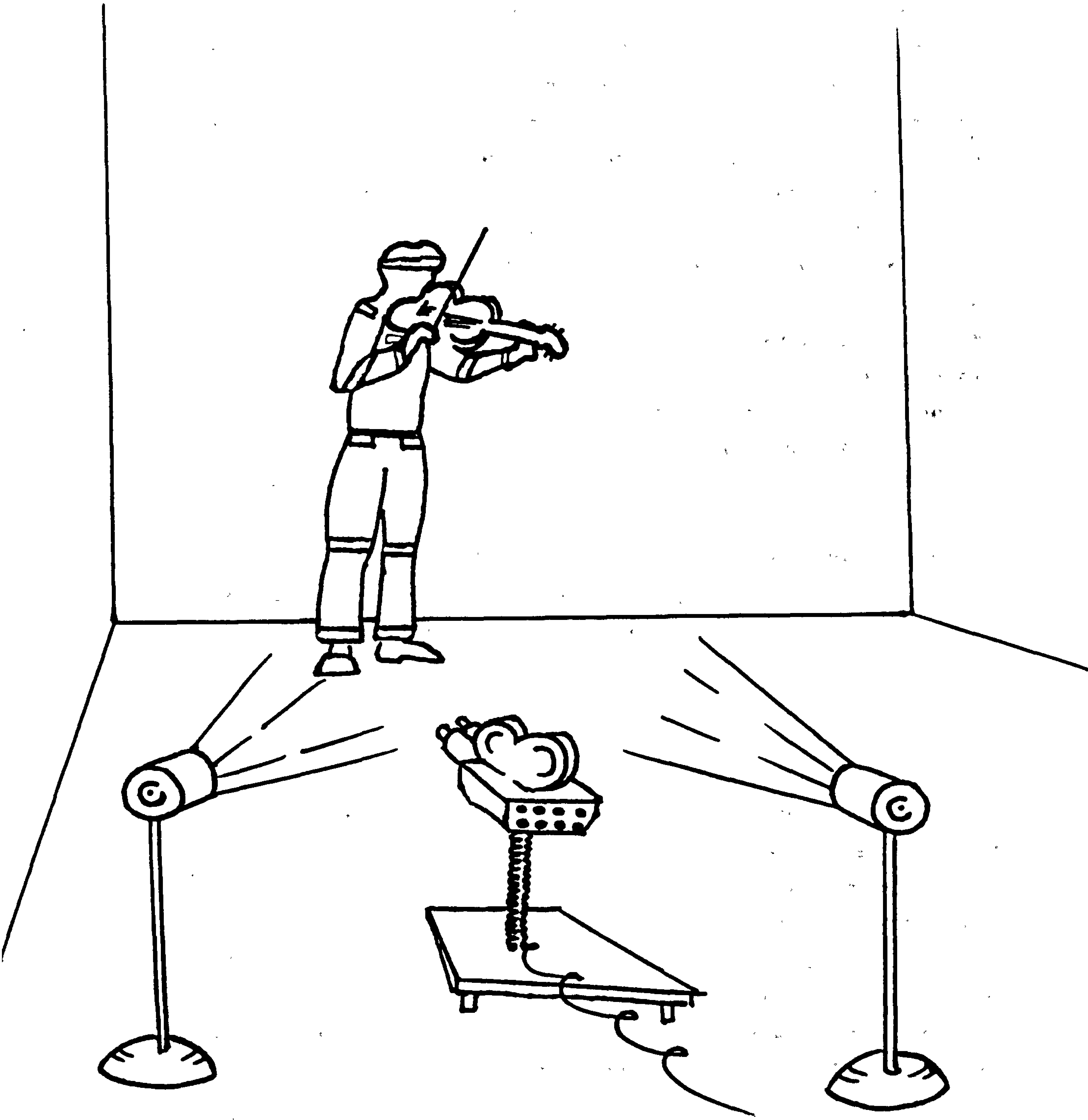


Figure 3.2 The apparatus layout for the collection of the point-light stimuli.

Reflection from the surface of the trombone was reduced by applying a quick-drying metal polish to the entire brass surface. Similarly, the high sheen of the piano was disguised with a covering of matt grey cotton fabric. The five performers were recorded playing their musical excerpts in the three manners of deadpan, projected and exaggerated performance. Since no specific instruction was given about how to achieve these differences, no reference was made to physical movement, although all the players were told that point-lights were a means of recording joint movement in performance. From the recordings, a total of thirty excerpts were prepared for presentation to the observers. There were fifteen excerpts (3 recorded manners for each of the 5 performers) for the vision only mode (V) and fifteen for the sound and vision mode (S&V). These excerpts were edited onto a test video in a random order.

Immediately prior to the presentation of the test data, a practice sequence containing one example from each performer in the projected manner was given in V and S&V mode.

Procedure

The edited test video was shown to the observers with the contrast and brightness controls of the video monitor adjusted to produce a screen image in which only the point-lights from the illuminated reflective tapes were visible. After the practice trials in V and S&V modes, the tape ran with five seconds of blanking tape placed between each excerpt. (See accompanying video tape references 1a, 1b, 1c, 1d, 1e and 1f for examples one performer shown playing in the three performance manners in both V and S&V modes, and video examples 1g and 1h which show two of the other performers.) The observers were tested individually and were asked to sit approximately 1.5 metres from the monitor in such a fashion that a view unimpaired by any screen reflection was achieved. Although the observers had no prior knowledge of the number of performers or performances, they were informed in a brief introduction to the test that they would see point-light performances taken from recordings of different performance manners. The observers were then asked to rate the performances on an interval scale 1-3, with 1 being deadpan and 3 being exaggerated. These scores were recorded on a response sheet and when they were collected, they were grouped according to observer experience (5 musicians and 5 non-musicians).[1] None of the observers was familiar with either point-light displays, or the individual performers.

3.2.3 RESULTS

Possible differences in the observer ratings were examined in an analysis of variance with repeated measures in the following mixed design: 2 (Observer Groups - Musicians, Non-Musicians) X 2 (Mode - V, S&V) X 5 (Performers) X 3 (Manner - deadpan, projected, exaggerated).

Analyses of the data revealed that there are main effects for manner [$F(2,8) = 84.79$, $p < 0.0001$] and performer [$F(4,16) = 13.37$ $p < 0.0001$], but neither mode [$F(1,4) = 0.37$, $p > 0.05$] nor observer group [$F(1,4) = 0.92$, $p > 0.05$] is significant. The mean scores in figure 3.3 show that the ratings are different across manner, with deadpan receiving the lowest and exaggerated the highest scores. The mean scores for performers shown in figure 3.4 reveal that there are apparently differences in the overall perceived intentions of the different performers.

There are also significant interactions for manner X observer group [$F(2,8) = 61.10$, $p < 0.0001$], mode X observer group [$F(1,4) = 29.58$, $p < 0.005$], mode X performer [$F(4,16) = 2.47$, $p < 0.08$], and performer X manner [$F(8,32) = 4.54$, $p < 0.001$]. However, the results are not significant for performer X observer group [$F(4,16) = 1.31$, $p > 0.05$] and mode X manner [$F(2,8) = 1.41$, $p > 0.05$].

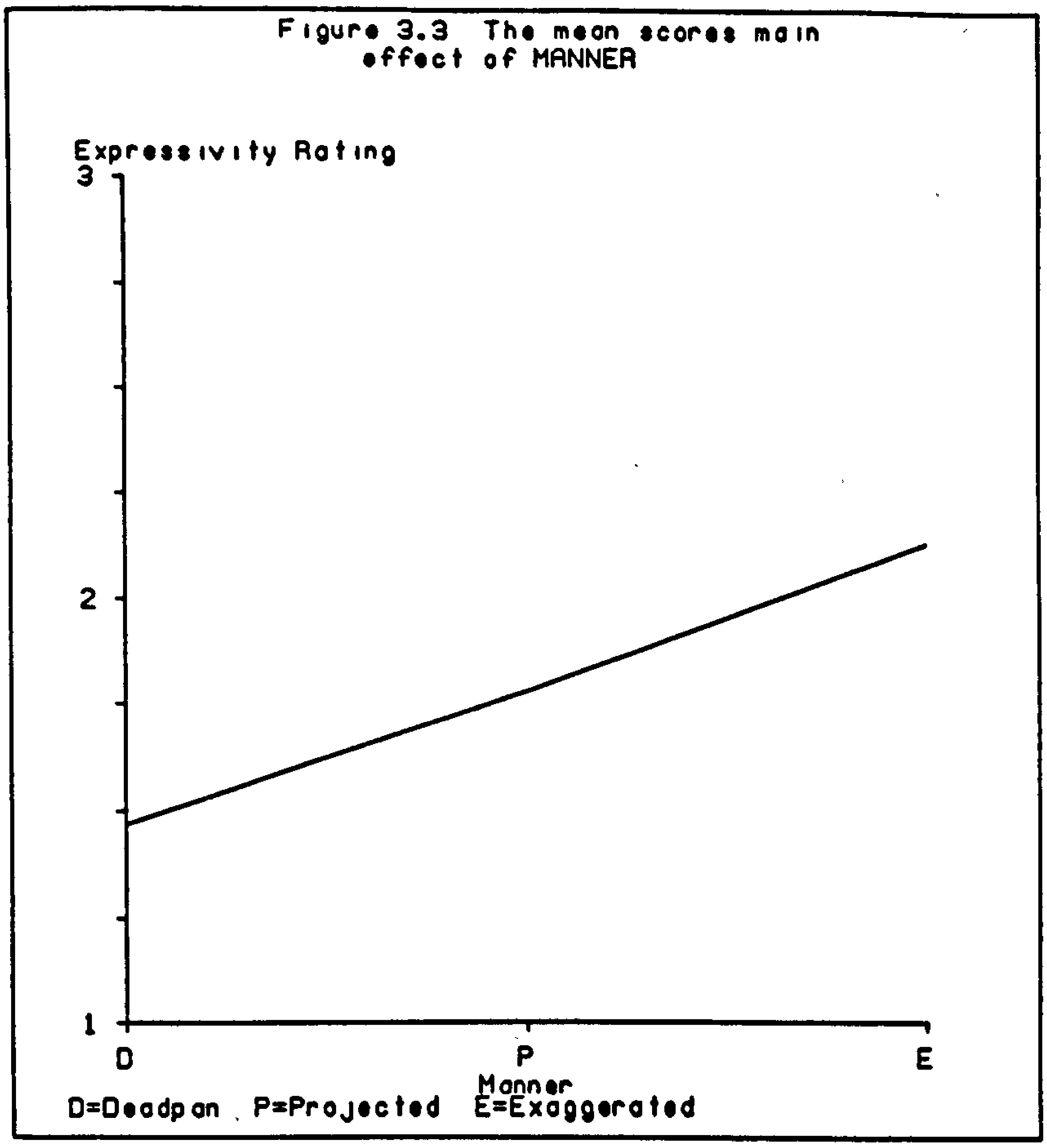


Figure 3.3 The mean scores main effect of MANNER
Expressivity Rating
3
2
1
D
P
E
Manner
D=Deadpan P=Projected E=Exaggerated

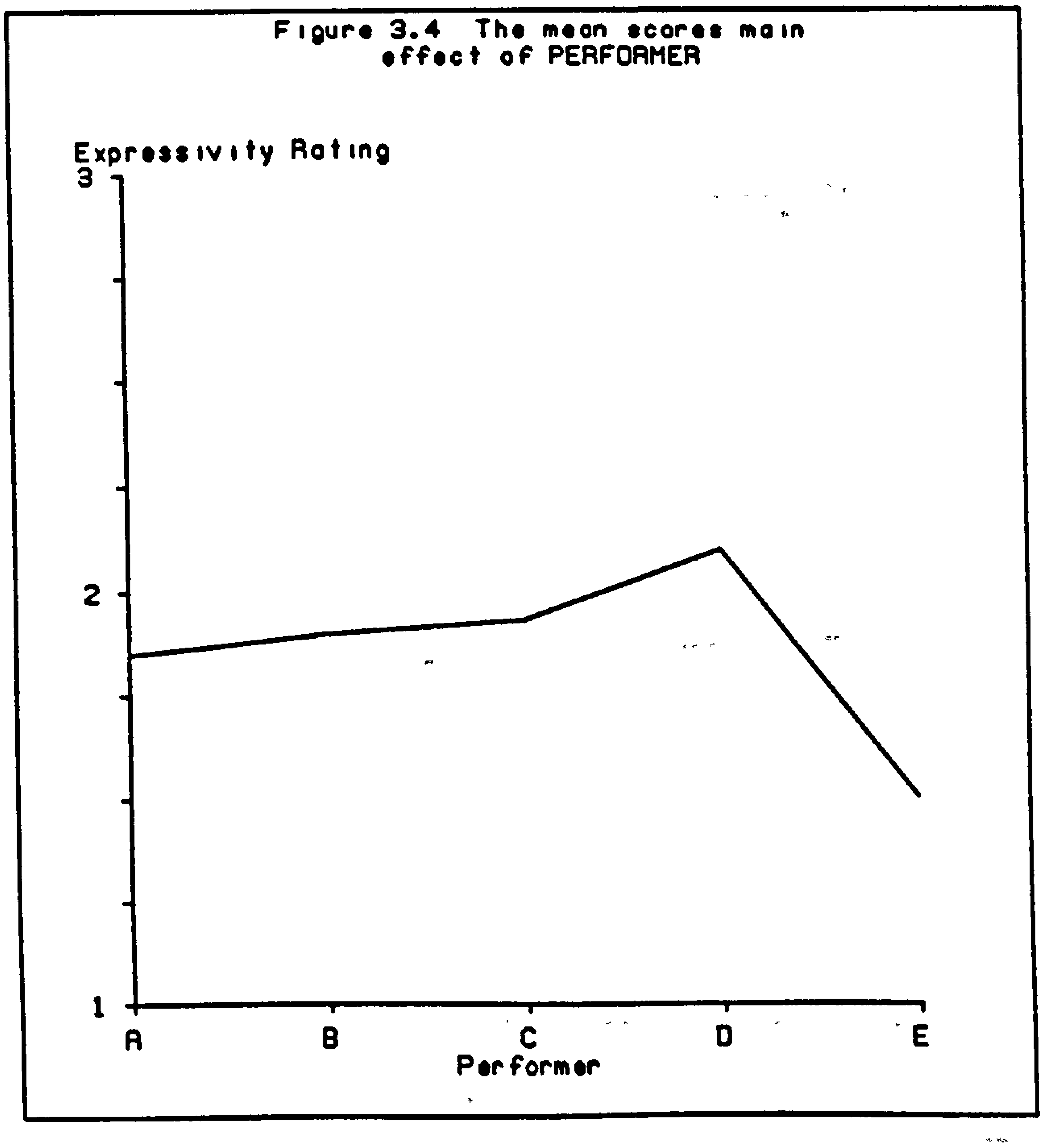


Figure 3.4 The mean scores main effect of PERFORMER
Expressivity Rating
3
2
1
A
B
C
D
E
Performer

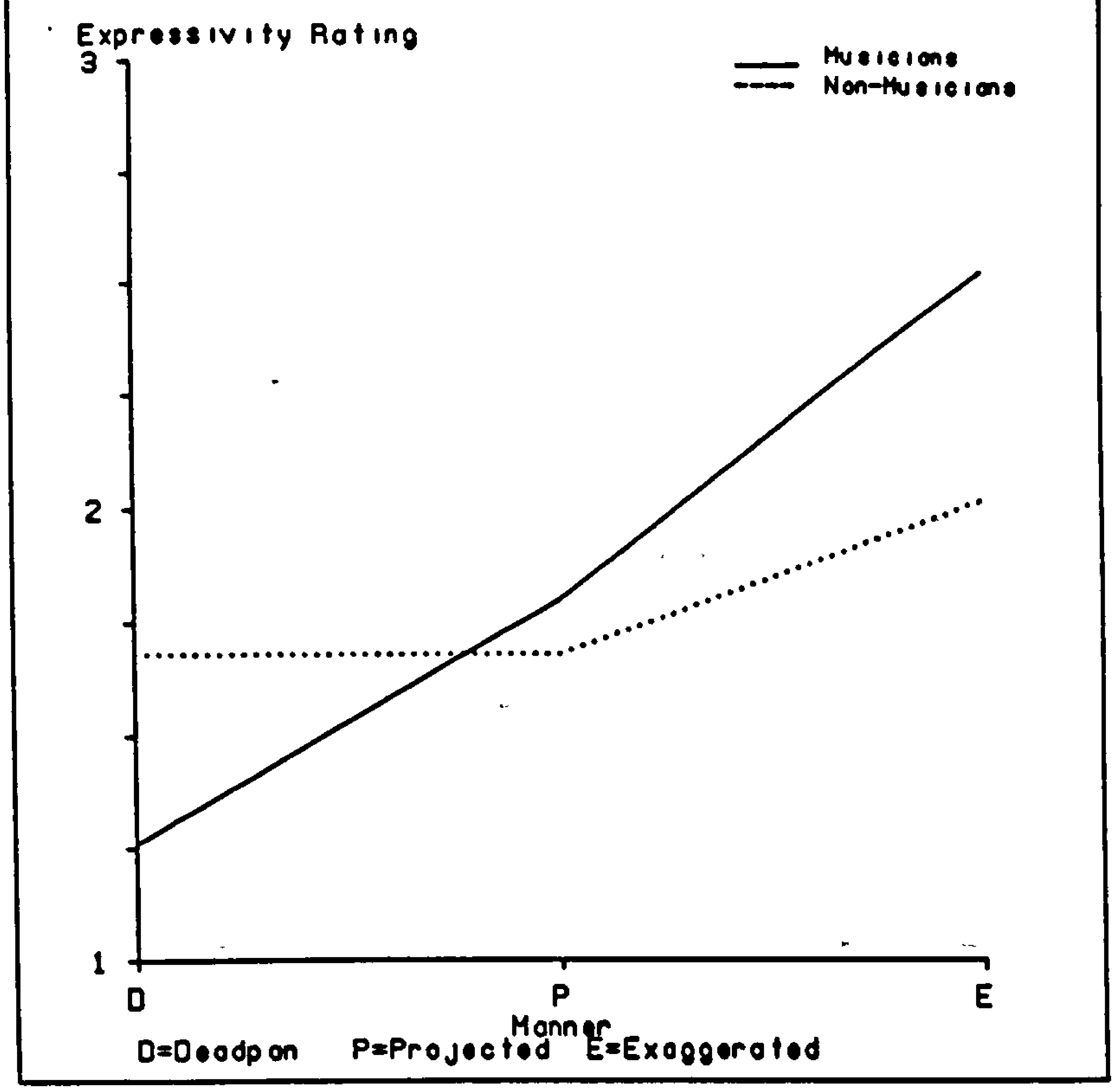


Figure 3.5 The mean scores two-way interactive effects of OBSERVERS by MANNER

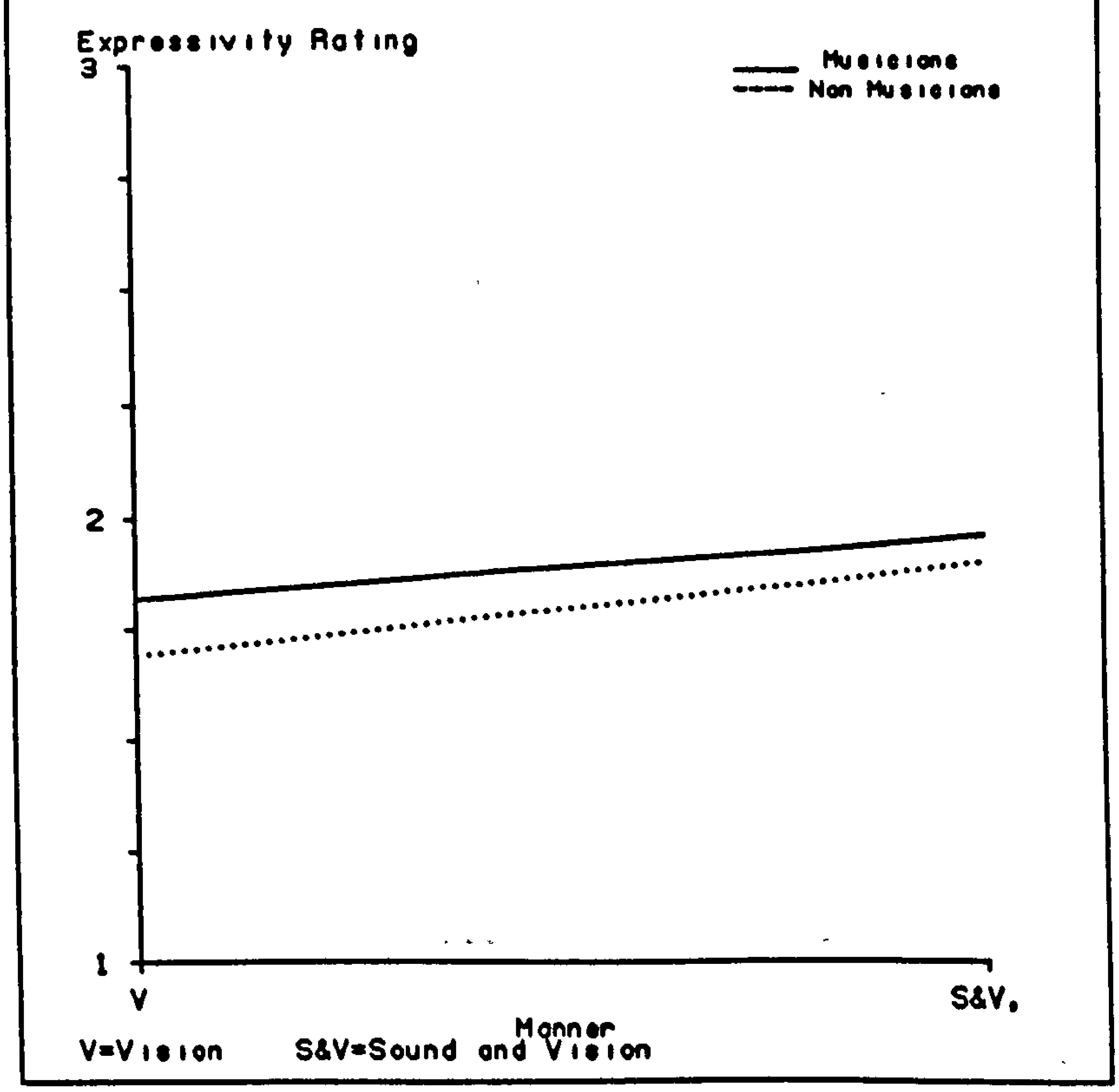


Figure 3.6 The mean scores two-way interactive effects of OBSERVERS by MODE

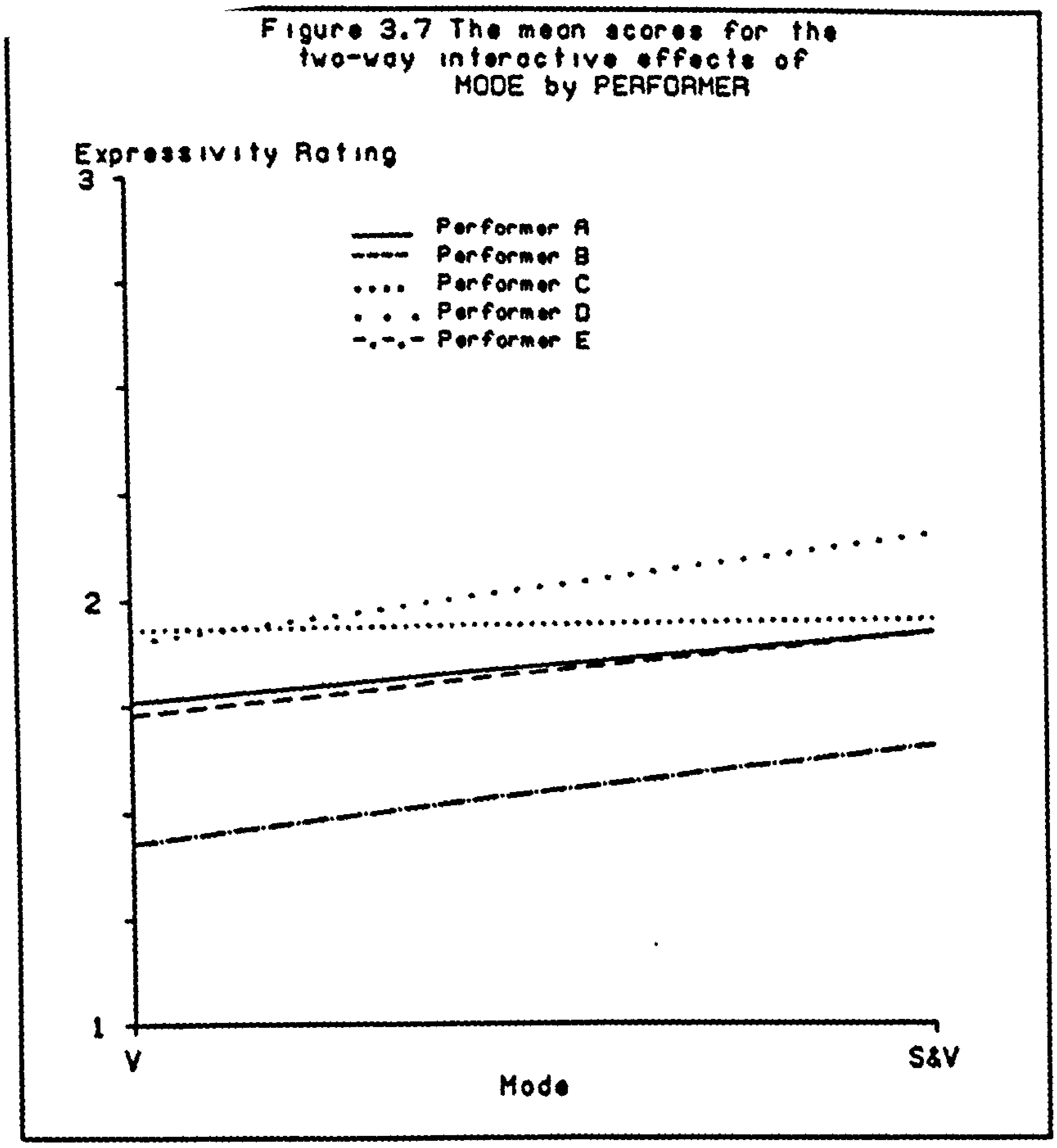


Figure 3.7 The mean scores for the
two-way interactive effects of
MODE by PERFORMER
Expressivity Rating
3
2
1
Performer A
Performer B
Performer C
Performer D
Performer E
V
S&V
Mode

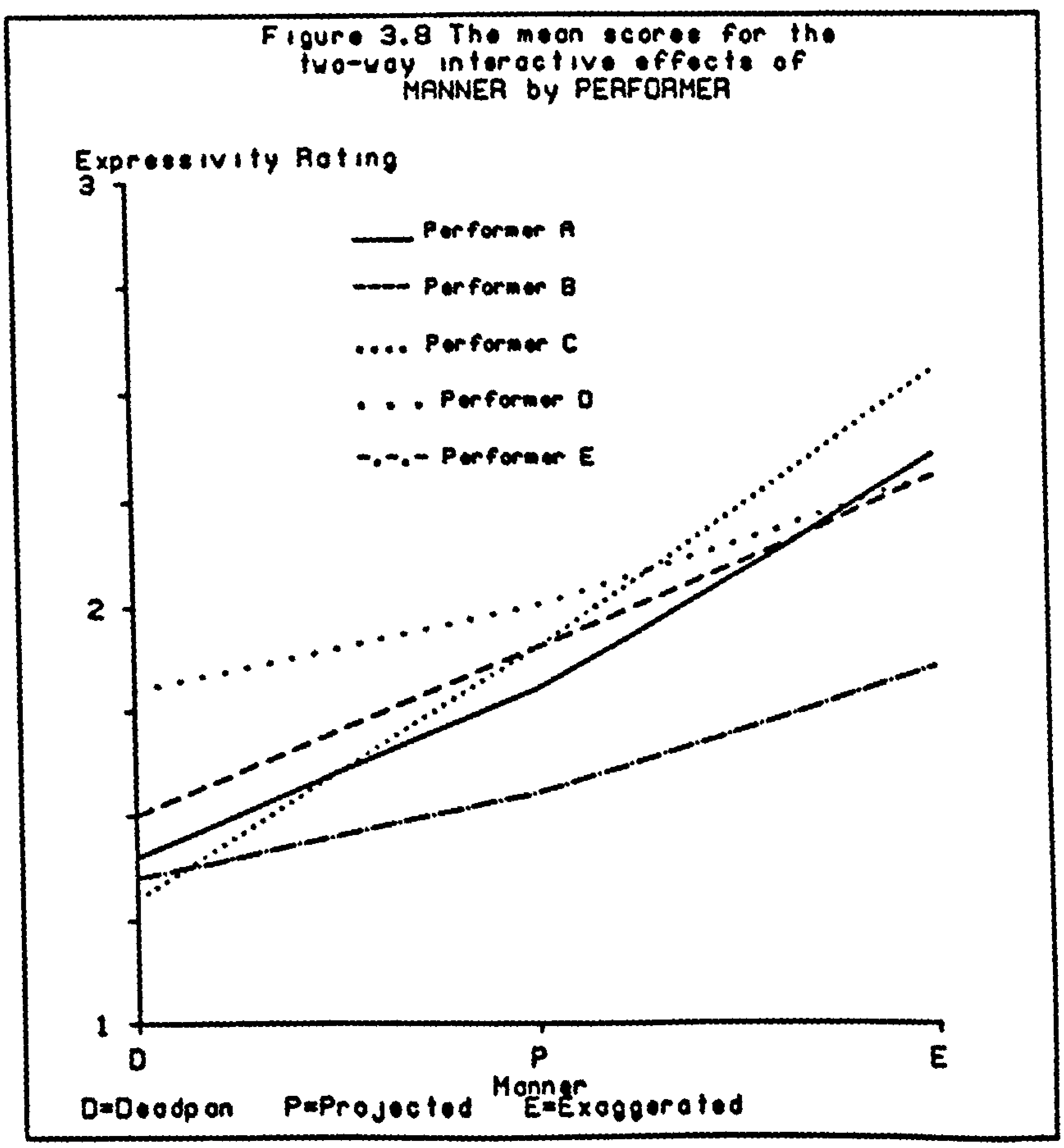


Figure 3.8 The mean scores for the
two-way interactive effects of
MANNER by PERFORMER
Expressivity Rating
3
2
1
Performer A
Performer B
Performer C
Performer D
Performer E
D
P
E
Manner
D=Deadpan P=Projected E=Exaggerated

Figures 3.5, 3.6, 3.7 and 3.8 illustrate the mean scores for the interactions. Figure 3.5 shows the interaction between manner and observer group and reveals that there is very little difference between the observers' ratings for projected performance, by comparison with deadpan and exaggerated. However, it appears that musicians award a slightly wider range of scores for manner than non-musicians. That is to say, the musicians give deadpan a lower rating and exaggerated manner a higher score. The non-musicians show no difference in their mean score ratings for deadpan and projected manners.

In the mode X observer group interaction, the mean scores shown in figure 3.6 illustrate that while there is barely any difference between the way the observers rate S&V, the non-musicians tend to rate V slightly lower than the musicians.

Figure 3.7, showing the performer X mode interaction, suggests that it is largely the scores awarded to performer C which cause the interaction, for her scores are the only ones which do not differ across mode.

The performer X manner interaction shown in figure 3.8 seems to be caused by some complex pattern of differences between the expressive range of the performers, with performers C and E representing the extremes of expression and conservatism respectively across the three conditions.

In sum, all the interactions involving performer show that the pattern of ratings display the same basic properties and that these properties are nonetheless sensitive to the particular performers involved.

The three-way analysis of the data reveals interactive effects of observer X mode X manner [$F(2,8) = 5.94$, $p < 0.02$] and mode X performer X manner [$F(8,32) = 2.64$, $p < 0.02$], but they do not offer any obvious interpretation.

For observer group X performers X manner [$F(8,32) = 1.69$, $p > 0.05$] and observer X mode X performer [$F(4,16) = 0.60$, $p > 0.05$] the results are not significant.

The four-way analysis of the data reveals an interaction of manner X mode X observer group X performer [$F(8,32) = 3.22$, $p < 0.005$], but again no obvious interpretation can be made.

3.2.4 DISCUSSION

The results suggest that both observer groups were able to use the kinematic information contained in point-light displays to detect differences between the performance manners. The similarities in rank ordering for manner between the observer groups - deadpan receiving the lowest ratings and exaggerated the highest - suggest that all the observers were sensitive to the performers' intentions. That is to say, the directions given to the performers to play in three manners were transformed into differences in their performances which were detectable for observers. However, it is to be recalled that the range of difference between the scores for deadpan and exaggerated awarded by the non-musicians is slightly less than for the musicians. The more extreme ratings by the musicians may indicate that the musicians are more confident in their judgements, and more consistent in awarding a score near 1 for deadpan, and a score near 3 for exaggerated than the non-musicians.

The effect of the performers on the results can be explained to some extent in terms of the variability between individuals. However, it is important to recall that each performer played a different instrument, so that some of the variations between ratings could be the effect of the different instruments. Indeed, it is possible that some types of instruments (by their design, the manner of performing them, or physical stance that they require) are always perceived as being more expressive than others.

Therefore, although the aim of using the five performers of different instruments to see whether ratings about different manners could be detected in all performance stances is fulfilled, in that the main effect of manner reflects the three manners in the different ratings, the effects of differences between the individual performers cannot be unambiguously interpreted.

The results also suggest that mode of presentation may have had some effect on the observers judgements, but it seems that further tests are necessary in order to identify whether the different mean ratings for mode according to observer group are the results of different abilities to extract information about performance intention.

In summary, these preliminary results establish that point-lights are useful investigative tools for music performance. Indeed, the evidence supports Runeson's (1984) claim that not only can the individual and the activity be detected in kinematics, but the intention of the activity can be detected too - even when the intentional differences are comparatively subtle, as in the present case.

It seems that a closer examination of the visual and sound components of the observations is necessary to determine whether sound added to vision does have a heightening effect on the perception of performance intention, or whether this result is purely the effect of observer groups equating two sources of sensory information with more expressive information than one sensory source.

3.2.5 MISMATCHING

In parallel to the experiment described above, a further set of stimulus materials was constructed in which mismatches (for instance, vision from the deadpan manner and sound from the exaggerated manner presented simultaneously) were used to determine whether one of the stimulus dimensions (S or V) is perceptually more effective in the detection of performance manners and the characteristics of individual performers.

Investigations into the nature of information contained in the different sensory modalities have been well documented in the psychological literature. Indeed, in ecological terms, similar information about an event should be available whether the event is seen, heard or both.

However, there has been contradictory evidence in the studies into the relative perceptual importance of the senses. For instance, work on spatial direction detection by Pick, Warren and Hay (1969) indicates that vision is the dominant sense modality. The tasks in their studies involve tracing sound and vision stimuli in space by either pointing a finger in the direction of the source or by using the touching potential of the whole hand to feel for the stimulus. In the latter instance, the hand is visually occluded from the observer beneath a fabric shelf. However, in other studies of sense dominance - temporal rate detection - Welch, Dutton-Hurt and Warren (1986) found that it is audition which is the dominant sense. The results of this study which focused on the use of varied volume and brightness in bimodal presentations of visual and aural rhythmic output, showed that for temporal rate perception both modalities provide information about rate, but that it is the auditory information which produces the most accurate detections. The authors propose that in this study auditory dominance occurs only because sound is the "*modality of appropriateness*" for the detection of temporal rate. Similarly they argue that vision is the "*modality of appropriateness*" for tasks such as spatial detection.

Perhaps the most pertinent discussion of the relative importance of specific sensory stimuli is made in

Frykholm's (1983a: 1-2) pre-amble to her K.S.D. studies. She reveals that depending upon the nature of an event, different perceptual systems may be more attuned to one kind of sensory information than others. For instance:

> *"The event of a falling tree is specified by the sound, and the sight, of its fall, and by the blow when it hits the perceiver. Thus, the sight and the sound and the touch, all, and each separately, may specify the event. Information about the event is available, or provided by all three ... Information is "better" when it is for some adaptive action ... [Thus] sound may be better than sight since it can be picked up at a longer distance..."*

Given Frykholm's and Welch, Dutton-Hurt and Warren's findings, it would appear that for music performance aural information must dominate perception since as an arrangement of sounds and silences in time, music is essentially an aural and temporal phenomenon. However, since no adaptive action like that described by Frykholm is involved in observing music performances, there may be little difference in the effectiveness of one sensory modality over another. Indeed, work by Green (1987) suggests that where two perceptual sources of information are presented simultaneously and in a manner which demands attention in both modalities, both sources of information are equally useful. Using the perceptual task of determining the speaking rate of a subject, Green asked observers to rate vision alone and sound alone of the speaker independent of the combined simultaneous sound and vision presentation. She found that there were no differences in ratings awarded to the three modes of presentation. Thus, Green's results may well hold for music performance, for as in speech, both sound and movement contribute to the complete activity.

To tackle the question of whether vision is an informational source equal to sound in music performance, Welch, Dutton-Hurt and Warren's strategy for discovering modality dominance is adopted by mismatching normally congruent sensory modalities.

3.2.6 METHOD

Subjects and Stimuli

The observers and the video recordings of five performers playing in three manners were identical to those used above. However, the stimuli for the observations consisted of the video recordings mismatched in the following combinations:

1) Exaggerated V recording and deadpan sound S,
2) Projected V recording and exaggerated S,
3) Deadpan V recording and exaggerated S.

Since all mismatch combinations for all performers would have produced too much stimulus material for observers to view in a single preliminary investigation, it was decided to use only the three mismatch combinations described above. Deadpan and exaggerated mismatches were chosen as an extreme combination of vision and sound, whilst the projected and exaggerated combination was included as a more moderate combination of sound and vision. The mismatch combinations were prepared for all five performers to produce a total of fifteen excerpts which were edited onto a test video in a random order. Since the performance durations of the three manners varied - for one performer, deadpan was 8 seconds shorter than exaggerated - it was decided to create asynchronous mismatches so that S and V could be played simultaneously. For example if V had the longest duration, it was recorded slightly ahead of S. Gross asynchronisation was considered to defeat the purpose of the mismatching, for it would provide single stimulus information that could be judged independently, so in all mismatches it was decided to allow no more than one second of single modality presentation at either end of the test excerpt. Therefore, a section of between two and seven seconds of the longer performance manners was removed from the ends of excerpts. (See video examples 2a, 2b and 2c for examples of the different mismatch combinations played by one performer, and video examples 2d and 2e which show two of the other performers in mismatched excerpts.) Rather than asking observers to award some kind of composite score in their assessments of the mismatches, they were instructed to score sound and vision independently. A line scale was presented to the observers with the following instructions:

> *You are about to see a mismatched vision and sound performance excerpt. Please use the initials V for vision and S for sound to indicate on this linear scale the most appropriate positions to fit the excerpt:*

DEADPAN ———————————————————— EXAGGERATED

It was anticipated that some observers would detect the mismatches as matched sound and vision performances, and it was therefore important to provide a rating method that would permit such a judgement to be recorded. Symbols representing either modality which were placed in the first third of the line were given a score of 1, those in the second third were scored as 2, and those in the final third of the line were scored as 3.

Procedure

Like the former experiment, the observers were tested individually, sitting 1.5 metres from the monitor. They viewed the prepared and randomised performer mismatches on the video in point-light display. Five seconds of screen blanking were placed between each of the fifteen excerpts. The practice trials, shown immediately prior to the test, consisted of five twenty second chunks of mismatched film - one example for each performer. These examples were arbitrarily chosen from the experimental trials. The practice trials included two examples of combination 1, one example of combination 2, and two examples of combination 3. Mismatches were explained to the observers as a means of investigating the respective effects of sound on vision and vision on sound in the observation of music performances. The observers were instructed that the mismatches comprised sound and vision from performances of the same piece in which the performers played with different intentions. Observers were asked to make their judgements on the rating scale as soon as they felt able to. The test lasted approximately twenty minutes.

3.2.7 RESULTS AND DISCUSSION

The mismatched data were collected from the two observer groups and were analyzed by examining mean and standard deviation values.

These results are shown in table 3.1 and demonstrate that musicians identify the manner of a performance in both S and V and can distinguish between different manners when they are mismatched. The scores show that deadpan receives a similar score whether visually or aurally presented, as does exaggerated. For example, in mismatch 1 where S is deadpan and in mismatch 3 where it is V which is deadpan the mean scores are the same. Furthermore, it seems that the data are unaffected by the information in the other sensory channel. For instance, the two scores for exaggerated S in mismatches 2 and 3 are similar even when in mismatch 2 the visual component of the mismatch is projected and in mismatch 3 the visual modality is deadpan.

Table 3.1. Mean and standard deviation values for the identification of mismatched sound and vision by musicians and non-musicians.

		VISION		SOUND	
MISMATCH	OBSERVER	SCORE	S.D (N =25)	SCORE	S.D (N=25)
1	Musician	2.36	0.64	1.32	0.48
2	"	2.08	0.70	2.6	0.58
3	"	1.32	0.56	2.52	0.59
1	Non-	2.00	0.76	1.76	0.66
2	Musician	1.72	0.94	1.88	0.73
3	"	1.72	0.74	2.16	0.75

For the non-musicians, the mean scores reveal that exaggerated manner always receives the highest score and deadpan always receives the lowest score whether in V or S modality. However, the difference between these scores tends to be less than for the musicians. The scores also indicate that non-musicians are not able to differentiate between the three manners of performance when they are mismatched. For example in mismatch 2 where V is projected, the mean score is identical to the mean score awarded to deadpan V in mismatch 3.

An independent t-test on the standard deviation values between observer groups shows that the non-musicians and musicians ratings are different in their levels of variability [$t(10) = 2.31$ $p < 0.05$]. Non-musicians tend to be more variable, that is less unanimous, in their judgements than the musicians. Since the non-musicians' margin of difference between mean scores is generally smaller than the musicians, it appears that non-musicians are less assured in their judgements than musicians.

Further t-tests between V and S modalities in the mismatches illustrate that differences between the scores in the mismatches are not always statistically significant for the non-musicians. For mismatches 1 and 3 correlated sample t-test are significant [$t(24) = 2.22$, ($p < 0.05$) and $t(24) = 4.71$ ($p < 0.01$) respectively] for non-musicians. In mismatch 2, the result is not significant [$t(24) = 1.66$]. Here it is evident that for the non-musicians in mismatch 2 where projected V is played with exaggerated S, there is no significant difference between the scores for the two modalities. Furthermore, mismatch 1 is only weakly significant. By contrast, the results of the musicians' t-tests confirm that musicians differentiate between the manners more assuredly than non-musicians: mismatch 1, $t(24) = 11.55$, ($p < 0.01$), mismatch 2, $t(24) = 6$, ($p < 0.01$), and mismatch 3, $t(24) = 4.14$, ($p < 0.05$).

Thus, the principal result of the mismatch study is that musicians are able to differentiate accurately and use both sensory sources equally well, regardless of which manner is presented visually and which manner is presented aurally. With the non-musicians, the rank ordering of the results is in line with those for the musicians: that is when either S or V is exaggerated, the score will be higher than in the other modality, and when either S or V is deadpan, the score will be lower than in the other modality. However, it is evident that the non-musicians are more variable in their individual ratings of the mismatches than the musicians.

3.2.8 SUMMARIZING DISCUSSION OF THE PILOT STUDY

The number of observers involved in this investigation is too small to draw definitive conclusions from the data analysis, and it is important to note that although the test videos for both modes of presentation, and for the mismatches, were shown with the performers, manners and modes randomised, the test videos were shown to each observer in the same random order. The fact that the data were not randomised for each observer could arguably have affected the results in terms of ordering effects. Also, as noted before, it is feasible that certain musical instruments are naturally more expressive which could lead to some confusion in the scoring. However, since both the data analyses (for the two modes of V and S&V and the mismatching) reveal that different performance manners can be detected from visual information, it is apparent that there is sufficient perceptual information available in kinematic point-light display to reveal differences of intention. These results show that the instructions to perform with different intentions were transformed by the performers into differences in their performances and these differences were detectable for observers, though the simple detection of differences between manners does not pinpoint what particular differences in the kinematic pattern occur.

Consistent with Scully's (1986) study, the results of this study reveal that musicians and non-musicians extract different kinds of information about the performances. It is evident that the experience of the musician observers gives them a higher level of confidence in their perceptual judgements, particularly when presented with the rather unnatural task of mismatch judgements.

It seems that for an investigation of information in kinematic displays it is more productive to use musician than non-musician observers to pursue further examinations of music performance, since it seems that musicians are more attuned to the fine informational details. Certainly, the non-musicians show more variability and less overall confidence in their abilities to discriminate between the performance manners in mismatches.

In sum, these findings support the idea that visual information is a primary source for observers of music performance. However, in order to extract the maximum possible information from this type of investigation, it seems that sound as an independent stimulus must be introduced as a variable of mode. Mismatching has already proved to be a useful methodology, and with the addition of sound only, it may be possible to determine whether the mismatching produces scores compatible with the single mode V and S stimuli. Such a possibility will place the study more in line with Green's investigation of speech where all the combinations of sound and vision - matched and individual source - were explored to establish whether one particular stimulus source was more effective than the others in the detection of intent.

Therefore, the next empirical step must be to remould the experimental design by adding a "*sound only*" condition to the previous presentation modes, to use larger numbers of musicians observers to obtain a more substantial data sample, and, for the sake of empirical clarity, to show the mismatches in all permutations. Finally, because individual differences in the expressivity levels of performers are difficult to interpret given that a variety of instrumentalists were used, performers of the same instrument are to be used in the follow-up study to eliminate any possible effects of inherent differences in the expressivity of the different types of instruments.

3.3 THE POINT-LIGHT STUDY OF VIOLINISTS

3.3.1 INTRODUCTION

To follow up the results of the pilot, this study replicated the investigation with its two principal aims: to identify whether kinematics can provide accurate information about differences in expression; and to determine whether kinematic information was as useful as aural or matched visual and aural information. Several modifications to the experimental design were made: sound only was added to the variable of mode; only violinist performers were used; a far larger group of musicians was recruited as observers; and a more complete randomisation of the materials was used. Additionally, a different response sheet with a seven point scale permitting more observer choice was used. Finally, it had been noted in the pilot study that the majority of assessments were made within the first 10 seconds of the excerpt's start. Therefore, in this study, excerpt length was reduced. Although longer than 10 seconds (the excerpts ranged from 30-70 seconds duration) the durations used were determined by the need to end up with coherent musical materials - that is, a complete phrase. Thus, each excerpt ended at a phrase boundary. As before, none of the observers was informed about the identities of the performers.

3.3.2 METHOD

Subjects

Twenty-one undergraduate music performance majors (13 female and 8 male with a mean age of 20.8 years) from City University volunteered as observers. None had participated in the pilot study, nor had any of them seen point-lights.

Apparatus and Stimuli

The apparatus included the same recording, lighting and point-light attachments as the pilot study. Stimulus production of the point-light displays was identical to the pilot study. Four final year undergraduate solo violinists, one of whom had performed in the first study, (2 male and 2 female with a mean age of 21.5 years) played musical excerpts of their choice in the three performance manners: deadpan, projected and exaggerated. With durations of up to 40 seconds, the violinists chose their excerpts from the following pieces:

Cadenza, 1st. mvt, Concerto No. 4 in D major, Mozart.
Opening, Adagio, Sonata No. 1 in G Minor, Bach.
Entry, 1st. mvt, Concerto No. 1, Mendelssohn.
Opening, Praeludium and Allegro, Kreisler.

As in the pilot study, all point-lights were attached to the front of the performer's limbs and head. When the original recording of the twelve pieces of music - the four performers playing each of the three manners - was completed, edits which gave a total of forty-nine excerpts for the test were made. These were: twelve vision only (V), twelve sound only (S), twelve matched sound and vision (S&V), and thirteen mismatched sound and vision. The S excerpts were created by blanking the image whilst leaving the sound channel unchanged. The mismatches were made in every possible combination using video from the four performers, but not all performers were seen in every combination of mismatch as this would have produced too much stimulus material to be observed in a single viewing session. There were three mismatches for violinists 1, 2, and 3 and four mismatches for violinist 4. Amongst the mismatches, two matched (same S and V manner) but asynchronised excerpts were included. These were included since no observers in the pilot study had rated components of the mismatches as matched, despite knowing that matching was a possibility. A run of practice trials including eight cuts of ten seconds duration each showing every performer in two different manners and modes was made:

violinist 1 in exaggerated S and matched projected S&V;
violinist 2 in projected V and mismatched projected S and exaggerated V;
violinist 3 in matched exaggerated S&V and deadpan S;
violinist 4 in mismatched deadpan V and exaggerated S and deadpan V.

The practice trials ran prior to the main test. (See video examples 3a to 3e for single stimulus and mismatch examples in all modes of presentation for all four performers.)

Procedure

The 49 excerpts were divided into three groups (groups one and two contained 16 excerpts, and group three contained 17 excerpts) with five seconds of blanking between each excerpt, and placed in a random order of manners, modes and performer on three separate videos. In order to increase the *"randomness"* of the video order, these three videos were presented to the observers in their six permutations. With a total of 21 observers, this meant that: three observers saw the videos in the order 1, 2, and 3; three saw the order 3, 2, and 1; three saw the order 2, 3, and 1; four saw the order 2, 1 and 3; four saw order 3, 1 and 2 and four saw order 1, 3 and 2. Although not a complete randomisation, this greatly improved on the technique of the initial investigation. These videos were shown on a prepared point-light monitor. The observers were told that they would see and hear performances by different performers with different performance intentions, and were asked to rate each performance by marking the appropriate number on the seven-point scale. In the case of the mismatches, the letter S over a number indicated sound, and V indicated vision:

DEADPAN 1 2 3 4 5 6 7 EXAGGERATED

The observers were not told the number or identity of performers in the study, nor the number of different performance manners.

After a run through the practice trials, each observer completed the test alone, with two resting periods of ten minutes between the three blocks of trials. The experiment lasted approximately one hour.

3.3.3 RESULTS AND DISCUSSION

Possible differences between the S only, V only and matched S&V data are examined in a 3 (Mode - V, S, S&V) X 4 (Performers) X 3 (Manners - deadpan, projected and exaggerated) repeated measures analysis of variance. Mismatches are tested with paired t-tests and are reported in a separate mismatch results section.

The analysis reveals main effects for mode [$F(2,40) = 3.32$, $p < 0.05$], manner [$F(2,40) = 217.08$, $p < 0.0001$], and performer [$F(3,60) = 17.98$, $p < 0.0001$]. Figure 3.9 shows that the main effect of mode is mainly due to the slightly higher expressivity score for S. The mean scores for manner seen in figure 3.10 illustrate that deadpan receives the lowest expressivity rating and exaggerated the highest. It is interesting to note that the greatest difference in the ratings occurs between deadpan and projected. This indicates that it is perhaps easier for the performers to withhold expression from the piece than it is for them to exaggerate the expressivity of a piece beyond its normal level. Finally, the mean scores for performer shown in figure 3.11 reveal that the four individuals are rated differently.

There are significant results for all two-way interactions: mode X manner [$F(4,80) = 10.58$, $p < 0.0001$], performer X manner [$F(6,120) = 28.77$, $p < 0.0001$], and mode X performer [$F(6,120) = 4.38$, $p < 0.0001$]. The mean scores in figure 3.12 illustrate the interaction for mode by manner. Here it is evident that V receives the most extreme scores whereas S is most moderate, but that both S and S&V tend to show very small differences between the ratings for projected and exaggerated.

Figure 3.13 shows the performer by manner interaction. It seems that it is the complex pattern of ratings ranging from the large spread of the ratings for performer 4, through to performer 1 for whom there is virtually no difference across the ratings for manner, which cause the interaction.

Figure 3.14 illustrates the mean scores for the mode by performer interaction. The performer who seems to cause the interactive effect is performer 3 who reveals little variation in his mode ratings.

There is a significant result for the three-way analysis, with an interaction between the effects of mode, performer and manner [$F(12,240) = 4.8$, $p < 0.0001$], but there is no obvious way to interpret what this indicates.

In sum, these results illustrate that when the observers are musicians and the performers are violinists, there is perceptual information contained in point-light displays which permits the identification of performance manner. Indeed, like the results of the pilot study, the main effect of manner reveals that the observers' ratings reflect the directions given to the performers to play in three manners. The results also illustrate that S is an effective indicator of manner. However, the interaction effect of mode by manner suggests that S produces results which are more constrained (there is less margin of difference between the S scores for manner) than the other modalities. Since it is the V ratings which produce the most extreme range of scores (the lowest rating for deadpan manner and the highest rating for exaggerated manner) the results shows that vision is the mode which most clearly conveys the intentional differences between the three performance manners and therefore suggests that V is the most "*effective*" indicator of manner.

Another result is that performers are rated in ways which reflect differences between them in terms of the overall levels of expressivity they communicate as performers.

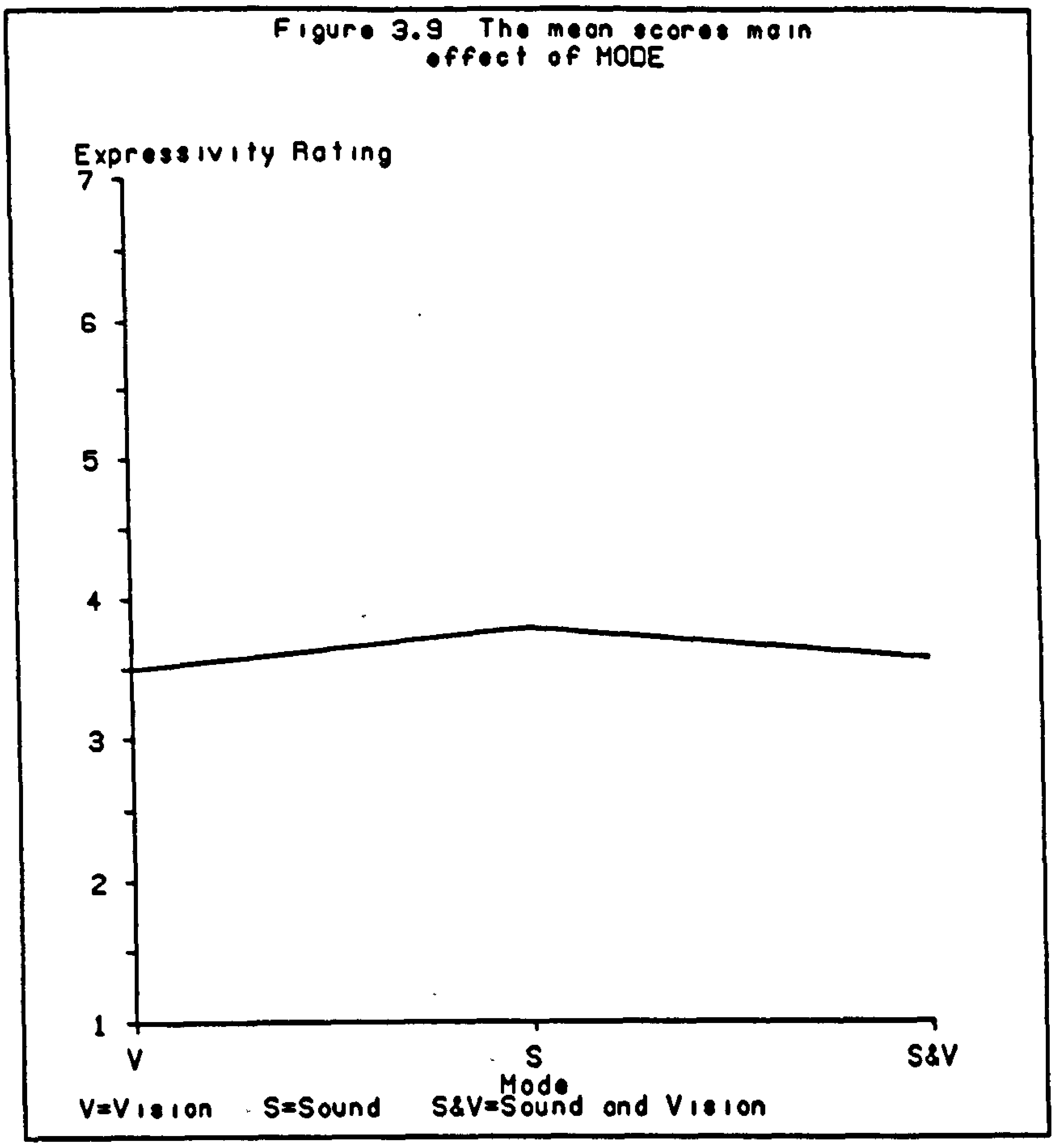


Figure 3.9 The mean scores main
effect of MODE
Expressivity Rating
7
6
5
4
3
2
1
V
S
S&V
Mode
V=Vision
S=Sound
S&V=Sound and Vision

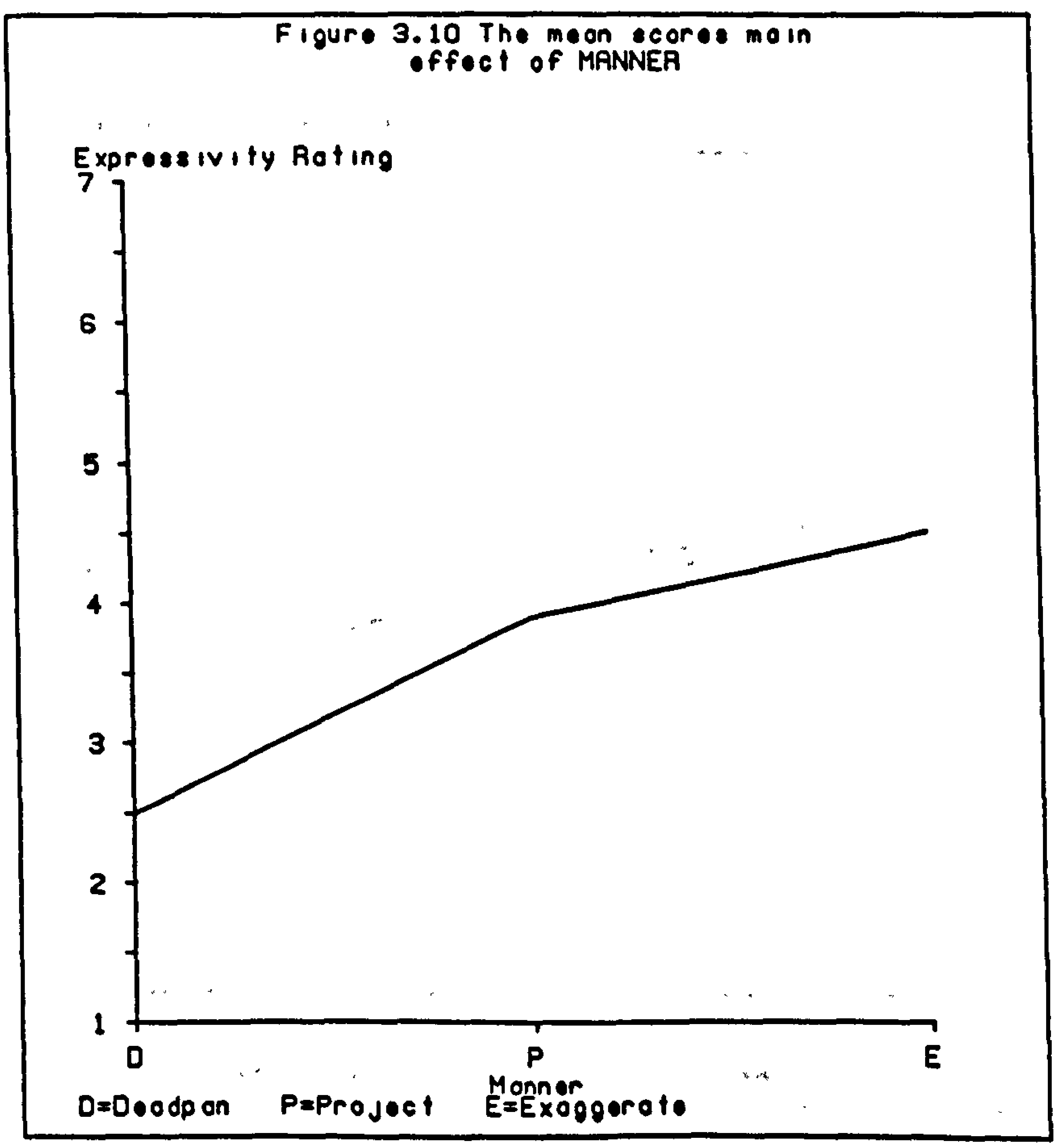


Figure 3.10 The mean scores main
effect of MANNER
Expressivity Rating
7
6
5
4
3
2
1
D
P
E
Manner
D=Deadpan
P=Project
E=Exaggerate

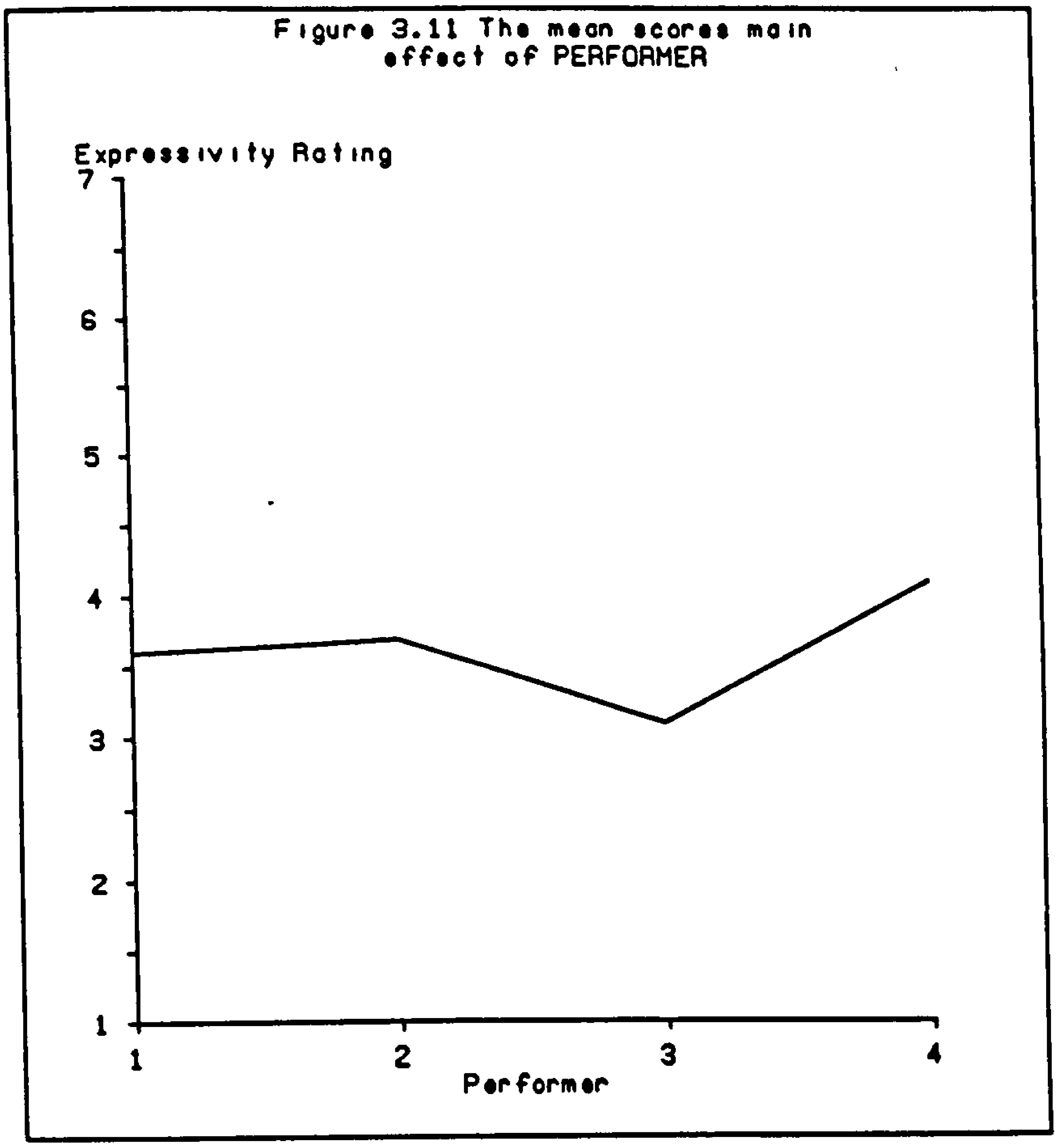


Figure 3.11 The mean scores main effect of PERFORMER
Expressivity Rating
7
6
5
4
3
2
1
1
2
3
4
Performer

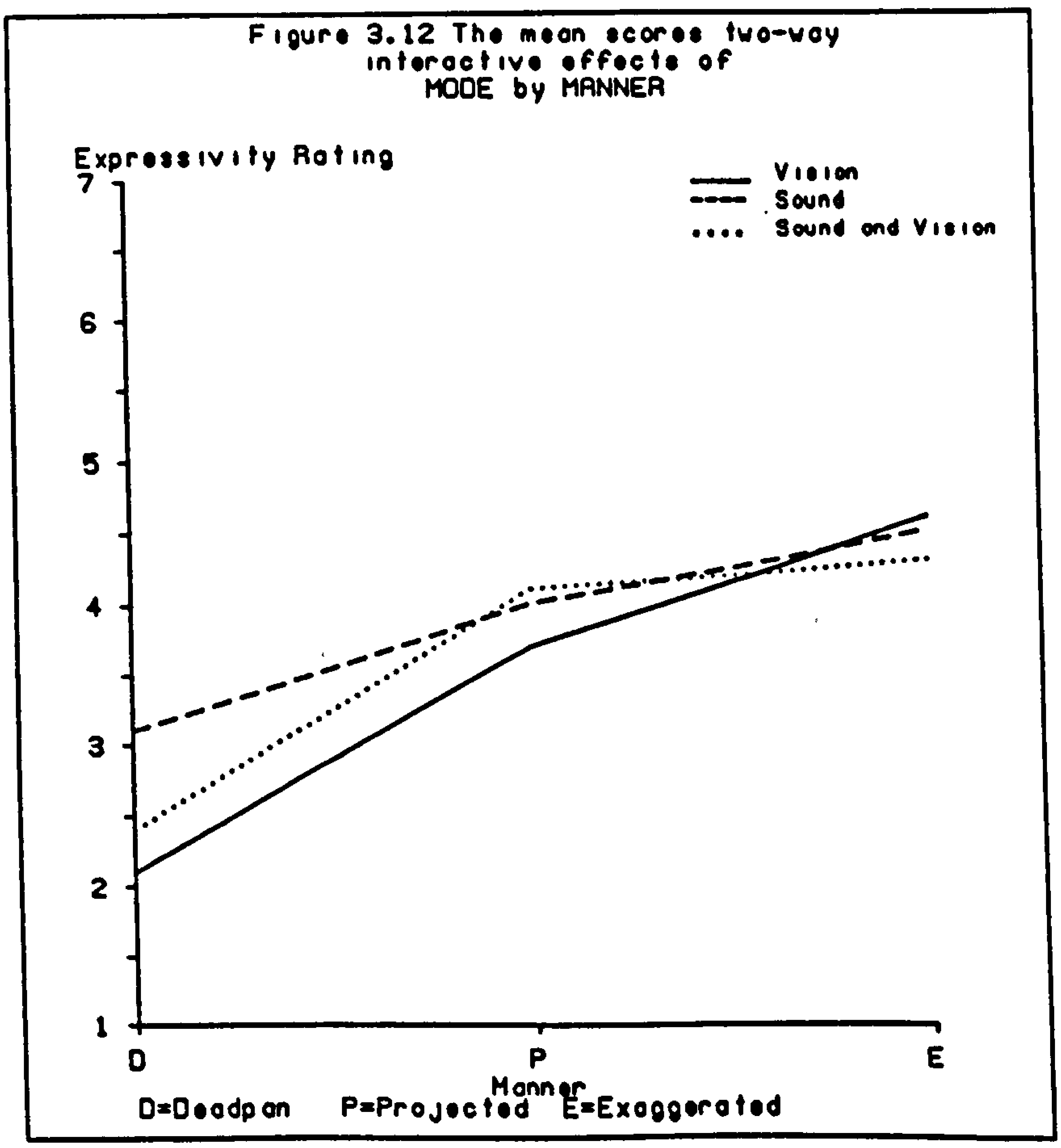


Figure 3.12 The mean scores two-way interactive effects of MODE by MANNER
Expressivity Rating
Vision
Sound
Sound and Vision
7
6
5
4
3
2
1
D
P
E
Manner
D=Deadpan P=Projected E=Exaggerated

Figure 3.13 The mean scores two-way interactive effects of MANNER by PERFORMER

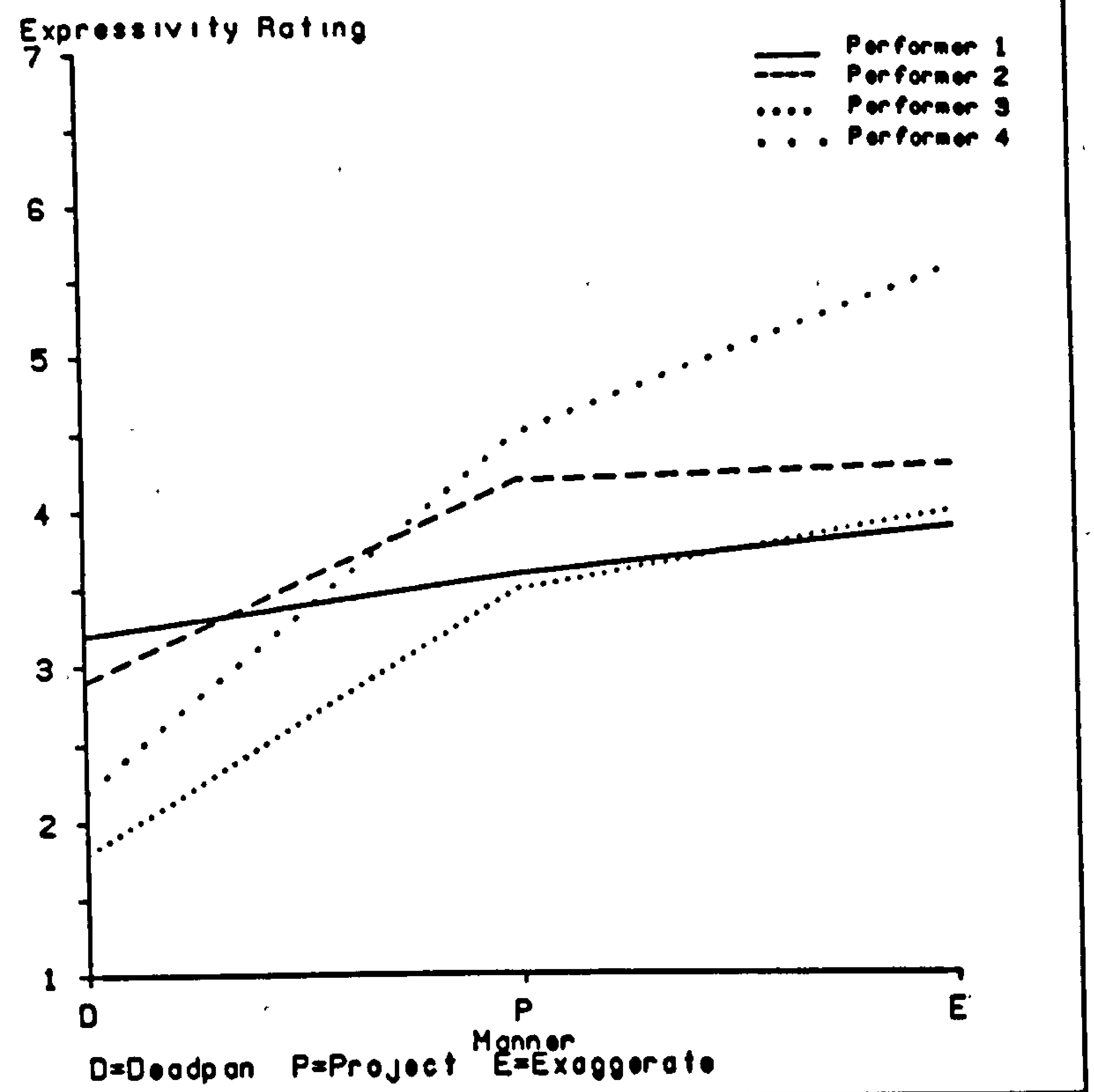
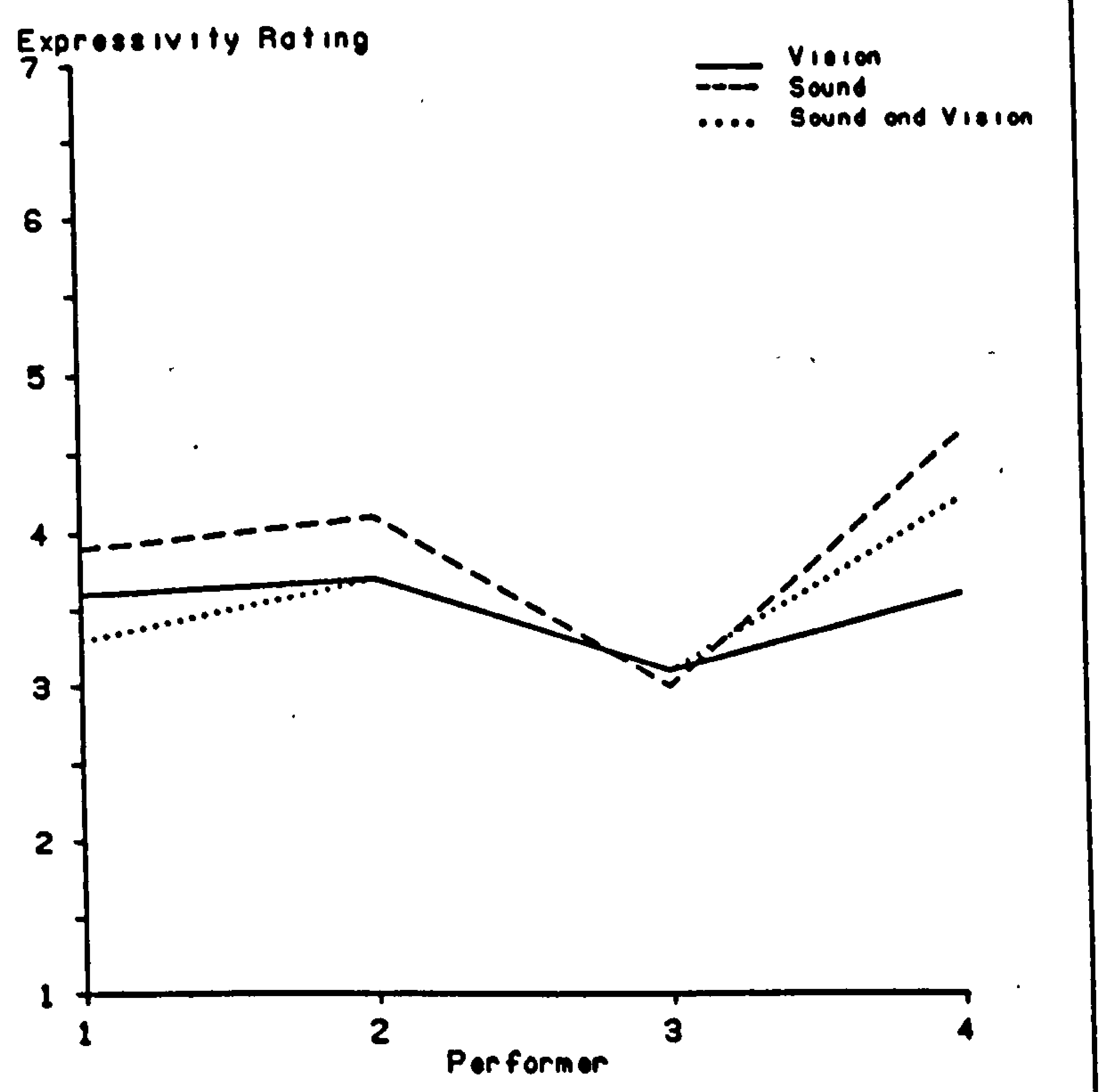


Figure 3.14 The mean scores two-way interactive effects of MODE by PERFORMER



Interestingly, several observers commented on the style of movements they observed, noting that some of the performers' movements were reminiscent of some of their fellow students. Indeed, in five instances (without any prompting from the experimenter) observers correctly identified some of the performers. Performer 4 was identified by all five observers and Performer 1 was recognized by two of the observers. The criteria for these recognitions were not easily articulated by the observers, though the observers comments indicated that knowledge about the performer's identity was based on recognising their general styles of movement as much as their style of movement in performance.

MISMATCHING

To analyze the mismatched data, t-tests were performed between the S and V modalities of each mismatch.

Note that in the tables which follow: N.S = Not Significant, D = Deadpan, P = Projected and E = Exaggerated, S = Sound and V = Vision and the bracketed numbers indicate the mean scores.

Table 3.2 showing t values for the mismatches for Performer 1.

MISMATCH			
Sound	*Vision*	*t value*	*p value. (for 20 d.f)*
P (4.40)	*D (2.62)*	*11.07*	*< 0.01*
E (4.52)	*P (3.30)*	*4.11*	*< 0.01*
P (4.20)	*P (3.00)*	*3.18*	*< 0.05*

Table 3.3 showing t values for the mismatches for Performer 2.

MISMATCH			
Sound	*Vision*	*t value*	*p value. (for 20 d.f)*
D (2.00)	*E (3.00)*	*2.33*	*< 0.05*
D (3.30)	*P (3.38)*	*0.53*	*N.S*
P (4.04)	*D (4)*	*0.00*	*N.S*

Table 3.4 showing t values for the mismatches for Performer 3.

MISMATCH			
Sound	*Vision*	*t value*	*p value. (for 20 d.f)*
E (3.76)	*D (1.38)*	*7.62*	*< 0.01*
P (3.60)	*D (1.48)*	*5.65*	*< 0.01*
D (3.23)	*P (4.38)*	*4.10*	*< 0.05*

Table 3.5 showing t values for the mismatches for Performer 4.

MISMATCH			
Sound	*Vision*	*t value*	*p value. (for 20 d.f)*
E (5.60)	*D (1.71)*	*8.95*	*< 0.01*
D (2.90)	*E (5.00)*	*7.08*	*< 0.01*
P (5.00)	*D (1.42)*	*4.89*	*< 0.05*
D (1.80)	*D (1.67)*	*0.08*	*N.S*

The t-tests illustrate that for performers 1, 3, and 4, observers extract very different information about S and V when mismatched. The single exception to these three performers' results is the non-significant result for performer 4 when S=D and V=D, showing that there is no statistical difference between the scores awarded to S and V modalities which belong to the same original deadpan excerpt. The result suggests that in the case of performer 4, observers were able to detect the matched S and V manners. However, in the case of performer 1, the perceived difference between the asynchronised but same projected manner S and V suggests that performance manner cannot always be accurately judged in the two modalities separately by the observers. One possible explanation for this result is that observers find performer 1's playing difficult to assess, so that when the observers rate mismatch presentations, the tendency is to score the modalities differently. Indeed, support for this suggestion can be found in the two-way interaction of performer by manner from the first half of the experiment which reveals that there is little difference between the scores awarded to performer 1 across manner. However, this result also underscores a weakness in the experiment - it would have been interesting to include more same manner performances to explore whether matched manners could be detected irrespective of individual differences.

Similarly, the results for performer 2 show that observers cannot reliably detect the different S and V modalities when the mismatch is S=D and V=P, and also when S=P and V=D, though there seems to be no obvious reason why this is the case for this performer.

One way to get a further understanding of the mismatched judgements is to compare each component of the mismatch with the score given to that component when presented in isolation. This additional test should also verify whether the scores awarded to the mismatch modalities of sound and vision differ from the observers' ratings for non-mismatched performances.

Note that in the following tables the two central columns show the mean scores for each S and V modality of the mismatch. The column to the far left shows the mean score for the S only mode and the column to the right shows the V only mode. The t-test results applies to the comparison of: the S component of the mismatch with the equivalent S only score in the far left column; and the vision component of the mismatch with the equivalent V only score in the far right column. N.S = Not Significant, D = Deadpan, P = Projected and E = Exaggerated, S = Sound and V = Vision, and the bracketed numbers in the modality columns indicate mean scores.

Table 3.6 showing the t-test results between sound only mode and sound modality of the mismatch and vision only mode and vision modality of the mismatch for performer 1.

SOUND ONLY	*t-test result*	*MISMATCHES SOUND*	*MISMATCHES VISION*	*t-test result*	*VISION ONLY*
P(3.66)	*t(20) = 1.76 N.S*	*P(4.40)*	*D(2.26)*	*t(20) = 0.48 N.S*	*D(3.20)*
E(3.88)	*t(20) = 1.25 N.S*	*E(4.52)*	*P(3.30)*	*t(20) = 3.74 p <0.05*	*P(3.80)*
P(3.66)	*t(20) = 1.78 N.S*	*P(4.20)*	*P(3.30)*	*t(20) = 4.62 p <0.01*	*P(3.80)*

Table 3.7 showing the t-test results between sound only mode and sound modality of the mismatch and vision only mode and vision modality of the mismatch for performer 2.

SOUND ONLY	*t-test result*	*MISMATCHES SOUND*	*MISMATCHES VISION*	*t-test result*	*VISION ONLY*
D(3.10)	*t(20) = 2.16 p<0.05*	*D(2.00)*	*E(3.00)*	*t(20) = 7.88 p<0.01*	*E(5.05)*
D(3.10)	*t(20) = 0.75 N.S*	*D(3.30)*	*P(3.39)*	*t(20) = 0.82 N.S*	*P(3.71)*
P(4.29)	*t(20) = 0.67 N.S*	*P(4.04)*	*D(4.04)*	*t(20) = 7.65 p<0.01*	*D(2.29)*

Table 3.8 showing the t-test results between sound only mode and sound modality of the mismatch and vision only mode and vision modality of the mismatch for performer 3.

SOUND ONLY	t-test result	MISMATCHES SOUND	MISMATCHES VISION	t-test result	VISION ONLY
E(3.14)	t(20) = 1.25 N.S	E(3.76)	D(1.38)	t(20) = 0.28 N.S	D(1.39)
P(3.66)	t(20) = 0.23 N.S	P(3.60)	D(1.48)	t(20) = 0.49 N.S	D(1.39)
D(2.19)	t(20) = 3.86 p<0.05	D(3.23)	E(4.38)	t(20) = 1.48 N.S	E(4.62)

Table 3.9 showing the t-test results between sound only mode and sound modality of the mismatch and vision only mode and vision modality of the mismatch for performer 4.

SOUND ONLY	t-test result	MISMATCHES SOUND	MISMATCHES VISION	t-test result	VISION ONLY
E(5.86)	t(20) = 1.05 N.S	E(5.60)	D(1.71)	t(20) = 0.42 N.S	D(1.38)
D(2.48)	t(20) = 0.75 N.S	D(2.90)	E(5.00)	t(20) = 0.43 N.S	E(5.24)
P(4.46)	t(20) = 1.01 N.S	P(5.00)	D(1.42)	t(20) = 0.37 N.S	D(1.38)
D(2.48)	t(20) = 1.27 N.S	D(1.48)	D(1.67)	t(20) = 1.67 N.S	D(1.38)

The absence of statistical differences in the t-test results for performers 3 and 4 with the S modality of the mismatch with the sound only data, and the V modality of the mismatch with the vision only suggests that mismatching has no effect on the rating of manner in either modality. The only exceptions to these results are performer 3's deadpan sound only when tested against deadpan mismatched sound. Although there is a significant difference between these scores, it is important to note however that the mismatch from which the S component is taken is associated with exaggerated vision and it is therefore possible that the exaggerated vision has increased the deadpan mismatch sound score slightly - thus making it different from the deadpan sound only.

The performer of particular interest is performer 2 whose initial t-test results revealed that there were no significant differences in the observer ratings for the two different stimulus manners of P and D when mismatched. The t-tests reveal that when the mismatch S=D and V=P is tested with the deadpan sound only and projected vision only, there are no differences in their scores. Yet when S=P and V=D are tested with their relevant single modality stimuli, there is no difference between projected sound from the mismatch and sound only, whilst there is a significant difference between deadpan vision from the mismatch and deadpan vision only. Examination of the mean scores reveals that the mismatched vision score has been pulled towards the projected sound score, resulting in the perception of a matched pair. What seems feasible is that one modality is detected as the most expressive in the mismatch and influences the observers' judgements of the other modality, the score being pulled towards the dominant modality. That is to say, the score awarded to V=D is higher than in the V only mode. This pulling effect can, to some extent, account for the significant effects of the t-tests between the first mismatch and the corresponding single vision and sound modes. Although there was a significant difference between the mismatched sound and vision elements in the first t-test results, it seems that in both cases the vision scores are pulled towards the lower score for sound. One possible explanation for this effect could be that when vision only is seen, all the movements of the performance are viewed as containing expressive information. Yet when the vision is mismatched with sound, the movements are treated purely as technical movements, and thus receives a lower score. It could be that in the mismatch one's attention is less focused on either component, the result being a regression towards the mean. It is difficult to know why this should be the case only for performer 2, but it is worth pointing out that this performer remains fairly still throughout her performances, and it could be that the observers pay less attention to her very small movements when sound is also present.

Another possible explanation for the difficulty in distinguishing performer 2's mismatches is perhaps a fault with the method of mismatch asynchronisation. Performer 2's performance timings varied more than the other performers, which meant that large portions (up to 6 seconds) of the longer manners - projected and exaggerated - were deleted in mismatch so that no more than one second of a single modality remained. It is possible, therefore, that critically important visual information was removed from performer 2's performances. However, it must be noted that the performance most affected by deletion was exaggerated manner, which was nonetheless given a similar rating in mismatch to its rating for single mode observation.

Ambiguity produced by mismatching can clearly be found in performer 1's result in which a statistical difference is found between the single stimulus projected vision ratings and the visual component of the asynchronised projected S and V modalities. In essence, this result suggests that the same expressive information is not detected in the mismatch. The mean scores demonstrate that in asynchrony, vision becomes more expressive than when observed as a single modality. This result also shows that the asynchrony seems to detrimentally affect the detection of intention. Indeed, when projected is rated in matched S&V the mean score is 2.31. However, the differences found between the asynchronised projected vision and the single V and matched S&V projected data provide an explanation for why in mismatch the projected scores for performer 1 are different. In the discrepancies between their rating levels, these results reflect the fact that observers detect information about performer 1 in an ambiguous way, or rather that performer 1 conveys ambiguous perceptual information to the observers.

Performer 4's non-significant result for the asynchronised same deadpan S and V placed in mismatch and tested with the scores collected from the single stimulus sources of the deadpan S only and V only confirms that the same expressive manners can be identified even when the modalities are asynchronised.

In summary, these results reveal that observers can consistently rate performance manner irrespective of stimulus modality. However, it is apparent that not all performers' modalities provide useful information when mismatched: besides some performers being detected as more expressive than others, it is evident that some players produce performance manners which are difficult to distinguish in mismatch.

3.3.4 SUMMARIZING DISCUSSION OF POINT-LIGHT STUDY WITH VIOLINISTS

This reformulation of the pilot study has confirmed the basic results, highlighted a number of inherent difficulties in some of the methods used, and most importantly, demonstrated a base from which other avenues of investigation can be explored.

In verification of the pilot results, this study confirms that since point-lights provide kinematic display only, there is sufficient perceptual information contained in movement to reveal differences of manner. Indeed, the V and mismatch results show manner scoring patterns similar to those of S and S&V modes. The pattern of results, in which deadpan scores the lowest rating and exaggerated the highest, illustrates that the directions given to the performers to play in three manners were transformed into differences in their performances and these differences were detected by the observers. This study shows stronger effects of modes than the results of the pilot study. Here, the mode by manner information in the analysis of variance described above illustrates that whilst the pattern for manner is retained, V produces the greatest scoring difference between deadpan and exaggerated scores, and S produces the least difference, with S&V between. This is interesting, for the result suggests that V is a better indicator of manner than either S or S&V, though these differences are small. Since, the overall mismatching results reveal that sound and vision are discriminated according to manner, it seems that each modality has an equally informative expressive potential. This study, like the pilot, confirms therefore that vision is a useful source of perceptual information - as informative as sound.

In terms of methodology, it seems that mismatching is a useful tool, although without some modifications in the technique of presentation, it is rather cumbersome.

An interesting anecdotal addition to this study is the observers' abilities to identify some performers. Such identifications were not possible in the pilot, since the postgraduate musician performers were not known to the observers. These identifications, in line with Cutting and Kozlowski's (1977) work, show that the point-light data used in the experiment were of a comparable standard, and moreover, that even in a specialised non-perambulatory activity like music performance, some performers could be identified.

Another factor which needs attention is the method of wrapping the bands around the body joints. Although Cutting and his co-workers, and Runeson and Frykholm (1983), Scully

(1986) and van Wieringen et al. (1987) all used wrapped ribbons in their studies, it became increasingly apparent through the experiment that the wrapped bands conveyed some 3-dimensional information to the observers. In the succeeding studies, therefore, smaller patches were used so as to result in more purely kinematic information. Finally, although the deadpan-exaggerated response sheet permits differences between the three performance manners to be scaled, it does not indicate what might be causing the observers to differentiate the expressivity levels of the different manners. One way to explore what may be influencing these ratings is to use scales which ask further questions about the qualitative differences between the manners.

3.4 THE SINGLE PERFORMER POINT-LIGHT STUDY

3.4.1 INTRODUCTION

This point-light investigation was undertaken for three main reasons: firstly, to modify several of the methodological details of the former studies; secondly, to see if the single mode (V, S and S&V) results were reproducible using different test stimuli and different observers; and thirdly to explore some of the factors which may indicate qualitative differences between manners. The major modification was to simplify the design by using only one performer and eliminating the mismatch mode.

Qualitative ratings were introduced to begin to explore what factors may make one performance different from another. As discussed in chapter 1 (section 1.6), Gibson and Pick (1963) suggest that different forms of physical behaviour convey different forms of information to the perceiver and that this information can be indicated in the observer's use of adjectives to describe it. Van Wieringen et al. (1987) successfully used bipolar adjective lists to extract information about the qualitative features of dance movements in point-light display.

Many such tests have been developed in an attempt to capture qualitative differences in the study of general personality and more specific individual states. The methodology adopted here relies on a combination of two approaches. The first is intended to generate lists of adjectives suitable to the task, and involves the technique used in Rosenberg and Sedlak's (1972) trait list design. In their work, subjects were asked to describe people they knew in a free way and from the 110 trait categories that were generated, Rosenberg and Sedlak found that only 10 were used with any frequency by the subjects. The principle that only a few major categories are commonly used in *"free"* adjective descriptions suggests that common and comprehensible adjective lists can be devised simply by looking for consensus between different observers' free responses to test stimuli. As the Rosenberg and Sedlak lists were based on observations of many different individuals, it seems likely that in a study which looks at only one performer, there should be less variation in the description. In line with the bipolar scale used in all the former studies (deadpan-exaggerated) it was decided to create bipolar pairs of the adjectives collected. This technique is consistent with Osgood, Suci, and Tannenbaum (1957) semantic differential scales.

Using the semantic differentials created according to the above mentioned techniques, observers rated the point-light performances of a single performer in the three manners and modes of performance.

3.4.2 METHOD

Subjects, Apparatus and Stimuli

34 music students (25 females and 9 males with a mean age

of 23.76 years) from City and Newcastle Universities acted as observers for the study. Two of the students had previously participated in the earlier point-light investigations. The apparatus used for this study were identical to the previous study. On this occasion, the only performer was a student pianist (male, aged 21 years) who played bars 7 to 19 of the *Promenade* from Mussorgsky's **Pictures at an Exhibition.** This excerpt had a duration of approximately 30 seconds which was consistent with the average duration of the excerpts in the previous study. Point-light patches of 8cm x 3cm were attached at the head, shoulders, elbows and wrists, and the pianist was filmed with 3/4 of his body in shot, a preliminary study having revealed that observers felt that a 3/4 length shot was more representative of a concert view of a solo pianist. The mean scores from the collected data indicated that the perceptual information available was equal to that collected from the full point-light displays of the earlier studies. (See video examples 4a-4c which show the performer in all three modes and manners.)

As in the previous study, spotlights were set close to the video camera which was at a distance of approximately three metres from the pianist. Recordings were made of the pianist playing the Mussorgsky excerpt in the three manners of deadpan, projected and exaggerated. These were recorded in such a way that when they were played back in point-light contrast/brightness, only the reflective patches could be seen.

Procedure

The three manners of performance were edited in vision only (V), sound only (S) and sound and vision (S&V) in ten different manner and mode orders so that the test stimuli could be randomised. With ten different orders of test material, each different mode and manner order was viewed by approximately three observers. The observers undertook the test individually, watching one of the random order videos on a prepared point-light monitor which was set at a distance of 1.5 metres from them. Nine excerpts were observed (three manners in three modes) with pauses of 45 seconds between each excerpt to allow the performers to respond to the differential scales. These were:

INEXPRESSIVE	1	2	3	4	5	6	7	HIGHLY EXPRESSIVE
CONTROLLED	1	2	3	4	5	6	7	WILD
SMOOTH	1	2	3	4	5	6	7	JERKY
DAINTY	1	2	3	4	5	6	7	CLUMSY
SLOW	1	2	3	4	5	6	7	FAST

These differentials were compiled by selecting words common to adjective lists created by two professional orchestral players who had previously given descriptions of the qualities of the sound and appearance of the Mussorgsky excerpts. There were thirteen words common to the lists (one list included twenty seven adjectives, the other thirty four), but only eight of these words could function as differential pairs. To these four bipolar scales was added the fifth inexpressive-highly expressive scale, intended to be equivalent to the deadpan, projected, and exaggerated instructions given to the performer. The test took approximately fifteen minutes.

3.4.3 RESULTS

Possible differences between the data are examined in a 3 (mode - V, S, S&V) X 3 (manners - deadpan, projected, exaggerated) repeated measures analysis of variance for each of the differential pairs.

The analysis for the inexpressive-highly expressive differential reveals main effects for both mode [$F(2,66) = 4.43$, $p < 0.01$] and manner [$F(2, 33) = 200.57$, $p < 0.0001$]. A Tukey post hoc test reveals that for mode there is only a weakly significant difference between S&V and S only ($p < 0.05$). Figure 3.15 shows the mean scores for mode. A Tukey post hoc test for manner reveals that all three manners are significantly different from each other ($p < 0.01$) (see Figure 3.16).

Thus, the analysis reveals that ratings on an inexpressive-highly expressive scale receive a pattern of results similar to those of the earlier studies for both mode and manner (compare with figures 3.9 and 3.10).

The analysis also shows a two-way mode X manner interaction [$F(4,66) = 3.046$, $p <0.01$]. Tukey tests reveal that there are no significant differences between modes in deadpan manner or modes in exaggerated manner, but a significant difference between projected S and both projected V and projected S&V ($p < 0.01$). All manners and modes are different from each other ($p < 0.01$) with the exception of projected S and all the mode scores in exaggerated manner, where there are no significant differences. As figure 3.17, which shows the means scores, demonstrates, it seems that the interaction is mainly the result of sound mode in the projected manner. The observers have rated it to be significantly more expressive than the other two modes, to the extent that it is indistinguishable from exaggerated manner.

The controlled-wild scale gives highly significant results for the main effects for mode [$F(2,66) = 12.77$, $p < 0.0001$] and manner [$F(2,33) = 23.93$, $p < 0.0001$]. In Tukey tests for mode, S is significantly different from S&V, and V is significantly different from S ($p < 0.01$). However, S&V and V are not significantly different. If the mean scores are examined (figure 3.18) it is evident that S receives slightly higher ratings which suggest that for this mode the performances are perceived to be less controlled than in the other modes. This could mean that when a performer is seen the performance may seem reasonable, but when it is only heard it may be perceived to be less reasonable. Tukey post hoc tests for manner reveal that deadpan and exaggerated manners are different from each other ($p < 0.01$), as are projected and exaggerated ($p < 0.01$); but that there is no difference between deadpan and projected manners. Figure 3.19 shows the mean scores.

The mode X manner interaction is not significant [$F (4,66) = 2.05$, $p > 0.05$].

Comparisons of figures 3.15 and 3.16 with figures 3.18 and 3.19 shows that the controlled-wild scale is used in a more conservative way (ranging from 2.6 to 4.2) than is the inexpressive-highly expressive scale which ranges from 1.5 to 5.8. This may indicate either that the scale is less meaningful or that control is more commonly shared between manners than is expressivity.

The results for the smooth-jerky scale show that there are significant main effects for manner [$F(2,33) = 6.2$, $p < 0.003$], but not for mode [$F(2,66) = 2.24$, $p > 0.05$]. Tukey tests for manner reveal that there is a significant difference between projected and exaggerated manner scores ($p < 0.01$), but no difference between deadpan and projected or deadpan and exaggerated manners. Figure 3.20 shows the mean scores for manner, and indicates that projected manner receives a slightly lower score, suggesting that projected manner performances are slightly smoother than deadpan or exaggerated manners. Although the range of these scores is fairly constrained, this result suggests that smoothness in performance is rather more associated with the manner which reflects a normal concert performance. It is possible that the similar scores for

Figure 3.15 The mean scores main effect of MODE for the Inexpressive-Highly Expressive differential rating

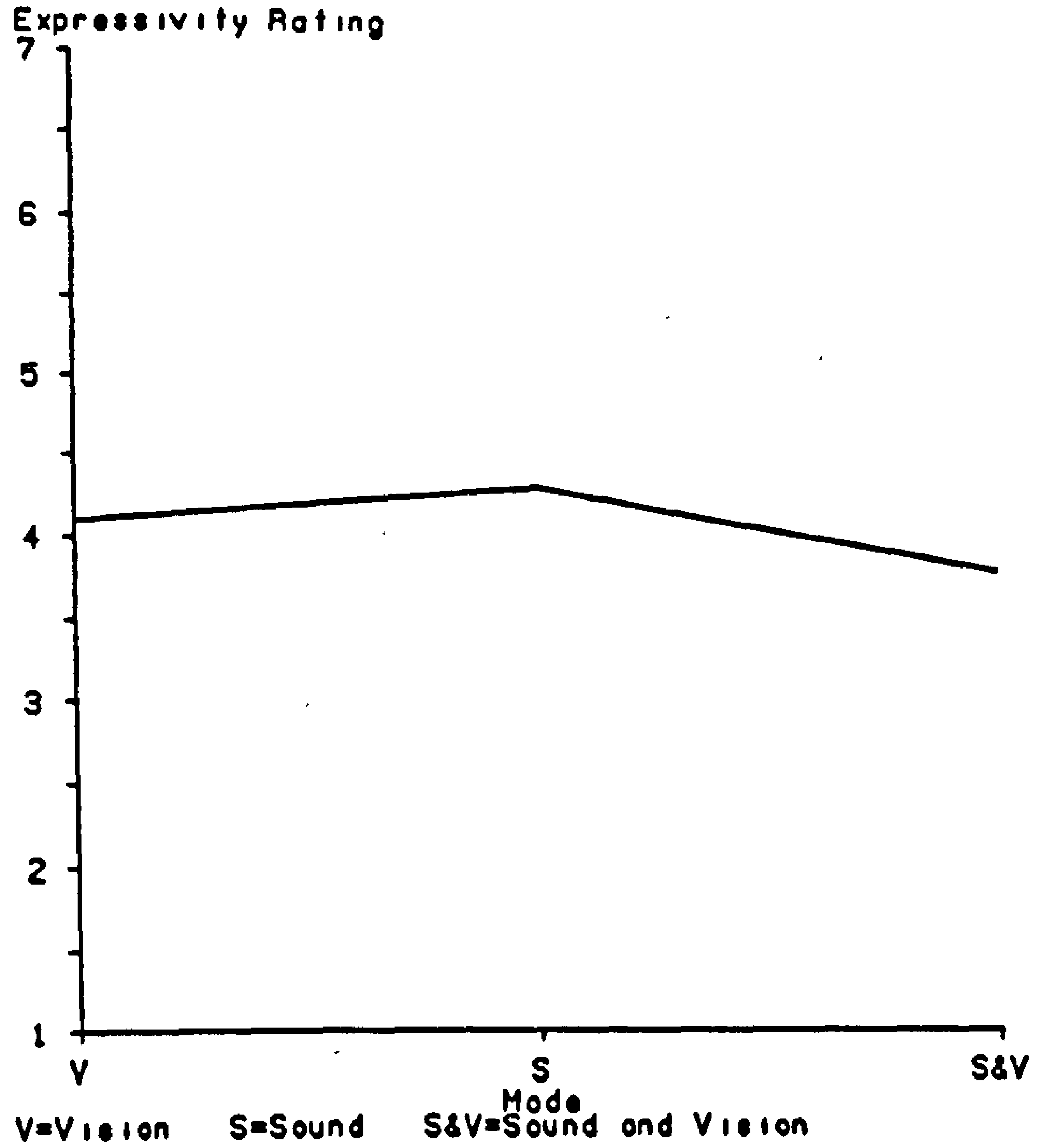


Figure 3.16 The mean scores main effect of MANNER for the Inexpressive-Highly Expressive differential scale

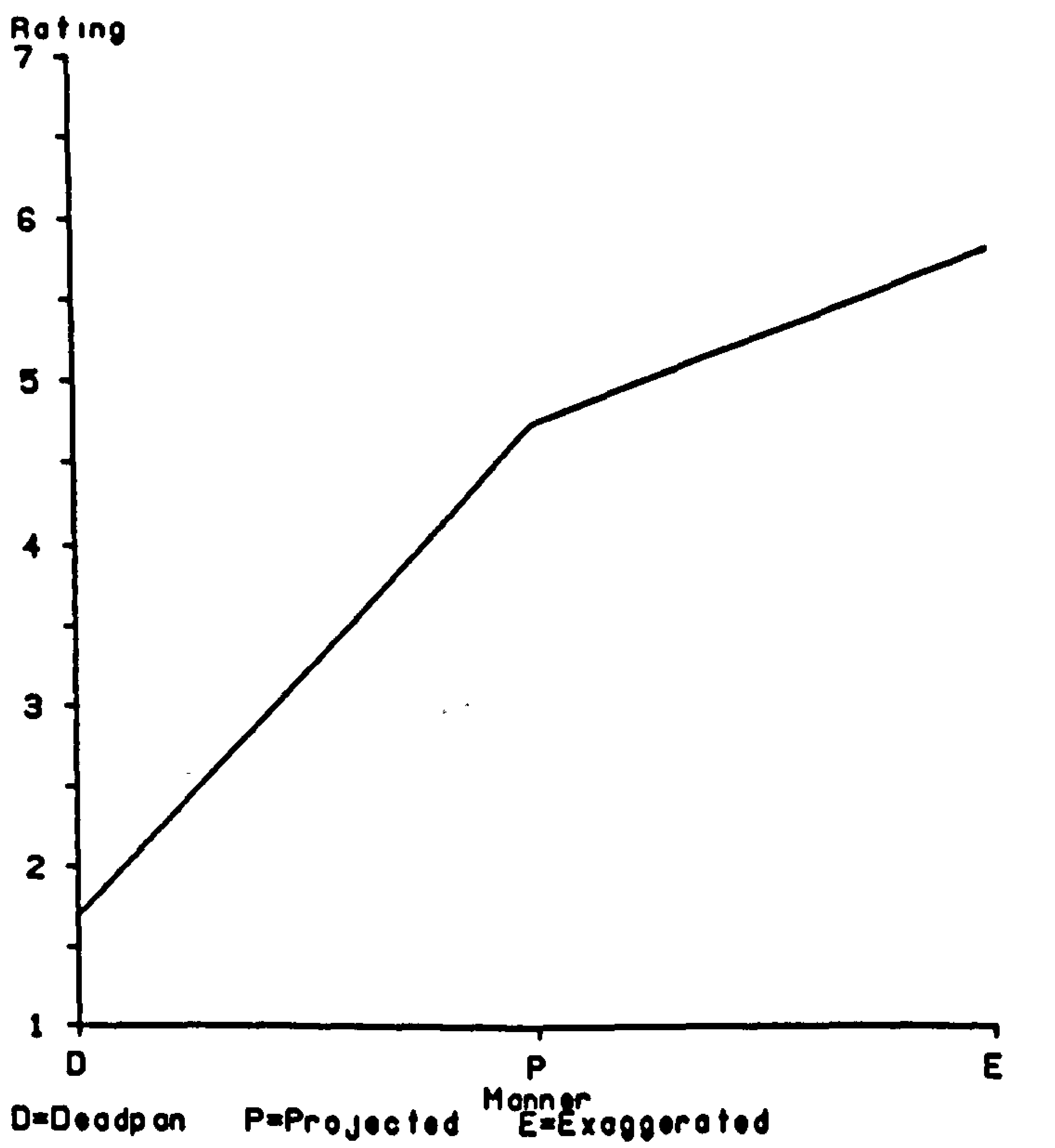


Figure 3.17 The mean scores two-way interactive effects of MODE by MANNER for the Inexpressive-Highly Expressive differential rating

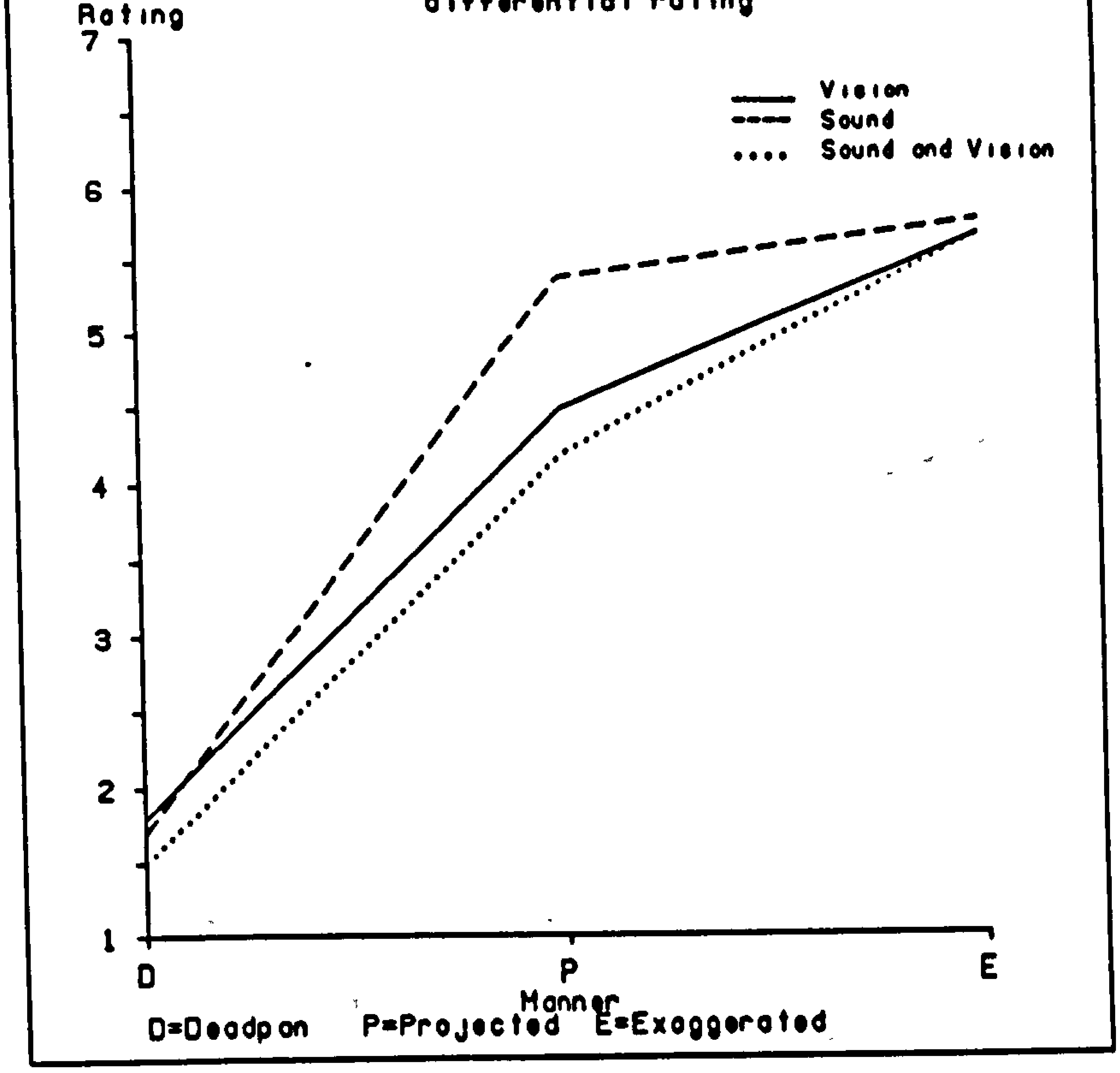
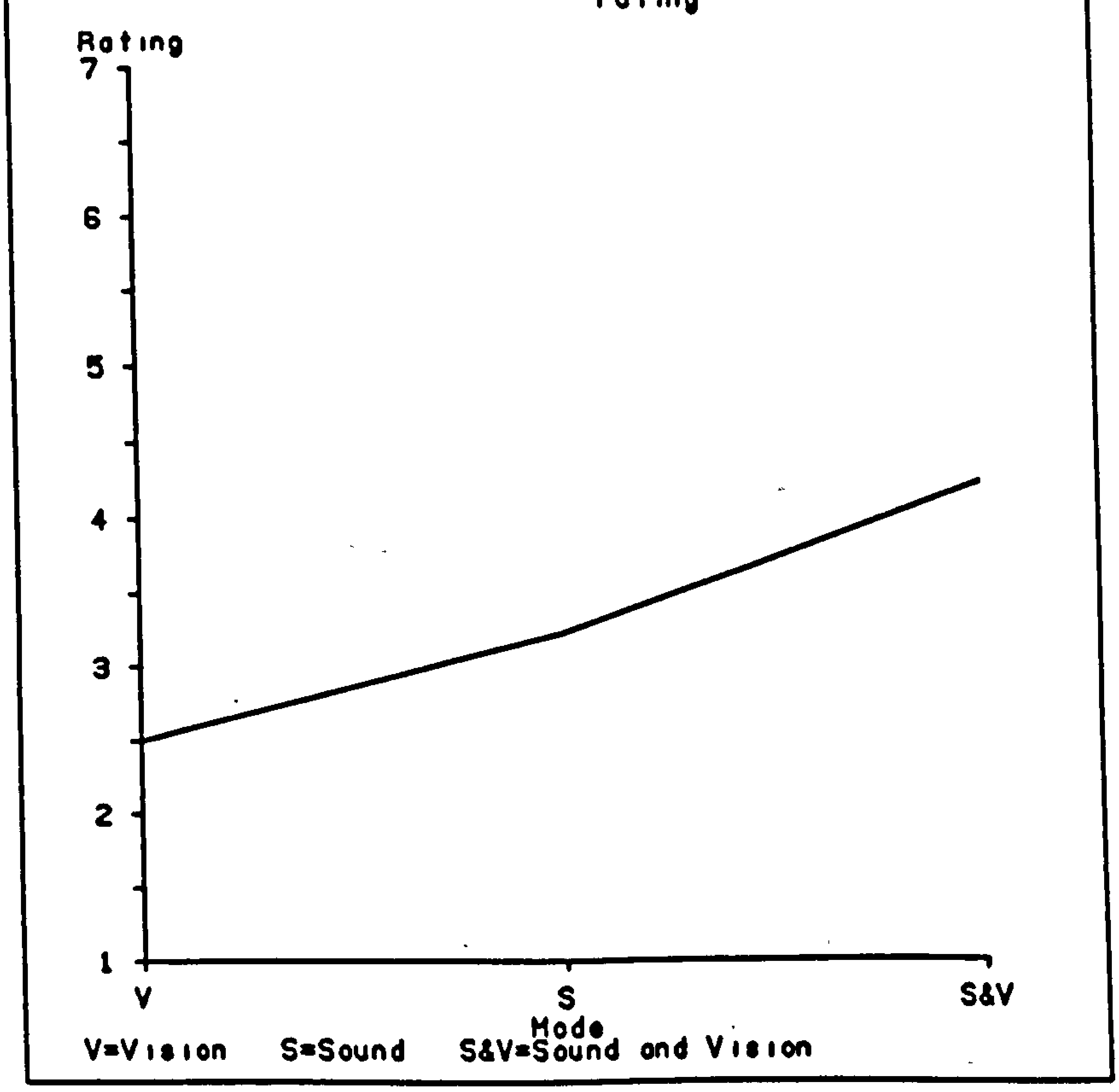


Figure 3.18 The mean scores main effect of MODE for the Controlled-Wild differential rating



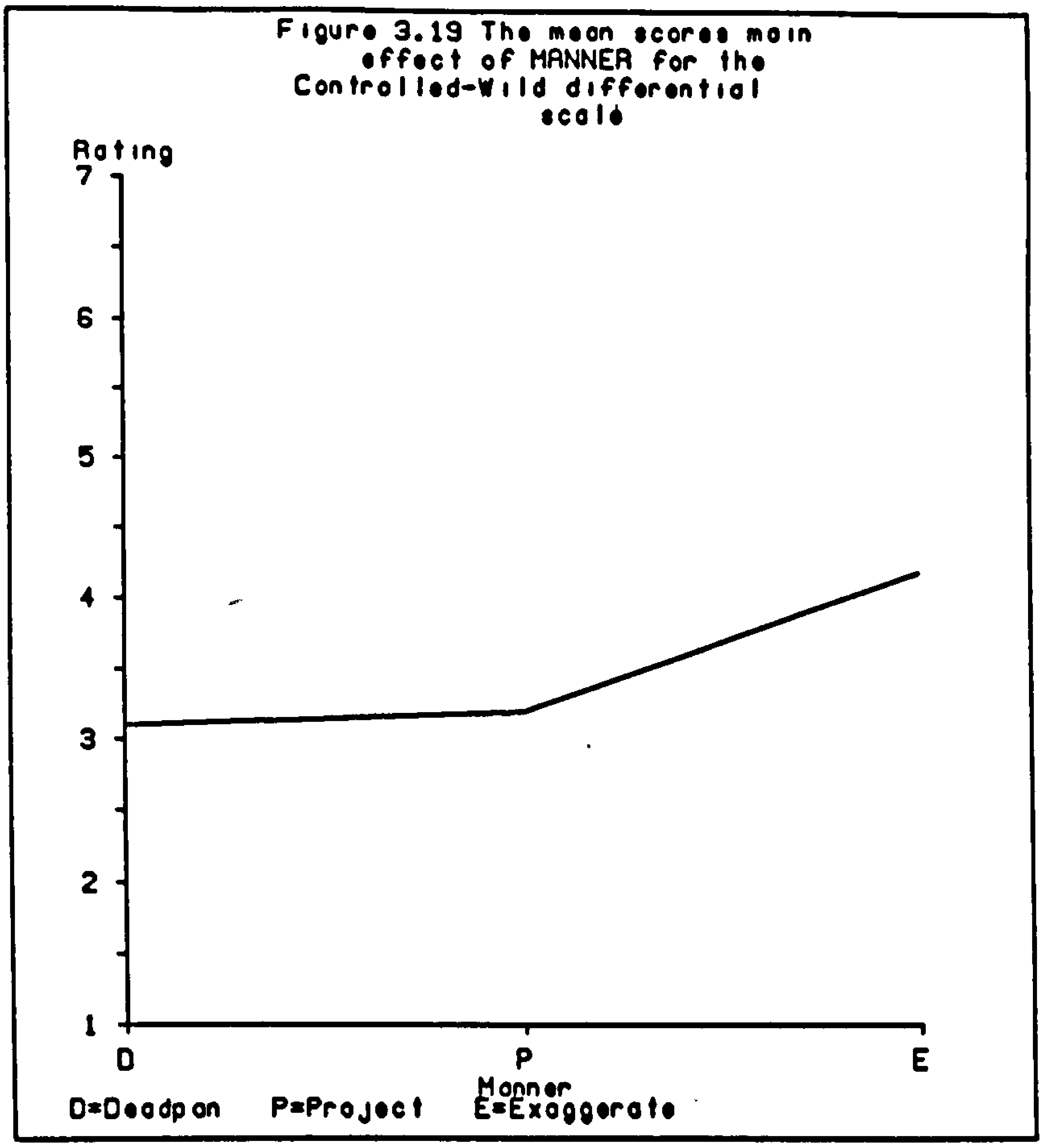


Figure 3.19 The mean scores main effect of MANNER for the Controlled-Wild differential scale
Rating
7
6
5
4
3
2
1
D
P
E
Manner
D=Deadpan P=Project E=Exaggerate

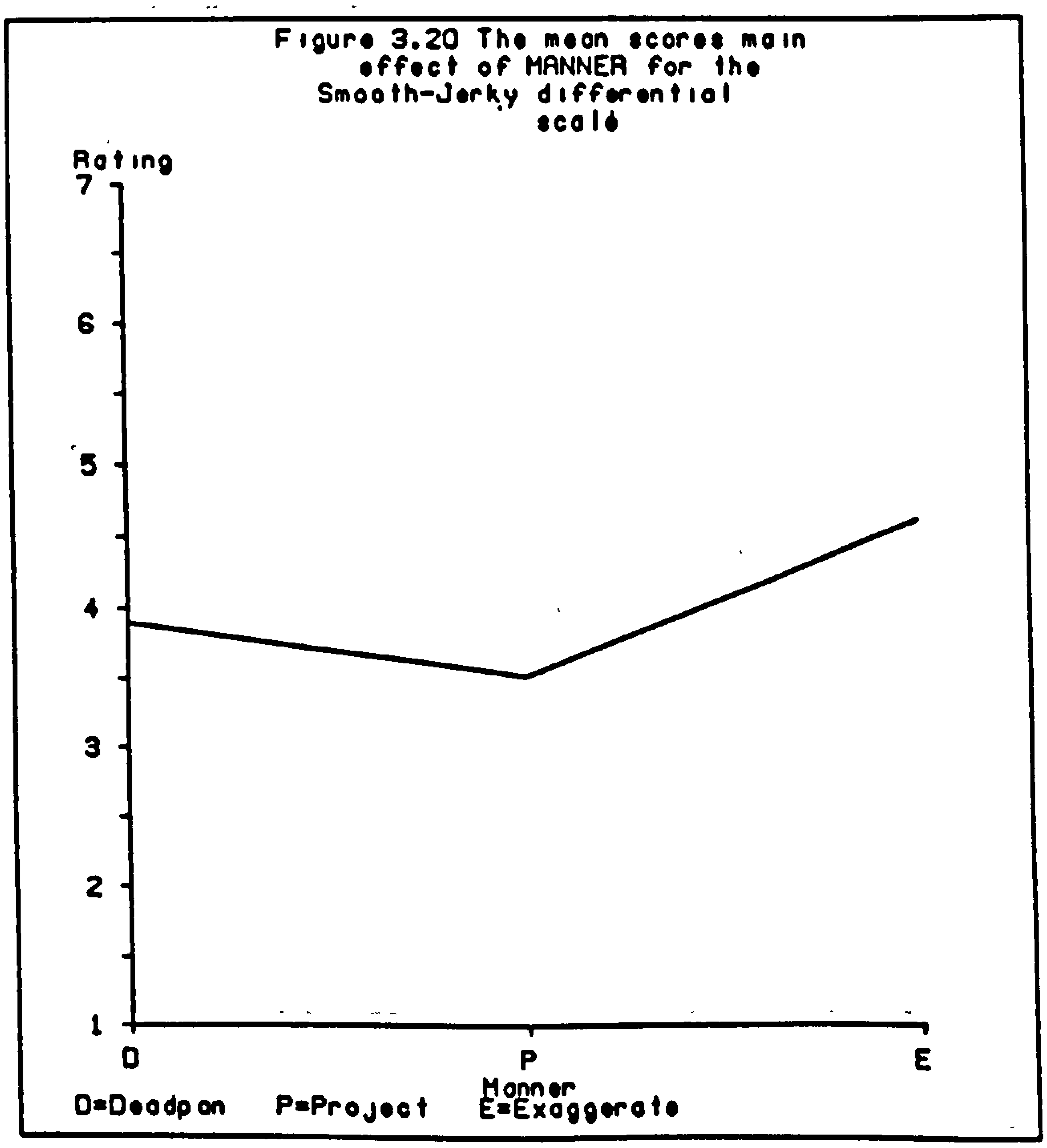


Figure 3.20 The mean scores main effect of MANNER for the Smooth-Jerky differential scale
Rating
7
6
5
4
3
2
1
D
P
E
Manner
D=Deadpan P=Project E=Exaggerate

Figure 3.21 The mean scores main effect of MODE for the Dainty-Clumsy differential rating

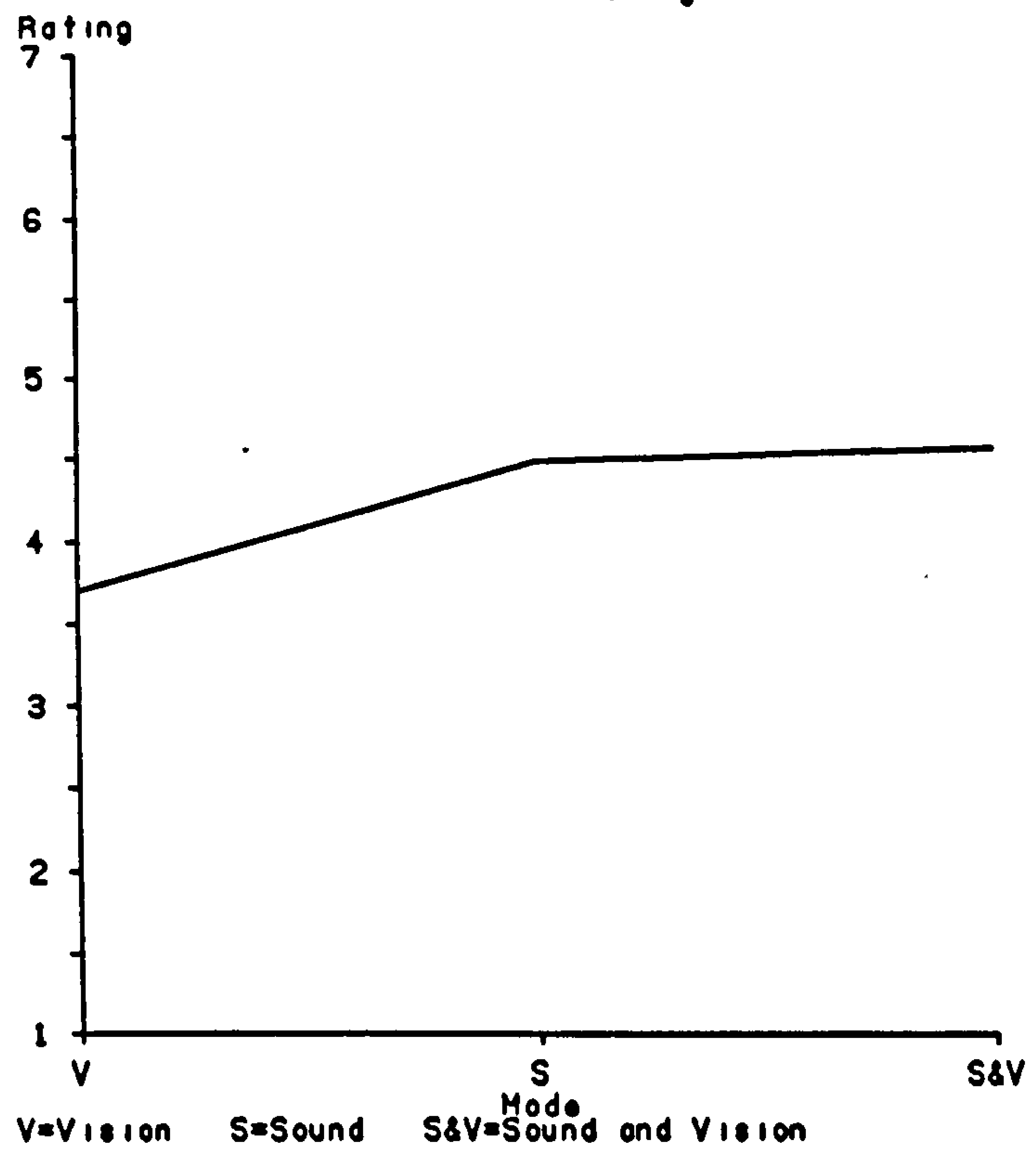
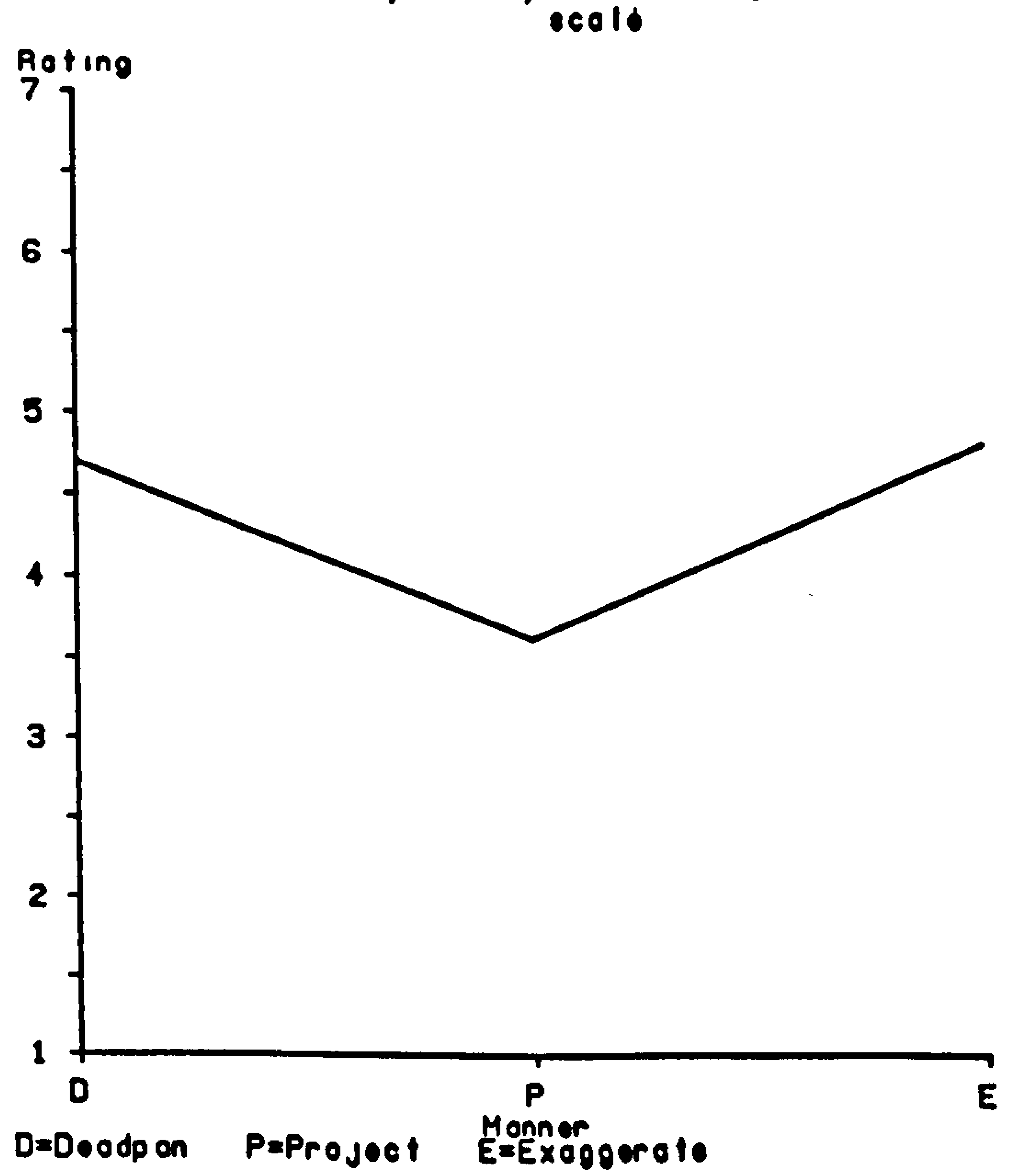


Figure 3.22 The mean scores main effect of MANNER for the Dainty-Clumsy differential scale



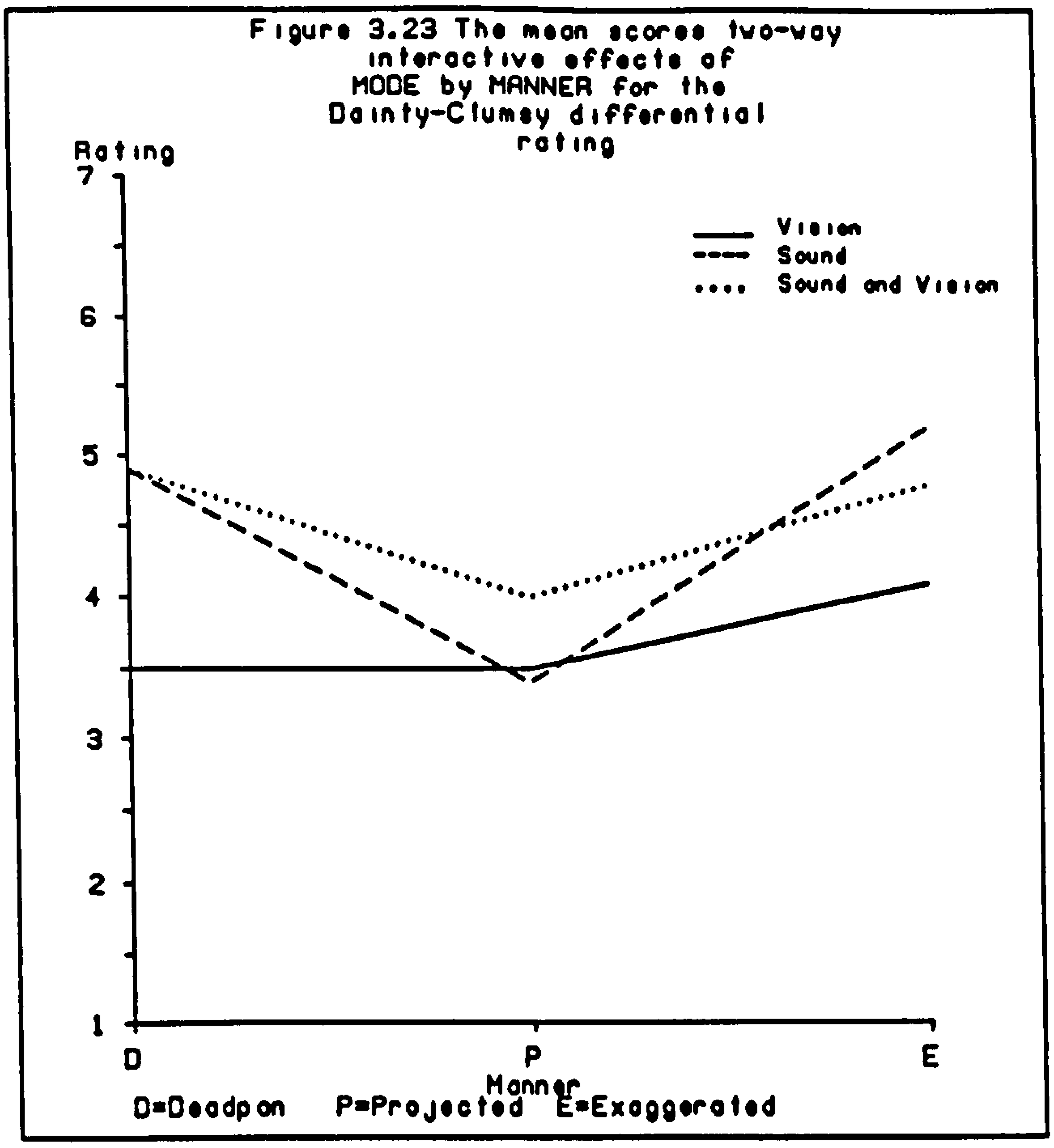


Figure 3.23 The mean scores two-way interactive effects of MODE by MANNER for the Dainty-Clumsy differential rating
Rating
7
6
5
4
3
2
1
Vision
Sound
Sound and Vision
D
P
E
Manner
D=Deadpan P=Projected E=Exaggerated

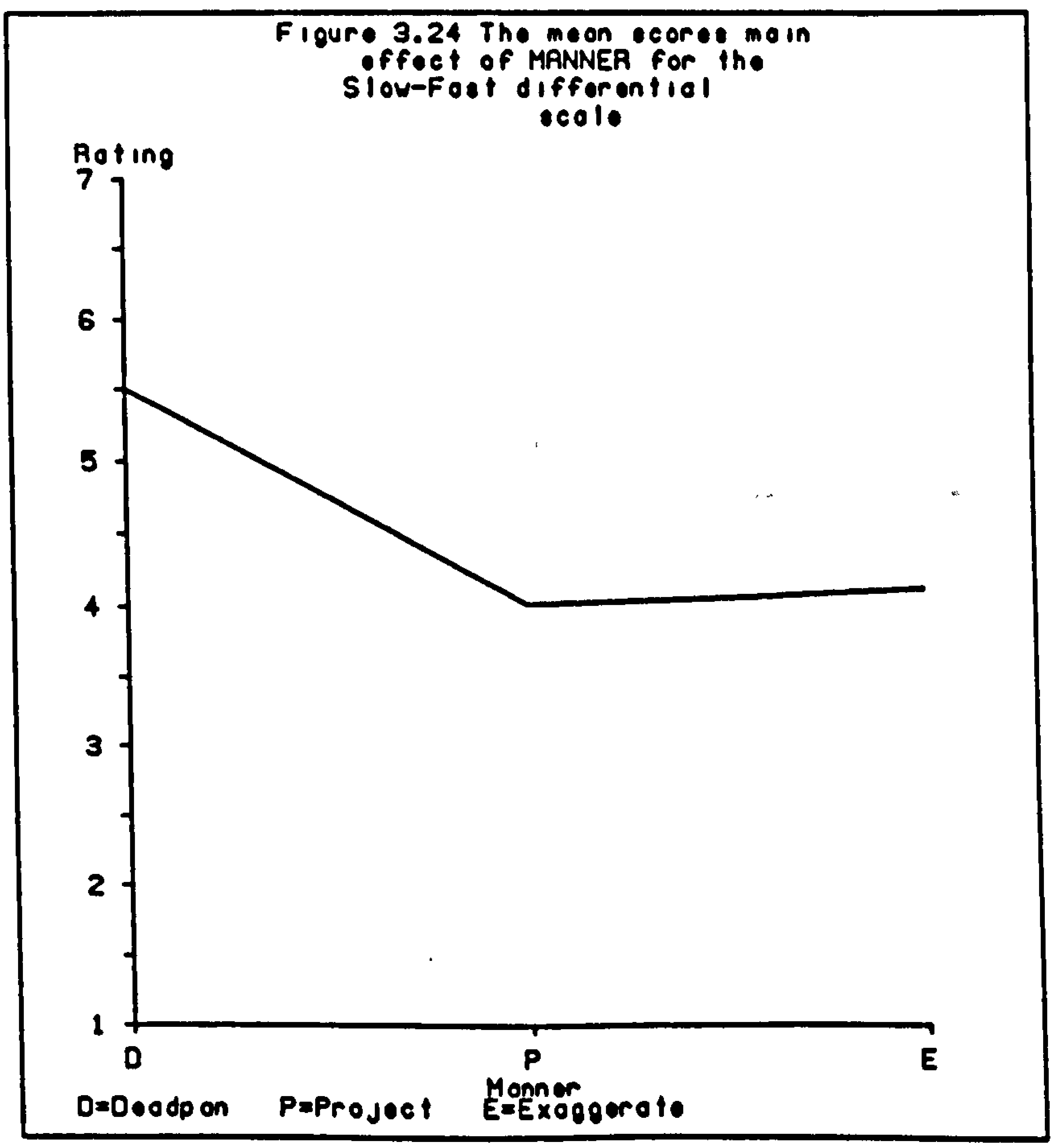


Figure 3.24 The mean scores main effect of MANNER for the Slow-Fast differential scale
Rating
7
6
5
4
3
2
1
D
P
E
Manner
D=Deadpan P=Project E=Exaggerate

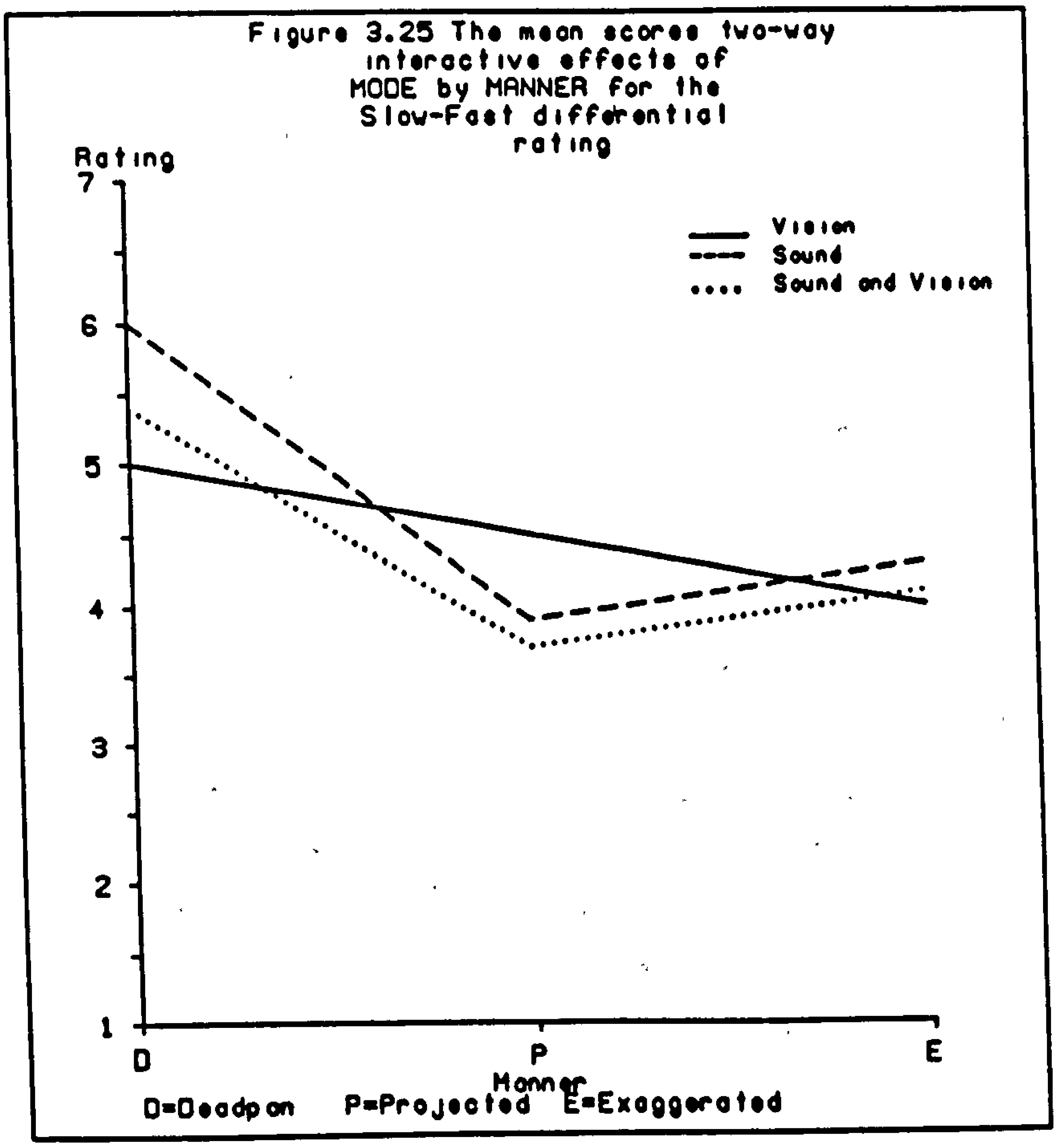


Figure 3.25 The mean scores two-way interactive effects of MODE by MANNER for the Slow-Fast differential rating
Rating
7
6
5
4
3
2
1
Vision
Sound
Sound and Vision
D
P
E
Manner
D=Deadpan P=Projected E=Exaggerated

jerkiness awarded to deadpan manner and exaggerated manner reflect different perceptions of jerkiness: it could be that constraint is the characteristic of the jerkiness of playing in a deadpan manner, whereas overexaggeration could be the characteristic of the jerkiness of the exaggerated manner.

There is no interaction between mode and manner [$F(4,66) = 1.14$, $p > 0.05$].

The results for the dainty-clumsy scale show significant main effects for mode [$F(2,66) = 12.94$, $p < 0.0001$] and manner [$F(2,33) = 13.66$, $p < 0.0001$]. Tukey tests for mode reveal that S is different from V ($p < 0.01$) and S&V is different from V ($p < 0.01$); however, S is not different from S&V. Figure 3.21, which shows the mean scores for mode, reveals that V does in fact receive slightly lower scores than the other modes. This suggests that in V mode the performances are perceived to be more dainty. This could be the result of the V giving a slightly false impression about the content of what is being played. It could be that the sound is necessary in order to provide accurate details about the style of music being produced. Tukey post hoc tests for manner reveal that deadpan is significantly different from projected ($p < 0.01$) and that exaggerated is significantly different from projected manner ($p < 0.01$); however, there is no difference between deadpan and exaggerated manners. Figure 3.22, which shows the mean scores for manner shows that projected manner does in fact receive slightly lower ratings which suggests that projected manner is perceived to be more dainty than either of the other manners. This result may indicate that daintiness is a feature of the real performance, and that clumsiness could be associated with the less realistic deadpan and exaggerated performances. The similarity between the deadpan and the exaggerated manner scores might reflect perceptions of different types of clumsiness, as with jerkiness.

The mode X manner analysis shows a significant interaction $F(4,66) = 3.94$, $p < 0.004$. Tukey tests show that projected manner in V mode is different from: deadpan S, deadpan S&V, exaggerated S and exaggerated S&V (all at $p < 0.01$). Projected manner in S mode is different from: deadpan S, deadpan S&V, exaggerated S and exaggerated S&V ($p < 0.01$). Deadpan V is different from: exaggerated S&V, exaggerated S, deadpan S and deadpan S&V ($p < 0.01$). All the other possible differences are not significant. Figure 3.23 shows the mean scores for the interaction. If this is examined in regard to the significant differences, it is apparent that in V only, deadpan and exaggerated manner ratings are far lower than in the other modes. These results indicate that visual information leads performances to be perceived as more dainty (or less clumsy) than either S or S&V in deadpan and projected manners. Finally, it is important to note that there is no significant result between the vision only scores across manner, suggesting that all manners provide similar levels of daintiness. One way to account for this latter result is to suggest that the observers are denied some important information about the element of clumsiness in V. The consistency across manners could be the result of a lack of information about the whole dynamic of the performance. It could be that the movements are perceived to be technical and thus neutral with respect to an evaluation like dainty-clumsy in the absence of sound.

Finally, the results for the fast-slow scale show that there is a significant main effect for manner [$F(2,33) = 34.95$, $p < 0.0001$], but there is no significant result for mode [$F(2,66) = 1.34$, $p > 0.05$]. Tukey tests for manner reveal a difference between deadpan and projected manners ($p < 0.01$) and deadpan and exaggerated manners ($p < 0.01$), but there is no difference between projected and exaggerated manners. Figure 3.24 shows the mean scores for manner and reveals that deadpan manner receives the highest score (that is, it is perceived as quickest) and that there is barely any difference between the scores for projected and exaggerated manners. This result simply reflects the fact that the performances were in fact different speeds.

There is a significant interaction for mode X manner [$F(4,66) = 4.314$, $p < 0.002$]. Tukey tests reveal that there are significant differences between projected S&V and deadpan V, deadpan S and deadpan S&V. Projected S is different from: deadpan V, deadpan S and deadpan S&V; whilst projected V differs from deadpan S. Exaggerated V is different from: deadpan S&V and deadpan S; whilst exaggerated S&V is different from: deadpan S&V and deadpan S. (All these differences are at the $p < 0.01$ level.) All other possible differences are not significant. Figure 3.25 shows the mean scores for the interaction and indicates that the vision only scores seem to cause the interaction, since there is little difference between the vision scores across manner. Once again, it seems that vision only may be a mode from which it is somewhat difficult to extract all the details of the performance. Indeed, here there is a weaker sense of time perception than in either S only or S&V mode.

3.4.4 SUMMARY AND DISCUSSION

The manner effects show basically that each manner has its own set of features which distinguish it. Indeed, deadpan manner, besides being the least expressive manner, is shown to be the most controlled and the fastest of the three manners, whilst it is slightly more clumsy than dainty and slightly more jerky than smooth. Exaggerated manner, besides being the most highly expressive, is the most wild and jerky manner, and is perceived to be slightly more clumsy than dainty and to be of a medium speed. Projected manner which receives a rating for expressivity which is nearer exaggerated than deadpan, is the most smooth and dainty of the manners. It is more controlled than wild and is of a perceived speed similar to that of exaggerated manner.

Evidently all these descriptors contribute towards a unified perception of each manner. Each manner was performed with a specific expressive intention and this intention was correctly detected (reflected in the observers' inexpressive-highly expressive ratings). The extra differentials provide important additional information to characterise the more qualitative aspects of the different manners. They indicate qualities of both sound and body movement which may provide specific information about each manner. For instance, a clumsy body movement or a clumsy sound may elicit a deadpan performance rating, though more needs to be known about each of these features before firmer conclusions can be drawn.

The results reflecting mode are more complex than those for manner. Indeed, the slight difference between the inexpressive-highly expressive differential for sound only, accounted for in detail in the mode X manner interaction shows that projected and exaggerated manners are rated similarly and suggests that once this performer plays with expression listeners find it difficult to differentiate between the levels of expression. Since the other two modes differentiate between projected and exaggerated manners with similar scores, the findings suggest that vision provides information in either V or S&V mode which permits projected and exaggerated manners to be distinguished. This suggests that vision is a more obvious source of information about expressivity. However, in the controlled-wild differential, as there is no difference between the V and S&V modes, but a difference between S and the other two modes, it seems that vision either alone or in combination with sound has a moderating effect on the rating of the wildness of the music. In the mode differences for the dainty-clumsy differential, it seems that sound is necessary in association with vision or alone to permit the observers to differentiate between levels of daintiness or clumsiness. The results that there are no differences between modes for the smooth-jerky differential and the slow-fast differential suggest that for these differentials all modes are equally informative. Thus, although these results show that in certain differential pairs one source of information may be slightly more effective than another, overall, they reveal, as in the earlier studies, that all three modes are useful perceptual sources.

Since the principal interest of this thesis is body movement, it seems that the most important first step towards finding out more about the information which provides the observers with perceptual detail rests in pursuing quantitative research on the movements. Indeed, it is feasible that a qualitative feature like daintiness may have something to do with the sizes of the movements in the different manners. It would be important, therefore, to find out which parts of the whole point-light display can be used most effectively for measurement. Cutting, Proffitt and Kozlowski (1978) revealed that the invariant for gender was spread across the entire kinematic display, so that any joint should provide adequate information. However, Winold et al. (1990) found that in the measurement of produced movements in cello playing the shoulder was of no use for it moved in a very different way from the rest of the arm. It is evident that the kinematic patterns for piano performance are so different from those of walking that if a centre of moment exists of the kind identified by Cutting, Proffitt and Kozlowski, it is likely to be differently located. A study based on the systematic point-light reduction that Cutting, Proffitt and Kozlowski (1978) undertook might therefore serve the double purpose of indicating which points are most informative for measurement, and at the same time go some way to identifying any centre of moment that may exist.

3.5 POINT-LIGHT REDUCTION STUDY

3.5.1 INTRODUCTION

Cutting, Proffitt and Kozlowski's (1978) approach to discovering whether all joints provide equally useful information was undertaken by using point-light reductions: working from the full set of joint patches, various combinations and reductions of numbers of patches were used as stimulus material for observers. For this study, the pianist's full set of point-lights was limited to the upper body. Left elbow and shoulder patches were also eliminated for the simple reason that in a right-profile performing position a pianist's left shoulder and elbow cannot be seen. However even with this modified point-light display, not all combinations of the patches on the head, right shoulder and elbow and wrists were presented in the reductions. It was essential to record stimulus material on the same day so that there would be as little difference between the performances as possible, and it was also important to maintain the pianist's concentration during the recordings. Understandably, the performer believed that he could not sustain his concentration through sixteen patch combinations (all the feasible reductions) for each manner. (Given the appropriate technology, an ideal method would have been to record a single performance of each manner with illuminated dot additions edited in afterwards.)

The choice of the original "*all patches*" and six combinations and reductions was based on the fact that the performer only felt able to give twenty performances of the excerpt, and beyond that he lost concentration (hence: all patches and six other combinations in three different manners meant 21 performances).

There was additional concern about the performer's ability manner. Other research (for example, Shaffer, 1984) has shown that expressive changes are reproducible across many performances of the same piece, and on this basis it was anticipated that once each manner was established, the seven renditions of each manner would be fairly consistent.

In this study only the inexpressive-highly expressive response scale was used since the primary aim of the experiment was to get information about which area of the body was most informative.

3.5.2 METHOD

Subjects

Fifteen postgraduate music students at City University (8 male and 7 female with a mean age of 23.91 years) volunteered as observers. None had participated in any of the other point-light studies.

Apparatus and Stimuli

Recording, lighting, point-light methods and play-back equipment identical to those of the previous studies were used. The *"all patches"* and different patch reduction combinations were all played in the three performance manners (deadpan, projected and exaggerated). The performer played all the band reduction combinations in projected manner first, then all the reduction combinations for deadpan, and finally exaggerated manner. A recording of the six combinations of reflective patches in all three manners and the original *"all patches"* of the previous study was created. All the recordings were in vision only. The combinations on video were:

1) All patches - the combination of head, right shoulder, right elbow and wrists.
2) All patches except elbow.

3) Head and wrists.
4) Wrists only.
5) Head only.
6) Elbow only.
7) Shoulder only.

A selection of these seven patch combinations, in the different performing manners, can be viewed on video examples 5a-5g. The 21 excerpts (three manners each with seven patch combinations) were then edited onto three videos, with seven excerpts per video (random mixes of manner and patch combination) so that the six possible combinations of the three videos could be shown to approximately equal numbers of observers. Three practice trials were also prepared, consisting of a deadpan excerpt with patches on the head and wrists, an exaggerated excerpt with the head patch only, and a projected manner with all patches.

Procedure

As in the previous investigations, subjects observed the videos individually, sitting about 1.5 metres from the point-light monitor. Prior to the test, the observers were shown the seven-point expressivity scale (inexpressive to highly expressive) and were told that the experiment was concerned with the identification of the regions of the body used to convey different expressive performance intentions. They were told that they would see a solo pianist perform in different manners, wearing different combinations of point-lights. They were not informed about the specific manners of performances. After viewing the practice trials, the observers saw the experimental sequences which ran continuously on the prepared monitor. The mean duration for an excerpt was 28.7 seconds, and the mean duration for a test video was 7 minutes, since there was a five second blanking placed between each excerpt. The entire test (including practice trials) lasted approximately 28 minutes.

3.5.3 RESULTS AND DISCUSSION

The possible differences in the visual stimuli were examined in a 3 (manner) X 7 (patches) analysis of variance with repeated measures.

The analyses revealed a main effect of manner [$F(2,28) = 122.84$, $p < 0.0001$]. The mean scores shown in figure 3.26 demonstrate that deadpan performances receive lower expressivity scores than projected and exaggerated manners. A Tukey post-hoc test reveals that all manners were significantly different from each other ($p < 0.01$). The pattern of scores is very similar to those from the previous experiments.

There is also a significant main effect for patches [$F(6,84) = 11.54$, $p < 0.0001$]. Figure 3.27 shows the means for the effect of patches. A Tukey post-hoc test for the effect of patches reveals that combination 2 is more expressive than combinations 5, 6 and 7, and that band combination 4 is more expressive than combinations 1, 5, 6, and 7 ($p < 0.01$).

The two-way analysis reveals there is a significant interaction between manner and patches [$F(12,168) = 10.57$, $p < 0.0001$]. The mean scores shown in figure 3.28 illustrate that not all patch combinations reflect the pattern for manner established in the results of the previous studies - deadpan scoring lowest and exaggerated scoring highest. Indeed, it appears that shoulder only (combination 7) receives scores which reflect no clear perception of information about manner. Wrists only also fails to reflect the variation between manners. As in the previous studies, the *"all patches"* combination reflects the pattern of deadpan scoring lowest and exaggerated highest, but interestingly so does head only, and head and

Figure 3.26 The mean scores main effect of MANNER

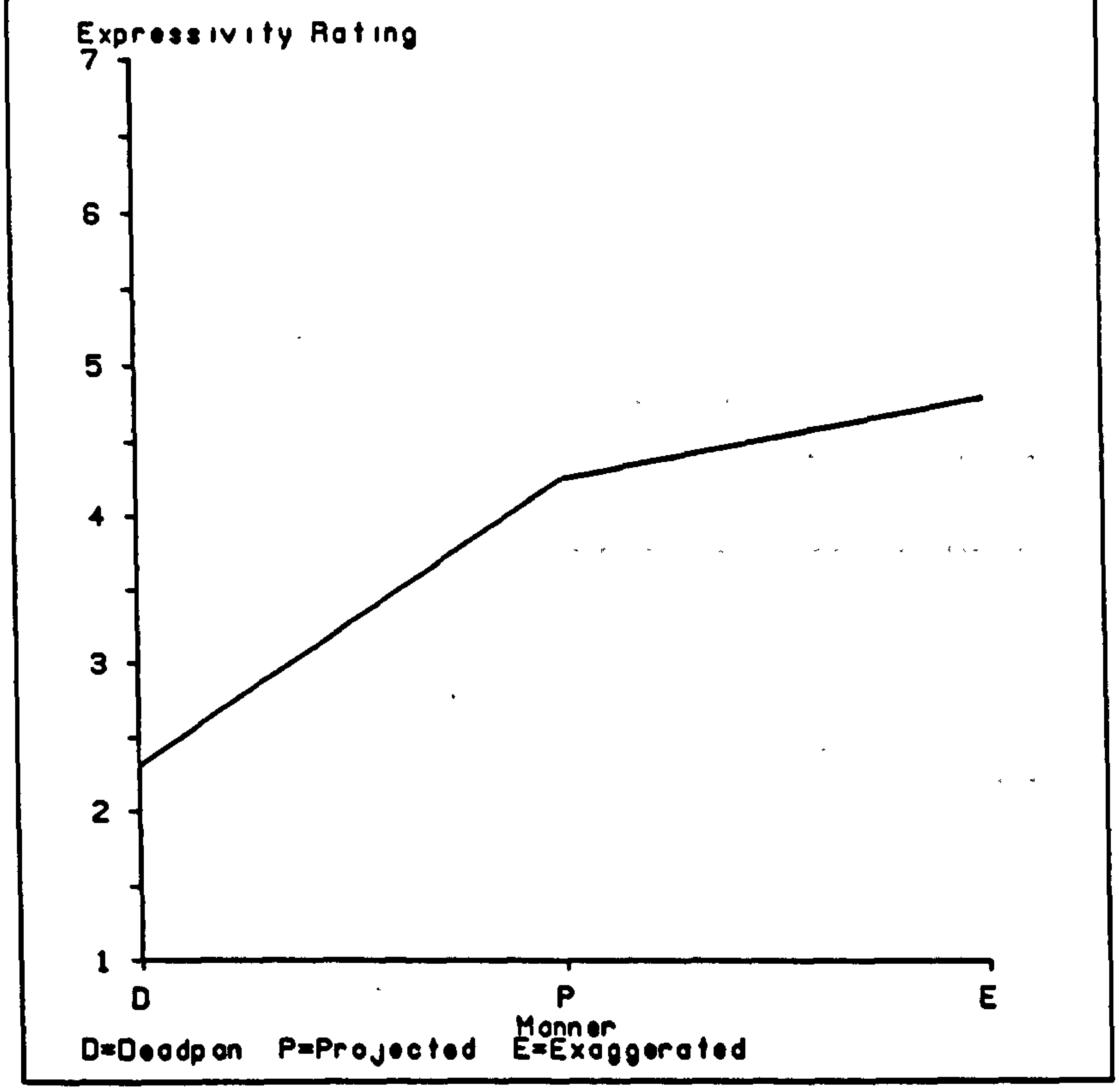


Figure 3.27 The mean scores main effect of PATCHES

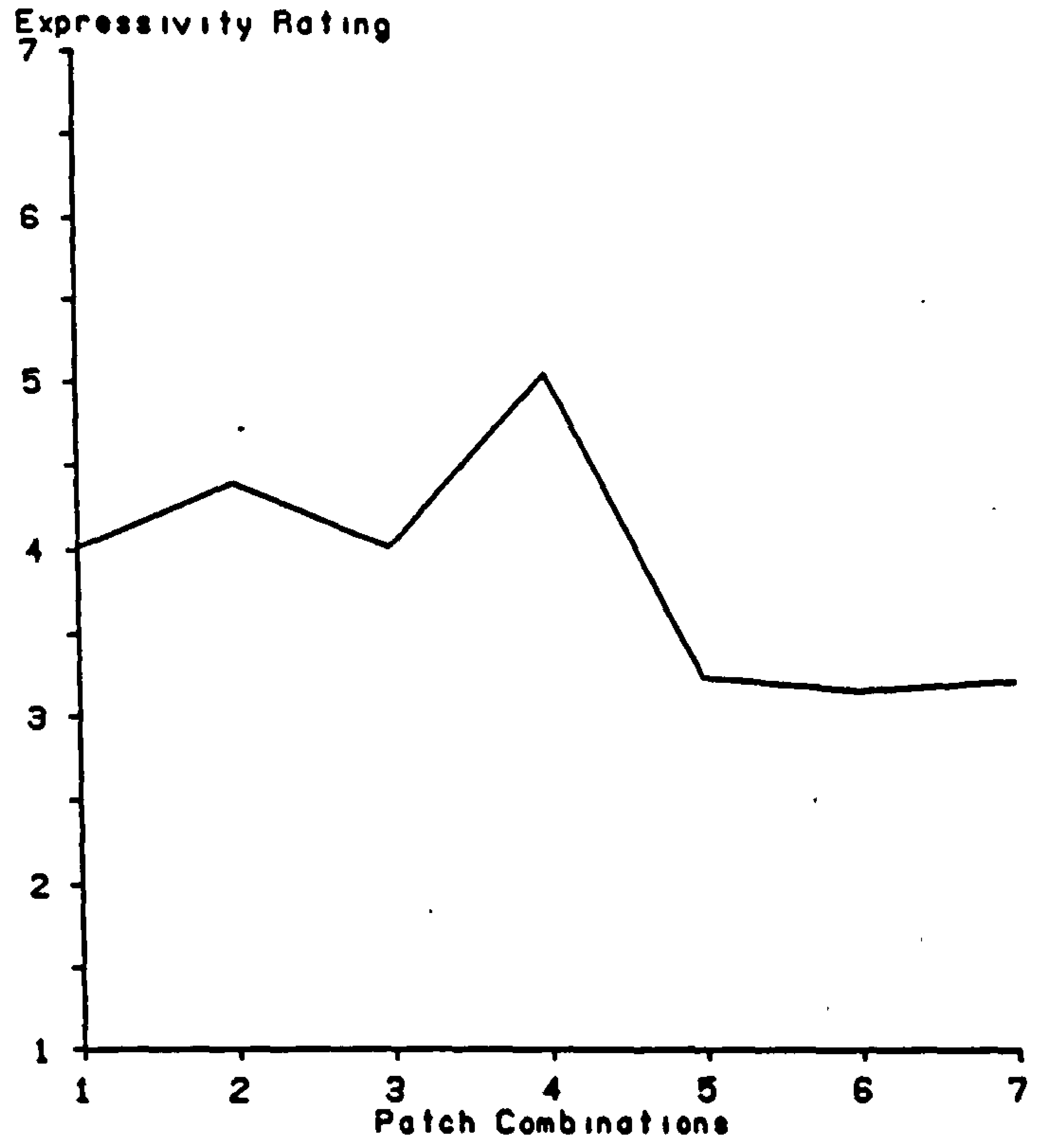
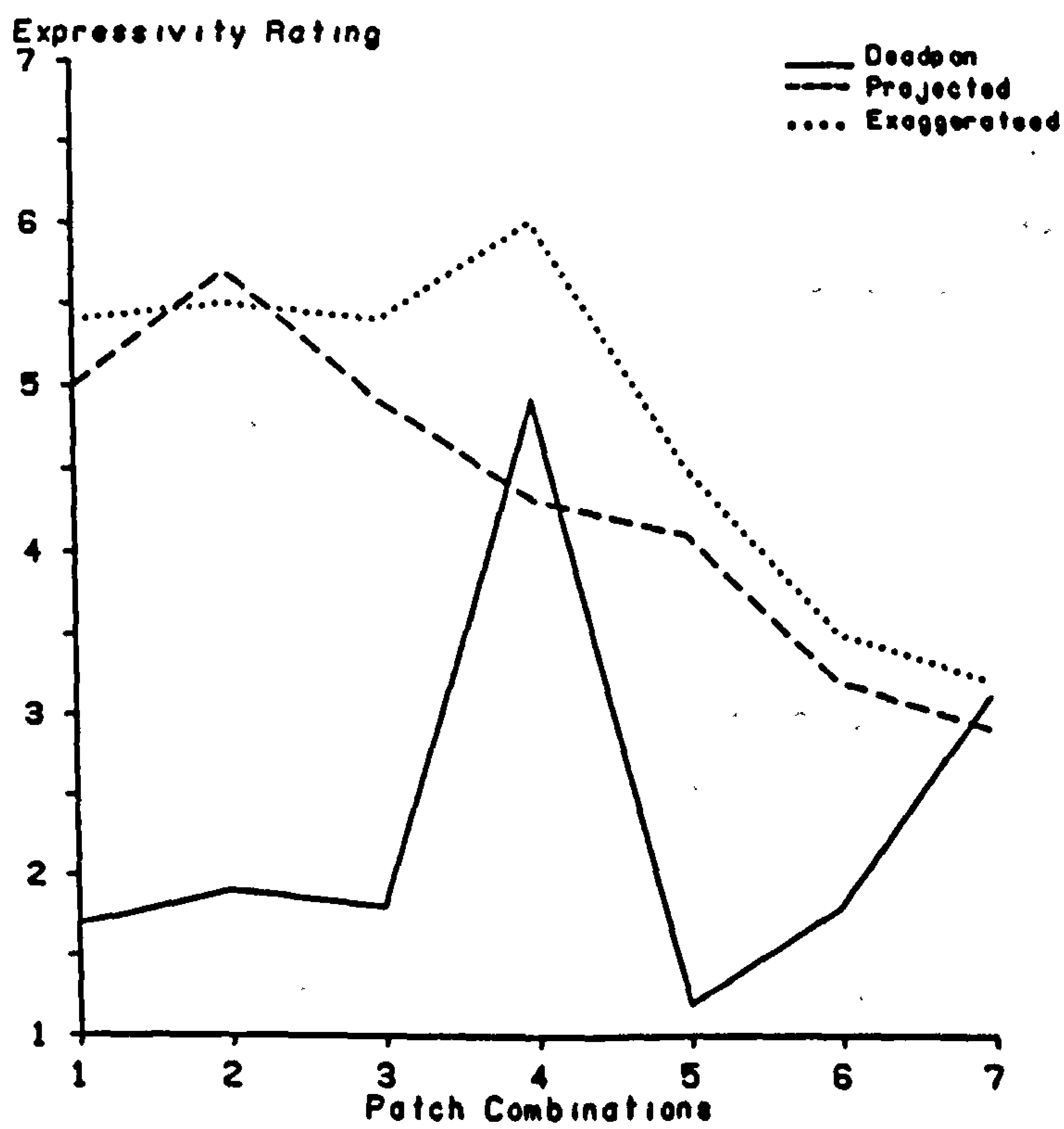


Figure 3.28 The mean scores two-way interactive effects of PATCH by MANNER



wrists. Of the patch reductions, the combination which most closely follows the pattern of all patches is head and wrists. Evidently head is useful, but the combination with wrists seems to produce the closest pattern to that of the all patches condition. This is an intriguing result, for when wrists only are rated, in deadpan manner, the scores far exceed the ratings awarded to either head or head and wrists. It is possible that the result could simply reflect an ineffective performance with wrist patches only, but this seems unlikely since all the patch combinations for deadpan manner were played in a single sequence, as were the combinations for projected and exaggerated manners.

The third observer to complete the test commented that the continual quick activity in the wrists made her score the wrists as if they were more expressive than all the other patch combinations. As a result of her comment, it was decided to ask the succeeding twelve observers to describe their rating criteria - if known - in an informal post-test report. These reports indicated that most of the observers were rating expressivity in both quantitative and qualitative terms. Indeed, there were references to a quality of movement - for instance, *"grace"* or *"uncontrolled"* - which seemed to parallel some of the judgements made in the semantic differential scales of the previous study. Yet, the main thrust of the comments indicated that for the wrists, expression had more to do with the amount of movement than different styles of movement.

In summary, these results reveal that performance manner is detectable by observers from single point-lights on the body. However, not all areas of the body are equally informative (for instance, shoulder and elbow alone are ambiguous). The point-light reduction which follows the pattern of scoring for *"all patches"* most closely is the combination of head and wrists. Informal post test reports indicate that the ratings for these judgements are based on some qualitative, but mainly quantitative, changes in the kinematic configurations.

These results suggest one of two things: i) if there is an invariant for expressivity in performance, it is dependent on information about the upper body (found here in the head position) and can be made more precise when combined with kinematic information in the hands. This, unlike Cutting and Proffitt's (1978) result, suggests that invariants for musical expression are not uniformly spread over the entire kinematic display; ii) the most logical explanation for this is that unlike walking, where all body joints are highly active, the degree of activity in the joints in a music performance varies considerably. In piano performance it seems that given the moderate scores for elbow and shoulder these joints are not sufficiently active, or active in a plane which cannot be perceived in point-lights to convey much information about expression. An explanation for why hands alone produce inaccurate results could be that the stimulus may not be providing the full range of perceptual information. Indeed, support for this argument can be found in this observer's comment:

> *"I suspect I'm rating this wrist performance as highly expressive just because there is plenty of action. When wrists are combined with other areas of the body, I look to the whole, and the emphasis on fast motion is reduced for I see an elegant arch of the back and a delicate hand lift and it is from the combined information that I am able to recognize the intention of the piece. But I must say that amount of movement does affect my judgements."*

It seems that hands produce more quantitative information whilst the head produced a more qualitative type of information. However, it could be that in order to get at most of the qualitative differences between the performances, the full display is necessary.

3.6 OVERALL SUMMARY

Taking all the experiments of this chapter together, the following results have been established: i) kinematics provide perceptual information about performance intentions; ii) this kinematic information appears to be as useful as the information conveyed in the stimulus modalities of sound only and combined sound and kinematic stimuli, though there is some evidence that the single modalities of V and S can distort the information of the natural performance (the combined S&V mode); iii) the distortion of some of the single modality results suggests that the intentions of a performer are conveyed collaboratively in sound and vision, and that the visual component of a performance is essential for the intentional information to be detected fully; iv) visually, the accurate transmission of information about performance interpretation is not dependent on a full kinematic display, though some areas of the body are more informative than others. In the case of the pianist, the full expressive potential is available in the head and hands; this result needs more detailed consideration to establish whether head and hands in combination produce information equivalent to the "*all patches*" condition; v) performance intentions seem to be conveyed in both movement quantity and movement style in kinematics; however, given the result of the point-light reductions, it seems that normal displays need to be studied to investigate whether all the qualitative information about performance intention is conveyed in the point-light display, or whether the kinematics convey only quantitative data about intention.

Endnote

1. It is to be noted that within the three-point rating scale used in this study, there is a possible violation of the assumption of the analysis of variance technique, namely the normal distribution of scores for each group. However, investigation of the variance for different groups shows that the assumption of homogeneity of variance is justified: for Musicians versus Non-Musicians the scores are 0.67 and 0.48 respectively; and for the three manners they are 0.32, 0.45 and 0.53. Given its robustness, the use of ANOVA is therefore justified.

CHAPTER FOUR

4.1 INTRODUCTION

As a first step towards determining what permits the observer to differentiate between the three performance manners, it was decided to focus on measuring the movements of the three manners. This was to establish whether quantitative differences contributed to the perception of the three performance manners. The previous chapter concluded with the finding that for a pianist kinematic information from the head and the wrists is sufficient to determine performance manner to a level of accuracy corresponding with the all patches point-light display. This finding suggested that head and wrists in combination should provide useful measuring points. Besides examining quantitative differences between the performance manners, however, it was decided to readdress the issue of movement quality. This was undertaken by using a more extensive semantic differential response sheet on the naturally illuminated stimuli, and also by asking observers to identify (from the natural stimuli) expressive locations in the performances.

In order to pursue these aims, the empirical work described in this chapter used data collected from the performances of a professional pianist.

4.2 TRACKING STUDY

4.2.1 INTRODUCTION

The technique of movement tracking used in this study involves the regular measurement of single body points in 2-dimensional (x- and y-axis) space over time. Wing and Smyth (1984) observe that such a technique captures a description of an event. The need to describe the movements of music performers is of primary importance for, as Wing and Smyth note, any observer who reports that someone actually did some physical activity is not describing the movement, only the end result. Tracking is an objective descriptor and as such it may permit differences between performances to be identified. Winold et al. (1990) also used measurement techniques to analyze bowing arm movement in cello performances of an excerpt played at different speeds. Thus there is empirical evidence to indicate that tracking is a useful way of recording the movements of musicians.

4.2.2 METHOD

Stimulus, Apparatus and Procedure

Beethoven's Bagatelle No.11 in Bb major (shown in figure 4.1) was performed by a professional pianist in the three manners of deadpan, projected and exaggerated performance - (see chapter 3 for a detailed description of the manners and the instructions given to performers). The Bagatelle, which lasts for approximately one minute, was selected so that rather than analyzing an incomplete section of a composition, an analysis of the whole piece could be undertaken.

In line with the results of the point-light reduction study, it was decided that measurements of the performer's movements should be collected from a marker attached to the face on the upper cheekbone set between the eye and the upper edge of the ear and two gold wedding rings on the fourth finger of each hand. The pianist performed at an upright piano which was set in left-side profile. A mirrored wall located directly behind the piano permitted data to be collected from the right-side profile of the pianist. A video camera with a speed of 25 frames per second, was placed approximately 2.5 metres from the piano with the lens set at a height corresponding with the upper edge of the keyboard so that the upper torso and head of the pianist and the mirror image were in shot. The video

Figure 4.1: The score of Beethoven's Bagatelle, op.119, No.11 in Bb major.

was made by recording the deadpan, projected and exaggerated manners in succession. After data collection, a video position analyzer (For-A-VPA 1000) with calibration grid, x-&y- plotting axes, and frame memory (For-A-FM 60) were used to make the tracking measurements. From the video frame in which the pianist's fingers made contact with the keys to the frame in which the final chord ceased to sound, x- and y- measurements for each of the measurement points were taken every 5 frames in each of the three manners of performance. This sampling rate was based on previous work by Alan Wing on rowers (Alan Wing, personal communication). Prior to undertaking the main tracking, sample tracking data were collected from the professional pianist for the head and wrist areas of the body for the first six seconds of the deadpan, projected and exaggerated manners. As a result of this preliminary test, additional measurements were taken from the point at which the pianist's tie and collar intersected at the base of the neck so that any differences between head and back positions could be noted.

Figure 4.2 shows how, using a station point S located at the edge of the keyboard, the x- and y- axes on the analyzer were manipulated to make the measurements. Video example 6 shows the pianist at the keyboard.

4.2.3 RESULTS AND DISCUSSION

Out of the 850 individual measurements for head, neck and hands, it was necessary to construct some measure of the size of movements during the performance. The approach adopted here was to break the performance into two second chunks and to measure the maximum and minimum positions on the x- and y- axes for each tracking point within the two second interval. This measurement can be regarded as a "*spatial difference*" score. The two second chunking was a comparatively arbitrary choice, though since Cutting and Proffitt (1978) depended on two second excerpts for the

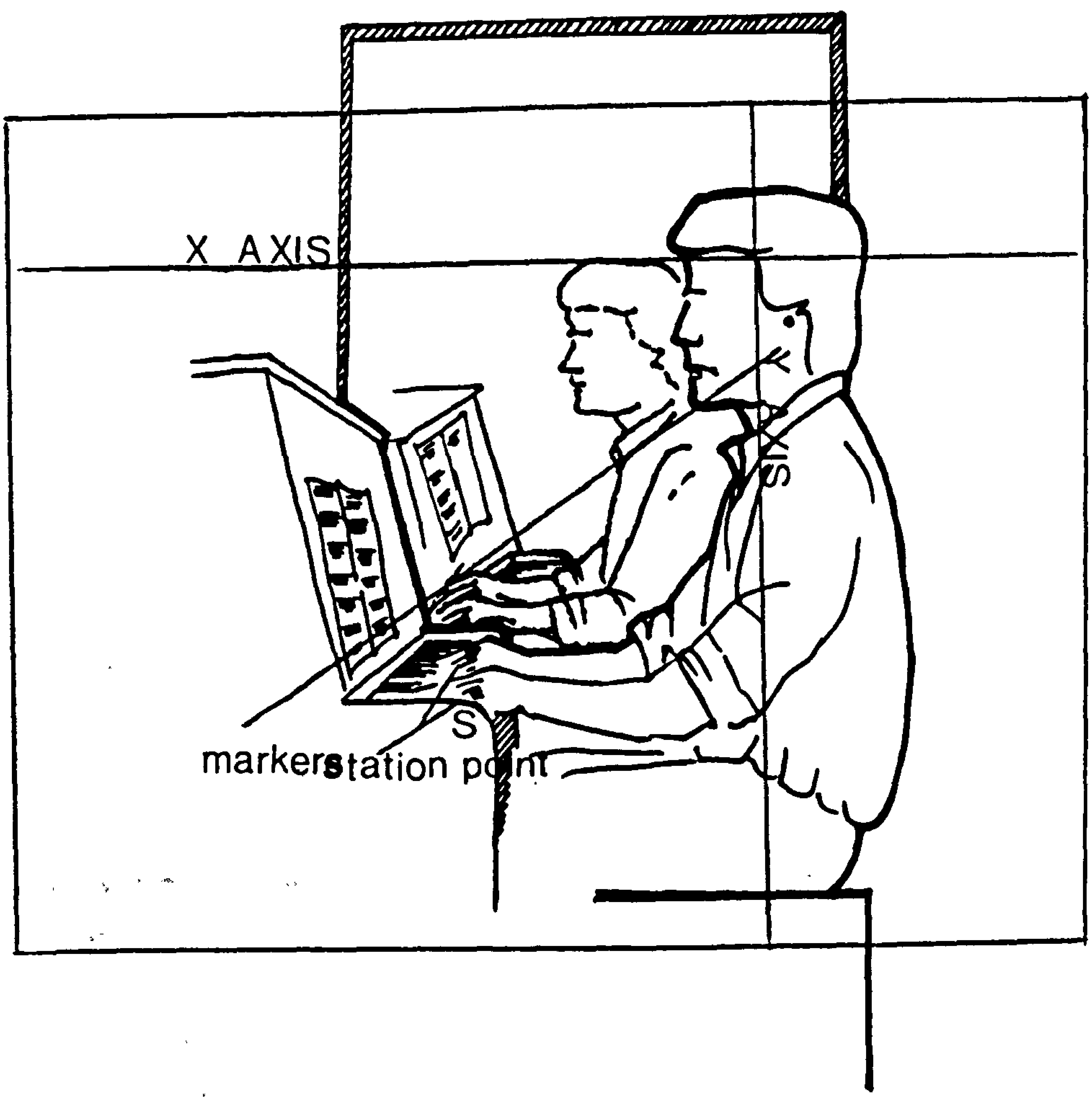


Figure 4.2: Using a station-point (S), the x- and y- axes on the video analyzer are manipulated to make measurements of body position.

recognition of gender in walking, the time span seemed to be of a length likely to contain useful perceptual information. In order to assess the quantitative effects of manner, the difference scores were analyzed with a separate one-way analysis of variance for each tracking point and each dimension.

For the head, both the x- and y-axis analyses show significant results [$F(2,82) = 15.54$, $p < 0.001$; and $F(2,84) = 11.69$, $p < 0.001$ respectively]. The mean scores illustrated in figure 4.3 a&b indicate that it is the low difference score values in deadpan manner which seem to account for the significant effect. Indeed, Scheffé post hoc tests reveal that for the x-axis there are significant differences between deadpan and exaggerated manners and also between projected and deadpan manners ($p < 0.01$), but that the difference between projected and exaggerated manners is not significant. For the y-axis, the Scheffé tests reveal that the difference between deadpan and exaggerated manners is significant ($p < 0.01$), but that for deadpan and projected manners and projected and exaggerated manners there are no significant differences.

The analysis reveals a significant effect of manner for the neck on both the x-axis scores [$F(2,84) = 17.27$ $p < 0.001$] and the y-axis scores [$F(2,84) = 12.74$, $p < 0.001$]. Once again the mean scores illustrated in figure 4.4 a&b reveal that difference scores are far smaller in deadpan than in either projected or exaggerated manners. It is interesting to note that the shape of the graphs for the neck follows those for head very closely, almost certainly reflecting the close anatomical link between the two. Scheffé tests reveal that x-axis differences between deadpan and exaggerated manners and also deadpan and projected manners are significant ($p < 0.01$), but that there is no significant difference between projected and exaggerated manners. For the y-axis, Scheffé tests reveal that there are significant differences between deadpan and exaggerated

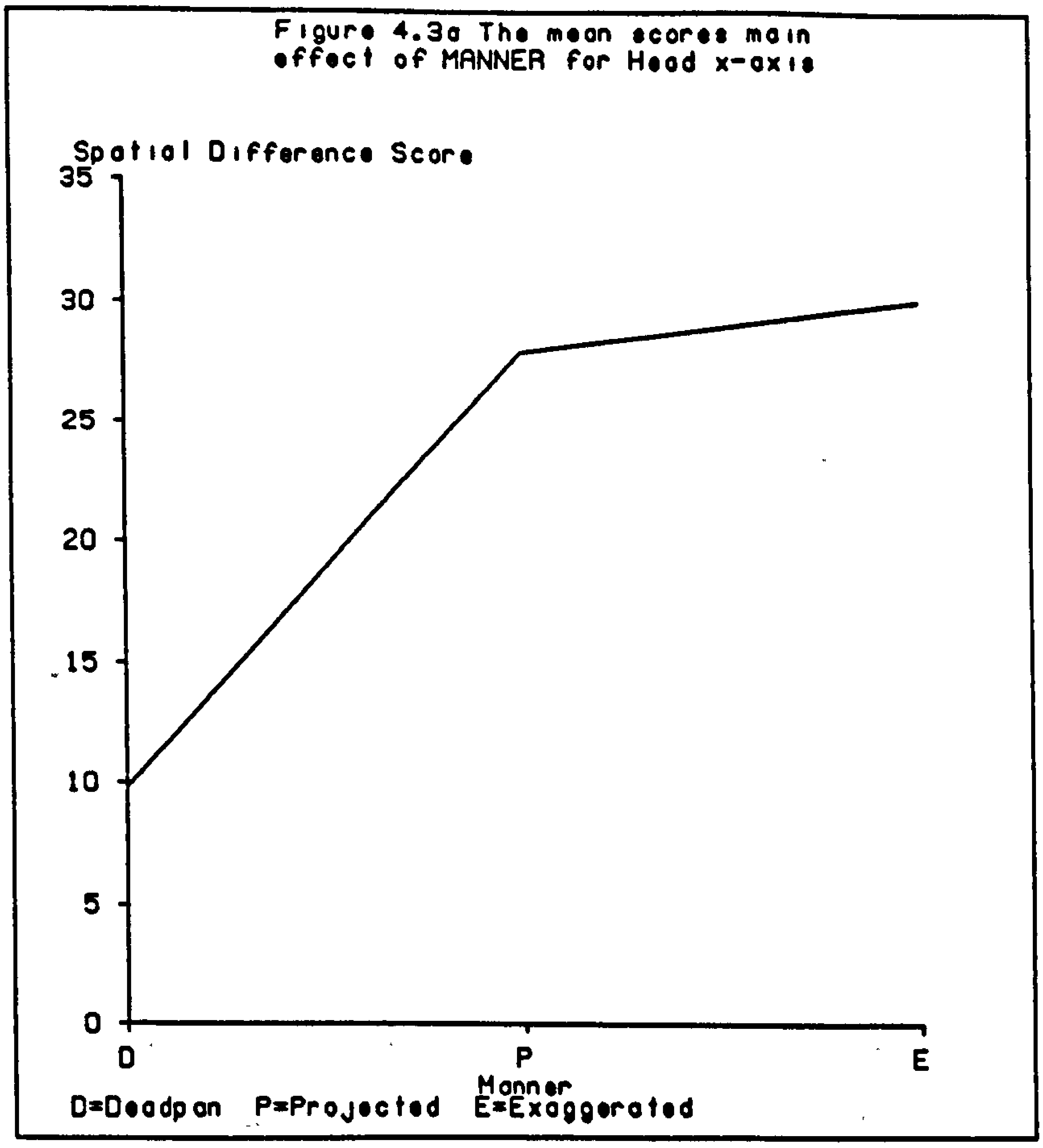


Figure 4.3a The mean scores main effect of MANNER for Head x-axis
Spatial Difference Score
35
30
25
20
15
10
5
0
D
P
E
Manner
D=Deadpan P=Projected E=Exaggerated

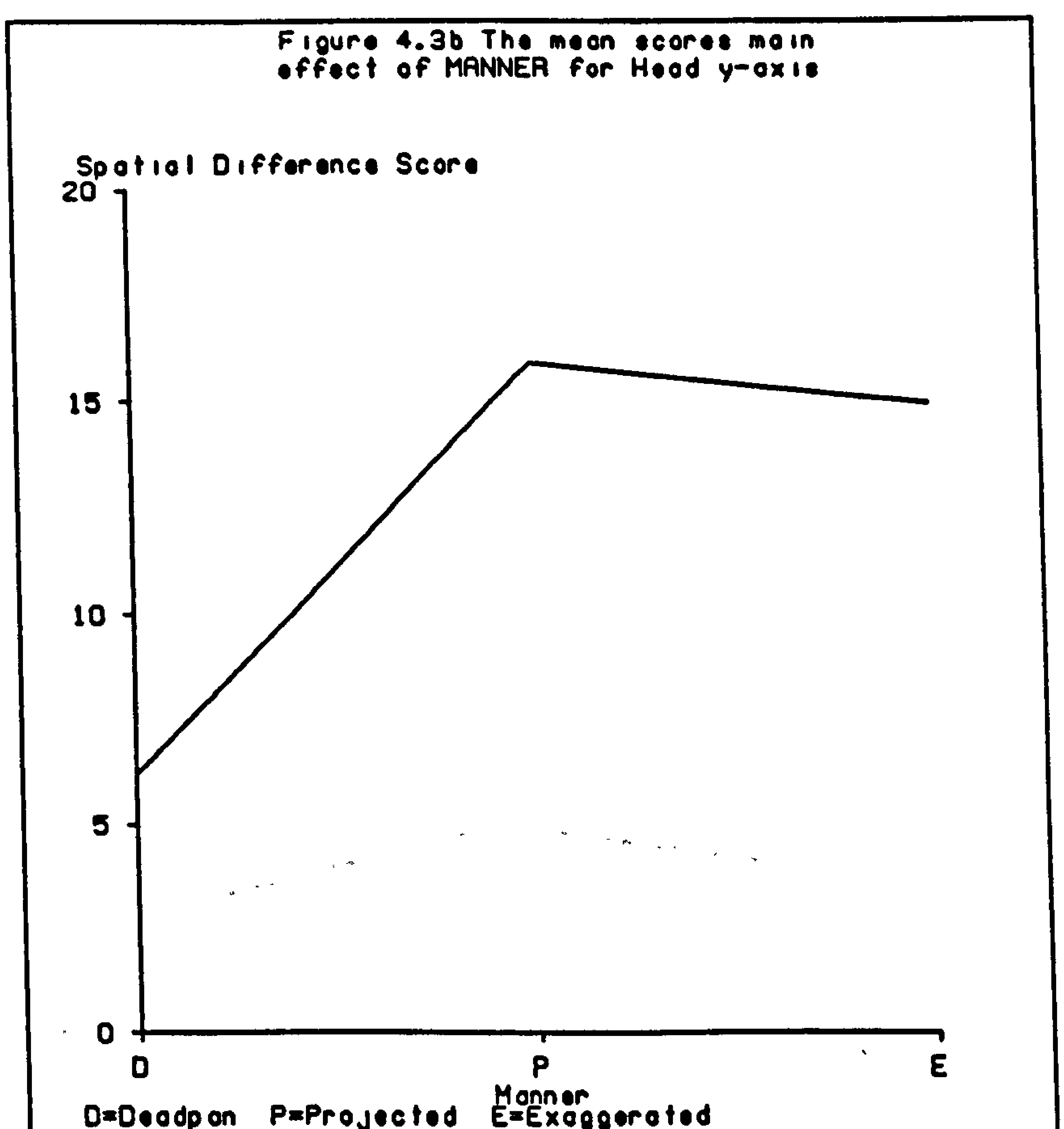


Figure 4.3b The mean scores main effect of MANNER for Head y-axis
Spatial Difference Score
20
15
10
5
0
D
P
E
Manner
D=Deadpan P=Projected E=Exaggerated

Figure 4.4a The mean scores main effect of MANNER for Neck x-axis

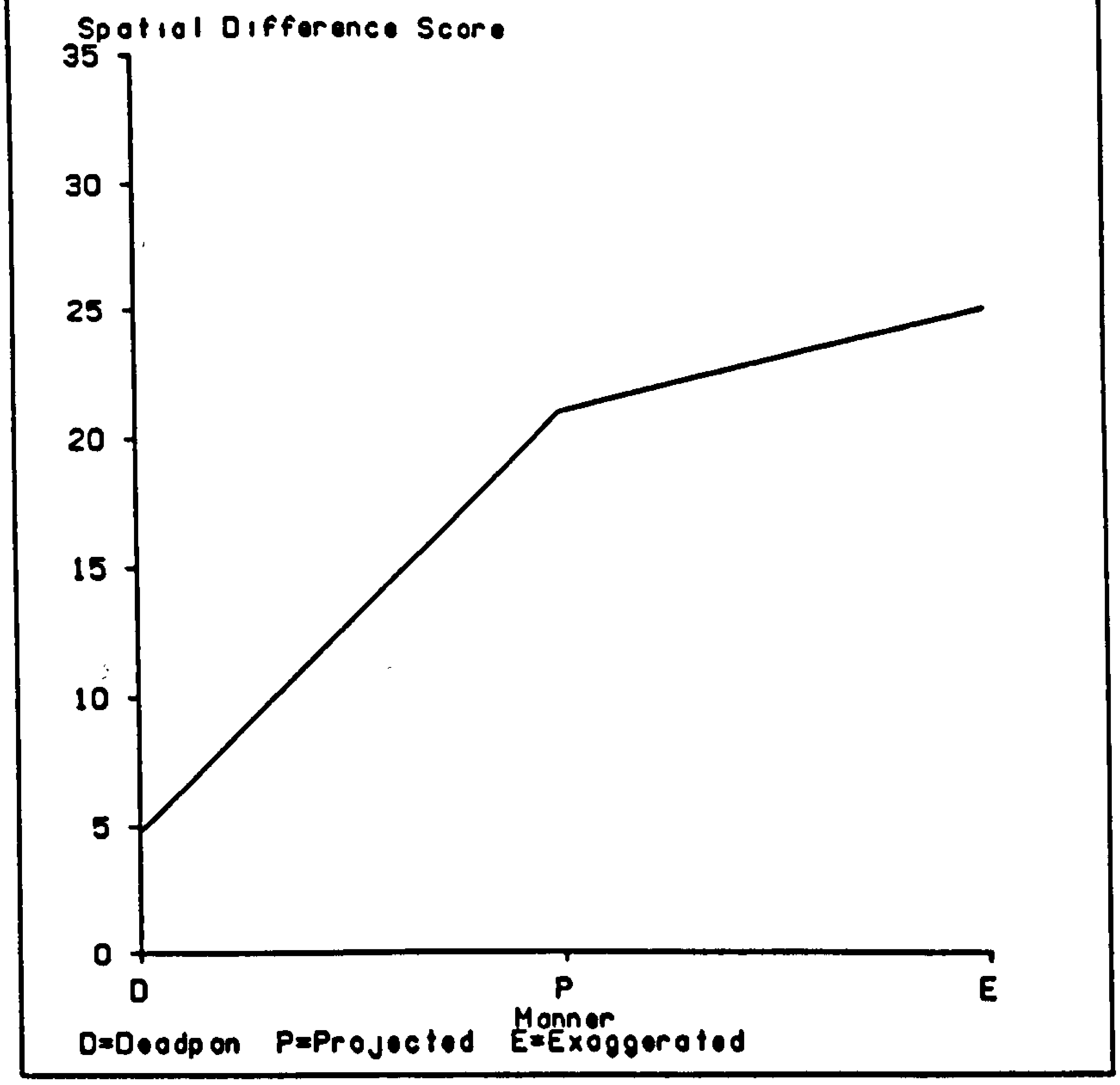
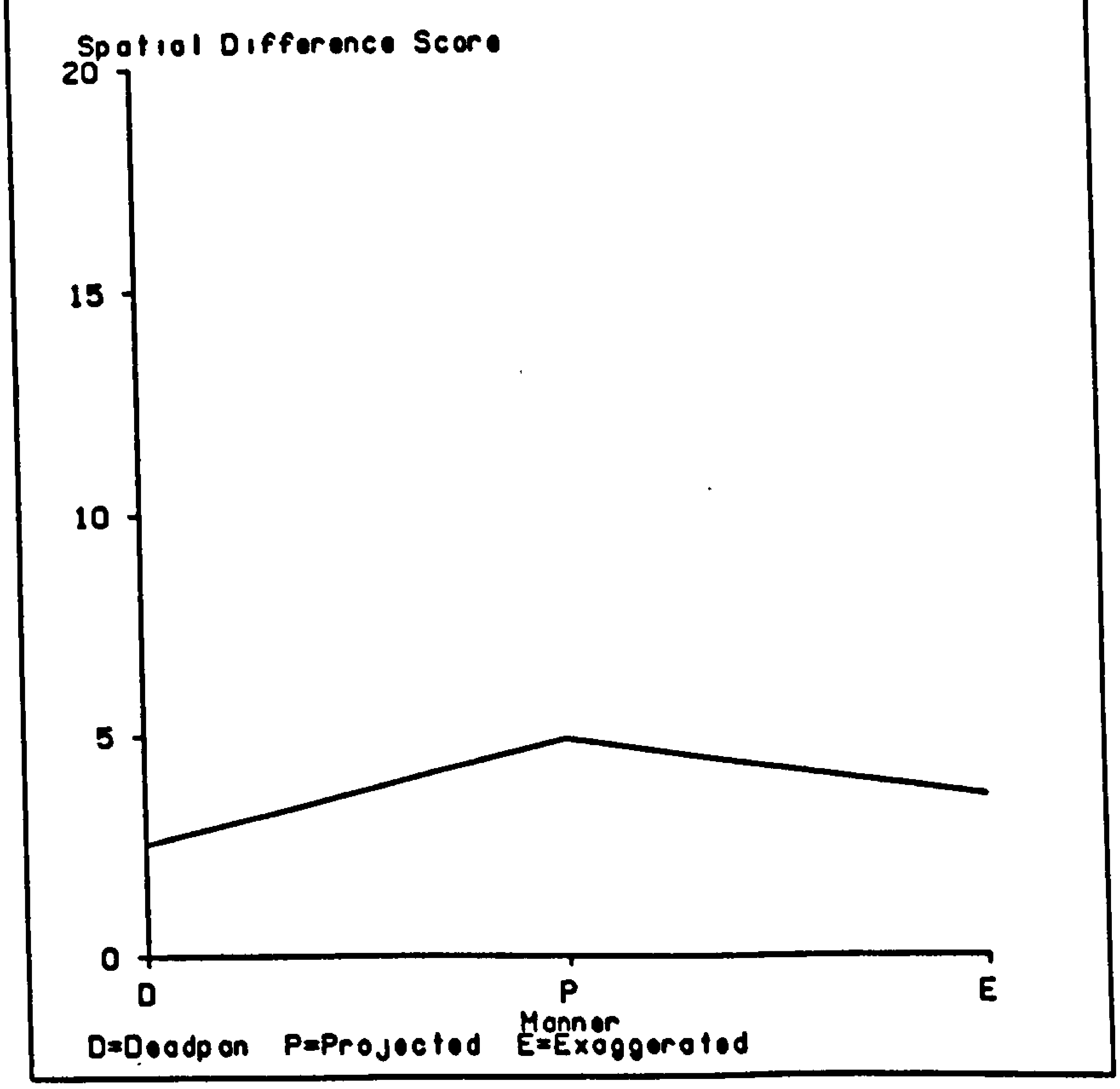


Figure 4.4b The mean scores main effect of MANNER for Neck y-axis



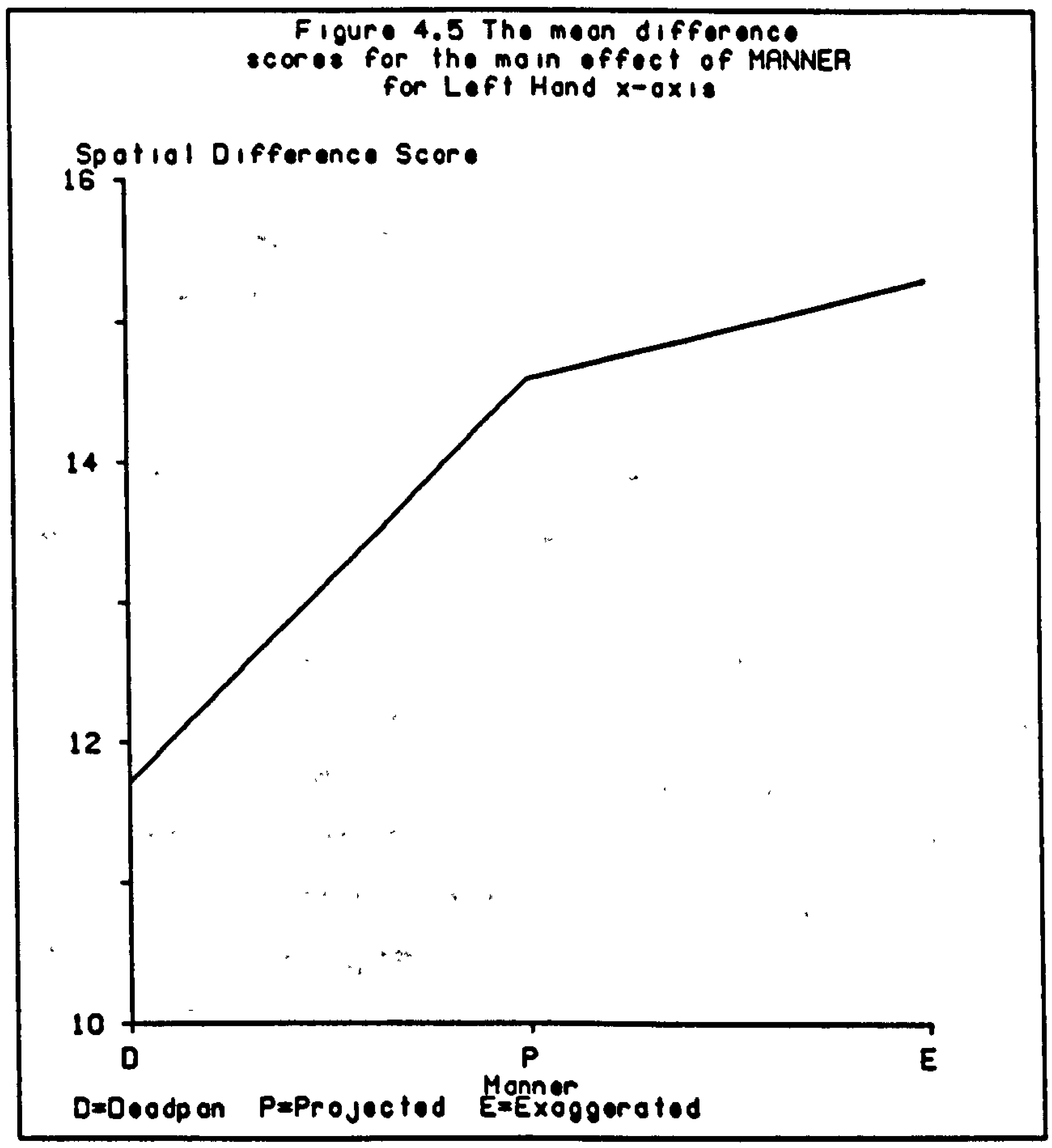


Figure 4.5 The mean difference
scores for the main effect of MANNER
for Left Hand x-axis
Spatial Difference Score
16
14
12
10
D
P
E
Manner
D=Deadpan P=Projected E=Exaggerated

manners, deadpan and projected manners, and also, projected and exaggerated manners ($p < 0.01$).

For the left hand, there is a significant effect for the x-axis scores only [$F(2,84) = 4.85$ $p < 0.01$]. The mean scores shown in figure 4.5 reveal that the scores are different for the three manners, but that these differences are far less pronounced than in the scores for head and neck (note the scale). Scheffé tests reveal that only deadpan and exaggerated are significantly differently ($p < 0.01$).

For the right hand, there is no significant effect for either the x-axis [$F(2,84) = 0.48$], or for the y-axis [$F(2,84) = 0.79$].

These results indicate that the pianist moves to a different degree across the three manners. The similarity in the rank order for the mean head and neck difference scores suggests that for this performer the head and neck move to similar extents in each of the three manners. For the hands, it seems that it is only the forward and backward movements of the left hand which differ according to manner. This latter result may provide one explanation why in the point-light display studies of the previous chapter the performance manners were difficult to assess from point lights on the hands only.

RAW TRACKING DATA

In order to discern whether the differences in movement between manners are simply differences in the amplitudes of the same movement patterns, or differences of the numbers of movements made in each manner, it is necessary to examine graphic presentations of the raw tracking data. All the raw tracking graphs are contained in supplementary booklet 1. (Each figure appearing in this booklet will be denoted by the abbreviation sb1. and its reference number.)

Because the three manners differed in total duration (deadpan lasted 52 seconds, projected 58 seconds and exaggerated 61 seconds), the data were normalized to the same total performance duration to allow comparison. The tracks are presented in two halves because of the large quantities of data. Each half performance is given a scale from 0 to 1 to show the start and finish of each half and this duration is broken into ten sections to provide reference points for the comparisons. For the x-axis measurements (Figures sb1: 1, 3, 5, 7, 9, 11, 13, 15) forward motion towards the piano is shown as peaks and backward motion as troughs. For the y-axis measurements (figures sb1: 2, 4, 6, 8, 10, 12, 14, 16) the peaks represent downward motion and the troughs represent upward motion. These figures are presented in x- and y-axis pairs: the x-axis tracks are on the transparent acetates, and the corresponding y-axis tracks are on the page beneath, under the white dividing sheets.

Figures sb1.1 and sb1.3 show the head x-axis tracks for the first and second halves of the Bagatelle. Across the entire duration of the Bagatelle performances it is evident that there are differences in the forward and backward movements for each manner. Indeed a considerable difference in the numbers and amplitudes of forward and backward movements can be seen. In deadpan manner, there are many small movements, whereas in projected and exaggerated manners, there are much larger movements.

If figure sb1.1 is considered in detail, it is apparent that most of the movement troughs for the first half of the performances occur between the tracking values of -85 and -100. If these troughs are compared with the starting point for all three manners, it is evident that measures between -85 and -100 are those of the pianist's upright sitting position. The margin of difference between the scores for upright sitting (-80 to -100) serves to demonstrate that the movements of backward and forward motion recorded for deadpan manner are very slight movements which rarely deviate from the upright sitting margin, though it is to be noted that the performer moves slightly forward during the first half of the performance. In the projected and the exaggerated manners there is a dominance of forward motion. For instance in the projected manner, with the exception of the definite movement backwards from the starting position (trough at 0.1), the subsequent troughs illustrate that the performer does not return to the starting position, but rather returns from forward peak positions to shallower trough positions. The increasing amplitude of the peaks across most of the projected performance underscores the fact that with each motion, the performer moves his head further forward. For the exaggerated performance, although the majority of troughs return to the starting position, the peaks also move increasingly forward. If the tracks are compared with what is occurring in the music (figure 4.1 shows the score), there is evidence to link the musical material and the increasingly large movement peaks. For instance, the initial four bars of the piece are united by thematic melodic material which is built from two bar soprano-part sections consisting of step-wise descents and leaping fourth intervals. The leaping intervals have pitch peaks on the high G in bar 2 and the high F in bar 4. If the performing durations of the piece are compared with the score, it is evident that the first major movement peak in deadpan and projected manners (0.1-0.2 on the tracking graphs) corresponds to bar 2 in the music. The subsequent peak at 0.4-0.5 corresponds to bar 4. In the exaggerated manner, there is forward motion at 0.1-0.2, though it is smaller and occurs slightly later than in the projected performance, this forward motion corresponds to the pitch peak in bar 2, and there is a clear forward motion at 0.4-0.5 which corresponds to bar 4. As for the step-wise descents, it seems that in these initial bars, the descending quavers coincide with backward (trough) movements. For instance, the trough found in 0.1 in all three manners corresponds with the descending quavers in bar 1, whilst the descent from the high G in bar 2 corresponds to a backward swinging motion at 0.2-0.3. In the section of music from bar 5 to 11 (bar 11 is the end point for the tracks shown in sb1.1) the correspondence between pitch height and forward motion continues. From bar 5 to bar 8 there are two bar sections in which the melody rises at the end of each small section, punctuated by cadences at the end of bar 6 and bar 8. These structural markers in the music correspond to the tracking peaks at 0.5 and 0.7 in projected and exaggerated manners. Interestingly, the cadenza section in bars 9 and 10 corresponds to the trough and relative stillness of 0.7-0.8 in all three manners. Again the high soprano entry at 11 corresponds to a forward movement peak at 0.9. Even in deadpan manner where there is far less movement, there is a tiny forward peak at 0.9. It seems, therefore, that the head tracks reflect important structural points in the score. These reflections may simply be movements that are essential to the production of the notes at these points, but given that the notes are produced in the deadpan manner with barely any head movement whatsoever, the varied contours of the projected and exaggerated manners seem to be connected to some form of expression.

The second half of the Bagatelle performance for the head is shown in Figure sb1.3. Although the deadpan movements retain their upright sitting position, the projected and exaggerated manners have a different movement direction: they work through a series of troughs of increasing amplitude which lead the pianist back to the upright sitting position at the end of the piece. For instance at 0.1, 0.2 and 0.4 there are troughs in both manners, and at 0.5 and 0.6 the head actually moves backwards beyond the upright sitting position. In the score, the troughs at 0.1, 0.2 and 0.4 coincide with the descending melodic material and tonic chords at the ends of bar 11, bar 12, and bar 14. The peaks in this section continue to occur at phrase climaxes. For instance, from bar 11 to bar 14 the soprano line tessitura is high, and forward motions continue to occur at phrase climaxes (for example, in projected and exaggerated manners the peak at 0.3 corresponds to the end of bar 13). Between bars 15, 16 and the first half of 17 (0.4-0.6) the melodic material contains trills while the harmony alternates between V-I chords. Here the movements are slower (because the tempo is reduced) and smaller. In contrast with the movements of the first half of the performance (the movements all move forwards towards the cadence at bar 8) the body movements reflect the fact that the music is harmonically thinner, and a repetition of earlier melodic material now played an octave lower. That is, the music is less intense and the body reflects this in its backward (retreating) movement. The only large peak in this half of the performance occurs at 0.7 which corresponds to the major cadence and ascending melodic figure in the soprano voice where there is a high G in tied quavers across bars 17 and 18. It is at this point that the association between forward movement and an ascending melody or phrase climax is changed however, for in both the projected and exaggerated manners the forward body position persists (0.8), corresponding to the first beat of the new minim figure in bar 19. It seems that despite the descending melodic line which resolves in a V-I cadence at the end of bar 18, the performer maintains his forward position. The performer leaves this forward position at slightly different places in the music in the different manners: in the exaggerated manner he moves as soon as bar 19 begins, whereas in the projected manner he postpones this movement until the second minim of the bar. The dramatic common backward movement (trough) at 0.8-0.9 in deadpan, 0.9 in projected and 0.8 in exaggerated manner at 0.8 highlights these differences indicating that there are perhaps different factors eliciting the movement. The trough does occur, however, between bars 20 and 21 in all manners, where a rest occurs. Since the rest follows a falling interval phrase and as the pace of the piece is in minims, it could be that the rest, having no requirement for musical action, is the first beat in which the performer can allow himself to move backwards. The difference between the positions of this backward movement could simply be that in the exaggerated performance he chooses to anticipate this position change. Indeed, this kind of difference between the manners could be one of the features which characterises a particular manner.

For a fuller consideration of the head movements, the y-axes for all manners need to be examined (see figures sb1.2 and sb1.4). In general terms the first point to note is the regular trough position at around -160 which evidently corresponds with the height of the performer in the upright sitting position. Certainly the most outstanding feature of these tracks is that there is a direct correspondence between downward motion and the pattern for forward motion and upward motion and the patterns for backward motion. Indeed, if the acetate x-axis tracks are overlaid by opening the dividing sheet between the graphs so that the y-axis can be viewed beneath, the correspondence between the downward and forward motions in all three performance manners can be seen. One single deviation from the forward/downward motion of the performer is found in the first half of the performance (figure sb1.2a) in deadpan manner at 0.5 which illustrates an upward motion in the y-axis, but a slightly forward motion within the range of upright sitting. This deviation may simply be an adjustment of sitting position, whilst the other forward and downward motions are deliberate movements essential to the performance. It is possible that this adjustment could be a consequence of the unnatural demands of the deadpan performance.

The next tracks to be considered must be those for the neck, since these were collected to determine whether there are differences between the head and neck positions. Figures sb1.5 and sb1.7 show the neck x-axis measurements for the first and second halves of the Bagatelle. In general terms, these graphs show that the three manners of performance have different forward and backward movement patterns, but the most interesting way to study these patterns is to compare them with the head tracks from figures sb1.1 and sb1.3. Here it is apparent that there is a striking similarity between the projected and exaggerated performances for the two body measurements. Where there are differences between the head and neck data points - in the deadpan manner - the overall trend for forward motion is maintained. Indeed in the first half of the neck x-axis tracks (figure sb1.5) the main forward (peak) motion which occurs at 0.2 coincides directly with the single major head peak (figure sb1.1). However, in deadpan manner there is less overall forward and backward motion found in the neck than in the head. Indeed, it is apparent that at several points there are up to two seconds of no forward or backward movements for the neck (for example, at 0.4, 0.7, 0.8, and 0.9). If these are compared to the head tracks - which are very small movements - they illustrate that stillness in the neck occurs at moments when tiny forward motion peaks occur in the head. Since none of these movements really deviate from the upright sitting position, these movements can be accounted for in terms of small physical adjustments (glancing at the hands or nodding for instance) which do not involve the neck.

The y-axis data for neck shown in figures sb1.6 and sb1.8 reveal up and down motions for the neck which are common to all manners. Once again, there is least movement variation in deadpan and most variation in exaggerated manner. However, there is a range of no more than 10 points between the tracking values. This very limited range of up and down movements shows that the neck hardly deviates from its upright position across manners. Therefore, these tracks indicate (not surprisingly) that in terms of correspondences between body areas, the neck produces less y-axis movement than head; this is for simple anatomical reasons.

In summary, these tracks show that between the head and neck there are very few differences in the x-axis tracks, indicating that whatever is revealed in the head describes what happens in the neck for backward and forward motion. In the y-axis up and down motion, a pattern of downward motion for forward movement and upward motion for backward movement is illustrated in the head tracks, but there are few variations in the height of the neck. This indicates that there is a difference in the movement occurring at the neck and the head. These tracking data also reveal that although there is least movement in deadpan manner and most movement in exaggerated manner, there are similar movement patterns across all three manners. A brief examination of the score illustrates that these common movement patterns reflect certain structural features of the music. Differences in the amplitudes of these patterns suggest that these may be moments where some important information may be contained. Other evidence for potentially expressive moments comes in the form of movement locations which are unique to a manner.

In order to complete the tracking description of the Bagatelle performances, it is necessary to examine the data collected from the hands. Figures sb1.9 and sb1.11 show the x-axis tracks for the left hand. These tracks illustrate that there is much forward and backward hand movement in all three manners, but that the amplitude of the movements is generally confined to between 5 and 30 on the tracking scale. Large numbers of small amplitude movements suggests that these are the movements of the hand on the keys. The fact that these movements are most constrained in deadpan suggests that this is the performance which is the most strictly technical. Since the range of differences in the amplitude of individual tracking points increases across manner - deadpan manner contains the least variation and exaggerated the most variation - the slightly larger amplitude movements in projected and exaggerated manners must include movements which are not strictly necessary in a simple technical execution. If this is the case, it could be that expressivity in the hands may have something to do with movements beyond those required by technical note production. The most obvious example of a similarly located but greater amplitude movement is the large movement back towards the body in exaggerated manner in the first half of the Bagatelle (figure sb1.9, 0.7-0.8). A movement towards the body occurs in the other two manners, but the movement is far smaller. Another difference between the performances can be seen at the very end of the second half of the Bagatelle (figure sb1.11, 0.9). Here the hand is maintained in the keyboard position at the end of the exaggerated manner but moves back towards the body in the deadpan and projected performances.

In order to have a clear impression of how the hand moves, it is necessary also to examine y-axis data. Figure sb1.10 which shows the first half of the Bagatelle reveals that these motion patterns of the hand are very similar across manners. However, there is one particularly large deviation in height of the left hand in the exaggerated manner at 0.4 where the hand moves upward. If compared with x-axis, it seems that the hand moves back towards the body and upwards. If this is considered in reference to the score, it is found to occur at the end of bar 6, which is an imperfect cadence preceding a move towards the relative minor with the left hand displaced by more than an octave. Again this could simply be a physical adjustment, but since there is no such lift in either the deadpan or the projected manners, this single lift could be one of the features which characterises the exaggerated manner. Another unique exaggerated manner hand movement occurs at 0.7-0.8. Here, having just made an upward movement (which is common to projected manner), the hand moves down below the keys and then returns to the key height. In the music, this moment coincides with the rest in bar 9. Once again there is absolutely no technical need for the hand to lift at this point, but this movement below the keyboard in addition to the lift indicates that it is only when the hands are not engaged in note execution that a movement pattern unique to a manner is established. This could be some simply arbitrary movement which fills in the time between rests, but it could equally be the only opportunity the performer has to use his body expressively.

Figure sb1.12, which shows the up and down motion tracks for the second half of the Bagatelle, reveals a common trough point at 0.5 which suggests a hand lift in all manners. This has no corresponding x-axis feature, indicating that this lift occurs in the x-axis plane equivalent to the hand in the key-playing position. In terms of the score this movement occurs again at a rest: the final quaver beat of bar 16. Once again the hand is required to shift register at this point. As the amplitude of the lift is virtually identical between manners, it could be that this lift is purely functional. Finally, there is a lift common to deadpan and projected manners at 0.9. Seen with the corresponding x-axis motion towards the body, the performer evidently lifts his hand towards his own torso. Since this lift occurs as the performer ends the piece, it could be that this is a general strategy the performer adopts for ending performances, though it is significant that he does not lift his hand in the exaggerated manner.

Figures sb1.13-sb1.16 show the tracking data for the right hand, for which no significant differences between manners in the analyses of variance were found. A quick examination of these tracks confirms that the patterns between manners are very similar for both x- and y-axis, and that in the y-axis tracks there is very little up and down movement in any manner. The x-axis tracks demonstrate that there are few deviations away from the key playing position. Of these deviations there are forward motions in all three manners at 0.6 to 0.8 in the first half of the Bagatelle shown in figure sb1.13, and backward (towards the body) motions of the right hand in the second half of the Bagatelle shown in deadpan and projected manner at 0.9 to the end of the piece.

One value of examining the differences between the hand tracks is to note any coordination there may be between the hands and the upper body. If the x-axis figures for head, neck and both hands are examined, it is evident that there are some moments when either large or particularly notable movements occur that are common to both the head and the hands. For instance, in figure sb1.1b and c there is a trough illustrating a backward movement at 0.5, which corresponds with forward hand motions in the x-axis data shown in figures sb1.9 and sb1.13. Similarly, the highest peaks in forward left hand motion in figure sb1.9 coincide with the highest peaks in forward head motion in figure sb1.1 at 0.6 in projected and exaggerated manners. In the second half of the Bagatelle, a trough at 0.9 in figure sb1.3 for the head coincides with a plateau for the left hand (see figure sb1.11). This indicates that as the head moves to a backward (trough) position, the left hand moves forward and remains in this virtually still position whilst the head moves forward to an upright sitting position. Thus, it seems that at moments where all manners produce movements which are different from the majority of the tracks, there is a correspondence in the movement of another part of the body, whether it be head and left hand, or neck and head. The head and neck correspondences are rather less interesting however than those of head or neck with hand for the purely anatomical reasons discussed earlier. The implication of the head or neck and hand link is that the two parts of the body are working together. This supports the point-light finding that it is head and wrists in combination which provide a source of perceptual information comparable with a full point-light kinematic display.

4.2.4 SUMMARY

The analysis of variance results of this study show that between the three manners of performing the Beethoven Bagatelle: i) there is less bodily activity in the deadpan than in either the projected or exaggerated manners; ii) although there are differences across manners between both the x- and y-axis measures for head, for the hands it is only the left hand x-axis which reveals a difference across manners.

In the examination of the raw data tracks the study reveals that: i) whilst the amplitude of the bodily activity is different across the three manners of performance, the head and the hands have many common patterns of movement (that is a movement feature for deadpan head has a corresponding feature in projected manner, though the movement is larger in projected manner than deadpan) with only occasional idiosyncratic deviations from these patterns across all three manners; ii) the additional neck measure has a very similar x-axis profile to that of the head, although the y-axis shows a far more restricted range of movements.

These results suggest that movement quantity contributes towards the perception of a particular manner: the more movement, the more expressive the perception (deadpan manner is given the lowest expressivity score and contains the least movement whilst exaggerated manner receives the highest expressivity score and most contains the most movement). The occasional unique manner deviations from the common movement patterns also indicate possible informational sources for the detection of particular manners, although these unique movements are few, therefore they seem unlikely sole determinants of manner.

Amongst the possible determinants of the movement patterns, note production is one factor, and since movements of similarity or difference occur at similar points in the score, it could be that musical structure may be directly related to performance expression. It is possible that the performer may be informing the observers about some feature of the structure of the piece and it is perhaps this information which permits them to determine manner.

Note production also provides an explanation for why it is that the hands alone are more difficult to distinguish between manners: clearly they are more constrained to the technical activity of note production than the neck or head. However, the tracks suggest that in combination the head and hands patterns seem to reflect some of the same moments in the music. It could be that these two areas body provide coordinated information - something along lines of Cutting and Proffitt's (1981) concept of a centre of moment, that is, an abstract location around which and in terms of which movements are evaluated.

Now that movement differences and common movement patterns between manners have been identified and described, it is essential to determine whether these motions of increased amplitude and idiosyncratic deviation are perceived as expressive, and if so whether they are in fact indicative of a specific performance manner and whether it is these structurally important moments which provide the manner information.

4.3 THE VISUAL IDENTIFICATION OF EXPRESSIVE LOCATIONS

4.3.1 INTRODUCTION

It is necessary to verify that measurable differences between performance manners are perceptually available to observers. Indeed, it is important to establish if the moments of deviation from the overall constraints of note execution in the hands or stillness in the head and neck are identified as moments which contribute towards the perception of different manners of performance. Thus in this study, observers were asked to view the three manners of the Bagatelle performance in normal video playback conditions and to identify any features of the performances which they thought were informative about the manner.

4.3.2 METHOD

Subjects, Apparatus and Stimuli.

Six musicians (2 lecturers and 4 post-graduate researchers with a mean age of 32.5 years) from City and Newcastle Universities participated as observers in the study. They were asked to view the video recordings of the Beethoven Bagatelle in a normal brightness/contrast setting. No modifications were made to the original recordings which were shown completely unedited - but without the sound - and were viewed on a 24" colour TV monitor.

Procedure

The observers viewed the videos sitting approximately two metres from the monitor. The experimenter sat to the side of the monitor to operate the video controls. Prior to running the video, observers were told the following about the study:

> *"You are about to see three performances of the same piece of music played by the same pianist. For each performance the pianist was given a different set of instructions about the interpretation of the music. From the visual information contained in these recordings of the performances, you are requested to identify all the moments which you believe to contain information you consider to be expressive and - as far as you are able - to give reasons for your*

selections."

First, they were asked to watch the three performances without any pauses. Then, in a second run-through, they were asked to stop the film at the points where they were aware of an *"expressive moment"*. All such locations and comments were recorded by the experimenter who noted the durations and locations of the expressive moments in terms of the bar number, and in real time. The observations were undertaken by three individual observers, and three observers who viewed the film together and made a group judgement. It took the observers between 50 and 60 minutes to undertake the test.

4.3.3 RESULTS AND DISCUSSION

The recorded observations showed a high level of agreement between the individuals' and the group's judgements for the identification of expressive locations in all three manners. Prior to discussing the locations in more detail, it is important to point out that all the observers noted that in the projected and exaggerated manners the performer set up a continuous rhythmic forward and backward swinging motion which was in itself expressive. However, for the identification of distinct moments within the performances, the observers gave themselves the criteria that moments would be chosen which either deviated from the swinging movement and which stood out as expressive in their own right, or else which were integral parts of the swinging pattern but which seemed particularly expressive at that moment. Interestingly, the observers spoke about the expressive moments exclusively in terms of either head and upper torso movements or hand movements. These commentaries were entirely spontaneous and corresponded well with the point-light reduction study which had revealed that head and wrist movements in combination provided information for the correct identification of different performance manners. Some fleeting reference was made to facial muscle movements, but these references indicated that a raised eyebrow or a dropped jaw were detected as extensions of a head movement and, therefore, informative in the same way as a head movement. Thus, although there was an awareness of expressive information being contained in the face, none of the observers seemed to regard it as a principal conveyor of information. The high levels of agreement between the observers locations of expressive moments indicated that even if head and hands were not the only conveyors of expressive information, these were areas of the body which readily conveyed the character of the performer's playing. This is important, since it confirms the choice of head and hands for the tracking study.

The head and left hand expressive moment locations are shown in figures sb1.17a, b & c. The locations are limited to the left hand as it was the only hand to be identified as a conveyor of expressive information. Of all the expressive locations, 47% were reported by all the observers; 38% by 3 of the observers (the group judgement and 2 of the other observers); 12% by 2 of the observers (the group judgement and 1 other); and only 1% were made by individual observers (this is a hand movement noted by observer 2 at the beginning of bar 1 in the deadpan manner). This suggests, therefore, that very similar kinds of perceptual information about moments of consciously identifiable expression are available to the observers. The only observer who notes slightly fewer expressive locations is observer 3. This is probably the result of a focus of attention on the hands as opposed to the hands and head, for if her locations are examined it is only the locations for the head which are fewer in number. Across the three manners of performance, the observers show differences in their decisions about the lengths of the expressive durations. It seems that in some instances observers see one long location, whilst other observers see several short locations. Discussion with the observers revealed that some detected distinct movement shapes at locations, whilst others just saw a section of different movements all of which were perceived to be part of one particularly expressive section of the performance.

Comparison of these locations with the score suggests that the links discussed in section 4.2.3 between the production of structurally important moments and expression have some foundation (for instance there are expressive locations in bars 2, 4 and 8 which correspond to the phrase climaxes), although these locations show only the number and durations of expressive movements, and therefore provide somewhat ambiguous information for interpretation. It is difficult to know whether the expressive locations made for the deadpan performance consist of movements similar in type to those identified in the exaggerated performance. Therefore, it is important to know where precisely in the tracking pattern these locations occur. Furthermore, it is essential to discover whether the deadpan locations are expressive simply within the terms of a deadpan performance, or whether they are expressive in any context. There are a couple of idiosyncratic expressive moment locations (bars 1 and 13 for the head in the exaggerated performance, and bar 7 for the hand in deadpan manner). It is important to discover whether these movements correspond to any of the other movements in terms of their shapes and durations or whether they are unique and specific to those particular moments in the renditions. However, in the main there is an absence of inexpressive moments - only beats 3 and 4 of bar 1, beats 1 to 2 in bar 2, and beats 1 and 2 in bar 13 appear to be without expression - which suggests that the content of the movements at these locations must be different across manner, for if the content were similar, the hypothesis would be that deadpan manner would contain large numbers of inexpressive moments and the exaggerated would have virtually no inexpressive moments. Finally, since the observers do not report swinging motions in deadpan manner, it may be that the absence of the swinging motion could constitute a deadpan manner. This certainly is a feasible hypothesis when it is recalled that the numbers and positions of the expressive moments are similar to those in the other manners.

In sum, these expressive locations imply a number of explanations for an observer's ability to discern different manners from the visual information. These explanations include the following: i) the overall swinging motion in projected and exaggerated performances distinguishes them from the deadpan performance; ii) the different durations of the expressive locations across manner have a role in determining the overall expressivity of a manner, for in some instances the deadpan expressive locations are shorter than those in the exaggerated manner; iii) the locations idiosyncratic to a manner may hold important expressive clues; iv) the large number of expressive moments in all manners suggests that these moments must differ qualitatively between manners; v) the discussion of specific movements indicates that there are perhaps recognisable movements which solely depict expression - that is, movements which are of no technical importance.

Further clues about the nature of the locations can be extracted by comparing the identified moments with the tracking data and by referring back to the musical score. However prior to doing this, it is necessary to determine which of the different observers' locations should be used. A systematic way to do this is to select those locations which are common to the majority of the observers' selections. Therefore as there was a near consensus between the group and observers two and four (87% of the locations), the locations shown in the following tracking display are those from the group's locations.

Figures sb1.18, sb1.19, and sb1.20 show the tracking data for head and figures sb1.21, sb1.22, and sb1.23 illustrate the left hand, with the expressive moments identified by the observers indicated by solid lines.

For the head, figure sb1.18 shows the deadpan performance. Here it is interesting to observe that the single largest forward motion is detected as being in part expressive (location two shows that it is in fact when the performer moves backwards and upwards from the forward peak that the movement is expressive), and that the two largest downward motions contain expressive moments. For instance, location five shows that when the performer moves back from the forward peak of the upward motion an expressive moment is observed. Similarly, location fourteen shows that the expressive moment occurs as the performer moves backwards and upwards towards the trough upward position. This finding indicates that there may be an equation between larger amplitude head movements and expressivity.

However, it is interesting that this performance (which shows a limited overall quantity of head movement) includes locations which contain moments of stillness which are considered to be expressive. For instance, locations one, eight and the final expressive location all include stillness. Of course it is not clear whether it is the still or the moving part of the location which makes the moment expressive, but one observer did comment upon the stillness and suggested why (for him) they are detected as being expressive. The comment is made about the very opening of the deadpan manner:

> *"Just look at that: the first note is struck, the head nods slightly and then the body position is "frozen". This stillness gives the effect of a pose which seems apart, yet by being detached, the pose is expressive...That lack of movement characterizes the whole physical delivery of the piece."*

It is clear from this comment, therefore, that expression is not simply dependent on large amplitude movements. As further evidence for this, if all the expressive locations are examined in relation to the tracks it is apparent that the tracking measurements for many of the expressive moments are identical to many other moments in the piece which receive no expressive markings.

Figure sb1.19 shows the projected performance. Here the large swinging motions described by the observers are plainly visible in the forward and down, and backward and up, smooth peaks and troughs of the tracks. Interestingly, the observers identify only parts of these motions as being expressive. For instance, locations two, three and four are all extracted from one large backward and upward swinging motion. There is no evidence in the tracks to indicate what feature of the swing elicits the expressive percept. However, the observers' descriptions suggest that these swinging motions do contain particular shapes that have identifiable beginnings and endings. In fact, one observer actually noted:

> *"I can see some surges or nods in these swings which have their own distinctive quality. By the way, I've seen these similar nods in the other manners too, but each manner seems to have its own character."*

Figure sb1.20 shows the exaggerated performance, complete with large swinging motions. Here it is evident that large sections of either the peaks or troughs are considered to be expressive.

If cross references are made between the three manners it is apparent that some of the common expressive locations have similar tracks. For instance, across all manners at bar 20 (see location thirteen in figure sb1.18, location eighteen in figure sb1.19, and location nineteen in figure sb1.20) there is always a backward and upwards moving swing - even in the deadpan performance where swings are not reported by the observers. However, there are other common locations for which the tracks are quite different. For instance, the common head location at bar two in both the deadpan and the projected manners occurs on a backward and upward motion (location two for figures sb1.18 and sb1.19). Yet in the exaggerated manner (figure sb1.20 location two), this location occurs on a forwards and downward motion. Similarly, the common expressive location in bar 6 is revealed as a small backwards and downwards movement in deadpan manner (figure sb1.18, location six), a surge forwards then retreating swing backwards in the projected performance (figure sb1.19, location five), whilst there is a forward peaking motion in the exaggerated performance (figure sb1.20, location five). These tracks for the common expressive locations do not give any clue as to the determinants of manner. However, the distinct types of common location (those with similar patterns and those with very different patterns) indicate that the observer must use more than just differences of amplitude between manners as perceptual guides.

If reference is made to the score (figure 4.1) and the locations for the head, it is evident that important structural moments in the score are identified as expressive locations. For instance, for the head in figures sb1.18, sb1.19 and sb1.20, the second location occurs at the phrase peak in bar 2 of the Bagatelle; location 4 in sb1.18 and sb1.19 and sb1.20 occurs after the cadence at bar 4 and just before the new material at bar 5; and location 8 in sb1.18, and locations 10 in sb1.19 and sb1.20, occur at the new high soprano entry at bar 11. Figures sb1.18, sb1.19 and sb1.20 reveal that all performances have expressive locations at the end of the piece where the final cadence occurs. This evidence suggests that musical structure may underpin the expressive locations, and therefore, the expressive movements themselves.

However, it is important to note that a location made in one manner at one specific structurally important moment in the score is not necessarily identified in the other manners: for instance, the location in beat three of bar thirteen (location thirteen in figure sb1.20) is not found in the other manners. On occasions such as these it would seem that there may be important structural information, but it does not consistently elicit an expressive identification. This would suggest that there is more underpinning the expressivity of the performance than musical structure alone. What makes this example particularly interesting is that the shape is similar to other tracking patterns in the exaggerated manner. This of course raises the question of why this moment is perceived as expressive whilst other moments are ignored. One possible explanation is that there is a physical adjustment which contains qualitatively expressive information, even though the size of the movement is same as other moments in the piece.

For the left hand, figure sb1.21 shows the deadpan manner. Every time the hand leaves the keyboard it is interesting to note that an expressive moment is perceived. This would suggest a relationship between movement quantity and expression. For instance, the tenth location occurs when the hand leaves the keyboard and is lifted high in the air. Similarly, the final moment of the piece includes a high lift which is also identified as being expressive. Structurally, it seems that the fact that there is "*space*" in the left hand (it has rests at location 10 which corresponds to bar 16, and there is a held note which provides time for the hand to move at the end of the piece) may elicit particularly expressive movements. Location four which occurs when the hand is in forward peaks and locations five and seven which occur when the hand is making movements backwards are all far larger than the vast majority of the hand peak and trough movements. This suggests that the hand is able to leave its close proximity to the keyboard and when this occurs expressive moments are detected by the observers. Structurally the locations share common features. For instance, location five occurs at bar

9 where there is a long rest, and location seven occurs at bar 11 where there are rests in the bass line. The only exception to this pattern of expressive locations at rests is location four which occurs at the start of the new phrase at bar 7. However, this clear structural break, provides a clear motivation for this hand lift.

It is not only larger movements which have similar structural and expressive locations, however. For instance, the movement at location 11, which occurs at bar 18, does not deviate from the majority of movements in the data, but it occurs at a rest before the new phrase and new musical material at the end of bar 18. Evidently the amplitude of the movement may contribute towards the perception of expression at these moments, but since small movements also occur at expressive locations, it seems that there is a clear case for linking perceived expression in movement and structurally significant moments in the music. The primary structure which seems to elicit expression is the held note, or rest, which provides "*space*" for the hand to manifest an expressive movement.

Figure sb1.22 shows the projected manner of performance and displays many similarities to figure sb1.21 in the graphic appearance of the located expressive moments. In common with sb1.21, the locations occur at structurally significant moments: location one occurs at bar 2 and location 9 occurs at bar 20. It is worth noting that these two locations which are not remarkable in terms of amplitude do not occur at rests. The more obvious locations in terms of larger amplitude do: for instance, the hand is in a peak forward motion at locations five (bars 8-12 where there are lots of opportunities for hand movements in the rests) and the final location (bar 22 where there is a crotchet rest in both hands). Thus, a link between structure, expression and amplitude seems apparent, but not in any simple way. Indeed, there is a distinctive forward and high hand lift in the final third of the projected performance which is not identified as an expressive moment even though it occurs at bar 16 where there are rests in the left hand. Since the lift in itself is not enough, there must be other information communicated for the observers to perceive an expressive moment.

Again, in figure sb1.23 (the exaggerated manner) when the hand leaves the keys an expressive location is identified. For instance, locations four (bar 6-7), five (bars 8-12), eight (bar 16), and ten (bar 18) all include lifts and all these locations occur at either rests or held notes. As for the other manners, there are moments such as locations one and two, which are not in any way different from unidentified hand movements. Although this performance does not finish with a hand lift, it is interesting to note that the final bar is still noted as expressive.

These hand locations are both interesting and in some respects surprising. At one level, it is possible to see a relationship between large amplitude movements, expressivity, and musical structure. However, as there is a lift which occurs in the final third of figure sb1.22 and which is similar in both amplitude and location (a rest) to lifts in the other two manners, but which is not noted by the observers as an expressive location, there is an indication that the relationship between amplitude, structure and expressivity is not a constant one and at least some perceptions of expressivity must include other kinds of information too. One observer's comment is interesting in this respect:

> *"... that type of hand lift happened in the other performances, but here the performer just lifts his hand in the air for no apparent purpose. In the other performances his hand communicates its meaning, by that I mean that the hand movement has a clear trajectory, and direction, even a shape."*

Thus it seems that the quality of the movements is vital.

Indeed, another observer said of expressive locations one, two and three of the exaggerated manner performance (figure sb1.23):

> *"These movements are the tiniest flexions of the wrist. When you look at the performer's whole body the essence of his appearance is captured in these motions. This performer seems to use these very small movements quite a lot."*

In the earlier discussion of the movement tracks (see section 4.2) it was hypothesised that the similar movement patterns of different amplitudes across manner may contain expressive information, for, in terms of the score, there were interesting structural features of the music at these points. Certainly, it is interesting to observe that all the observers note an expressive location in both the head and the hands at bar 2, that structurally this was an important moment, and that it was a moment in which there was a forward motion. However, the forward surge was detected as being expressive only in exaggerated manner, whilst in the deadpan and projected performances, the expressive locations occurred as the performer moved away from the phrase climax (see the second expressive locations in all of the figures for the head). Of course it is feasible, as the observer who referred to specific head nods commented, that the performer may actually make some specific movement within the swinging motion at the location points. It could be this specific movement which elicits expressive effects which would account for the slightly different durations of the expressive locations.

Finally, linking back to the earlier discussion in which the importance of the coordination between the head and hands is examined, it is apparent that whilst a forward head motion may occur when the hand is lifting, there is no real evidence that the head and the hand are part of the same movement, though the earlier quoted comment about wrist motions characterizing the essence of the body's movement quality does suggest that the coordinated movements have the same origin.

4.3.4 SUMMARY AND CONCLUSIONS

The expressive locations reveal: i) a high level of consensus between observers in their selections of the locations; ii) that the majority of the expressive locations occur at the same point in each performance though their durations vary across manner. When viewed in association with the movement tracks and the musical score, these locations show: i) there is a relationship between movement amplitude and expressive location, and a relationship between musical structure, amplitude and expressive location; however ii) many "*unremarkable amplitude*" moments are perceived to be expressive whilst other large amplitude moments are not detected as being expressive; iii) the observers' comments reveal that the style of the movement is important, and that there may be specific movement shapes used by the performer. Given the latter points, it could be that the qualitative differences between manners stem from movements of similar amplitudes, but whose shapes afford different expressive meanings.

Initially, however, since these results indicate that expressive information is more apparent in some locations than others, there is a need to investigate whether manner can be detected by observing short excerpts of the three manners (Cutting and Kozlowski, 1977 found that only two seconds of kinematic information was necessary for the detection of gender), or whether the whole performance or sizeable excerpts (10 seconds and above - as was the case in the point-light studies) are necessary. In other words, it is important to discover whether it is just the specifically identifiable expressive locations which include perceptual information for the detection of manner. Of course the observers' comments about the expressivity of the swinging movements is not to be forgotten, and it is feasible that when these expressive moments are combined with the swinging movement the result is expressive. It could be that the locations derived from the projected and exaggerated manners were simply portions of the swinging motion that were easy to detect, and which, out of context, have no expressive meaning. Furthermore, the whole performance context could have been a reason why similar movements like the nodding (which was referred to by one observer as a movement which appeared in all three manners at the same locations) were perceived differently.

4.4 EXPRESSIVITY RATINGS OF ISOLATED LOCATIONS

4.4.1 INTRODUCTION

In order to find out more about what links and differentiates expressive locations and the movements contained within them, this study examined whether the context of the whole performance was necessary for an individual movement to be detected in terms of its manner.

For the study, observers were asked to view and rate the expressivity levels of two second excerpts taken from each manner. The two seconds segments were those used in the previous tracking study. The experiment therefore has the potential to verify whether the measurable differences between the segments demonstrated in the tracking study correspond to perceptual differences.

4.4.2 METHOD

Subjects and Stimuli

Fifteen postgraduate music students (8 male and 7 female with a mean age of 24.4 years) from City University acted as observers. They viewed from the three manners of the

Beethoven Bagatelle under conditions of normal illumination (that is, not point-light). The complete collection of two second segments were put in a rank order according to spatial difference scores (see section 4.2.3) and split into upper and lower quartiles. Segments from the lower and upper quartiles for each manner were randomly presented to the observers. (Because of the differences in the lengths of the renditions - deadpan, 52 seconds; projected, 59 seconds; and exaggerated, 61 seconds - there were 6 low difference score segments and six high difference score segments for deadpan, 7 for low and 7 for high projected performance and 8 for low and 8 for high in the exaggerated performance.) Since the two wrists in combination had provided the information for the observers in the point-light reduction study, and since the right hand could not be excluded from the two second segments of the Bagatelle performance, the difference scores for each wrist calculated for the analysis of variance in the tracking study were combined to produce a single score from which the quartiles were derived. As it was the head rather than the neck which had provided the most salient information for the observers in the reduction and the observation studies, and as these tracks had produced similar x-axis tracking patterns, the head segments were selected in preference to the neck to illustrate the torso/head movements. In presenting these segments on video, only the relevant body parts were shown by using a masking card to blot out the rest of the body. (See figure 4.6 for examples of the use of the masking card.) From a potential of 84 segments, only 75 were finally used for the test because of faults in the edits: there were five mistimed 2 second segments and four segments with rolling sound bars. The test segments were randomly arranged on 5 video tapes (15 segments per tape), and these video tapes were in turn randomly presented to the observers so that each observer saw a different combination of the five tapes. Gaps of 10 seconds were placed between segments and a period of five minutes between films.

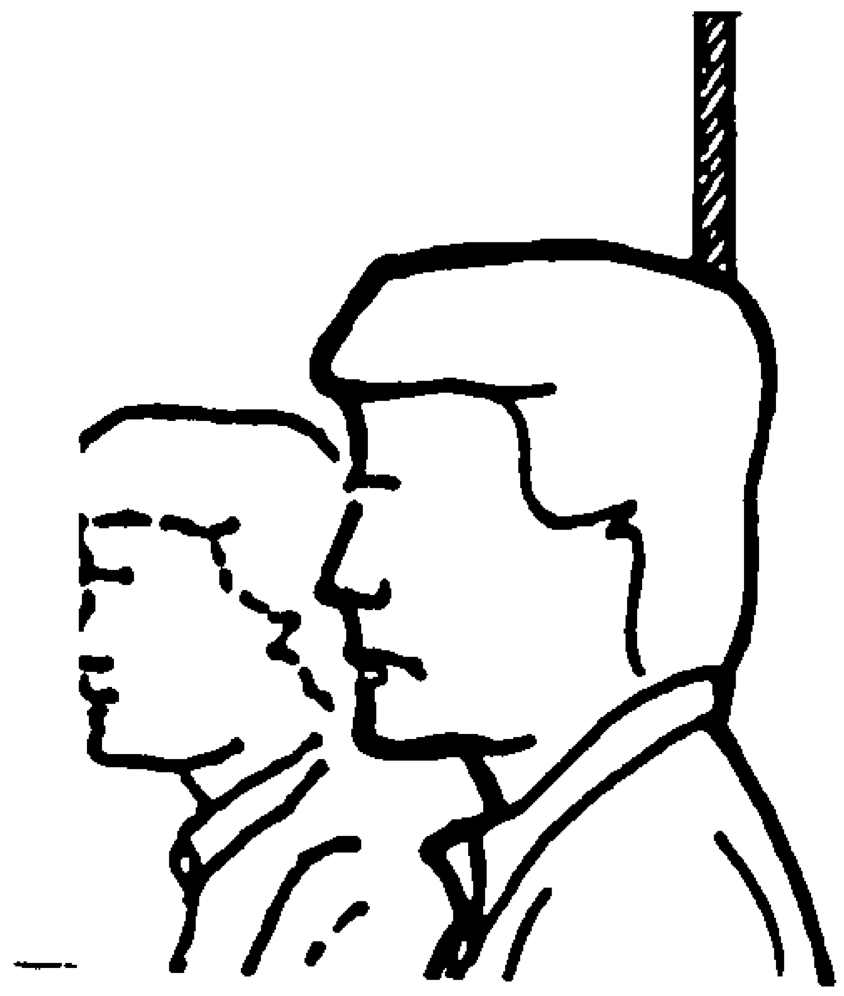
Interestingly, there is a strong correspondence between the quartiles and the expressive locations of the previous study, 97.4% of the high segments and only 24.3% of the low segments corresponding to the expressive locations.

Apparatus and Procedure.

The edited videos were shown on a 24" colour monitor with portions of the screen blanked to conceal all but either the hands or head regions of the pianist's body (refer back to figure 4.6). The excerpts were shown in normal brightness/contrast display without sound. Viewing the films individually, each observer sat at a distance of 1.5 metres from the monitor. The observers were asked to rate the expressivity of each 2 second excerpt using the seven-point inexpressive-highly expressive scale used in chapter 3, and after a brief explanation of the scale, three practice trials were presented to the observers to establish segment lengths and the interval between them. These trials used segments not included in the prepared test video. Subsequently, each observer viewed the test segments in a random order.

There were gaps of five minutes between each tape; otherwise the tapes ran continuously, observers having a ten second gap in which to rate the segment. (See video examples 7a-7m for an illustrative selection of test segments.) In total, the experiment ran for approximately 50 minutes. Like all the preceding studies, the observers were told they would see excerpts from different interpretations of the Bagatelle. At the end of the observations, they were asked to respond to the following question:

> *What were your rating criteria for the segments? That is, did you make your judgements based on the quality or quantity of the movements you observed? Did you rate expressivity according to the amount of movement, or the style of movement or some combination of quantity and style?*



A

B

Figure 4.6 showing: (a) the isolated head and (b) the isolated wrists for the observations of the two seconds segments.

This question was included since the former study had suggested that there were some qualitative differences between specific locations which had little to do with movement amplitude or musical structure. The observers were given as much time as they required to answer the question, and were given the choice of either writing their responses or dictating them to the experimenter.

4.4.3 RESULTS

For each observer a mean score for the segments in each of the six conditions (3 manners and 2 quartiles) was calculated, and possible differences in the scores for the hands and head were examined through two separate 3 (manner) X 2 (quartile - high/low) mixed design analyses of variance with repeated measures - one for head and one for hands.

The analysis for head revealed main effects for manner [$F_{(2,28)} = 196.21$, $p < 0.0001$] and quartile [$F_{(1,14)} = 110.44$, $p < 0.0001$]. Figures 4.7 and 4.8 illustrate the mean scores for these variables. Figure 4.7 for manner shows that the three manners are distinguished from one another and that the rank ordering for deadpan, projected and exaggerated performance is as expected. Similarly, figure 4.8 shows that high difference score quartile segments are awarded higher overall expressivity ratings than the low difference score segments.

The analysis for head also shows a two-way interaction between manner and quartile [$F_{(2,28)} = 9.56$, $p < 0.001$]. The mean scores for the interaction are shown in figure 4.9. There is hardly any difference between the low and high quartiles for the projected performance, by comparison with deadpan and exaggerated.

The analysis for hands reveals significant main effects for manner [$F_{(2,28)} = 73.11$, $p < 0.0001$] and quartile [F

(1,14) = 129.38, $p < 0.0001$]. The mean scores for manner shown in figure 4.10 indicate that the rank ordering for manner is the same as for the head, though with differences in the size of the effects between deadpan, projected and exaggerated as compared with the head data. For the effect of quartile, the mean scores shown in figure 4.11 again illustrate that low difference score segments for hands receive lower expressivity scores than the high quartiles.

The analysis for hands also reveals an interaction between quartile and manner [$F(2,28) = 36.77$, $p < 0.0001$]. Figure 4.12 illustrates this interaction in terms of mean scores. It demonstrates that low quartiles are essentially unaffected by manner (that is, they are not differentiated across manner), whilst high quartiles are. This indicates that only the high difference score segments become more or less expressive as manners change.

4.4.4 DISCUSSION

These are interesting and in some respects complex results to interpret. The main effect of manner for both head and hands indicates that two seconds exposure to a performance provides observers with sufficient information to detect differences between performance manners. Indeed, the rank ordering of manner scores established in the earlier studies is reproduced to suggest once again that the performer is able to convey his intentions to the observers even when only momentary excerpts are shown. This gives an affirmative answer to the main question of this experiment - whether expressive moments are still judged as expressive when they are removed from the context of the whole performance and when the stimulus materials are not just the specifically identified expressive locations. The fact that the manner is detected for hands alone suggests that there is perhaps more information in the full displays than the point-light reductions. As figure 4.6 illustrates, it was impossible to show just the hands, it may have been the

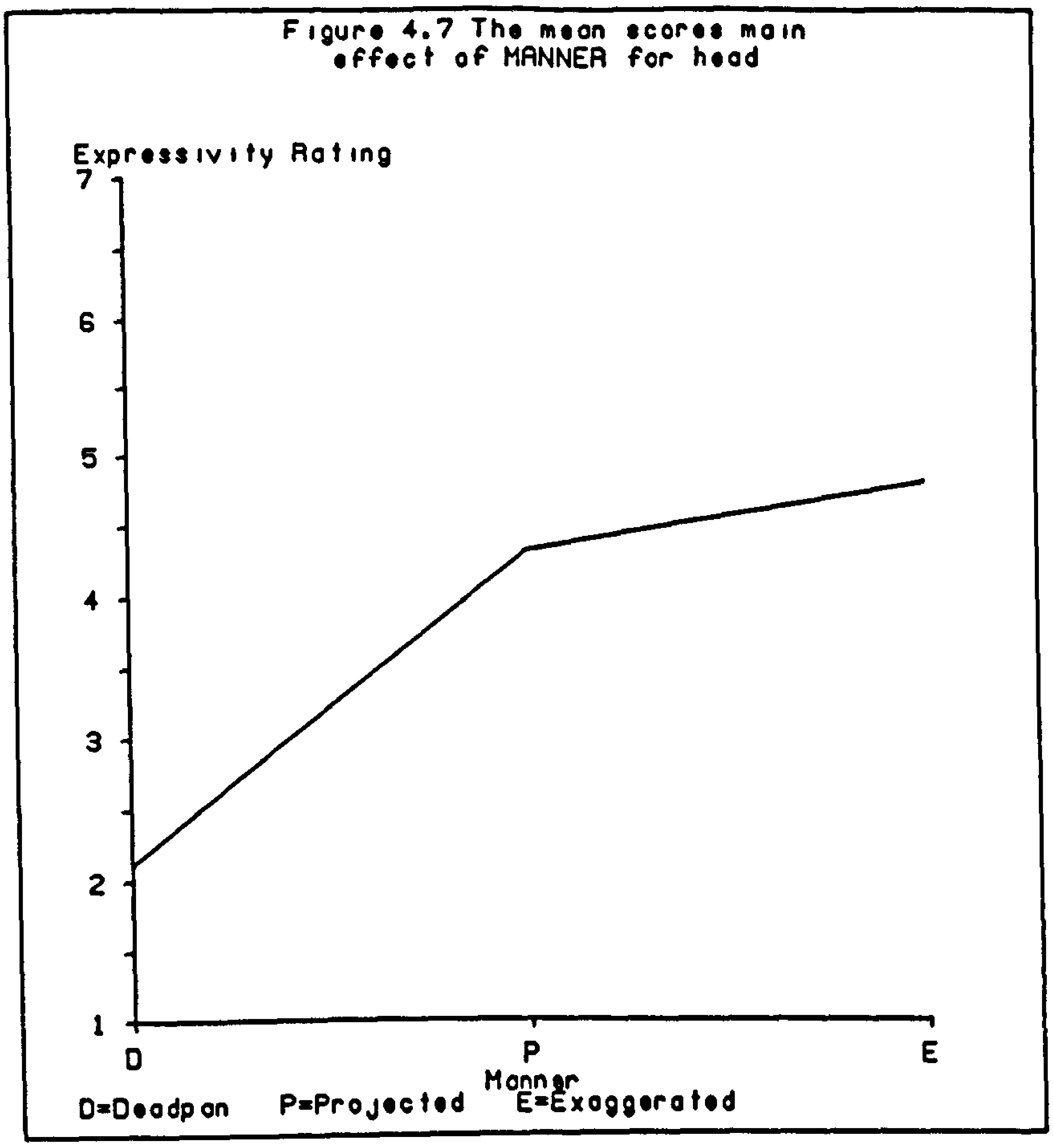


Figure 4.7 The mean scores main effect of MANNER for head
Expressivity Rating
7
6
5
4
3
2
1
D
P
E
Manner
D=Deadpan
P=Projected
E=Exaggerated

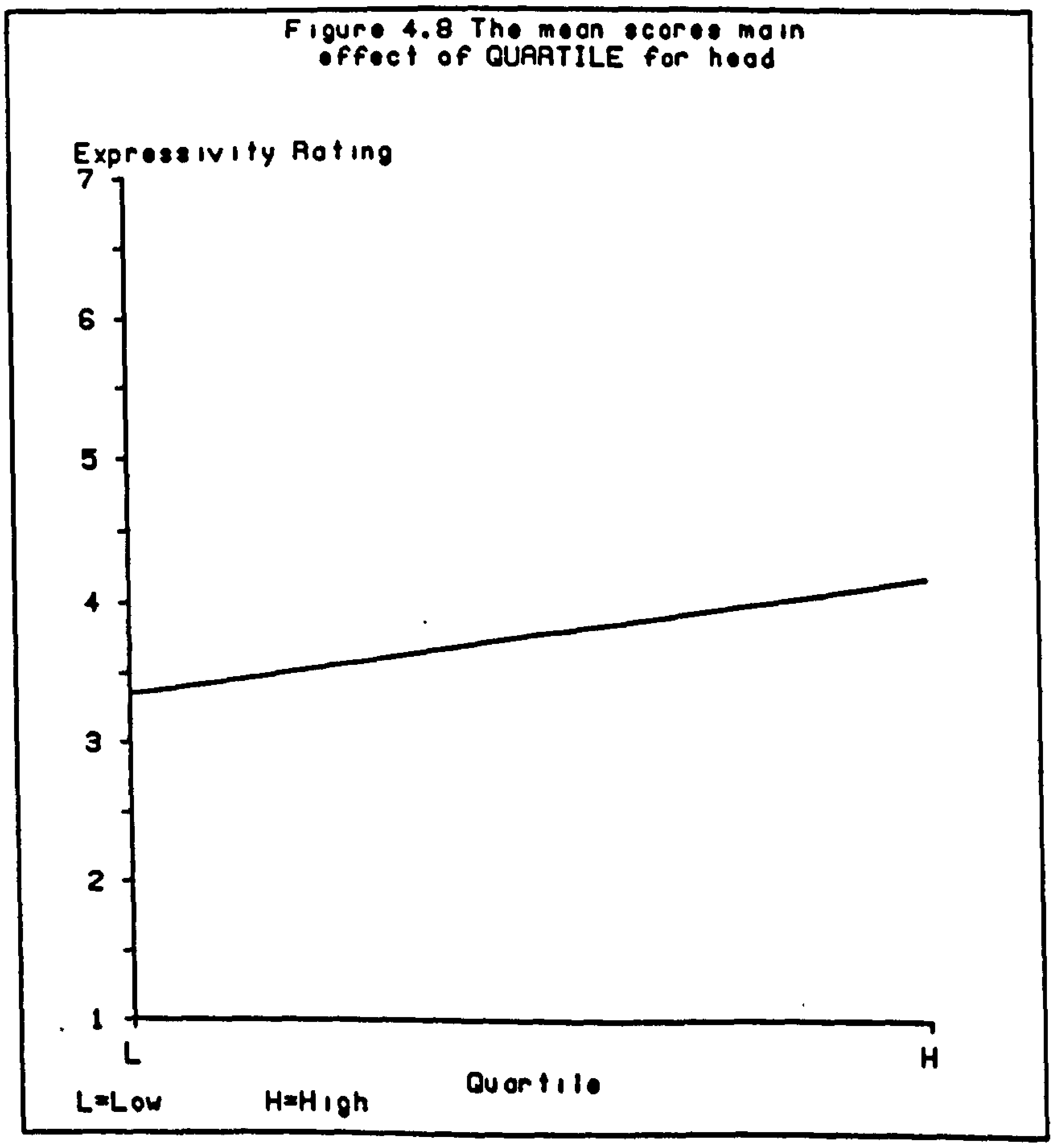


Figure 4.8 The mean scores main effect of QUARTILE for head
Expressivity Rating
7
6
5
4
3
2
1
L
H
Quartile
L=Low
H=High

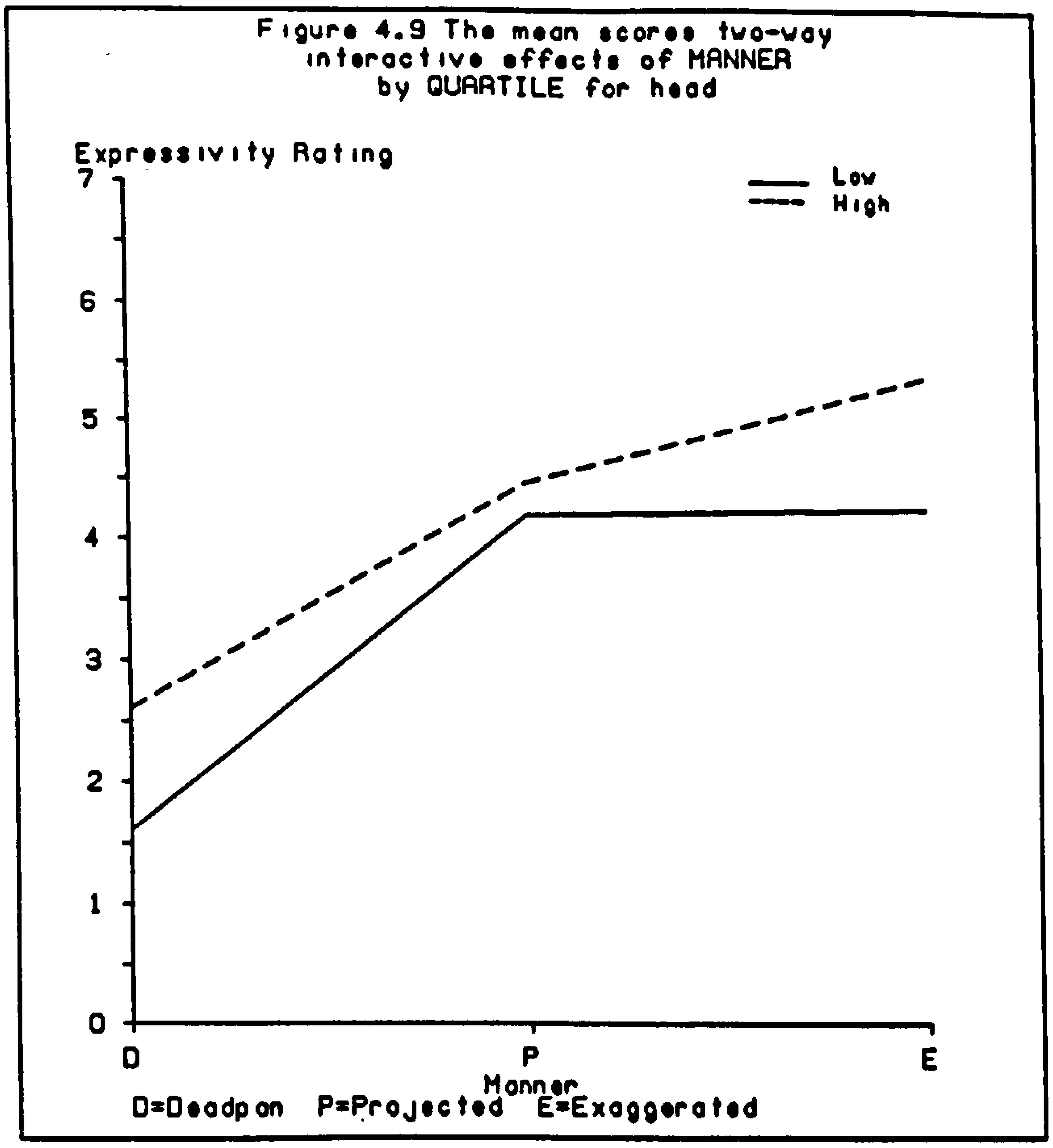


Figure 4.9 The mean scores two-way interactive effects of MANNER by QUARTILE for head
Expressivity Rating
7
6
5
4
3
2
1
0
Low
High
D
P
E
Manner
D=Deadpan P=Projected E=Exaggerated

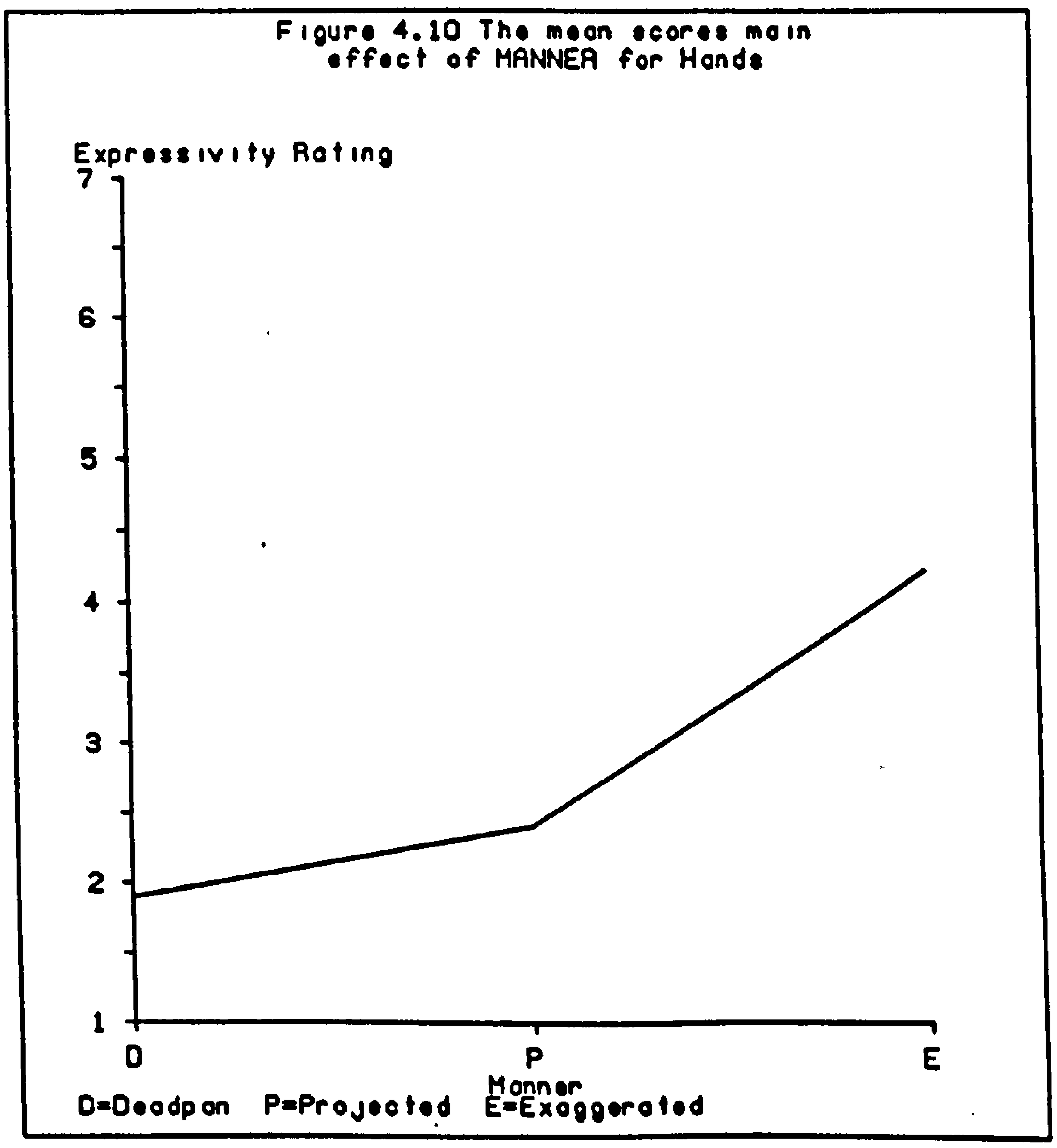


Figure 4.10 The mean scores main effect of MANNER for Hands
Expressivity Rating
7
6
5
4
3
2
1
D
P
E
Manner
D=Deadpan P=Projected E=Exaggerated

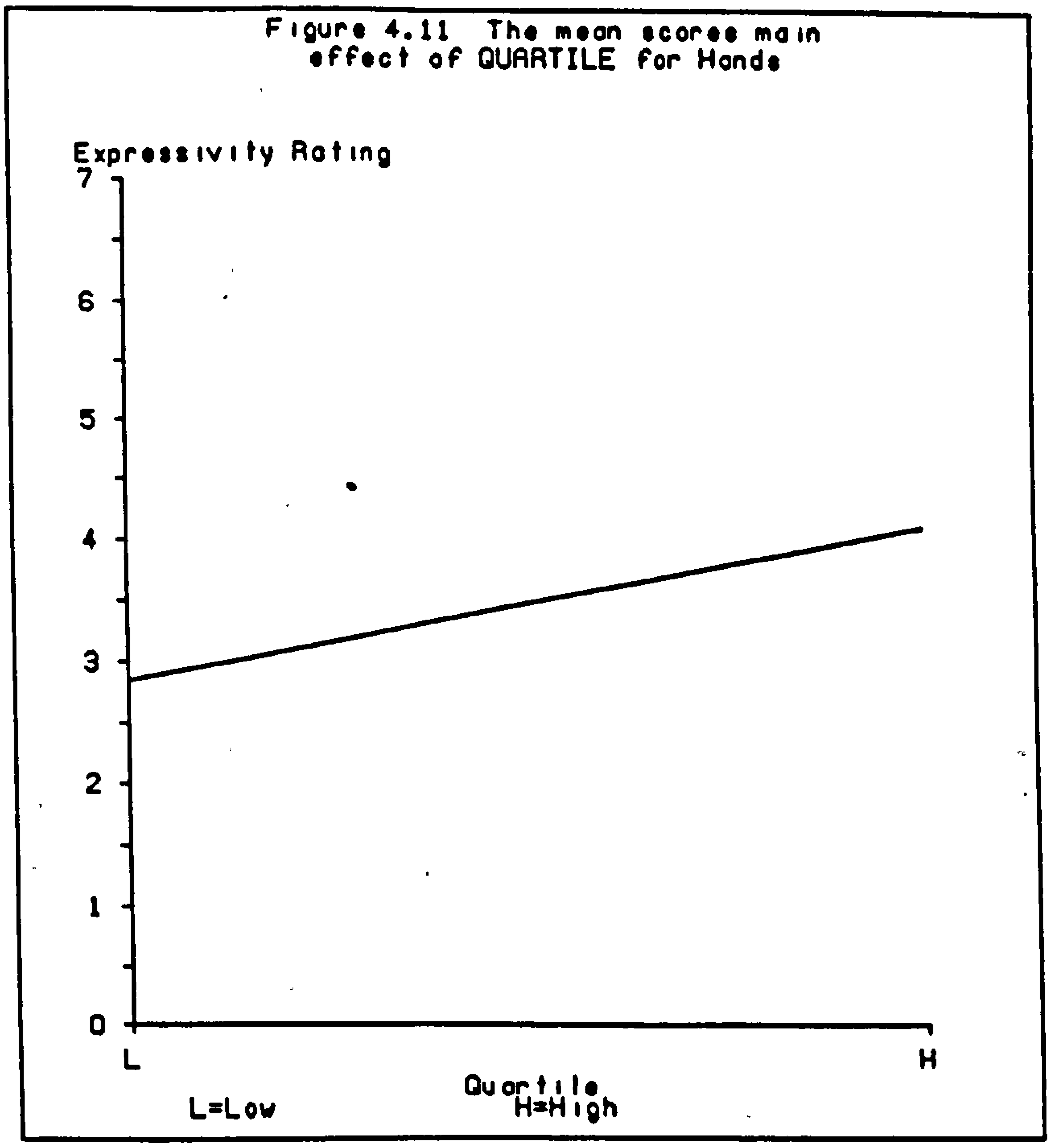


Figure 4.11 The mean scores main effect of QUARTILE for Hands

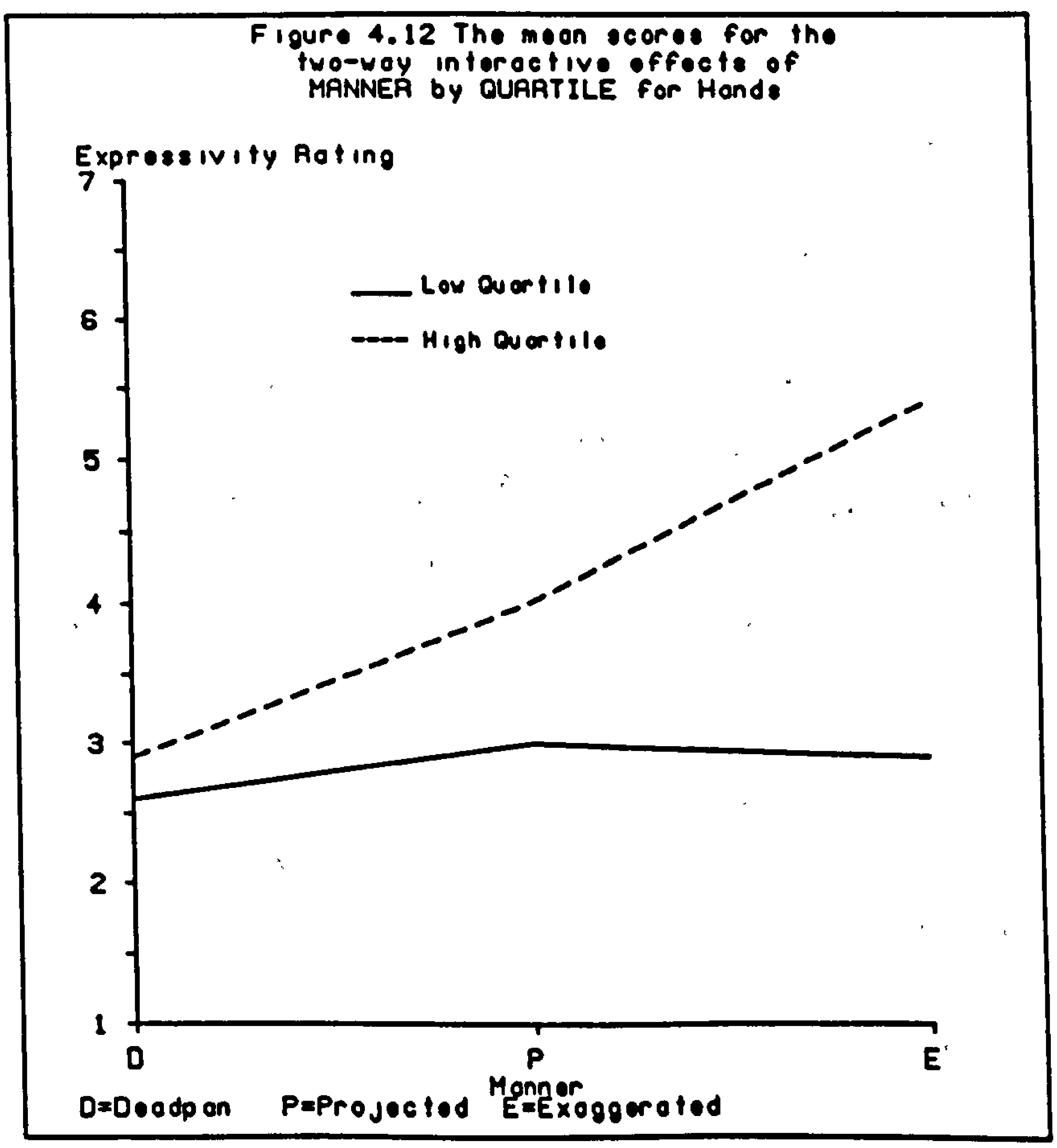


Figure 4.12 The mean scores for the two-way interactive effects of MANNER by QUARTILE for Hands

torso that provided the additional information necessary to determine manner.

When the interaction results for both body areas are considered, it is apparent that whilst manner is very easily distinguished for high difference score segments, the low difference score segments are a lot less informative about the manner of the performance. The reason for this seems to be that in the low difference score segments, stillness prevails and judgements are difficult to make without further context. This suggests once again that the observers must be judging manner in terms of the quantity of movement contained in a segment. Indeed, the main effect of quartile underscores this point: the high difference score segments are detected as being more expressive than low difference score segments.

This interpretation of the results seems sound, especially since there was a 97.4% correspondence between the high quartiles and the locations of the expressive moments in the previous study. However, there is something of a problem when the low quartiles are also considered since 24.3% of the low difference score segments for the hands occurred at moments that were identified by observers in the previous experiment as expressive. One possible explanation is that there may be something expressive in the head at the same moment which is not visible due to the selective blanking of the screen which leaves only the hand area visible. Another explanation might be that the high difference score segments are the most perceptually obvious or easy moments of expression to extract, and can therefore be judged out of context. The low activity or still moments might require more subtle perceptual judgements which the context of performance may facilitate. It is possible that the high level of popular support for extrovert performers such as Liszt and Liberace or in a different style Keith Jarrett, depends on the very direct expressive value of large amplitude movements.

The subjective comments of the observers provide some possible answers to the issue of observer response to the two second excerpts and to the full performances. For instance, one observer noted that the excerpts were so short that she did not have time to "*think*" about what was going on in the performance. All she could do was note the degree of activity and respond to the amount of movement she saw. However, there were other observers who were aware that the quantity of movement was not the sole criterion they used to judge a performance. Indeed, one other observer commented:

> *"That was a tough test. I spend ages looking at performers when I'm at a concert, so two seconds didn't give me much time to establish how that performer really moved! Though I must say there were some segments that contained a certain "mood" that was easy to know. Whether still or with an arm lift, I seemed to know instinctively about what the performer's body said to me... There were other segments that seemed to have no shape - as if a part of a movement was missing - and I didn't have a clue about what these segments were saying. Actually in such cases, I just guessed the rating - usually pretty inexpressive."*

From this comment it seems that at least some of the observers were able to detect different qualities in similar shaped movements, and that some were also aware of specific movement shapes.

4.5 EXTRACTION OF SPECIFIC MOVEMENT SHAPES

4.5.1 INTRODUCTION

The previous study produced interesting results which nonetheless failed to replicate the results of the tracking and the expressive locations study that some moments of stillness were detected as being expressive. Indeed, the study revealed that although manner was perceptible, the expressivity ratings of the segments were based essentially on the amplitudes of the movements. The present study was undertaken to help resolve the issue of the relative contributions of the quantity and the quality of movement to the perception of expression. It was decided to examine the locations of the expressive moments study (section 4.3) to see whether there were any identifiable movements specific to the locations which might convey expressive information. It was thought that this investigation could also help to resolve why locations common to the three performance manners were perceived to contain different expressive information.

4.5.2 METHOD

Subject and Stimuli

The experimenter acted as the observer for the study, basing her judgements on the information she had gleaned from the observation and the segment identifications studies. The stimulus was the video recording of all three performances of the Beethoven Bagatelle.

Apparatus and Procedure

The For-A-FM60 frame memory was used in association with an ordinary VHS editing suite to observe the recordings. Initially, the analysis was undertaken by looking at the moments identified by the observers in the observation study to see if any particularly distinctive movements could be identified. In order to do this, a slow, systematic observation of the performances was undertaken. All repeated body movements and particularly distinctive individual body movements were recorded in terms of their duration and a verbal description of the movement.

4.5.3 RESULTS AND DISCUSSION

After careful observation it appeared that the movements made by the performer at the expressive locations could be classified into nine distinctive and repeated movement shapes in the left hand and six distinctive types of head movement patterns. It is to be noted that every head movement identified corresponded without exception to an expressive location made in the study described in section 4.3. The same, however, is not true for the hands: there are a number of places in the three manners where hand movements of a non-technical nature occurred and which are of a similar type to the identified expressive movements but which did not match-up with any of the expressive locations from the previous study. The movement types are shown in the notation below and according to the expressive moment location in figure sb1.24.

Movements belonging to the same category, were not always of the same amplitude or speed in each manner or in each location, but always preserved the same character.[1]

THE HEAD

nod = ✦

reverse nod = ✧

shake of the head = □

forward swing⊛ = ⟶

backward swing⊛ = ⟵

wiggle of the back, shoulders or whole upper torso = ✱

⊛*Note that the forward and backward swing locations are the moments when an expressive moment is located yet where there is no identifiable movement pattern other than the swinging motion which has already been noted as the overall movement of the pianist.*

THE LEFT HAND

wrist rotation	= •
depressed wrist	= ▽
upward wrist movement	= △
raised, arched and held wrist	= ▲
raised forearm	= ∩
flicked lift of hand away from the body with fingers remaining in close proximity to the keys	= ↘
flicked lift of hand towards the body with fingers remaining in close proximity to the keys	= ↖
medium-high hand lift	= ↑
high hand lift	= ⬆
hand movement downwards (below the keyboard height)	= ⬇

In order to see what each of these movements look like, video examples 8a-8x show a selection of them randomly mixed from the different manners. Here it is possible to see what the selection criteria were to characterise each movement. In the case of the nod for instance, it always contains a forward and back movement which is led by the head, though it can involve the entire upper torso. The definite head movement distinguishes it from the forward and back swinging motion which seems not to involve the head in such a manner. For the reverse nod, the same rules of characterisation apply, though this head movement always occurs from a forward and downward head position. This can vary from an upright sitting position to an entire upper torso movement. For the shake, there is a range of movement amplitudes, but it is restricted to a head movement which can vary in speed. It is usually executed in the upright sitting position, but can occur at any part of the swinging movement cycle. It involves the head in a horizontal plane (side-to-side) movement. For the wiggle, again there is a range of movement amplitudes, but the features which distinguish it are that there is always a sideways movement of the torso - either just the shoulder or the whole back - which is fast and part of either a forwards or a backwards movement. For the hand movements, rotation involves the wrist in a 360 degree movement around the fixed point of the fingers. This can occur either directly above or below the keys, with the fingers remaining in contact with the keys. For the upward wrist movement, the fingers remain in contact with the keys and the wrist is raised over the keys. The depressed wrist also includes finger contact with the keys, but in this movement the wrist is dropped below key height. The raised, arched and held wrist, is self-explanatory, as are the remaining hand movements, though it is worth pointing out that the hand movement downwards does involve the hand leaving the keyboard.

Figure sb1.24 demonstrates that across the three manners a variety of movements is used in each manner. It seems that each manner does not have one specific type of movement associated with it. This suggests, therefore, that movement shapes do not have one expressive function; rather if movements are used in different manners they can elicit different messages. Indeed, on those rare occasions when a common movement type is used at the same point in the music across the three manners (for example, bar 11 with the shake motion notated), it is possible to see from video examples 9a, 9b and 9c that the essential form of the movement is the same across the manners, but that in the deadpan performance the motion is more confined to the head region, whereas in the exaggerated performance, there is a more liberal engagement of upper torso. Thus one conclusion that can be drawn from these examples is that the movement patterns are similar, but that as the amplitudes increase so the expressive message becomes stronger. However, if the majority of the locations are examined across manner, it is apparent that whilst the movements are of different shapes, there are also common features. For instance, consider bar 5 where there is a shake in deadpan and exaggerated manners and a swinging movement and nod in projected manner. It could be that these differences are the clearest evidence to explain why the manners are perceived differently: certain movements may contain specific kinds of expression. However, if video examples 10a, 10b and 10c are compared (bar 5 in each manner), although the movement shapes are different, it is possible to see that these movements have common features. For instance, the performer's spine is erect and there is a quality of control in all of the movements. This could have something to do with the production of the notes.

So far this discussion of the similarities and differences between manners has focused on the head, but a similar set of observations can be made for the hand movements. In fact, the hands provide interesting examples because of the evidence that the expressive movements only occur at points in the score where there is "*space*" in the structure (rests and held notes). Again however, although the lifts occur at similar points in the music, different types of hand movement are employed. For instance across the deadpan manner there is every kind of lift from flick lifts to high lifts. This suggests that although the movement may be executable because of the rest or held note in the music, the precise manner of the movement is different, though it has to be noted that across the same location in the three manners where different hand movements are found (for instance, bar 12 where there are raised wrists and medium lifts across manner - see video examples 11a, 11b and 11c) the speed of these movements is similar.

One feature of key importance in the perception of expressivity may be the rocking forward and backwards motion. Even the hand movements may be part of this swinging movement, the lift being an arm extension of the swing. Indeed, it seems that if the swing is not included, expressivity is not detected, since only the deadpan manner contains no swinging motion and this is perceived to be inexpressive. Therefore although specific movements can be characterised and notated at the expressive locations, it could be that they need to have the impetus of the swinging movement for their expressivity to be perceived. Indeed, this swinging impetus could be more important than the identified movement itself. It is possible that the specific movements detected at the expressive locations are movements that the performer has developed as an expressive movement *"vocabulary"* which, in association with the technique of playing notes, can be applied to the music in a non-specific way. That is, each movement can express a variety of ideas. It is equally possible, of course, that these movements are specific to this single performance and that in other performances specific movements for specific intentions may be used. Thus it is clear that this study raises many issues which need to be explored.

4.5.4 SUMMARY AND CONCLUSIONS

This study indicates that: i) this performer uses a series of movements confined to the expressive moment locations in the Bagatelle; ii) these movements appear at both similar and different locations across manner. This suggests (despite the indications in the tracking study that expressive locations often have tracking formations similar to non-expressive moments) that there are in fact specific physical features contained within an expressive moment which make it expressive. However, it is also possible to see that these specific movements all derive from the overall swinging motion the performer establishes in his performances. It appears that in many instances, each movement type (for instance the wiggle) can be executed in a range of ways which give the potential for a range of expressivity levels to be elicited. For instance, the same movements at the same locations often differ in amplitude. However, in other cases there are common locations across manners which are associated with different movements which nonetheless appear to share some common features.

Clearly, further investigations of the similarities and differences between the movements of all three performance manners need to be made before conclusions about the information contained in the expressive movements can be made.

4.6 QUALITATIVE DIFFERENCES BETWEEN MOVEMENT TYPES ACROSS THE THREE PERFORMANCE MANNERS.

4.6.1 INTRODUCTION

The two previous experiments in this chapter have already shown that locations in the music described by all observers as being expressive can sometimes consist of different kinds of movement (see the movements listed in section 4.5). This suggests that there is some complex relationship between the degree of expression perceived at a particular location across the three manners of performance, and the particular kind of movement that is responsible for the percept: on some occasions the same movement underlies different expressivity levels, and on other occasions, different movements produce essentially the same pattern of responses. Therefore, this study was undertaken to investigate the commonalities and differences in the identified movements at expressive locations. Since the two second excerpt study had shown that manner could be detected from arbitrarily selected locations within a performance, it was decided to study identical locations across different manners and to see what links and differentiates them across manners given that they are created out of the same musical structure. The semantic differential technique was used to extract qualitative data from observers.

A frustration of the semantic differential is that the selection of words limits the description, but if the crudity of the experimental tool is accepted, and its role made specific enough, it can be very informative. In an effort to make the differentials as powerful and effective as possible, the differentials used in this study were derived by asking a musician who is both a lecturer in analysis and a pianist to create differential lists based on observations of the specific expressive movements which were to be shown to the observers in the test.

4.6.2 METHOD

Subjects

20 music students from City and Newcastle Universities acted as the observers for the study (14 females and 6 males with a mean age 23.6 years).

Stimuli

In order to produce a test of a reasonable length, video stimuli for the study were assembled by selecting seven expressive locations which were common to all three manners (7 x 3 = 21 excerpts). These locations lasted between 2.5 and 8 seconds and were selected because they comprised a selection of locations some of which showed the same movement shapes across manner, while others showed different movements across manners, and because with the exception of the excerpt from bar 1 they were locations which included both head and hand movements. Bar 1 was included because observers of the other studies had tended to make judgements very early on in viewing a performance, and it therefore seemed important to include the very first expressive location. The locations were: bar 1, bar 6, bars 8-12, bar 14, bar 18, bar 20 and bar 22. The movement characteristics across manners for each of these locations, as identified in the previous experiment, are shown in table 4.1.

Table 4.1 showing the movement types of the expressive locations selected for judgement using semantic differentials.

BAR NUMBER	MANNER DEADPAN	PROJECTED	EXAGGERATED
1	*nod*	*swing*	*reverse nod*
6	*depressed hand nod*	*depressed wrist flick lift surge reverse nod*	*flick/high hand lift nod-backwards swing*
8-12	*upward wrist, wrist flick, hand flick lift, raised held wrist, shakes*	*raised held wrist, medium and high hand hand lifts, backwards swing, nod, shakes, wiggles*	*raised held wrist, medium,high upwards & downwards hand lifts, nods shakes wiggles*
14	*upward wrist, wiggle shake*	*downward wrist, wiggle*	*upward wrists, forward swing, wiggle, backward swing*
18	*upward wrist, forward swing, wiggle*	*raised forearm, upward wrist, raised forearm, shake/nod*	*raised wrist, upward wrist flick lift high lift shake*
20	*wrist rotation, raised wrist shake*	*wrist rotation, depressed wrist, wrist rotation, nod*	*wrist rotation, upward wrist, flick lift backwards swing*
22	*forward swing, high hand lift*	*medium hand lift, nod*	*forward swing, nod, raised hand*

These excerpts were randomly mixed and copied onto three videos, so that observers could view the excerpts in different orders. Three examples of the excerpts (one from each manner) are shown in video examples 12a-12c.

The semantic differential list was created by asking a member of staff from the music department of Newcastle University who lectures on musical analysis and performs regularly as a concert pianist to describe, using freely chosen adjectives, the appearances of each excerpt from each of the three manners of the Beethoven Bagatelle performance. From observations of all the excerpts, the lists of adjectives contained five which applied to the excerpts for the deadpan manner, twelve for projected manner and ten for exaggerated manner. With these adjectives, the lecturer was then asked to create differential pairs of adjectives. Of the total of 27 adjectives, there were 9 adjectives which either did not pair up or were so similar to other adjectives that the lecturer discarded them. When this task was completed, the lecturer re-viewed the stimulus material to confirm that the adjectives and the differential pairs could be used for each excerpt in each manner. With two minor modifications, the lecturer settled for nine differential pairs to which the earlier inexpressive-highly expressive pair was added. The ten semantic differentials were presented on response sheets in ten different orders so that each observer only used the same order of differentials twice on the test stimuli. The differential pairs were: inexpressive-highly expressive, uniform-varied, stiff-flexible, arbitrary-controlled, artificial-natural, unstructured-poised, economical-wasteful, jerky-smooth, understated-overstated and cautious-quirky. An 80mm line was used to separate each differential pair, and in an instruction sheet accompanying these differentials, it was explained that the line of 80mm was to be viewed as a continuum between the two words, and that ratings were to be made by intersecting the line with a pen stroke. The following example shows the layout of the differentials:

Inexpressive	______________________	Highly Expressive
Cautious	______________________	Quirky
Economical	______________________	Wasteful
Uniform	______________________	Varied
Jerky	______________________	Smooth
Understated	______________________	Overstated
Stiff	______________________	Flexible
Artificial	______________________	Natural
Arbitrary	______________________	Controlled
Unstructured	______________________	Poised

A practice trial video with three arbitrarily chosen excerpts from the manners was also prepared.

Apparatus

The video examples were played to the observers on a video play-back and monitor which was set in normal contrast/brightness and at a distance of 1.5 metres from each observer.

Procedure

Observers performed the test individually. Following the practice trials, the excerpts were viewed in any one of six random orders. This meant that each of the six orders was viewed by approximately three observers. After each excerpt, the test video was paused so that the differential lists could be completed. The test lasted for approximately 40 minutes.

4.6.3 RESULTS AND DISCUSSION

The pen mark on the line between the two words of each differential was turned into a score by measuring the distance in mm. from the word on the left to the intersecting pen stroke. The scores were analysed by examining any possible differences between identical locations across manners in a one-way analysis of variance for each differential. Owing to the large number of analyses, the results are shown in table 4.2.

Overall, the results show that of the differentials: 30% are significantly different across manner for all seven excerpts; 20% have six excerpts which that are significantly different across manner; 10% have five excerpts that are significantly different across manner; 30% have four excerpts which are significantly different across manner; and finally, 10% which have only one excerpt which is significantly different across manner. These results indicate, therefore, that the differentials were used in different ways. For the inexpressive-highly expressive, understated-overstated and stiff-flexible pairs, the observers perceived each of the locations to be relatively distinct across the three manners. In the case of the arbitrary-controlled differential (where only one of the seven excerpts was different across manner) it appears either that the observers perceived that the extracts did not differ in terms of the differential; or that they were unable to use the differential in a stable way.

Details of these differentials can be seen in figures 4.13 - 4.19 which show all the mean scores for the differentials

Table 4.2: F Values for the one-way analyses of variance between manners (deadpan, projected and exaggerated) at each of 7 bar locations. With 2,38 degrees of freedom for each analysis result, the significance value for $F = 5.39$, $p < 0.01$. (N.S = not significant).

DIFFERENTIAL PAIR	*BAR*						
	1	*6*	*8-12*	*14*	*18*	*20*	*22*
Inexpressive/ Highly expressive	*13.58*	*65.84*	*47.45*	*80.47*	*46.28*	*38.88*	*87.80*
Uniform/Varied	*N.S*	*36.47*	*15.02*	*97.79*	*17.32*	*21.35*	*28.87*
Stiff/ Flexible	*27.78*	*35.45*	*9.52*	*33.77*	*53.31*	*44.87*	*71.38*
Arbitrary/ Controlled	*N.S*	*7.93*	*N.S*	*N.S*	*N.S*	*N.S*	*N.S*
Artificial/ Natural	*N.S*	*8.78*	*28.71*	*22.84*	*10.59*	*12.26*	*66.15*
Unstructured/Poised	*N.S*	*N.S*	*6.36*	*N.S*	*24.49*	*6.74*	*28.18*
Economical/ Wasteful	*15.51*	*N.S*	*6.09*	*16.93*	*11.93*	*10.33*	*N.S*
Jerky/ Smooth	*N.S*	*N.S*	*6.79*	*N.S*	*7.93*	*21.83*	*47.40*
Understated/ Overstated	*22.80*	*17.68*	*25.29*	*32.20*	*6.25*	*7.48*	*28.84*
Cautious/ Quirky	*11.43*	*N.S*	*18.59*	*N.S*	*30.66*	*13.81*	*N.S*

for each bar. From these figures it is evident that each bar has a different profile across the three manners. Comparing these mean scores with a vertical reading of table 4.2 it is apparent that bar 1 has 5 differential scales which do not differ significantly across manner, whereas bars 8-12, 18 and 20 have only one differential (the arbitrary-controlled pair) which shows no differences across manner. This suggests that bar 1 has more unifying qualitative features than the other bars, and that bars 8-12, 14 and 20 have the least common features. Since it has already been shown (from the earlier experiment in this chapter) that each manner can be perceived from a two second excerpt, this vertical reading of the table suggests that qualitatively there are subtle variations from bar to bar. Here, the issue of movement quantity re-enters the discussion, for as figure sb1.24 reveals, bar 1 has only one expressive movement, whereas bars 18 and 20 comprise different numbers of movements across manner and bars 8-12 comprise many different types and numbers of expressive movements. The long extract from bar 8 to bar 12 was included in this test because the observers of the previous study perceived it to be a single expressive location. Since all the other locations used in this study are single bar durations, a shorter excerpt might have produced results that were more comparable between locations.

Looking at figures 4.13 to 4.19 together, it seems that each manner may have a set of qualitative features which distinguish it. Certainly, deadpan manner is always perceived to be the least expressive, the most uniform, the most stiff, most artificial, most unstructured, most understated and the most cautious. Projected and exaggerated tend to be more similar to each other, but bearing in mind the closer proximity of the scores, there are features which are unique to each manner. For instance, projected is perceived to be the most varied of all the manners, the most poised, and (two results which seem somewhat surprising) the most wasteful and least cautious of all the manners. Finally, exaggerated manner is always perceived to be the most expressive, more unstructured than poised, and more overstated than understated.

The finding that projected manner is perceived to be the least cautious manner needs detailed consideration, for according to the differential this would make it the most quirky manner, yet it must be stated that the observers regularly checked what "*quirky*" meant. The experimenter explained the word to the observers by using the creator's description: *"by quirky, I mean that the movements are a little eccentric: played without regard, played with abandon, I suppose"*. With a manner like projected which has already been described as natural, it seems that to use the term "*with abandon*" may be a better descriptor than quirky. Even though the word "*quirky*" is problematic, from the main effects of the analysis, it is clear that deadpan perceived to be the most careful of the manners.

The other result which need some detailed discussion include the finding that projected manner is also perceived to be the most wasteful of all the manners across the bar locations. Bearing in mind the other attributes of this manner (naturalness, flexibility, variation and control), the attribute of wastefulness seems incongruous. However, the scores show that projected manner rating is never higher than 45, and indicate that the projected manner performances are simply less economical rather than being actually wasteful. This result is still somewhat surprising when it is already known that exaggerated manner consists of the largest movements.

The overall findings of the test cannot be compared directly with the earlier qualitative assessments of the three manners (the single performer point-light study of chapter 3, section 3.4) because the differentials are not identical. However, the single performer study showed that deadpan was the least expressive manner and had features

FIGURES 4.13-4.19

In the following figures, each semantic differential pair is indicated by a number:

Inexpressive-Highly Expressive	=	1
Uniform- Varied	=	2
Stiff-Flexible	=	3
Arbitrary-Controlled	=	4
Artificial-Natural	=	5
Unstructured-Poised	=	6
Economical-Wasteful	=	7
Jerky-Smooth	=	8
Understated-Overstated	=	9
Cautious-Quirky	=	10

On the y-axis rating scale, the score 0 represents the left extreme of the linear scale and corresponds to the first of the differential words, whilst 80 represents the extreme right of the linear scale and corresponds to the second of the differential words.

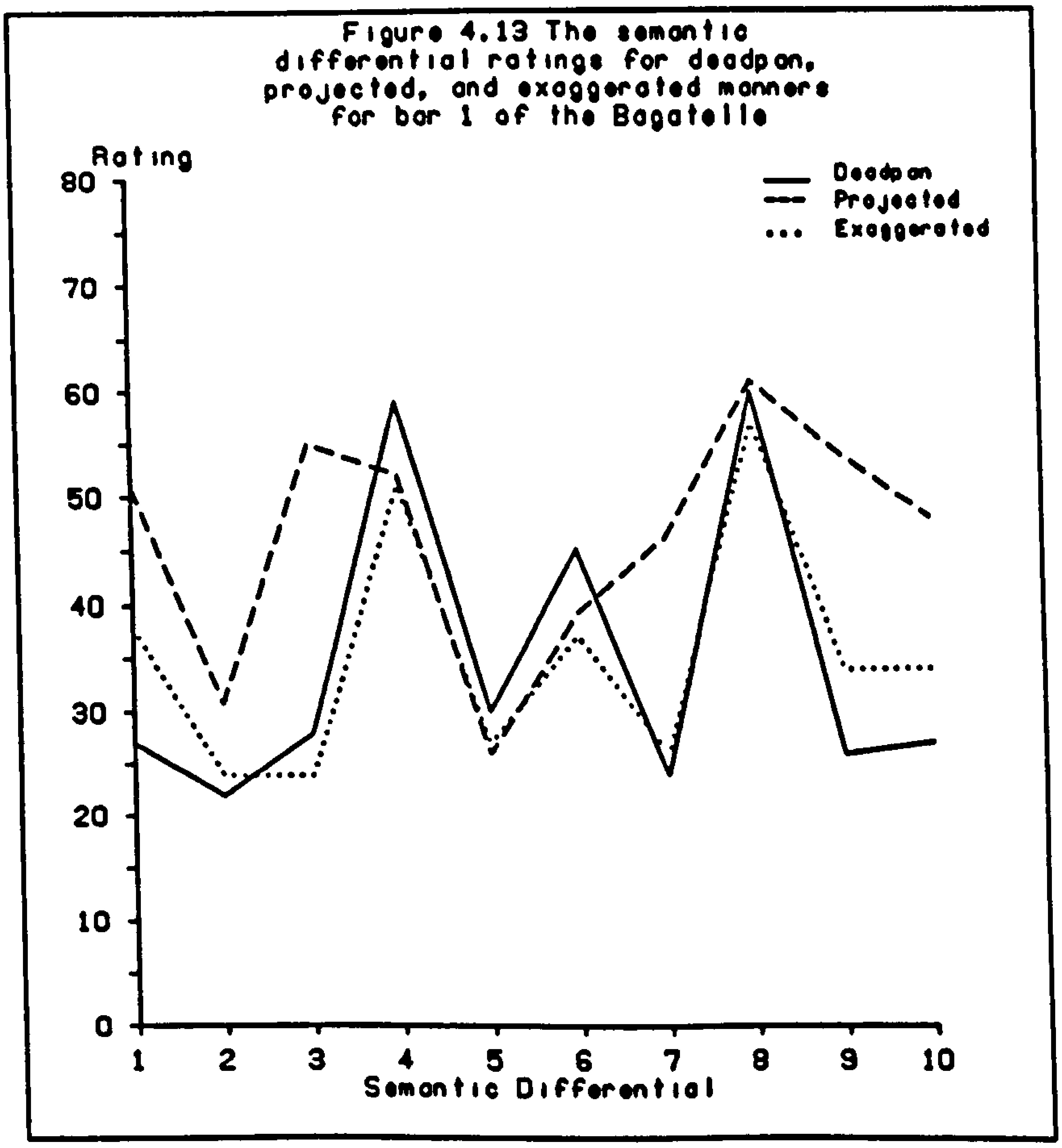


Figure 4.13 The semantic differential ratings for deadpan, projected, and exaggerated manners for bar 1 of the Bagatelle

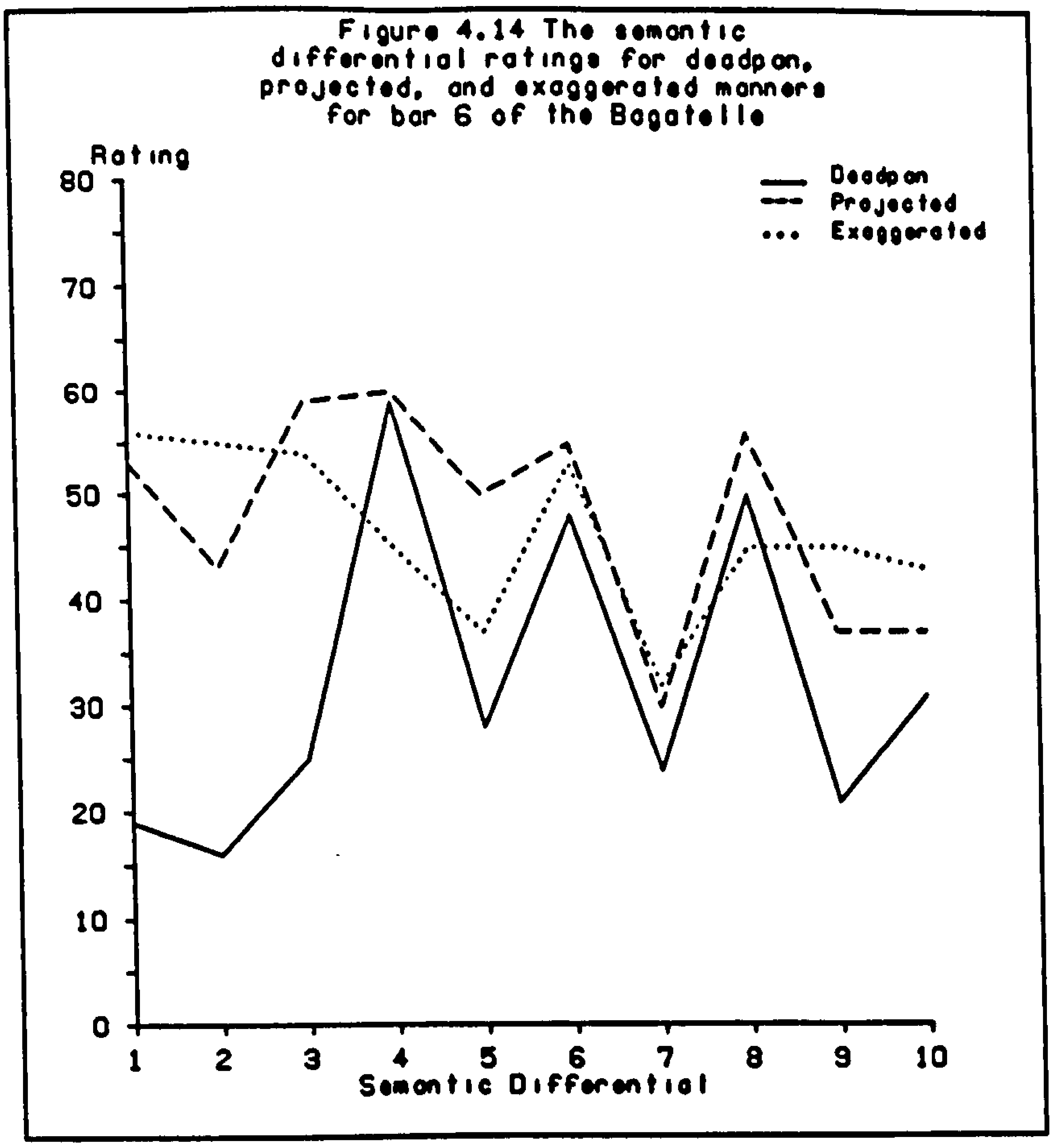


Figure 4.14 The semantic differential ratings for deadpan, projected, and exaggerated manners for bar 6 of the Bagatelle
Rating
80
70
60
50
40
30
20
10
0
Deadpan
Projected
Exaggerated
1
2
3
4
5
6
7
8
9
10
Semantic Differential

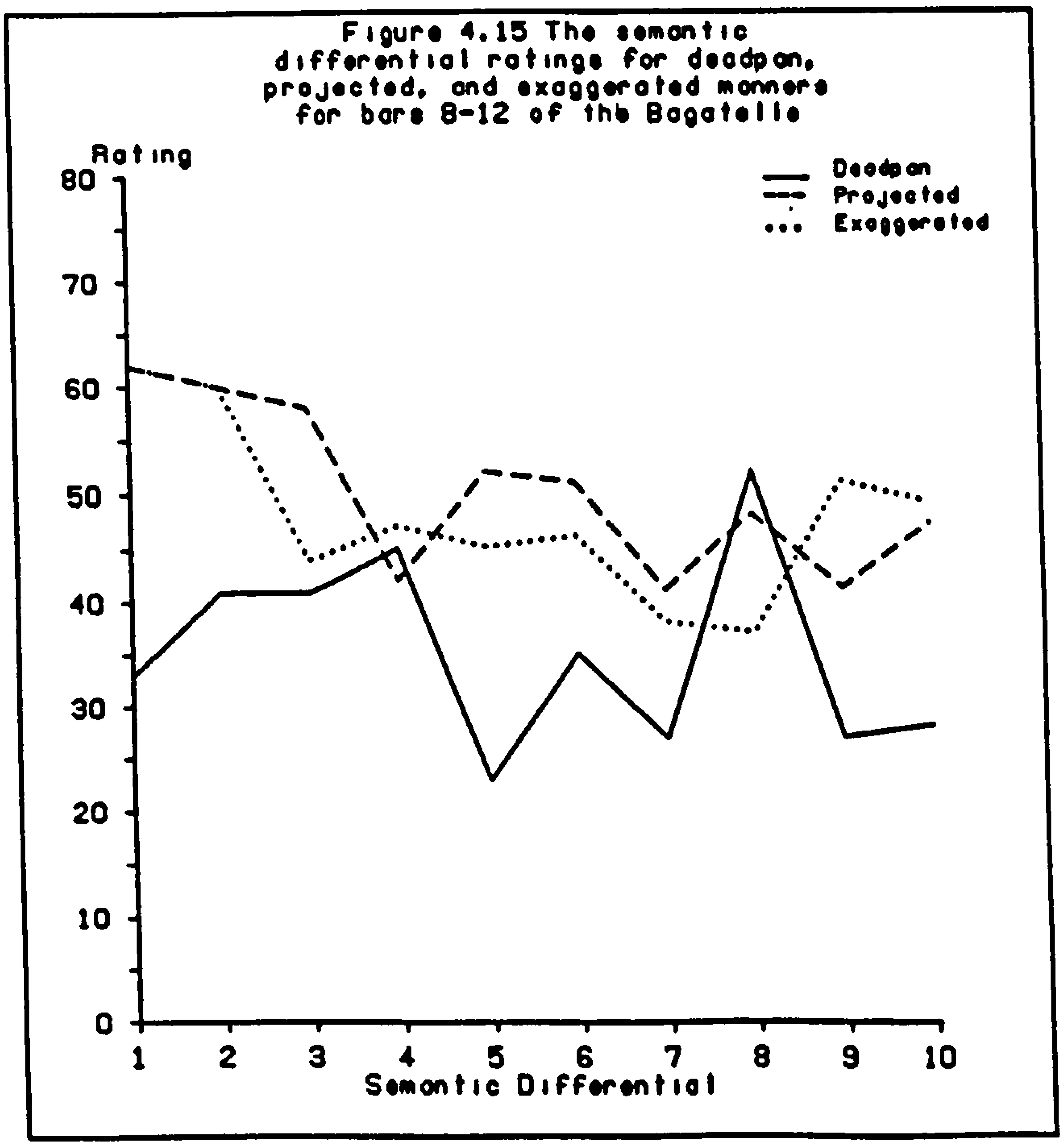


Figure 4.15 The semantic differential ratings for deadpan, projected, and exaggerated manners for bars 8-12 of the Bagatelle
Rating
80
70
60
50
40
30
20
10
0
Deadpan
Projected
Exaggerated
1
2
3
4
5
6
7
8
9
10
Semantic Differential

Figure 4.16 The semantic differential ratings for deadpan, projected, and exaggerated manners for bar 14 of the Bagatelle

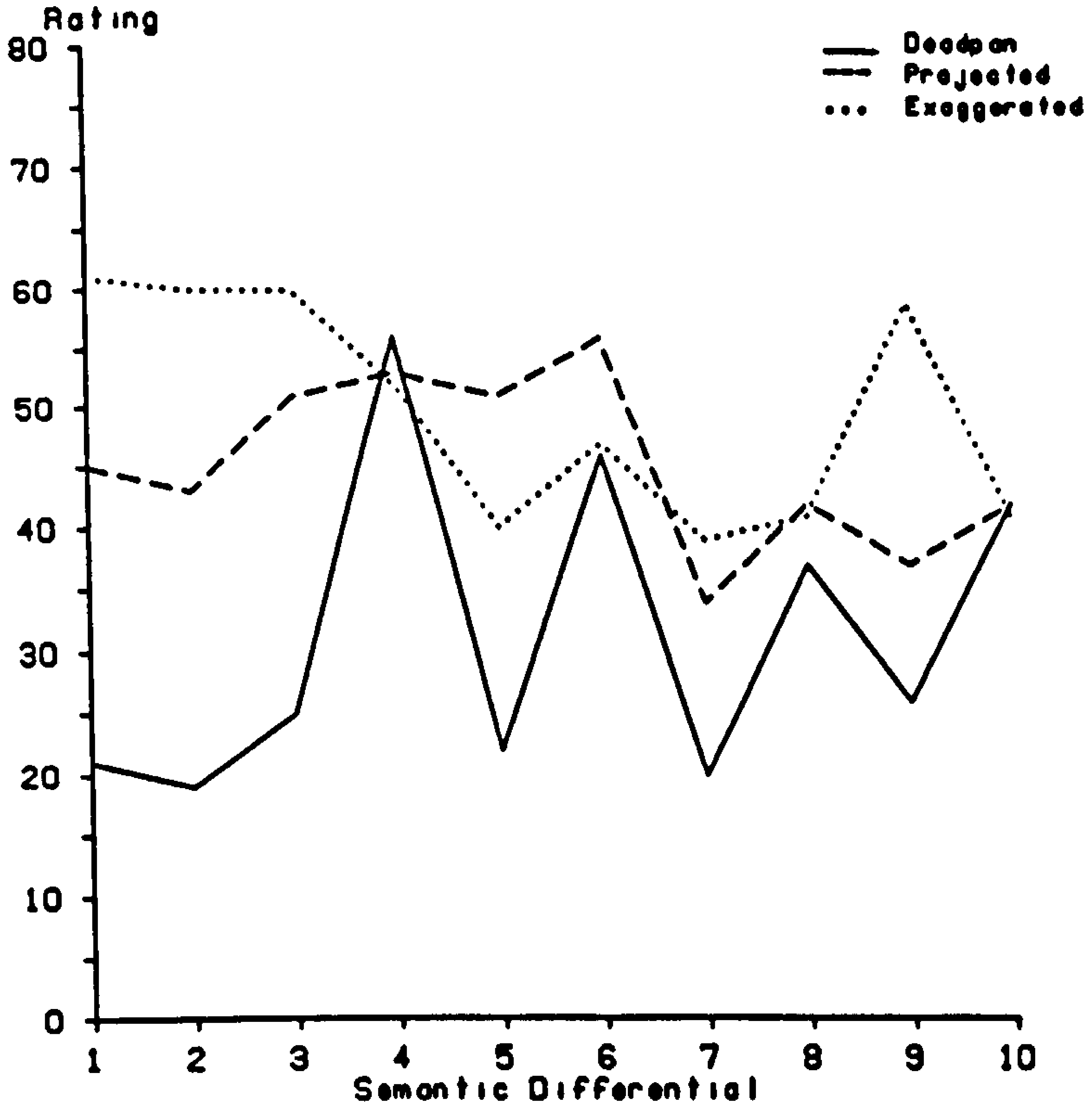
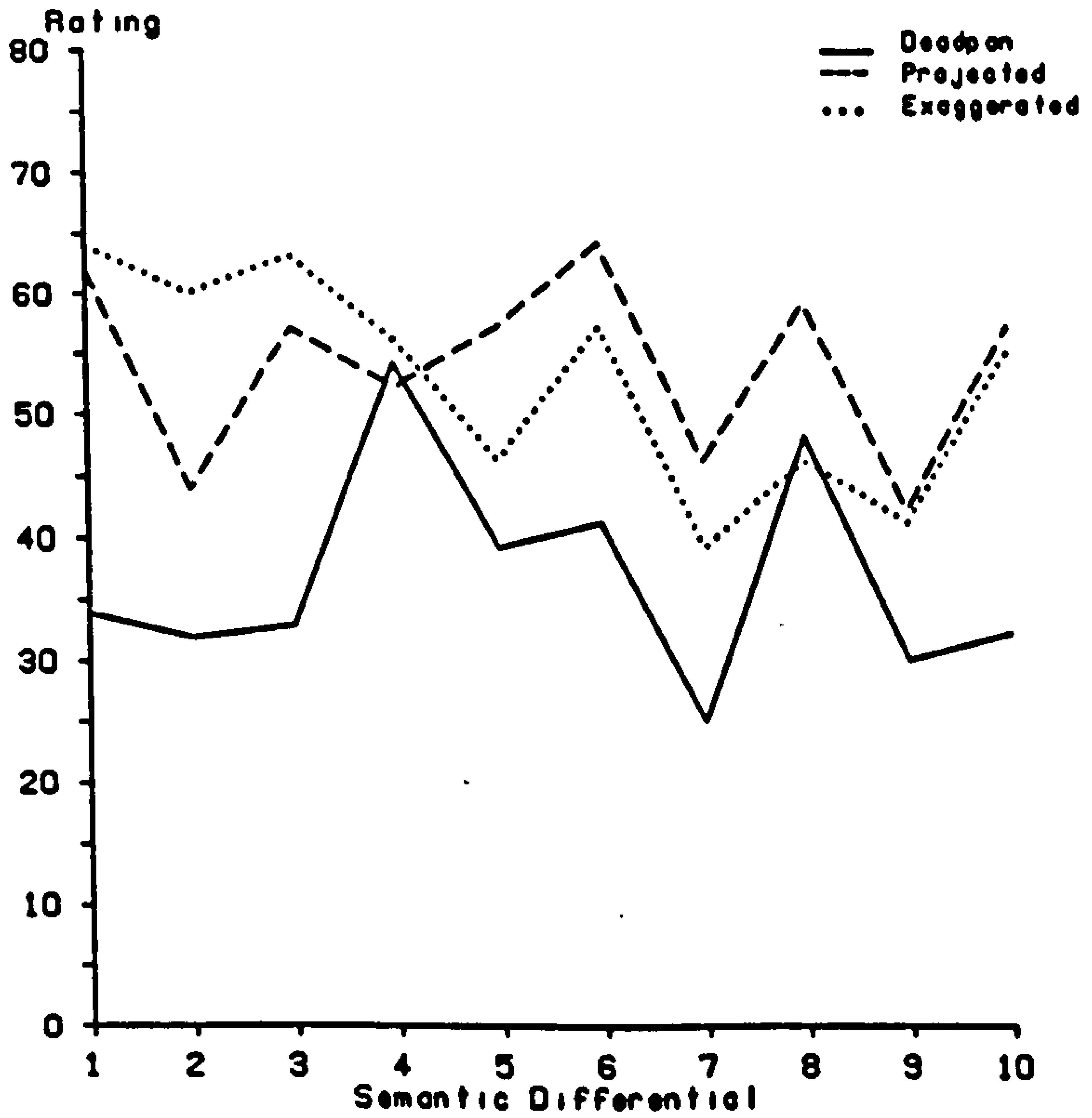


Figure 4.17 The semantic differential ratings for deadpan, projected, and exaggerated manners for bar 18 of the Bagatelle



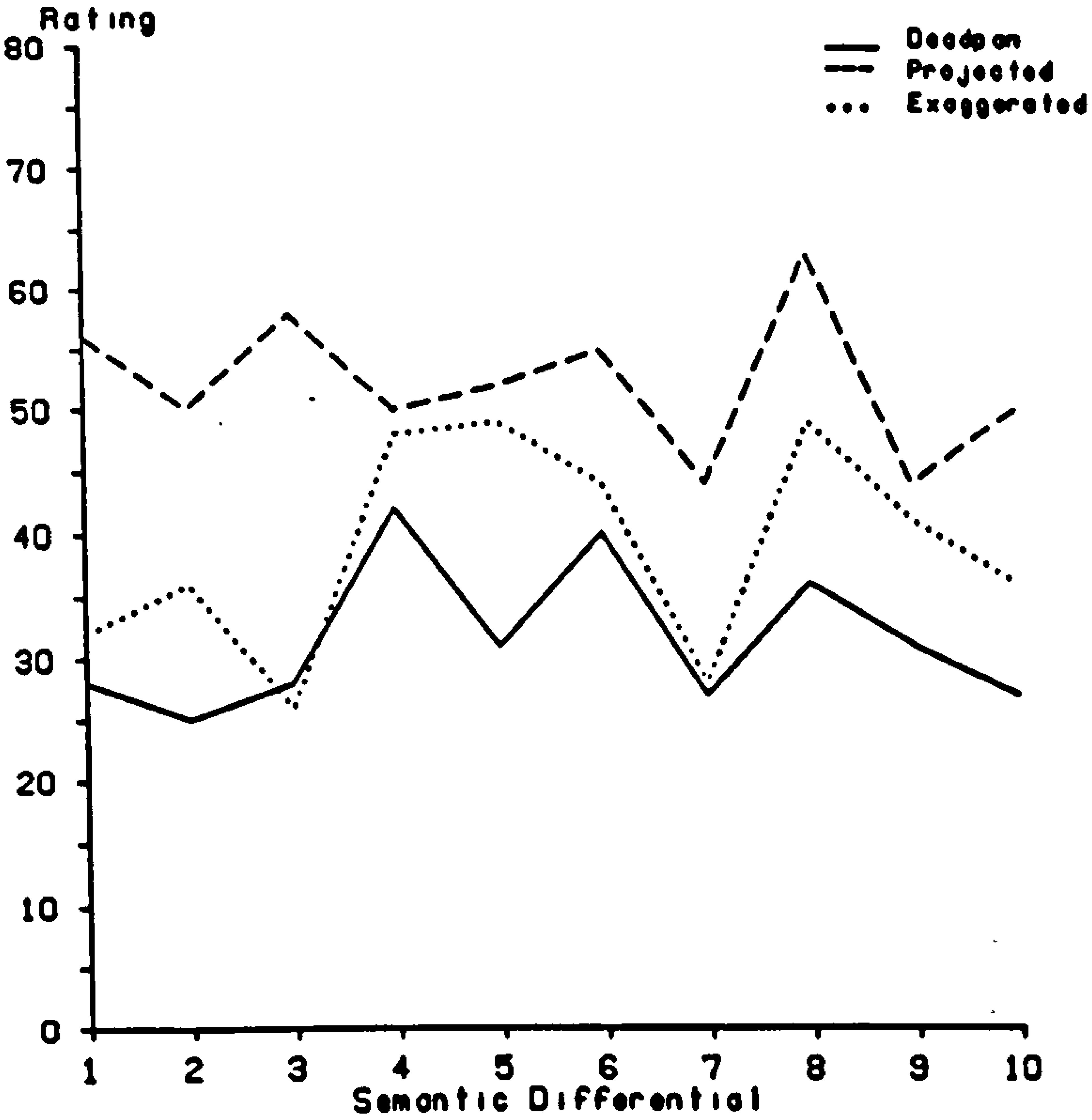


Figure 4.18 The semantic differential ratings for deadpan, projected, and exaggerated manners for bar 20 of the Bagatelle

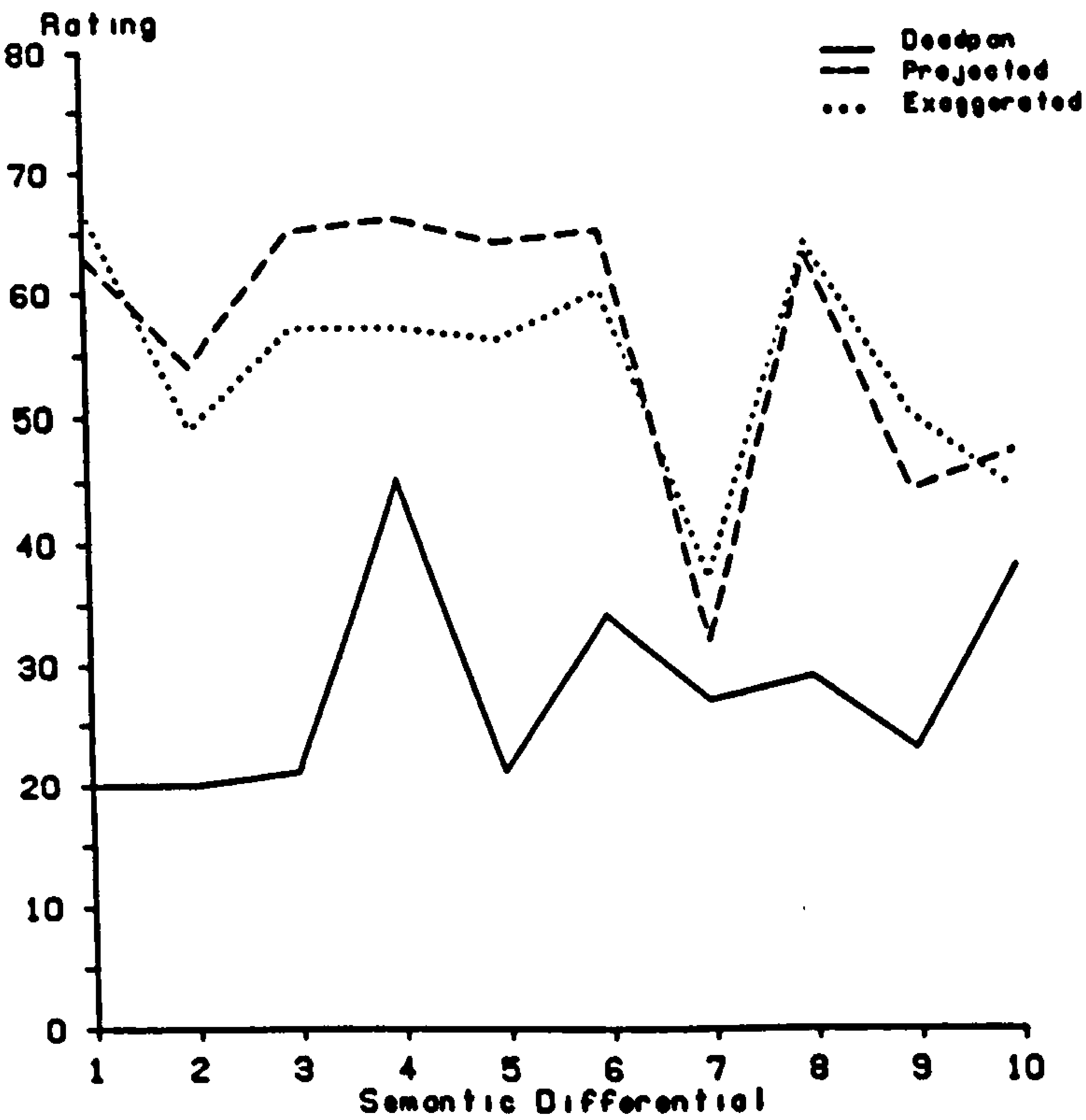


Figure 4.19 The semantic differential ratings for deadpan, projected, and exaggerated manners for bar 22 of the Bagatelle

of clumsiness, jerkiness and control, and these features can be seen to persist in this study in that deadpan manner is perceived to be unnatural, stiff, and, again, the least expressive of the manners. In the single performer point-light study, projected manner was perceived to be expressive, dainty and smooth. Here there is some similarity in that the projected manner is rated to be expressive, natural, flexible, poised and is always rated to be more smooth than jerky. Exaggerated manner was rated to be highly expressive, jerky and clumsy in the single performer study and in this study some of these qualities persist in that the performance is rated to be highly expressive, overstated, and unnatural. Thus, the features identified in this study and the earlier study may be persistent qualities of the three different manners of performance. However, more direct comparisons need to be drawn for this suggestion to be substantiated.

Finally, although the results of this study have highlighted some problems with the differentials, this set of differentials has been more fruitful than those used in chapter 3 in that it has provided greater scope for information to be collected. These results confirm that the manners are qualitatively different from one another, and suggest that some movements (in this case the nod) may have specific qualitative features (for instance, a sharpness of the movement style or a certain stiffness in the neck) when used at the same location irrespective of manner. The almost total lack of significant differences in the arbitrary-controlled semantic differential indicates that a common feature to all the performances is an overall level of control. This may be related to the production of the music, for a certain amount of movement must be common in order for all the notes to be played. However, more verification of this finding is necessary.

4.7 OVERALL SUMMARY AND DISCUSSION

This chapter, which dealt with a professional pianist's deadpan, projected and exaggerated manner performances of Beethoven's Bagatelle opus 119, No.11 has revealed that the head and hands provide stimulus information which illustrates that: i) there are measurable differences between the three manners and these manners can be differentiated when observers are given only two seconds exposure to the isolated body region in fully illuminated displays; ii) the observers are able to identify specific "*expressive locations*" within each manner, though they refer to an overall swinging movement which is of itself expressive for the projected and exaggerated manner; although the durations of the locations vary across manner, they tend to occur at the same points within the music; iii) specific movement shapes are identifiable for each of these locations (indeed the specific shapes for the head occur exclusively at the location points), though there are some hand movements (notably the high hand lift) which occur at moments other than those identified as being expressive; iv) these movement shapes cannot simply be categorised as being either manner-specific or musical structure-specific, movement shapes common to locations across manner and different locations within manner share some features, they also differ; v) a qualitative analysis of some of the similarities and differences between some of the specific movement shapes and their locations suggests that the deadpan manner movements (irrespective of their shape) tend to be stiff, understated, economical, uniform, jerky and unstructured, and whereas projected and exaggerated manners share elements of overstatement and variety, the projected manner emerging as being the most flexible and poised of all the performances. A degree of control seems to provide a commonality between all the manners.

These are complex findings to interpret. Since any arbitrary two second excerpt from the performances contains information about manner, it is possible that the swinging movement is the movement which provides the overall information about expression. (Recall the findings of chapter 3 and this chapter that there is always a greater scoring difference between deadpan and the other manners. It is feasible that this could be because the swinging makes the projected and exaggerated manners more similar.) Clearly all the results indicate that there is some combination of quantitative and qualitative factors which contribute towards the perception of each manner. The specifically identifiable expressive locations and movements could be particularly important indicators of specific features of the manner, and the evidence that certain movements have a relationship with musical figures (hand lifts tend to occur at rests and held notes) suggests that some of the specific movements may be the best, or the only possible, movements to deal with the expressive content of a particular location. Indeed, it is to be recalled that even when the performer tries to give an inexpressive performance, the movement vocabulary persists. However, many of the movements occur at many different points across the score and do not appear in the same order in each manner. This suggests that some movements may be used in a fairly flexible way and muddies the discussion of the apparent relationship between movement shape and musical structure.

This chapter begins to address many important issues with regard to the visual perception of music performance. However, a good deal of further investigation is necessary before firm conclusions can be drawn about the possible existence of a movement vocabulary, the swinging movements and the information they contain. This would include investigating: i) whether this vocabulary is specific just to these three performances or whether the movements are reproducible in other performances of the Bagatelle; ii) whether the same movements are used in performances of all kinds of classical music or whether there are different vocabularies for different musical styles: iii) whether other areas of the body are perceived to be expressive.

Endnote

1. It is to be noted that no systematic attempt has been made to establish the reliability of this classification system. That is, the extent to which it will reveal the same distribution of scores across categories when the same observer repeats the analysis or will provide the same results when different observers carry out the analysis. However, some care was exercised in preparing the observers for their task (see section 5.4.2 p236) and some evidence is presented (section 5.4.3 p237) which appears to demonstrate that there was considerable agreement between the observers regarding types of movement. This agreement is not, however, assessed quantitatively, for instance, by using index such as the 'kappa' described by Cohen (1960). This widely used index provides a measure of the degree inter-coder agreement for any sample of the data.

CHAPTER FIVE

5.1 INTRODUCTION

The results of the previous chapter indicate that when the pianist performs the Beethoven Bagatelle there are some specific movement shapes which appear in the head and hands and which are used at points where expressive locations are observed. This suggests that these movements may belong to some sort of expressive movement vocabulary.

However, for such a claim to be substantiated, it is necessary to test whether these same movements are used on different occasions and across different styles of music.

In the studies in this chapter, the same pianist is asked to play the Beethoven Bagatelle some six months after the initial recording to see if the movements and locations of the movements alter over time. Then, by asking the pianist to perform six pieces of music from different musical epochs, the movement content is examined and compared with the movements extracted from the Beethoven performances.

Lastly, questions about the performer's own knowledge of the way in which he moves during performance, and his own choices of expressive moments are addressed in order to assess whether there is any link between the performer's locations and those perceived by observers. Finally, the performer is asked to simulate a piano performance on a table top in order to establish whether the expressive movements remain when the technical component of note production is removed.

5.2 EXPRESSIVE LOCATIONS AND MOVEMENTS IN THE BEETHOVEN BAGATELLE SIX MONTHS LATER.

5.2.1 INTRODUCTION

Since it was discovered that the same repertoire of movement shapes occurred across the three performance manners, and that different ratings of expressivity were seemingly awarded according to the different amplitudes of these movements combined with some qualitative differences between the movements in the three manners (the descriptive vocabulary), it was decided to investigate whether the movement repertoire and the locations themselves were constant performance details over time. The aim of this study was to ask whether the movements recorded in Chapter 4 were in fact movements of an expressive vocabulary and to investigate the hypothesis that the swinging movement may be a factor in the determination of the expressivity of the performance. Because the deadpan and exaggerated manners are not consistent with performances in front of recital audiences, it may be problematic to reproduce these interpretations at a later date. For this study, therefore, the performer was asked to give two projected manner performances of the Bagatelle. The idea was that this test would determine the extent to which the movements of the performer were a constant feature of his performance and would also provide further evidence to establish if there were specific areas within the composition where these expressive movements occurred.

5.2.2 METHOD

Stimuli and Subjects

The stimuli for observation were drawn from two projected manner Beethoven Bagatelle performances recorded on video six months after the recordings used in section 4.5. Six months was a somewhat arbitrary choice, but it seemed suitable in that the pianist had done a lot of performing in the interim, and had not looked at the Bagatelle score. This meant that he would be well practised in "*projecting*" performances, but that his approach to the Bagatelle, based on long term memory, would be essentially the same as at the time of the first recordings.

In this second session the pianist was given exactly the same instructions to produce projected performances. It was explained to him that similarities and differences between the second set of performances and the initial performances were to be examined and it was explained that two projected performances would be required so that any differences between the two could be noted. For this second set of recordings, the location, and the use of recording apparatus were identical to those for the first performance (see section 4.2 for details of the recording equipment and scene lay out). For consistency with the other video performances, the piano was placed in the left side profile. The camera distance from the performer was altered, however, to bring the upper body even more clearly in shot. That is, the upper body was set further away so that all the hip region was in shot (see video example 13). The camera was set at a distance of 2.5 metres from the pianist and the lens was aligned with the upper edge of the keyboard. These performances were viewed by the experimenter, since she had identified the original set of expressive movement shapes.

Apparatus and Procedure

The For-A-FM60 frame memory was used in association with an ordinary VHS editing suite to analyze the recordings. The aim of the observations was to identify any expressive moments and the movements (if any) which were part of each moment. All movements were to be noted, irrespective of whether they corresponded with the original performance movements or not. Initially, the two projected manner performances were observed in a straight run through. Then on a second observation, locations and definitions of the expressive moments were made. This was done by examining the located moment in slow motion in forward/rewind on a number of occasions.

5.2.3 RESULTS AND DISCUSSION

The most simple way to assess these results is to begin by considering the two renditions in terms of their similarities and differences, and then to continue by drawing parallels between the two renditions and the performances of six months earlier.

(Because of the large number of figures included in this chapter, a second supplementary booklet of figures is used. All figures included in this booklet are referred to with the prefix sb2.)

The most striking feature about the two renditions is the fact that the swinging movement reappears as the overall movement of the piece and that none of the movements noted in the two performances differed in overall formation from the movements identified in the earlier performances. Figure sb2.1 illustrates the movements and their locations.

For the head, there are 14 common expressive locations and 9 for the hands. Of the head movements, 10 are exactly the same movement shapes, and of common hand locations, 6 are the same movement shape. For example, in bar 4 both renditions include a nod and there is a high hand lift in bar 10. As in the previous chapter, these common locations suggest that there is a feature within the music which motivates expression at these particular points, and once again it is a rest which seems to elicit this high hand lift. Since both these performances were undertaken with exactly the same intention, it could be that: i) these particular movements are simply part of essential technical movement needed to negotiate the notes; ii) all these movements are best suited to convey the particular intention at that location; or iii) some combination of these two factors. Indeed, if video examples 14a and 14b, and 15a and 15b are viewed, which show bars 4 and 10 in each performance, it appears that the emphatic quality of the nod at bar four and the amplitude and smooth quality of the hand lifts at bar 10 are common to both performances. These features may be linked to the optimal economy of execution, but it is equally possible that these are in some way a defining characteristic of the performer's interpretation. Without further investigation, it is impossible to decide between these two alternatives.

Whilst the examples from bars 4 and 10 could be interpreted to suggest that the movement vocabulary is manner specific (that is, nods and high hand lifts occur in both performances at the same locations, and therefore suggest that all projected manner performances may have the same movement at this location), the fact that there are 5 common locations which are associated with different movements across renditions suggests that there is similar information conveyed in the movements - the conclusion of chapter 4. If video examples 16a and 16b are viewed they show bar 14 in each rendition, and show that although the movements are different, the direction and speed of the movement are similar. There is, therefore, a commonality between the different movements. It was previously discussed that unique expressive locations may be of some importance in the identification of manner. However, from these repeat performances of the same manner, it is apparent that of a total of 10 unique locations, 8 either immediately precede or follow a location common to both manners. For the hand, for instance, there is a medium hand lift in bar 6 of the first projected performance which follows a hand flick which is common to both manners, and in bar 9 in the second projected performance there is a double raised wrist location which precedes a common wrist depression and lift. One possible explanation for the close proximity of these unique locations to the common locations is that the unique location is simply an anticipation or continuation of the common location in such a way that it looks like a separate moment. If the links with the structure of the music are recalled, it is evident that over bars 8-9 there is a harmonic, pitch, and dynamic build towards the huge cadence at the end of bar eight and beginning of bar 9 which would link the musical intentions of the unique and the common locations movements in that both locations are found in points in the structure which are working towards exactly the same musical ends. In bar 6 such a case is a little more difficult to argue, however. Indeed, if the earlier evidence (chapter 4.5) is recalled, it would seem that held notes and rests provide a structural opportunity for hand lifts to occur, therefore, it would seem more likely that the unique location of the raised hand at bar 6 is an optimal moment for expression to be manifest in the hand since it occurs at a held note. It could be that the first performance lacks the expressive hand movement because the performer's hand was somehow engaged in note production in such a manner that there was not *"space"* for his hand to move in an expressive way.

The primary aim of the study was to investigate the similarities between the expressive movements and locations of the pianist's interpretation of the Bagatelle after a period of time had elapsed, and in order to make a precise comparison, more detailed reference must be made to figure sb1.24 which shows the expressive movements for the three manners of performance six months before.

Comparison of the two sets of performances indicates that all the locations common to the two projected repetitions of the Bagatelle match the expressive locations in the three performances (in different manners) played earlier. However, very few locations have common movements. Between the projected performances in figure sb2.1 and the projected performance of six months earlier, those common to both are: a hand lift in bar 9, a shake and wiggle at bar 11, a shake at bar 16, and a nod and a hand lift in the final bar. It could be, therefore, that these particular movements are integral to projected performances of the Bagatelle. However, this possibility is brought into question when it is noted that there are locations in both the deadpan and exaggerated manner performances of the original recordings which are common to both renditions of the repeat performance, for instance: a nod (granted the nod is both forwards and reverse) in bar 1; a shake in bar 11; and a forward surge in 17. This seems to suggest that in order for the different manners to be detected, there must be some qualitative differences between these movements. So perhaps what these results most strongly replicate is the earlier indication (see chapter 4) that it is essentially the quality of the movements and not the specific movements themselves which lead to the detection of a specific manner.

From the results of this study, therefore, it is possible to conclude that the expressive movements used by the performer in the Bagatelle performances have some consistency over time. The locations of the types of movements are common, but the movements used at these locations come from a repertory that seems to be used flexibly. The next section pursues the possible qualitative similarities and differences between these movements by the use of semantic differentials.

5.3 QUALITATIVE MEASUREMENTS OF THE EXPRESSIVE LOCATIONS MOVEMENTS.

5.3.1 INTRODUCTION

This study was undertaken to see if the qualitative features which seemed to link the variety of expressive movements in each performance manner in chapter 4 were present in the two repeated Bagatelle performances.

5.3.2 METHOD

Subjects and Stimuli

The observers for the test were 8 music students from City University and 7 individuals who either teach music or who are involved in music as amateur performers: that is a total of 15 observers (9 females and 6 males with a mean age of 31.5 years). To be consistent with the qualitative test undertaken in chapter 4, excerpts were used as the test stimuli. These excerpts were bars 1, 6, 8-12, 14, 18, 20 and 22 of both Bagatelle performances. The observers viewed random mixes of these excerpts and rated each one using semantic differential scales. Although the differentials were essentially the same as those in the chapter 4 study, two were modified in an attempt to clarify their meanings. Economical-wasteful was replaced by economical-uneconomical and cautious-quirky was replaced by cautious-with abandon. This last pair was not ideal, but it did attempt to encapsulate the notion of careful and tentative playing through to eccentric playing. Therefore, the ten differentials were: inexpressive-highly expressive, uniform-varied, stiff-flexible, arbitrary-controlled, artificial-natural, unstructured-poised, economical-uneconomical, jerky-smooth, understated-overstated and cautious-with abandon. Again, these were separated by a line of 80mm which was explained to be a continuum between the words. These differentials were presented to each observer in a different randomisation so that no observer read the differentials in the same order. In addition to the test stimuli, practice trials including two excerpts from locations other than those of the test were prepared.

Apparatus and Procedure

Sitting approximately 1.5 metres from a video monitor each observer in turn viewed the practice trials followed by the experimental trials, and completed the semantic differentials in their own time. Each observer received the following instructions:

> *You are about to see short excerpts taken from similar performances of the same piece of music. Please rate each excerpt according to the ten bipolar pairs by intersecting the line scale with a pen stroke.*

The test ran for approximately 40 minutes.

5.3.3 RESULTS

The data were first analysed by examining the correlations between the pattern of semantic differential scores at each location (for example, bar 22) in the two repeat performances. The correlations were performed on the mean scores of the fifteen observers for each location for each semantic differential.

(Note that the significance of the correlation coefficients has been assessed using a t-test as in Howell (1989: 176.)

Owing to the large numbers of correlations, these have been presented in table form.

The results shown in table 5.1 reveal that both performances were perceived to be similar at each location, with only bars 8-12 and 14 showing no significant correlation.

In order to examine whether the differentials were used in a consistent way across both performances, possible correlations between repeat performances for each semantic differential across all locations were analysed and these results are shown in table 5.2. Again, the correlations were performed on the mean scores of the fifteen observers.

Table 5.1 showing the correlation coefficients for all semantic differentials at each of the seven bar locations for both repeat performances of the Beethoven Bagatelle. (Note that there are 8 degrees of freedom.)

LOCATION	*CORRELATION COEFFICIENT*	*T VALUE*	*SIGNIFICANCE LEVEL*
Bar 1	*0.87*	*4.90*	$p < 0.01$
Bar 6	*0.86*	*4.89*	$p < 0.01$
Bar 8-12	*0.28*	*0.84*	*N.S.*
Bar 14	*0.44*	*1.38*	*N.S.*
Bar 18	*0.93*	*7.33*	$p < 0.001$
Bar 20	*0.89*	*5.33*	$p < 0.001$
Bar 22	*0.95*	*8.12*	$p < 0.001$

Table 5.2 showing the correlation coefficients for each semantic differential across all bar locations for both repeat performances. (Note that there are 5 degrees of freedom.)

SEMANTIC DIFFERENTIAL	*CORRELATION COEFFICIENT*	*T VALUE*	*SIG. LEVEL*
Inexpressive/ Highly Expressive	*-0.06*	*-0.13*	*N.S.*
Uniform/ Varied	*0.47*	*1.20*	*N.S.*
Stiff/ Flexible	*0.68*	*2.09*	*N.S.*
Arbitrary/ Controlled	*0.60*	*1.68*	*N.S.*
Artificial/ Natural	*0.77*	*2.69*	$p < 0.05$
Unstructured/ Poised	*0.63*	*1.81*	*N.S.*
Economical/ Uneconomical	*0.80*	*2.99*	$p < 0.05$
Jerky/ Smooth	*0.66*	*1.96*	*N.S.*
Understated/ Overstated	*0.54*	*1.70*	*N.S.*
Cautious/ With Abandon	*0.90*	*5.05*	$p < 0.01$

Table 5.2 demonstrates that only three of the ten differentials show any correlations (artificial-natural, economical-uneconomical, and cautious-with abandon). This suggests that each of the semantic differentials is not a terribly stable measuring device on its own. Since the economical-uneconomical and cautious-with abandon differentials show positive correlations and since these differentials were the two that were modified after the difficulties encountered using the original pairs in chapter 4, there is an indication that their meaning has become clearer by the slight modification.

In order to compare the qualities of these two performances with the original performance, it is possible to correlate each of the two repeat performances with the original projected manner performance. It must be recalled, however, that the economical-uneconomical and the cautious-with abandon differentials of this study are not identical to the differentials of the chapter 4 study, so these particular differentials do not provide strict comparisons.

First, the correlations (on the mean scores) between the pattern of semantic differential scores at each location in the first repeat performance and the original performance are examined. These results are shown in tables 5.3 and 5.4.

Overall, tables 5.3 and 5.4 show that there are few similarities between either of the repeat performances and the original performance. Only bars 6 and 22 for both repeat performances correlate with the original performance, and bar 14 of the first repeat performance correlates with bar 14 of the original performance. It is interesting to note that both bars 6 and 22 have nods common to the original and the two repeat performances. Since it was proposed in chapter 4 that the nod may have its own set of specific qualities, it could be that it is the qualities of the nod which make these locations similar.

Table 5.3 shows the correlation coefficient and t-test results for the original projected manner performance and the first of the two repeat performances for all semantic differentials across bar location. (Note that there are 8 degrees of freedom.)

LOCATION	CORRELATION COEFFICIENT	T-VALUE	SIGNIFICANCE LEVEL
Bar 1	0.09	0.26	N.S
Bar 6	0.91	6.02	$p < 0.05$
Bar 8-12	0.54	1.79	N.S.
Bar 14	0.70	2.79	$p < 0.05$
Bar 18	0.26	0.78	N.S.
Bar 20	0.57	1.96	N.S.
Bar 22	0.78	3.50	$p < 0.05$

Table 5.4 shows the correlation coefficient and t-test results for the original projected manner performance and the second of the two repeat performances for all semantic differentials across bar location. (Note that there are 8 degrees of freedom.)

LOCATION	*CORRELATION COEFFICIENT*	*T-VALUE*	*SIGNIFICANCE LEVEL*
Bar 1	*-0.08*	*-0.24*	*N.S*
Bar 6	*0.85*	*4.52*	$p < 0.01$
Bar 8-12	*0.18*	*0.54*	*N.S.*
Bar 14	*0.34*	*1.08*	*N.S.*
Bar 18	*0.25*	*0.74*	*N.S.*
Bar 20	*0.52*	*1.70*	*N.S.*
Bar 22	*0.76*	*3.24*	$p < 0.02$

Table 5.5 showing the correlation coefficients for each semantic differential across all bars for the original and the first of the repeat performances. (Note that there are 5 degrees of freedom.)

SEMANTIC DIFFERENTIAL	*CORRELATION COEFFICIENT*	*T VALUE*	*SIGNIFICANCE LEVEL*
Inexpressive/ Highly Expressive	*0.69*	*2.11*	*N.S.*
Uniform/ Varied	*0.81*	*3.11*	$p < 0.02$
Stiff/ Flexible	*0.50*	*1.29*	*N.S.*
Arbitrary/ Controlled	*0.33*	*0.79*	*N.S.*
Artificial/ Natural	*0.35*	*0.84*	*N.S.*
Unstructured/ Poised	*0.78*	*2.81*	$p < 0.05$
Economical/ Uneconomical	*-0.32*	*0.79*	*N.S.*
Jerky/ Smooth	*-0.45*	*-1.14*	*N.S.*
Understated/ Overstated	*-0.68*	*-2.10*	*N.S.*
Cautious/ With Abandon	*-0.54*	*1.45*	*N.S.*

Table 5.6 showing the correlation coefficients for each semantic differential across all bars for the original and the second of the repeat performances. (Note that there are 5 degrees of freedom.)

SEMANTIC DIFFERENTIAL	*CORRELATION COEFFICIENT*	*T VALUE*	*SIGNIFICANCE LEVEL*
Inexpressive/ Highly Expressive	*0.55*	*1.43*	*N.S.*
Uniform/ Varied	*0.18*	*0.42*	*N.S.*
Stiff/ Flexible	*0.89*	*4.28*	$p < 0.01$
Arbitrary/ Controlled	*0.09*	*0.22*	*N.S.*
Artificial/ Natural	*0.17*	*0.38*	*N.S.*
Unstructured/ Poised	*0.58*	*1.62*	*N.S.*
Economical/ Uneconomical	*-0.27*	*-0.64*	*N.S.*
Jerky/ Smooth	*-0.68*	*-2.12*	*N.S.*
Understated/ Overstated	*-0.64*	*-1.89*	*N.S.*
Cautious/ With Abandon	*-0.60*	*-2.10*	*N.S.*

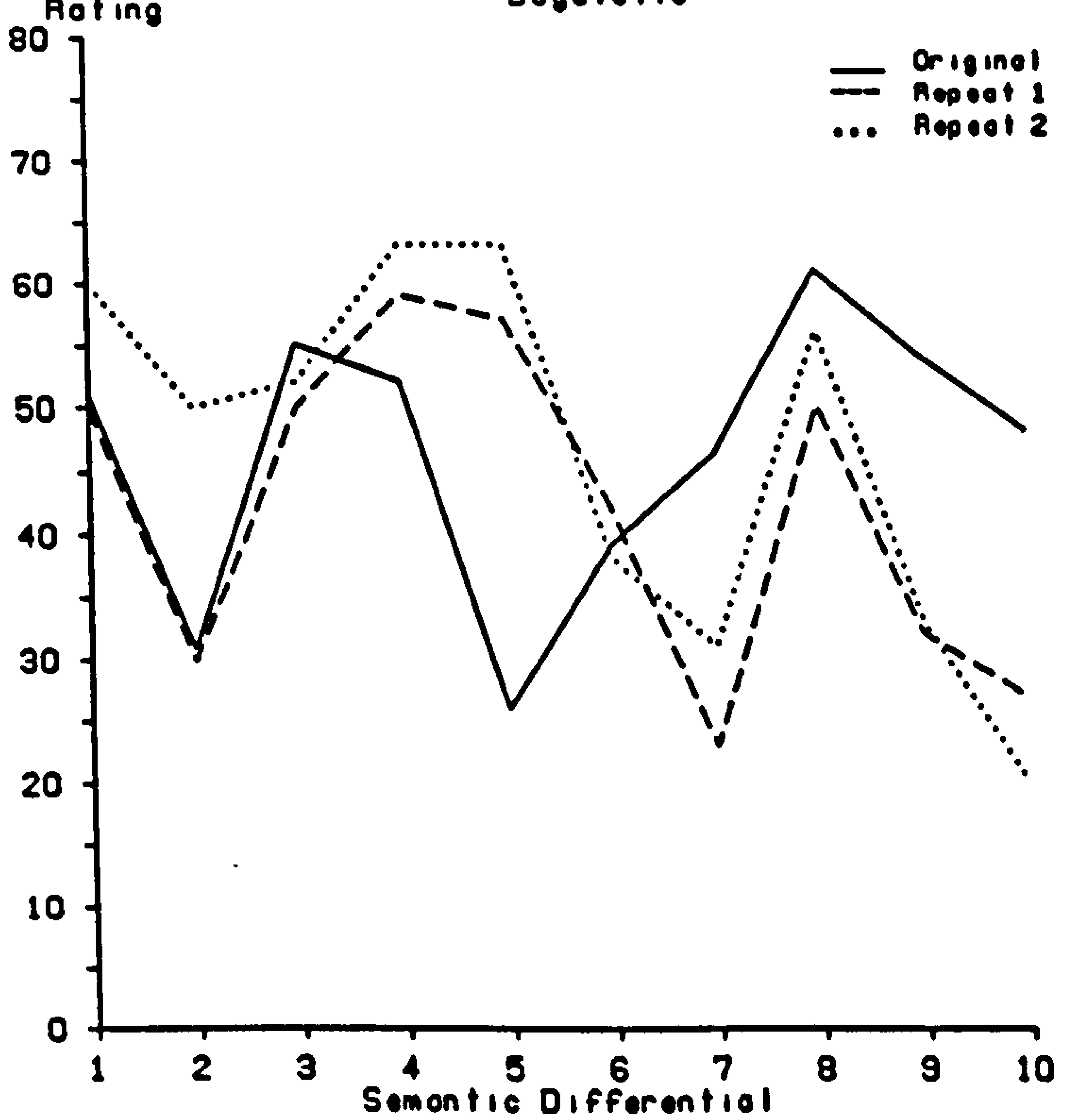
FIGURES 5.1-5.7

In the following figures, each semantic differential pair is indicated by a number:

Inexpressive-Highly Expressive	=	1
Uniform- Varied	=	2
Stiff-Flexible	=	3
Arbitrary-Controlled	=	4
Artificial-Natural	=	5
Unstructured-Poised	=	6
Economical-Uneconomical	=	7
Jerky-Smooth	=	8
Understated-Overstated	=	9
Cautious-With Abandon	=	10

On the y-axis rating scale, the score 0 represents the left extreme of the linear scale and corresponds to the first of the differential words, whilst 80 represents the extreme right of the linear scale and corresponds to the second of the differential words.

Figure 5.1 The semantic differential ratings for the original, first and second repeat performances of bar 1 of the Bagatelle



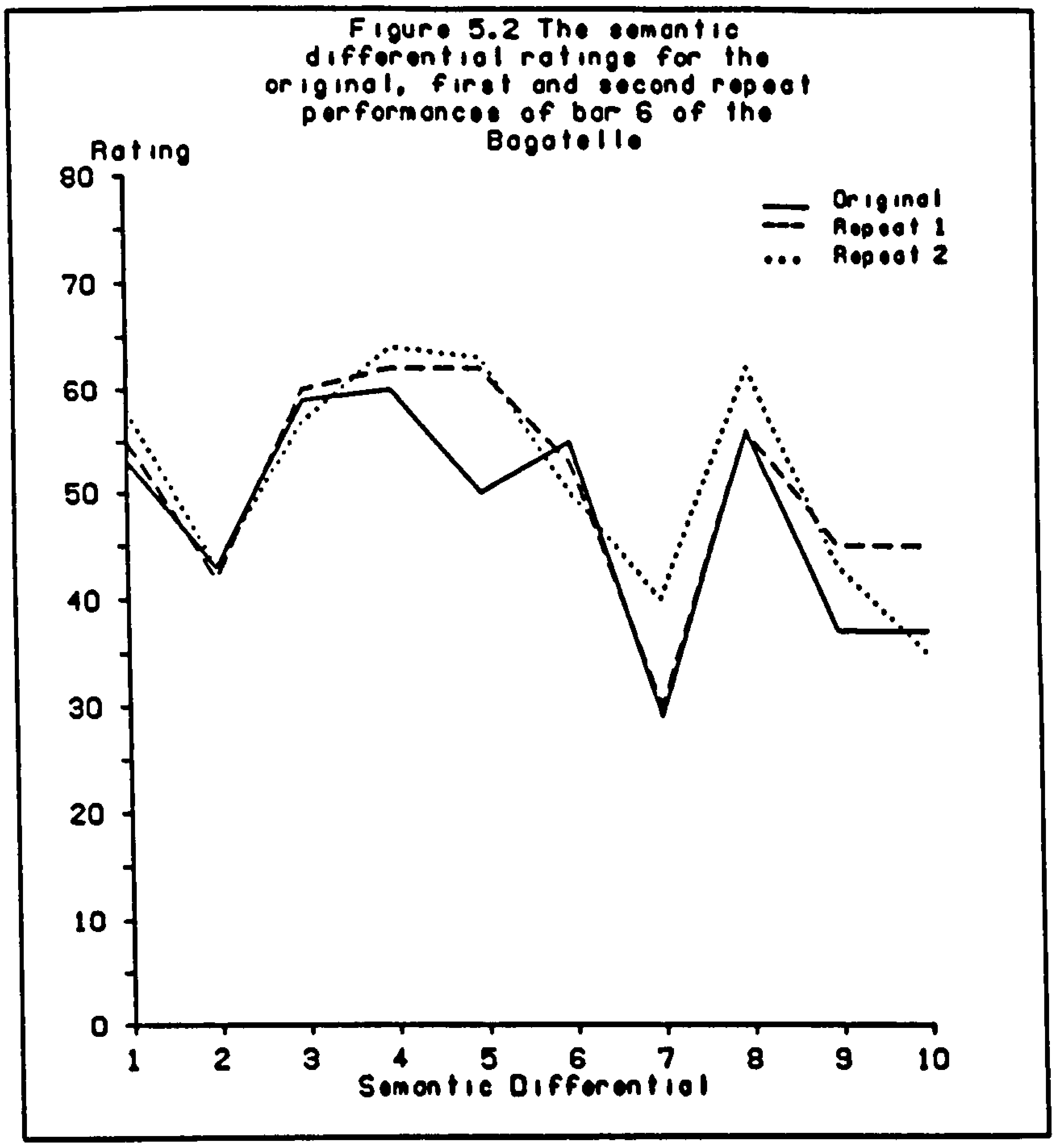


Figure 5.2 The semantic differential ratings for the original, first and second repeat performances of bar 6 of the Bagatelle
Rating
80
70
60
50
40
30
20
10
0
Original
Repeat 1
Repeat 2
1
2
3
4
5
6
7
8
9
10
Semantic Differential

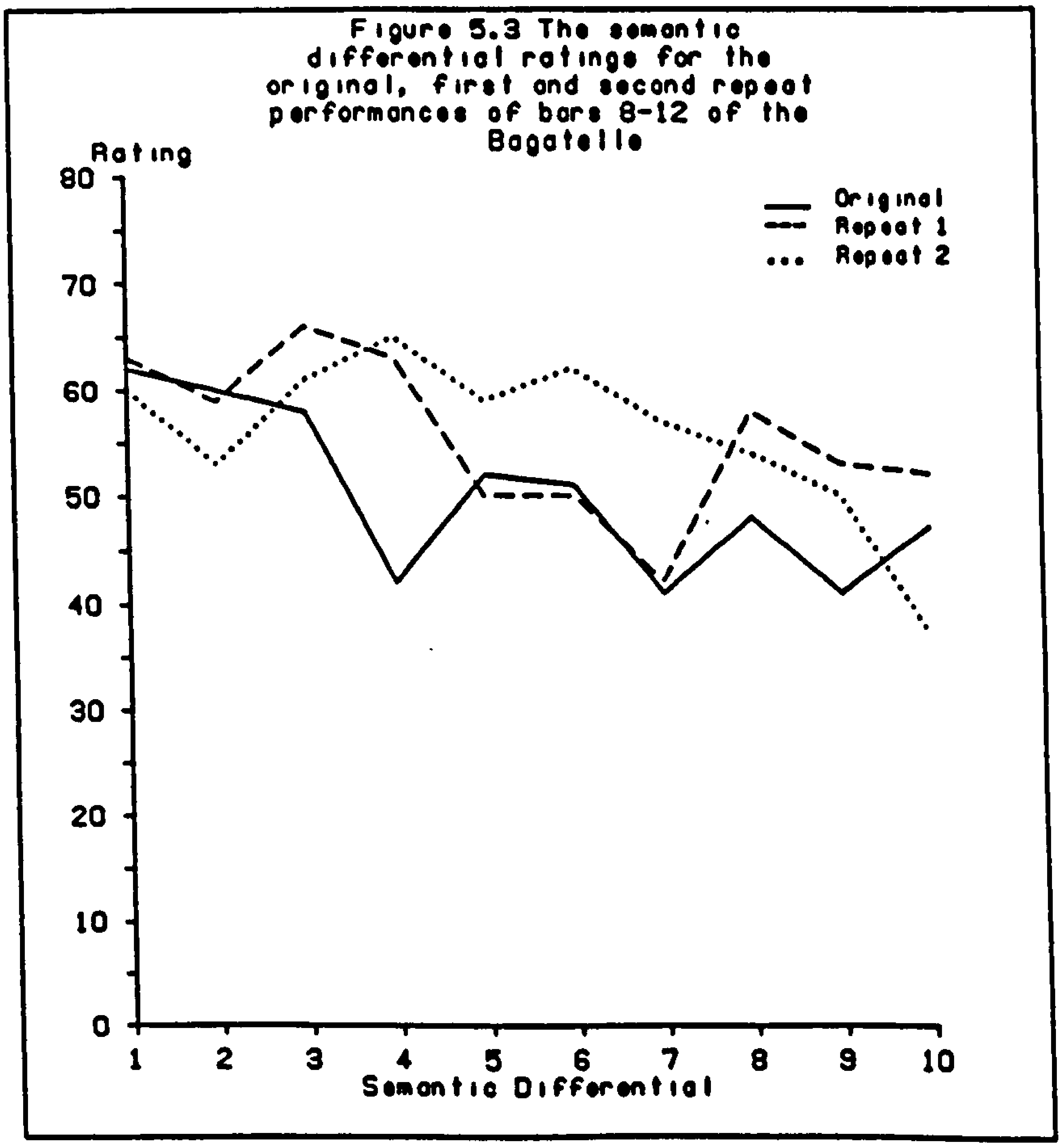


Figure 5.3 The semantic differential ratings for the original, first and second repeat performances of bars 8-12 of the Bagatelle
Rating
80
70
60
50
40
30
20
10
0
Original
Repeat 1
Repeat 2
1
2
3
4
5
6
7
8
9
10
Semantic Differential

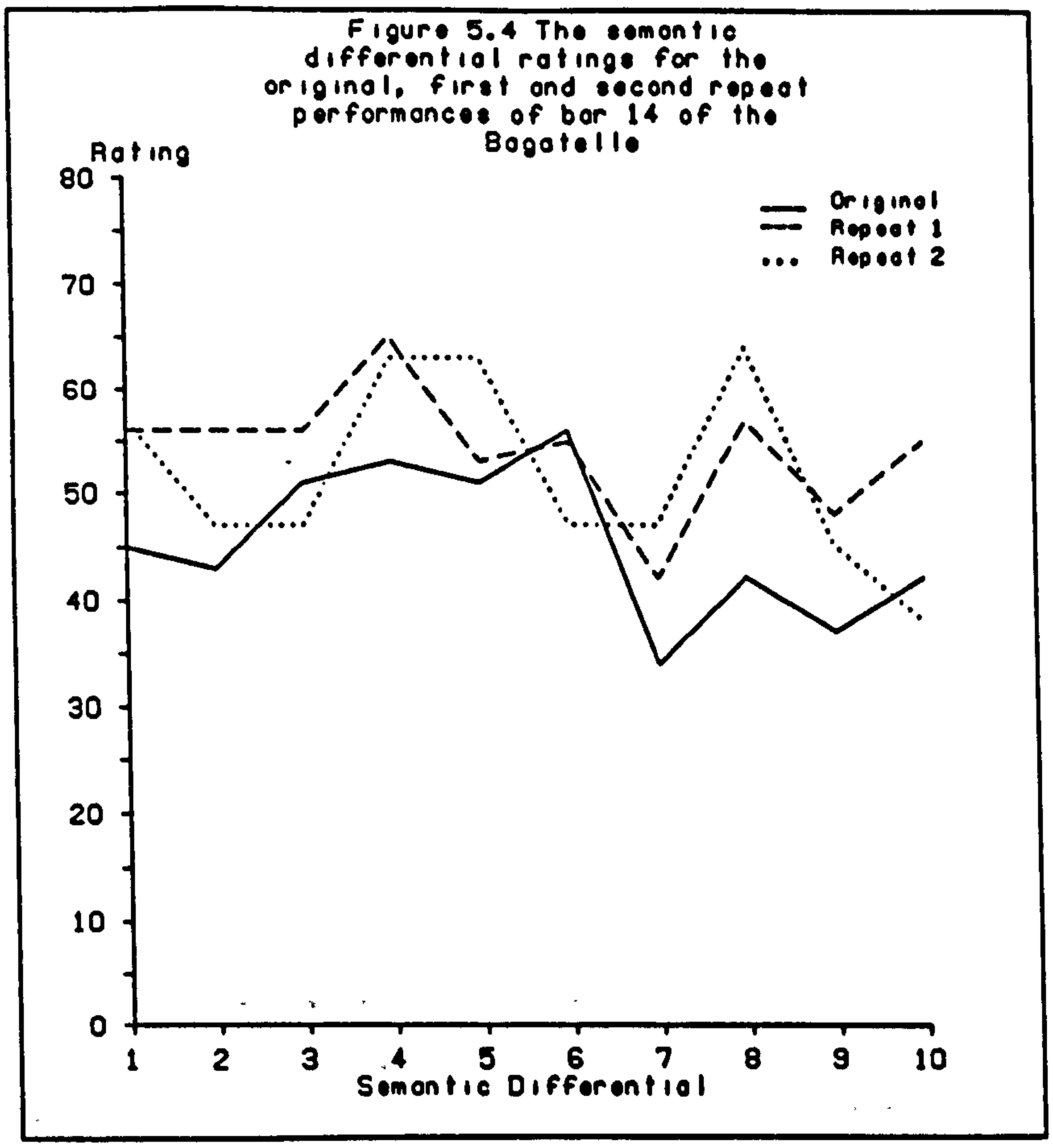


Figure 5.4 The semantic differential ratings for the original, first and second repeat performances of bar 14 of the Bagatelle
Rating
80
70
60
50
40
30
20
10
0
Original
Repeat 1
Repeat 2
1
2
3
4
5
6
7
8
9
10
Semantic Differential

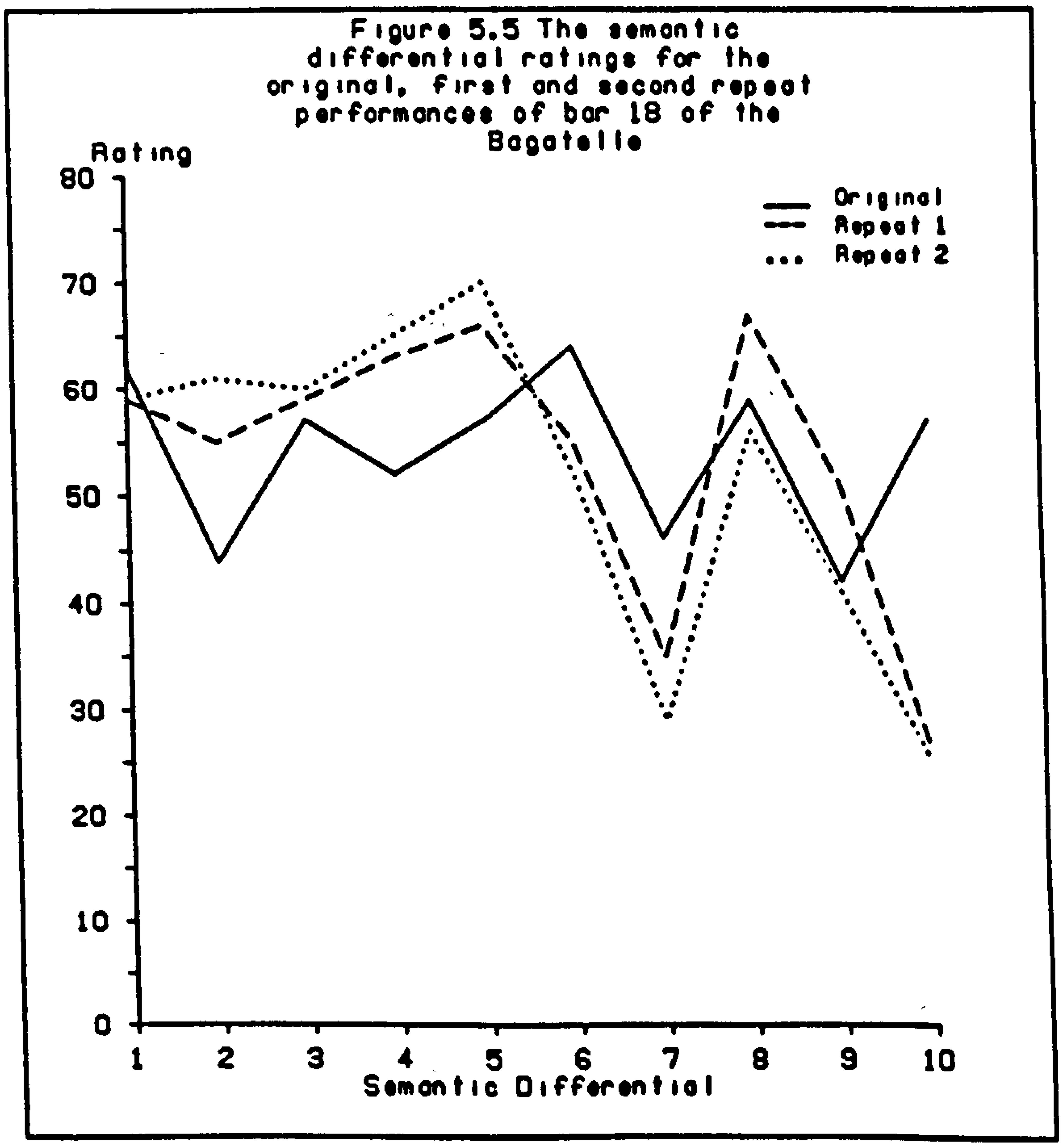


Figure 5.5 The semantic differential ratings for the original, first and second repeat performances of bar 18 of the Bagatelle
Rating
80
70
60
50
40
30
20
10
0
Original
Repeat 1
Repeat 2
1
2
3
4
5
6
7
8
9
10
Semantic Differential

Figure 5.6 The semantic differential ratings for the original, first and second repeat performances of bar 20 of the Bagatelle

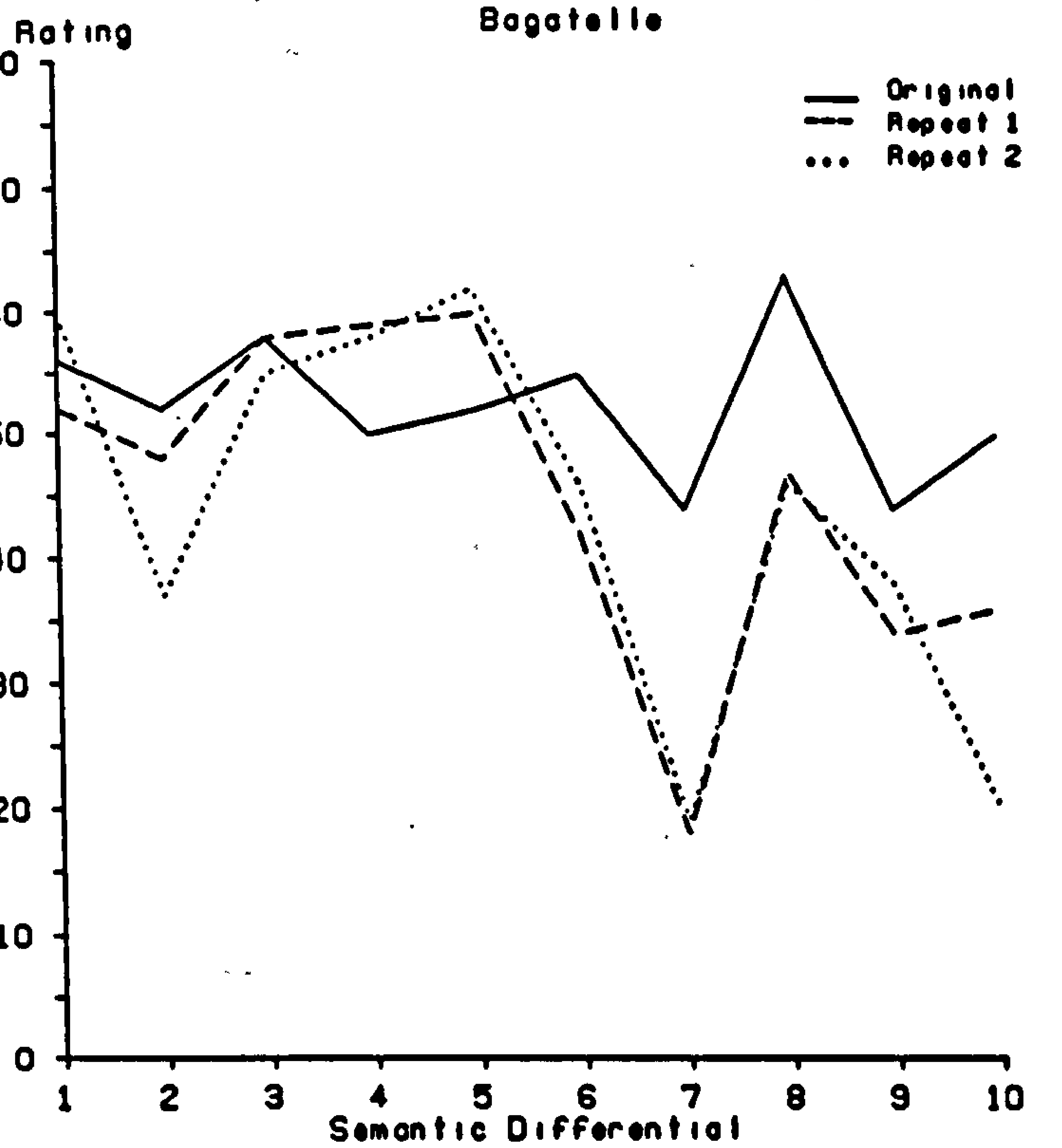
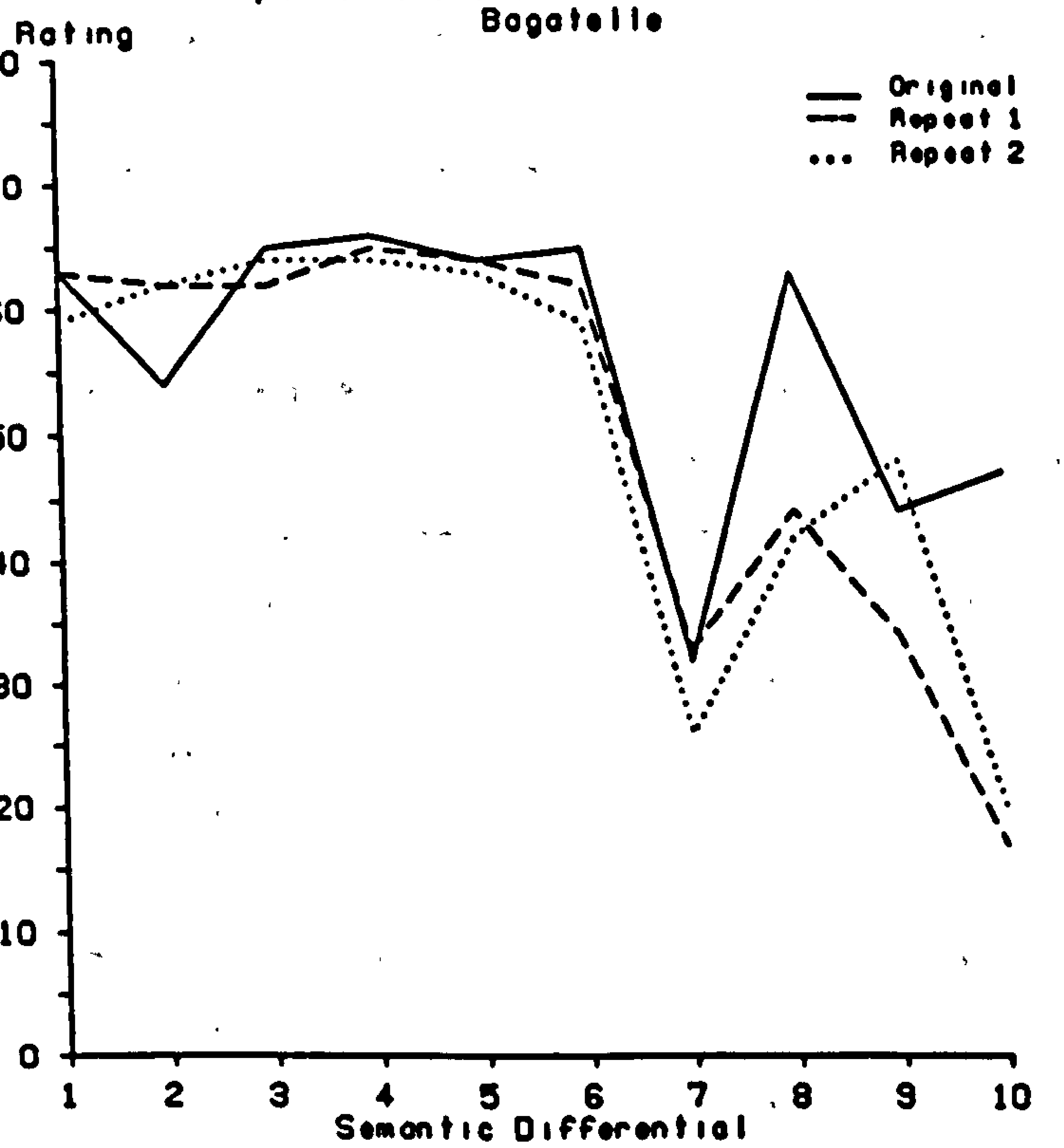


Figure 5.7 The semantic differential ratings for the original, first and second repeat performances of bar 22 of the Bagatelle



(Video examples 17a-17c show the original, first repeat and second repeat performance excerpts from bar 22 to show the common nodding.)

The mean scores used in the correlations are shown in figures 5.1 to 5.7. From these it is evident that for bars 6 and 22 the qualities of expression, variety, flexibility, control, naturalness, poise, economy, smoothness, overstatement and caution are very similar. However, when possible correlations (on the mean scores of the observers) between the original performance and each repeat performance for each semantic differential across all locations were analysed to test whether each differential was used in a consistent way across the whole performance, the results (shown in tables 5.5 and 5.6) reveal that between the original and the first repeat performance there are only two semantic differentials which correlate (uniform-varied and unstructured-poised). Between the original and the second repeat performance only the stiff-flexible differential correlates significantly. Again, these results suggest that the semantic differential is not a terribly stable measuring device on its own.

5.3.4 SUMMARY AND CONCLUSIONS

This study shows: i) there are some qualitative links between the performances of the Beethoven Bagatelle, though these are bar location links, rather than links across performance; ii) the repeat performances of the Bagatelle have many qualitative links across location, but when these are correlated with the original performance, there are only two locations which show qualitative links across the three performances.

These results are interesting for in terms of the two repeat performances they show that despite differences in the movements at the bar locations (for instance, in bar 20 there is a nod in the first repeat and a shake in the second repeat), certain qualities are maintained between the two performances. However, since the only locations to correlate across all three performances are bars 6 and 22 which are the only locations to include nods in all three performances, there is evidence to suggest that it is the unique qualities of the nod which give these locations their qualitative links.

This and the previous study together have indicated that a specific range of expressive movements is preserved in multiple performances of the same piece. If the performances are consecutive, there are qualitative links between them, however, when the performances are six months apart, the qualitative links are reduced to locations where nodding occurs. The obvious interpretation is therefore that over time, the performances are just not very similar. But it is also important to add: i) the observers do not use the differentials in a stable way; ii) the observers for the original and the repeat performances were different; and iii) modifications to the differentials may have had an effect on the result.

5.4 MUSICAL STYLE INFLUENCES ON EXPRESSIVE MOVEMENT

5.4.1 INTRODUCTION

No empirical evidence exists that considers the way in which a performer's physical approach may differ according to composer and musical epoch. Runeson and Frykholm (1983) report that individuals approach the activity of box lifting in a number of ways according to their knowledge of its weight and their performance intentions. By loose analogy, it could be that different styles of music might have different metaphorical weights and therefore elicit different expressive movements in performance. Indeed, it is feasible that expressive movements (which seem to be interchangeable between expressive locations) may not in fact be part of a movement vocabulary, but rather may be a flexible set of movements for one particular musical style. In order to examine whether this is the case, this study examines the expressive movements and their locations in a number of pieces from different styles of classical music styles.

5.4.2 METHOD

Stimuli and subjects

The same professional pianist who took part in the previous study was asked to play six pieces of his own choice representative of six different musical epochs in projected performance manner. The pieces he chose were:

Sonata for keyboard, 2nd Movement: Andante	in G minor	C.P.E.Bach
Bagatelle Op119, No.11	in Bb major,	L. van Beethoven
Etude No.3, from **Trois nouvelles études,** published in 1839 [work no. 130 <u>In:</u> M.J.E Brown's <u>An Index of Chopin's Work in Chronological Order</u> (London, 1960)].	in Ab major,	F.Chopin
Romance Op.118, No.5	in F major,	J.Brahms
Prélude:Danseuses de Delphes	in Bb major,	C.A.Debussy
Op.19, No.1 from Sechs Kleine Klavierstucke,		A.Schoenberg

The scores of these pieces can be found in figures sb2.10 to sb2.15. The Beethoven Bagatelle was included again so that further measurements of expressive locations could be made. When the recordings were made, the pianist expressed a desire to repeat performances of the Debussy and the Schoenberg pieces, therefore, these repeats provided additional performances from which measurements were also made. The pianist played the pieces sitting 2.5 metres from a video camera which was set in alignment with the upper edge of the piano keyboard in right side profile. For consistency with the other video performances, the piano was placed against a mirrored wall so that both hands could be seen clearly. The performances were recorded on video with thirty seconds of blanking placed between each performance, and were presented in a random order to four experienced male musician observers (two examiners of undergraduate performances, one music therapist, and an accompanist, with a mean age of 33.25 years).

Apparatus and Procedure

The recordings of the performances were played back to the observers on the editing equipment described in chapter 4 (procedure section 4.5.2). Prior to watching the six pieces, video examples of each movement type extracted from the first recordings of the Bagatelle were shown. The examples were prepared and played with ten seconds of blanking between each example. These examples were viewed as many times as the observer requested - which varied between two and four occasions. It was explained to the observers that the examples had been previously identified as expressive moments and that the examples were taken from performances that were not included in the experimental pieces. It was emphasised that they were to use the examples as a starting point in identifying expressive movement and should note the location of, and describe, <u>any</u> movement they felt to be expressive in character. No sound was used in the examples and the observers were not told they would see a different interpretation of the same Bagatelle amongst the six performances used in the experiment. Each of the four observers viewed the recordings individually with the experimenter operating the editing equipment. Each of the six pieces of music was first played twice from beginning to end, and the observers were then asked to work systematically through each performance, locating the start and finish of each expressive moment, and describing the type of movement identified. When an identification was made, the experimenter rewound the film and played it in slow motion to permit the observer to give precise frame identifications. Once the main test was underway, the test length varied according to the observer, but in all cases the test was divided into two main sessions which took place on separate days, each session lasting at least 3 hours. One observer asked to see the test examples prior to each observation session, whereas the others chose to begin the second session without being reminded of the movement types. In three cases, breaks of thirty minutes were taken after the first 1 1/2 hours of observation. In the fourth case, the observer worked far more quickly, completing all observations in a total of 4 1/2 hours. The task was very demanding on the observers' concentration, but all observers reported that the observation periods seemed to pass quickly. It seemed that the task parameters were clear. All the expressive locations and movements were recorded by the experimenter in terms of frame, musical location and duration with accompanying brief transcriptions of the observers' verbal descriptions of the movements.

5.4.3 RESULTS AND DISCUSSION

The figures illustrating the expressive movements of the six pieces are shown in supplementary booklet 2, (sb2.2 to sb2.9).

Looking at the results as a whole, it is apparent that the vast majority of the pianist's expressive movements are movements of the head and left hand which are of the same types as those identified in the earlier studies (sections 4.5 and 5.2). Again, like the former studies of expressive locations, there is considerable agreement between the observers regarding the locations and types of movements, though it is worth noting that observer 1 recorded slightly more locations than the other observers. However, as he was the most experienced of the observers, it is feasible that his experience provided him with greater stimulus attunement than the other observers. Interestingly, observer 4 was inclined to report and then reject those locations which became unique to observer 1. As the criteria for the rejection included a discussion of the locations being "not big enough" to be significant (for instance, bar 6 in the Beethoven performance, figure sb2.2), it is possible that observer 4's judgements were based rather more on quantitative factors than observer 1. There may, of course, be many movements which have unconscious perceptual effects on the observers, but given the degree of agreement between the observations, the results seem to confirm that at least some of the information about expression is transmitted to the observers in specific movements that are generally perceptually available to all the observers. One area of difficulty between the observer locations, however, seems to have been the matter of where one expressive location ends and another one begins. For instance, in figure sb2.9 (bar 14) where there is a group of movements in a location (nods), observer 2 records only the first of the group. When he was asked to name the number of expressive nods at this location he commented that there were two nods, but that the second was linked integrally to the first, and formed part of the same expressive movement.

Another general result of this study is that the Beethoven Bagatelle (included for comparative purposes with performances discussed in sections 4.5, 5.2 and 5.3), and the two repeated performances of the Debussy and Schoenberg pieces illustrate that between several performances of the same piece, the expressive locations remain constant across the performances. Therefore, it is apparent that there is a relationship between the musical structure and the expressive locations. However, it is worth noting that the durations of the locations and the movements within these locations are not identical across the repeated performances. Yet again, there is evidence to suggest that there is some flexibility in the performer's use of movements at the locations.

An example of the relationship between the structure and the expressive location appears in the Debussy performances where there are many held notes and rests, all of which appear to provide opportunities for hand movements.

Another general result of the study is that in some of the pieces only one kind of movement is repeatedly perceived at each expressive location, almost to the exclusion of all other movements. This is certainly true of the predominance of the hand movements in the Debussy performances. In the Chopin performance, by contrast, there is a relative absence of expressive moments in the left hand. Video example 18 shows a section of the composition taken from bars 37-40, and as can be noted, the hands are both continually involved in executing notes. The repeating rhythmic figure in an *allegretto* quaver tempo seems to leave little space in the music for expressive hand motions to show themselves. Indeed, it is only when the music slows in the final eight bars that a greater number of expressive hand motions are detected. In this piece, it is the head which seems to contain the majority of the expressive information. This Chopin performance and the Bach performances are both dominated by the head shake, however, there is nothing in either score to suggest what may be causing the performer to use this movement. It is important to note that although the expressive locations for the head in the Chopin persist over several bars, these locations are not in fact significantly longer than the one bar durations which appear in the majority of the pieces, for the tempo of the Chopin is much quicker than the tempi of the other pieces, therefore, the location durations are similar.

A further example of only one type of movement is found in figure sb2.5b which shows the *Allegretto grazioso* section of the Brahms performance. This illustrates that the wiggle movements predominate, and that the locations occur only once every four bars. Here, the use of one movement can be explained in structural terms, for the wiggle locations occur on the first beat of the first of four bars. If video example 19 is observed (it shows the four bars from 17-21) it is evident that it takes the body the whole four bars to move from the initial wiggle through to the next wiggle at the start of the next four bar phrase. Therefore, it seems as though the wiggle emphasises the phrase structure and since the passages are fast and ornamented, it appears that the body is injected with some of this decoration and speed in the quality of the wiggle itself.

The numbers of the locations can also be accounted for in terms of the structure of each piece. For instance, in the Brahms, the first of each four bars comprises new material and as this is thematically part of the same section, the same movement is produced in the body. In the Beethoven, however, because the piece is far shorter and the thematic material is more varied, there are lots of variations in the movement types and a proportionally larger number of expressive locations than the Brahms.

These general results show that the fixed repertoire of movements identified in the previous chapter interacts with the musical structure. However, this study also reveals movement features that were not apparent in the earlier studies of the pianist (sections 4.5, 5.2 and 5.3) and which add to the discussion of expressive movement.

First there is the emergence of the right hand as a source of expressive information. This appears only in the Brahms (figure sb2.5), Debussy (figures sb2.6&7) and Schoenberg (figures sb2.8&9) performances. Although the right hand locations in these figures all come from the same repertoire as the movements for the left hand, it is interesting that the right hand should be expressive in these performances and not in the Beethoven, Bach or Chopin performances.

The first general comment about the right hand locations, however, is that they occur only once in the Brahms performance, six times in the first performance of the Debussy and ten times in the second performance of the Debussy, and five times in each of the Schoenberg performances. Therefore, the right hand is not a frequent source of expressive information, irrespective of the different styles of music played. The fact that the right hand is most frequently used in the Debussy performances fits with the finding that the left hand dominates the expressive locations of the piece. The reason ascribed to the dominance of the left hand in the Debussy piece was that the piece was slow and therefore required the movements to be extended. Indeed, since the piano produces notes instantaneously, there is a period of time before the hand needs to be used again, thus, in a slow tempo piece, the performer must control and occupy his hand over the time lag between key depressions. The perception of the right hand as an expressive information source in the Debussy piece suggests that the right hand is used in the same way. Indeed, all the locations (bars 12/13, 15, 26, 27, 28 and 31 in the first performance, and bars 4, 5, 6/7, 16, 24/25, 26, 27, 27/28, 30 and 31 in the second performance) occur at moments when the hand is playing high held chords, so it could be that the extension of the note's value at these points allow, or even demand, that an expressive movement is made.

Of the other right hand locations, the single location in the Brahms performance (figure sb2.5c) occurs at bar 39/40. Structurally, the music is very different in style to that of the Debussy, for it moves quickly. However, prior to the location, the right hand plays a sequence of ornamented rising arpeggiated notes, and as bar 39 is the climax of this particular section, it could be that the final flourish of notes, with the hand being very high and being obliged to shift to a lower register (two octaves lower at the start of bar 40) at the end of the phrase, elicits its own expression. It is, therefore, perhaps a matter of flight trajectory which leads to the right hand making an expressive movement. In the Schoenberg performances similar cases can be argued: for bar 8 in both performances the hand makes a quick shift of register from a high F′and B′ down to a C and F ♯, so the movement trajectory could account for the existence of an expressive location. In the other right hand locations (bars 7, 10, 12/13 and 17) the music is not played in a high register, but in all cases there are pauses in the form of rests or held notes. Therefore, the expressive hand movements at these points could have been the most effective ways of occupying the space (perhaps even linking the space) between musical ideas. It is perhaps the issue of musical "*space*" which determines why the performer used the right hand to expressive ends in these particular performances and not the other performances, for if the Beethoven, Bach and Chopin performances are examined, it is evident that the right hand is far more occupied with note playing than the left hand. It could be that there needs to be a metaphorical "*space*" in the music in order for any expressive hand movement to be elicited.

Besides the right hand, the Bach, Chopin, Brahms and Debussy performances all contain locations which were found to be expressive, but which contained movements that were not part of the movement repertoire identified in the Beethoven performances. Again, there are only one or two of these locations per performance. An example of these locations can be seen in video example 20 which shows bars 15/16 of the Bach performance (shown in figure sb2.3a). Although observer 2 who notes fewer expressive locations than any of the other observers does not refer to this moment, all the other observers note this as an expressive location. Observing the location, it is apparent that there is a body lean. The fact that this lean occurs at a dramatically tense movement in score (in the soprano line there is a tied high G which is the highest pitch tie of the tied note section; and over the bar line to bar 16 there is an octave leap which represents the largest soprano part intervallic leap of the whole piece), suggests that this movement may be another body configuration which can be used at structurally important locations in the score. However, it is a fairly constrained movement, and because the tempo of the piece is slower than the Bagatelle it may be that the leaning is simply a body shape along the lines of a wiggle but that with more time in which to execute the movement, the whole upper body becomes involved.

A similar location appears in the Chopin performance at bar 48 (see figure sb2.4c). This bar can be seen in video example 21 and as can be observed, on this occasion the transference of weight is backwards and away from the camera (a shift to the pianist's back left). In musical terms, bar 48 is interesting in that it is a bar of harmonic transition between Db major and the tonic key, Ab major, and that it is also a moment which precedes a new rhythmic figure in the bass line. However, the bar is in no way unique to the piece for it is part of a recapitulation section. In the exposition of this same material (bar 8) there is an expressive location, though in this case it is a shake. Evidently then, there is nothing within the Chopin performance to suggest that this lean is a movement specific to a particular musical structure. Of course the fact that the musical material is identical is no guarantee that the performer interprets the location identically. However, more evidence of this type of movement being used in a variety of locations is found in the Brahms and the Debussy performances.

In the Brahms performance the movement is far larger, with a clear transference of weight from one hip to the other, and occurs at bars 5, 9, and 48 (see figures sb2.5a and sb2.5c). The bar 5 example can be seen in video example 22. Here it is apparent that a mid-back wiggle occurs, but the feature of this motion dominant to the observers is the shift of weight from one hip to another. Structurally this occurs at another interesting musical point in the score: the first occasion where there is successive quaver motion. The location also has the melody in octaves between the alto and tenor lines. However, this moment is not unique to the piece for it occurs again at bar 13 and is recapitulated in a slightly extended form at bar 52. In terms of body movement from note to note, it is feasible that a rolling motion is integral to a smooth flow between musical phrases from bar 4 with its I-III-V7 cadence which only resolves on the first beat of bar 5 (I). In addition to the idea of smoothness is the idea of a link between sections for there is a large shift in register for the top three lines between bar 4-5. The video example 23 which shows the *"hip roll"* location in bar 9 reveals a much larger, slower transference of weight from one hip to another. Observer 4 suggested that the movement was a functional shift for the purpose of playing at the extremes of the keyboard, but went on to note that this movement somehow characterised the motion of the phrase. As the video example also shows, this motion seems directly related to the arpeggiation in the bass line, so the combination of pitch height and arpeggio may have elicited this particular kind of expressive movement in performance. The other additional motion in bars 47-48 is particularly interesting and demonstrates the link between this motion and the wiggle/shake, for if it is compared with the motion at bar 51 (which is noted as a wiggle moving into a shake at 52) it can be seen to have many common features. Indeed, it is the larger hip motion in 47-48 which causes the observers to give it the hip roll description, though essentially, the wiggling/shaking element is the same as that of bar 51. These bars may be observed in video examples 24 and 25. The differentiating feature between the musical locations that are associated with these two types of movement seems to be that in the case of the hip roll, the pianist not only has to shift registers between bars 47 and 48, but also has to change speeds. Therefore, it is feasible that the roll enables him to move most naturally between sections.

The Debussy performances (figures sb2.6a&b, and sb2.7a&b) have hip roll locations at bars 6, 7, 24-25, and 28-30 in the first performance shown in figure sb2.6a&b, and in bars 24-25 and bar 29 in the second performance (sb2.7b). From the descriptions given by the observers, it seems that the locations at bars 24-25 and 28-30 are very similar in terms of the shapes and directions of the movements. Indeed, these similarities can be observed in video examples 26, 27, 28, and 29. Musically, both locations share the structural feature of a huge shift of register between chords, so it could be that at these points the hip roll is the most expedient movement to achieve the technical ends. In the first performance the hip rolls at bars 6 and 7 also occur at points where the performer is playing with his left and right hands at opposite extremes of the keyboard and with the rhythmic displacement of left hand against right hand, therefore, the roll could be the most fluent way of achieving these technical demands in a style which is consistent with the sounds being produced. This seems unlikely, however, because it does not happen in the second performance.

The discovery of a new movement type serves to illustrate that the pianist may in fact possess a repertoire of movements more varied than the initial investigations of the movements suggested (section 4.5). However, as the hip roll itself appears to have features common with the wiggle it seems that there are underlying links within the repertoire of movements. Indeed, the Schoenberg performance is an important and interesting case in point for it includes expressive locations which are made up of movements not described in the movement repertoire and which are not like the hip rolls. These movements are found at bars 1 and 3 in figure sb2.8, and bars 1, 3 and 4 in figure sb2.9. Video example 30 shows the location in bar 1 of sb2.8, and it is apparent from the excerpt that this movement involves an upper torso depression or collapse with a hunching of the shoulders. Observer 4 assessed this movement by stating that he felt the performer was trying to "*squeeze*" the sound out of his body. The other location in figure sb2.8 is at bar 3 and also originates in the collapse of the upper torso, only this time the movement is from the "*squeezed*" position upwards, to full body height. In structural terms, the collapse downwards of the body in bar 1 can be seen to link the different registers of playing between the rests in the left hand, whereas in bar 3, the body moves to full height over the rising left hand single line. Thus it seems that the movements may be physical mirrors of the musical segments (See video example 31 for the first performance of bar 3). In the second performance shown in figure sb2.9, it is possible to see that there are additional movement types also at bars 1 and 3. In accordance with the observers' descriptions of these movements and the video examples 32 and 33 which show these movements, it is evident that these movements are of the same type of "*squeezed*" torso found in figure sb2.8. The consistent use of this motion in the repeated performance suggests that it is the most appropriate way the pianist has of producing that moment, indeed, as the next study reveals, this movement reflects how the pianist regards this part of the music. There is a third unmarked location in figure sb2.9 at bar 4 which again is a "*squeezed*" upward moving motion (see video example 34) of a similar type to the movement in bar 3. However it is worth noting that there is no "*squeezed*" counterpart to this movement in the first performance of the Schoenberg - indeed, there is no expressive location in bar 4 of the first performance. Therefore, the movement is expressive, but it is not a movement that is synonymous with a particular location in the music.

Keeping with the Schoenberg performances, it is important to add that the observers felt that this piece presented the most stylistically unique performance, and because of the unpredictability of the musical structure, it was perceived as the most expressively *"vivid"* of all the pieces. Indeed, observer 2 who noted fewer expressive locations than the other observers in the other performances, noted nearly all those recorded by the other observers. He said that the piece was bold and decisive in its expressive impact upon him, and he mentioned the moments of silence permitted the performer to prepare his body for the various portions of the composition. The conclusion that can perhaps be drawn from this comment is that the structural variations in the score elicited a greater number of potential expressive moments than a work like the Chopin where the character of the musical material builds to one single culmination. This point only adds to the earlier discussion of the fact that the expressive locations vary in number and type from piece to piece.

A major point relating to the vividness of the Schoenberg is the fact that none of the observers reported any swinging movements in the Schoenberg performances, whereas the swinging movements were the expressive undercurrent of the other pieces. The earlier discussion of swinging movements (chapter 4, and chapter 5, section 5.2) led to the conclusion that swinging was perhaps an important invariant feature of the expressive performance. The Schoenberg finding suggests that this is not always the case. However, it also suggests that swinging may also be dependent on the type of musical content. In all the pieces except the Schoenberg, the observers viewed the expressive locations as expressive movements in excess of the overriding expressivity of the swinging movement. With the Schoenberg, on the contrary, the observers spoke of the expressive movements as totally independent entities. The reason for this could be simply that the fragmentary nature of the composition with its constantly changing rhythmic structure and the short detached surges of sound does not permit the body to establish one motion for the whole performance. This could have something to do with the performer's expression of the timing of the pieces, the metrical pieces eliciting swinging movements, the unmetrical Schoenberg supporting no swing. The differences between the two types of performances (the metrical and the unmetrical) have some links with Cutting and Proffitt's (1981) study of walkers and their search for the invariant specifying gender. It could be that the body which tends to operate within regular rhythms - for instance, the regular movement of walking - makes gender obvious, just as the rhythmic movement of swinging makes the pulse of a piece obvious.

To develop this argument one stage further, the discovery that the hip roll and squashed torso have some connection between them and the other movements of the repertoire suggests that there may be a common point of origin for all the perceived expressive movements. Indeed, it is possible to hypothesise that the rotation point for the body's upper half - the body's fulcrum is on the piano stool, therefore the rotation point is the hip region - is the key point from which the expressive movements are physically generated. It could be, as Cutting and Proffitt (1981) suggested, that there is in fact a grammar of movement. The hand movements could be some second order movements which characterise the same expressive information as the first order upper torso movements, but which can work independently as well as consonantly with the first order movements.

5.4.4 SUMMARY

Overall, the pianist uses the movements initially described in reference to the Beethoven Bagatelle regularly in his performances of music from different epochs, but there are four movement exceptions in the other styles of performance: i) in the Brahms, Debussy and Schoenberg performances, the right hand is a conveyor of expressive information; ii) there is a hip shift which appears in the Bach, Chopin, Brahms and Debussy performances; iii) there is a *"squeezed torso"* movement unique to the two Schoenberg performances and iv) the pianist does not use the swinging motion associated with the other performances in the Schoenberg performances.

These findings suggest that the movements found in the Beethoven Bagatelle performance are part of a movement vocabulary, but that this vocabulary is slightly more varied than the movements of the Bagatelle indicated. The variation in the vocabulary does not necessarily suggest that all the movements are unrelated, however. Indeed, the observers noted that the hip roll was closely related to the wiggle and the torso *"squeeze"* was, in essence, a nod of the torso rather than the head. The fact that all the movements were common to either the head and the hand region suggests that the categorisations of 9 or 10 head movements and 7 hand movements are perhaps more accurately described as variations of a single broad movement type - a swinging movement with the hips as its fulcrum. Indeed, such a proposal would account for the way in which movement types varied across the repeat performances of the Beethoven, Debussy and Schoenberg, the indication being that there is a certain amount of movement flexibility. However, this statement is perhaps a little too simplistic when it comes to the discussion of the pieces in which specific movements are used over whole sections of the composition. The repeated wiggles in the Brahms and the predominance of the shakes in the Bach and Chopin performances suggest that certain musical structures elicit particular movement types. An emergent example of the constancy of certain movement types seems to be found in the swinging movement, for it appears that swinging is a feature which expresses the pulse of a metrical performance, but is a feature which has no role in an unmetrical performance. (This is a particularly interesting proposal when it is recalled that in section 4.2 the tracking revealed that the pianist did not swing in his deadpan manner performance of the Beethoven Bagatelle. This suggests, therefore, that when the performer is prevented from becoming involved in the music this feature (the swing) disappears.)

The findings eliminate the notion that the swing is itself the single invariant for expressive performing. However, this study does support the notion that the invariants for expression are found in the head and hands regions of the body. It seems that this information is presented in the performer's body through a movement vocabulary.

In order to assess these movements in more detail, it was felt that an insight about the origin of the movements in terms of the performer's intentions and the constancy of the locations across different performances of the same piece might be achieved by asking the performer what he knew of the expressive content of the pieces and how he might interpret these moments. The aim was to discover whether the movements which were detected as expressive, occurred at moments that the performer believed to be expressive. Since it had already been established in the point-light studies of chapter three that manner could be discriminated by the audience in a way which indicated that these were the manners the performer aimed at achieving, it was essential to establish whether the performer had any awareness of the movements identified by the observers as the conveyors of expression.

5.5 PIANIST'S LOCATIONS OF THE EXPRESSIVE MOMENTS IN THE SIX PIECES AND HIS IMAGININGS OF EXPRESSIVE MOVEMENTS

5.5.1 INTRODUCTION

The aim of this study was to establish whether the pianist was aware of the locations at which he transmitted expressive information to the observers and also to know whether he was aware of how he moved when he performed these expressive moments.

During the earlier performances of the six pieces, the pianist had spontaneously used some terms of physical description to describe the quality of his performance. Therefore it was important to find out whether the performer had any conscious knowledge of where and how he moved expressively. Did he, for instance, pin-point moments for special attention in the performance, or was he interested only in an overall approach to his playing?

5.5.2 METHOD

The pianist was presented with the scores of the six pieces he had prepared and performed (see section 5.2) and was asked to locate expressive moments in the score. Then, in a subsequent examination of the scores, he was asked to discuss why he felt these locations were expressive or needed to be presented expressively. In a final examination of the scores he was asked to hypothesise in what ways he might show expression in his movements.

The pianist sat at a table in a semi-profile position so that the scores could be easily observed in a video recording which was made to enable a transcription of his remarks to be collected as experimental data. With the experimenter present, the pianist was asked to work systematically through each score.

5.5.3 RESULTS AND DISCUSSION

The material produced by this study consists of the six scores with locations marked that the pianist thought were important and a long verbal report which discusses the expressive meanings of the locations and the pianist's intuitions about how he might express the meanings through movement in performance. Material of this kind is inevitably difficult to present in a systematic way and is not intended to be considered as empirical data in the normal sense of the word. Its purpose is to provide the basis for an explanation of this player's performances as presented in the previous experiments, in the hope that this may reveal some general principles that may apply to all the experiments in this thesis.

A transcription of the pianist's comments about these locations appears in the appendix to the chapter and scores of the six pieces with the pianist's expressive locations are shown in supplementary booklet 2 (figures sb2.10 to sb2.15). The following section summarises the pianist's comments about the locations, and then discusses the comments with regard to the results of the previous study (section 5.4).

In general, the pianist's comments reveal that he has two principal concerns when selecting what he considers to be expressive locations: i) structural concerns which relate to an effective communication of the music; ii) emotional concerns which are related to technical execution.

There are 12 different types of structural feature to which the performer commonly refers, amongst which are cadences, intervals, and rests. An example of the pianist's comments about the cadence can be found when he talk about bar 8 of the Beethoven Bagatelle: "*...the shift from G minor, through Bb, to the controlled climax at the end of the bar on the V7 chord is particularly worthy of attention during* *performance"*. His references to intervals include the following comment about the notes which span the end of bar 2 and the beginning of bar 3 in the movement from the C.P.E. Bach Sonata: *"... this is a large rising interval in the soprano voice. It is important because it is the leap to the highest note of the piece to this point; in fact, it remains a high note in the context of the whole piece"*. For rests, the following comment about bars 27 and 28 from the same C.P.E. Bach piece provides an interesting example: " *the rests on the first beats create moments of focus on the single voicing (so much of the expression of this piece rests with the rests!)"*.

There are 6 commonly used emotional features, amongst which are eroticism, sincerity and poise. An example of the pianist's comments about eroticism can be found in his discussion of the Chopin Etude. He says: *"Really, as far as I'm concerned, this piece has an erotic disposition which communicates a sense of languish rather than straightforward fulfilment"*. His references to sincerity include his comment that the final four bars of the Beethoven Bagatelle should be played with a: *"sense of earnest commitment...try to be sincere with the sounds"*. For poise, he says of the Brahms Romance: *"From the upbeat this piece must be absolutely poised"*. The link with the technical execution is particularly clear in this last example for the pianist continues his comments by looking at the first 10 bars:

> *"The movement of the music suggests a sarabande, therefore, there is a fussy power conveyed in the hemiola at bar 4. This is then lyricised in the alto and tenor quavers at bar 5. One gets increasingly aware of the wonderfully androgynous nature of this piece in the doubling, especially across bars 6-7. Bar 8 is almost excessively formal in its rendition of the V-I cadence. The suspension in the bass at the beginning of bar 10 should be noted for it did not occur at its thematic parallel in bar 2."*

It is striking that the pianist has little idea about the movements he makes at the locations he identifies for structural and emotional reasons. Nonetheless in the discussion of the locations he suggests *"hypothetical movements"* which turn out to be descriptions of many of the movements he actually employs at the expressive locations. His locations have some degree of consistency with the locations made by the observers of the six performances, but the consistency varies according to piece.

The relative emphasis placed by the pianist on the various structural and emotional concerns are illustrated in table 5.7. There are some structural and emotional concerns that are specific to only one location out of all the locations in the six performances, but, there are also several concerns that are recurrent across many locations of the pieces. Table 5.7 shows the 18 most commonly used concerns across the six performances.

On balance, it seems that the pianist tended to have more technical concerns than emotional ones for specific locations, but it is worth noting that he had overriding emotional concerns for all of the Chopin, Brahms and Schoenberg performances. It could be, therefore, that emotion is the predominant expressive intention in these performances. There are many strictly technical features which always need to be clarified in any performance (for the sake of accuracy in production of the music), so, this table may give a slightly distorted image of the balance of the pianist's intentions since it deals with many of these technical moments. Indeed, it could be that the pianist gave himself technique as the principal criterion in the selection of the expressive locations because sitting down with the score naturally biases one to make technical as opposed to emotional points. Added to the comment above, it is also essential to point out that the pianist has an awareness of the physicality of some of the music he performs. For instance, in the Debussy performance

In the following table: 1 = Beethoven Bagatelle; 2 = Bach Sonata, second movement; 3 = Chopin Etude; 4 = Brahms Romance; 5 = Debussy Prelude; 6 = Schoenberg Kleine Klavierstucke No 1. The bar locations in each piece are noted after a period. For instance, 5.11 = Debussy prelude, bar 11.

Table 5.7 showing the 18 most commonly referred to expressive location types with examples of their locations.

LOCATION TYPE	*EXAMPLES*
cadences	*1.8, 1.14, 1.21, 1.22, 2.44, 2.47, 2.48, 3.19, 3.45, 4.8, 4.57, 5.5, 6.11*
intervals	*1.1, 1.2, 1.3, 1.14, 1.17, 2.2-3, 3.18, 3.39, 3.40, 4.11-12, 6.8.*
melody (pitch height)	*2.9, 2.25-26, 2.41-42, 3.5, 3.8-9, 4.47-57, 5.8-9, 5.11, 5.16, 6.2, 6.5*
rests	*1.14, 1.18, 2.8, 2.13, 2.18, 2.27, 2.28, 3.56, 2.28, 3.56, 6.1, 6.2, 6.4*
key changes	*1.5, 3.21, 3.33, 3.38, 4.17, 4.40, 5.16*
dissonances	*1.6, 2.12, 2.38, 3.9-10, 6.4, 6.13, 6.14*
rhythms (note values)	*1.11, 3.41, 3.45, 5.6, 6.4, 6.7*
crowding of musical ideas	*2.15, 2.16, 2.32-33, 2.42*
bass line	*2.8, 2.22, 6.1*
doubling	*4.6-7, 5.21-22*
crescendo	*4.49, 4.52-53*
dislocation of hands	*3(all), 6.6*
erotic/sexual atmosphere	*3.13, 3.14, 3.18, 4.6-7, 4.47-57, 5.27-28*
dramatically tense	*2.22-23, 3.40, 6(all)*
intense	*1.20, 2.8*
sincere	*1.14, 1.18-22*
poise	*3.39, 4(all)*
joyous	*1.18, 3(all)*

he notes that his principal intention is to convey the programmatic feature of the music. As the pianist comments: *"This is one extraordinary gesture in which long limbs, dancing in slow motion, waft in and out of the viewer's and listener's sensory focus."*

With this point in mind, it is also vital to note that in his comments, the Chopin references are filled with sexual body imagery which suggests that the pianist responds to some of the music in physical terms. Also, in his discussion of the Beethoven Bagatelle the pianist notes that although he is aware that he uses particular movements to convey or to execute particular expressive features of the music, he believes that he "cannot afford to be too body conscious", and that this is because if he planned the movements too carefully he might *"make the performance stiff or even too controlled"*. This suggests that the pianist wants his performance to look as natural as possible and is aware that fixed body positions may impair the performance. It seems, therefore, that the pianist does not choreograph his performances in any way.

It has already been pointed out that the pianist had little explicit knowledge of his body movements in performance, though he was aware that he used his body to expressive ends. The hypothesised movements of these expressive features are interesting, especially when it is recalled that the pianist wanted to eliminate any debilitative tensions from his body in performance. What follows are six tables which illustrate the hypothesised movements that the pianist considered conveyed some of the technical and emotional features of the expressive locations. Since hypothesised movements were few in proportion to the total number of expressive locations (hypothesised movements were suggested for less than half the locations for each piece), the tables show all the hypothesised movements for each piece.

Table 5.8 showing the locations and apparent functions of the hypothesised movements in the Beethoven Bagatelle.

LOCATIONS	*HYPOTHESISED MOVEMENTS*	*EXAMPLES (BAR)*	*APPARENT FUNCTION*
cadence	*sit at full height and move forwards and upwards*	*8*	*get weight behind the substantial chords*
cadenza	*lean to right*	*9-10*	*to make the moment seem casual*
trill	*tension between neck and shoulder*	*12, 16*	*aim for precision (enthusiasm)*
note-crowding	*press fingers hard into keys*	*17*	*drive and drama, sing out alto line*
chords	*draw body together (priest-like)*	*18-22*	*to give sincere, straight forward sounds.*

Table 5.9 showing the locations and apparent functions of the hypothesised movements in the Bach Sonata (second movement).

LOCATION	*HYPOTHESISED MOVEMENT*	*EXAMPLES (BAR)*	*APPARENT FUNCTION*
interval	*move trunk forwards or backwards*	*2-3*	*emphasise importance of the highest note to that point*
bass line	*something intense (bulge in right hand)*	*8*	*drama to heighten the importance of the level of bass involvement at the end of a phrase*
pitch	*floaty/ airy*	*9*	*create sense of great musical height*
upbeat	*intimate hand-oriented*	*12*	*create sense of a musical embrace*
harmonic transition	*matter of fact body*	*13-17*	*prevent any rushing - not too much involvement with the note production*
bass line	*rotation of the hand*	*18*	*delay the harmonic resolution*
cadence	*sideways body towards the audience*	*20*	*extend sense of yearning*
new key	*alert, cheeky body*	*21-22*	*give the new key repetition of the opening material, drama*
harmonic transition	*smooth (no protrusions)*	*25-32*	*allow the intensity of the harmonic excursions to be presented in an unhindered manner*
note crowding	*lean towards audience*	*32-33*	*show audience that performer is in control of the situation*
final note	*turn to audience*	*48*	*metaphorically ask: "did you get the message"*

Table 5.10 showing the locations and apparent functions of the hypothesised movements in the Chopin Etude.

LOCATION	*HYPOTHESISED MOVEMENT*	*EXAMPLE (BAR)*	*APPARENT FUNCTION*
whole piece	*left hand move slightly behind right*	*whole piece*	*dislocations to give sense of gravity to the piece. Try to radiate pleasure.*

Table 5.11 showing the locations and apparent functions of the hypothesised movements in the Brahms Romance.

LOCATION	*HYPOTHESISED MOVEMENT*	*EXAMPLE (BAR)*	*APPARENT FUNCTION*
whole piece	*levitated feel in the small of the back*	*whole piece*	*create a sense of poise*
arpegg-iated bass, high melody	*create a beautiful appearance*	*9-10*	*help the sound to flow*
repeti-tion	*attempt to be still*	*13-14*	*present material in a contrasting style to its first presentation (bar 5)*
ritenuto (cadence approach)	*press hard into key*	*15*	*heavy and wonderful moment to stress the contrast with what is coming in bar 17*
new section	*turn towards the audience*	*17-24*	*show surprise at the allegretto grazioso and make sure the oat-filled heather of the section is communicated*
trills/ ornaments	*try to flow*	*36-39*	*embody the musical imagery of a "gurgling brook"*
trebled melodic line	*"knead" with fingers*	*52-53*	*exploit male/female sexuality of the three octave spread*

Table 5.12 showing locations and apparent functions of the hypothesised movements in the Debussy Prélude.

LOCATION	*HYPOTHESISED MOVEMENTS*	*EXAMPLES (BAR)*	*APPARENT FUNCTION*
whole piece	*energized hand motion*	*whole piece*	*communicate weight, poise, and flexibility of the long limbs of the dancer moving through the piece*

Table 5.13 showing locations and apparent functions of the hypothesised movements in the Schoenberg Piece.

LOCATION	*HYPOTHESISED MOVEMENTS*	*EXAMPLES (BAR)*	*APPARENT FUNCTION*
accents	*hunch over the piano*	*1, 2, 3,*	*get a sense of springing surprise into the music*
rests	*flop and drop hands*	*1, 2 4,*	*emphasise suddenness of the stops*
cadence	*something to look reverential*	*11*	*communicate seriousness of the moment*
various locations	*snort, expel air*	*various bars*	*stress the incomprehensible nature of the composition*
various locations	*dandy-like and absurd*	*various bars*	*communicate that a language is being used but that it is not being understood*

Looking at these hypothesised movement tables together, it is immediately apparent that although the pianist claimed his ideas were purely hypothetical, there are some specific kinds of hypothesised movements which appear at similar locations across the different pieces. For instance, the pianist talks about a movement forwards and upwards, or forwards and backwards which leans towards the audience at the cadence locations referred to in the Beethoven and the Bach. He also refers to some specific kinds of movements for similar apparent functions. For instance, when the function is to give a location weight and heaviness, the movement always concerns the hands (for instance, all of the Debussy performance, bar 17 of the Beethoven, and bar 15 of the Brahms). Therefore, although the movements are hypothetical, there is some application of these movements to specific expressive aims, though it is not a consistent application. This description of similar movements at similar expressive locations is interesting when cross reference is made between the pianist's hypothesised movements and the movements the observers of the previous study noted.

Take for instance, the hypothesised hand movements in the Debussy, bar 17 of the Beethoven and bar 15 of the Brahms. In the case of the Debussy, figures sb2.6 and sb2.7 (observers identifications of expressive movements) reveal that the piece is dominated by hand movements. In the Beethoven, figure sb2.2 shows that there is an expressive raised wrist movement at bar 17. In the Brahms performance, a wrist rotation is observed in bar 15. Therefore, it seems that some of the pianist's intentions are formed into specific movements, though the type of movement is unknown to the pianist.

The forward and backward movements referred to as the movements at cadence points are interesting for if reference is made to figures sb2.2 and sb2.3 which show the observers locations, in both pieces nods occur at these locations. In bar 8 of the Beethoven there is nod (movement forwards as the pianist predicted) and in bars 20 and 48 of the Bach there are reverse nods (backwards from the keyboard).

All the above mentioned examples suggest that the pianist has an implicit understanding of how he moves in performance, yet his descriptions of the first four bars of the Schoenberg seem to reveal a far more explicit knowledge of his movements that corresponds precisely with what is actually perceived by the observers (the study described in section 5.4). The hunching over the notes is clearly noted by the observers in bars 1, 2, and 3 in both performances (figures sb2.8 and sb2.9), as is the flopping and dropping of the hands (bars 1, 2 and 4). Since it was the performer's explicit aim to communicate what he considered to be the incomprehensible nature of this piece, it could be that the performer was more self-conscious about the specific nature of his expressive intentions at particular moments in the score, and it is perhaps for this reason that he has a precise knowledge of his movements at these locations. Added to this, it could be that this determination to be explicitly expressive is transferred to his movements, for it is to be recalled that the observers found this piece to be the most perceptibly expressive of the pieces (section 5.4). To link this comment back to the pianist's own conscious efforts to make the performance relaxed and natural, it would seem that these movements, although explicitly understood by him, are natural and expedient. The fact that he has an implicit knowledge of many of the other expressive movements he uses indicates that all these movements are movements which are necessary to the performance.

If reference is made to some of the apparent functions of the hypothesised movements, the performer spontaneously uses the word *"poise"* and *"flexibility"* to describe many of the locations. If the semantic differentials of section 5.3 are recalled, it is interesting to note that the only qualitative links across performances between the original and the repeat performances were the differentials which showed the performances to have poise and flexibility (see tables 5.5 and 5.6). It could be, therefore, that these qualities are communicated to the audience.

To look generally at the tables 5.8 to 5.13 again, it is important to stress that of all the locations with hypothesised movements, only one of these locations did not contain perceptible expressive movements for the observers (bars 32-33 in the Bach). All the other locations had expressive movements, though, at first glance, even an implicit knowledge of some of the movements seems tenuous. For instance, in the Bach piece, the pianist spoke about a rotation of the hand at bar 18 when in fact the hand is lifted. However, if video example 35 is observed it is apparent that the hand lift has a rotational quality to it.

The performer's implicit knowledge of the kinds of movements he makes is not always correct, however. For instance, in his discussion of the movements of the Chopin performance, the pianist proposed that the hands would be his principal source of expressive movement. However, the observers perceived head shakes to the virtual exclusion of all other movements. If the discussion relating to the Chopin performance (section 5.4) is recalled, it seems that the pianist may have played with the expressive intention of dislocating the timing of his hands, but since his hands were so preoccupied with note playing, there was no musical space for the expression to be manifested in movement. The head, however, was free to move.

To draw direct comparison between the pianist's locations and the observer locations, there were high levels of consistency between locations by both the pianist and the observers in the Beethoven Bagatelle and the Schoenberg Piece. The only difference in the Bagatelle was that the pianist believed that bar 13 contained an expressive location, but the observers did not detect an expressive movement. And in the Schoenberg, the pianist did not regard the last two bars of the piece to be particularly expressive, whereas the observers noted expressive movements. In sum, these two pieces suggest that the pianist's specific expressive intentions are communicated to the observers in the form of expressive movements. However, this finding is not consistent for the other four pieces. In the Debussy Prélude, although all the pianist locations coincide with observer locations, the pianist identified nearly 50% fewer locations than the observers. In the Chopin Etude, although the expressive locations are approximately equal in number, only 60% coincide. In the Brahms Romance, there are 20% more observer locations than pianist locations, and of all the locations, 60% coincide. Finally, in the Bach performance, all but 3 of the pianist's locations were perceived as expressive movement locations by the observers, but the observers identified 30% more expressive locations than the pianist.

The inconsistency between the locations and numbers of locations of the pianist and the observers can be explained, however. In the case of the Chopin performance, the pianist believed that the entire piece was expressive (he commented: "*I resent your premise* [marking specific locations]...*I ought to encircle the whole piece*"), and he said that the locations he made were those of "*subsidiary importance*". Therefore, it could be that there were other locations that were just as expressive, but were not marked because they were perhaps of a third or fourth level of importance in terms the criteria that the pianist may have set himself when selecting the locations. This could certainly explain why only 60% of the locations of the observers and the pianist coincide. A similar explanation can be offered for the Debussy and Brahms performances, as well.

For the Debussy piece, the pianist's sole comment about the hypothesised movements was that all the hand movements of the piece should be "*energised*". It is feasible, therefore, that in giving specific locations, the pianist has just given particular examples of what he considers to be an all pervading feature of the performance (recall that virtually every crotchet beat has an observed expressive hand movement). Similarly in the Brahms, there was to be a "*levitated feel in the small of the back*" and from the very first note of the piece the playing was to be "*absolutely poised*".

As for the Bach piece, the pianist said that he wanted to "*move the music along*" and "*sustain the sense of legato*", so these overall aims could account for the greater number of observed specific locations, the pianist locations being specific moments within these overall aims, but these overall aims nevertheless elicited expressive movements that were detectable to the observers at other moments too. The only aspect of the Bach locations which is difficult to reconcile is the fact that there are four pianist locations that have no observer location counterpart. These pianist locations are bars 19, 32-33 and 42. Table 5.9 shows that bars 32-33 were actually bars for which the pianist gave hypothesised movements, which is quite surprising especially since the majority of the pianist's locations coincide with observer locations. However, there are some possible explanations for these differences.

For bar 19, it is evident that the pianist saw the right hand line as the expressive voice, and the absence of any observed locations in the right hand in the Bach may simply be a reflection of the fact that there was no opportunity for expression in movement. This is because the constant quavers of the right hand give it no opportunity to make movements of anything other than a technical nature. It seems that the location is unlike the previous bar where there is a crotchet rest in the left hand, and therefore, "*space*" for a movement to occur. In fact, there is evidence to suggest that the performer has no idea that he does not use his right hand as an expressive source in this piece, for in the beginning of his discussion of the work he notes that the bass line in bar 8 is important, but because of the rest in the right hand that hand might make "*a slightly excessive hand lift...in counter balance*" to the bass line. In fact, it is the left hand which makes a raised and held forearm movement.

For bars 32-33 it could be that the pianist once again was talking primarily of hand expression, and since there is only one crotchet and no rests in the left hand, perhaps there is not enough opportunity for the hand to make a perceptible expressive location. It should be noted that the pianist does have some awareness of the apparent expressive role of the rests. In his discussion of this piece, he mentioned that "*so much of the expression of this piece rests with the rests*". What makes this comment particularly illuminating is that the pianist was clearly talking about the rests in terms of their compositional structure, yet this structural concern is evidently also translated into consequences for movement expression. In fact, this consideration of the rest as an expressive opportunity can also help to explain why there is no expressive location in bars 42-43 of the Bach, for there is no rest.

In summary, it would seem that given that the repeat performances of the Beethoven, Debussy, and Schoenberg performances all show that locations are constant features of performance, but that movement types can vary, the comparison drawn between the pianist and observers' locations provide a better indication of expressive location than the particular type of movement used at a location. However, the evidence suggests that the movements convey the performer's specific intentions to the observers.

5.5.4 SUMMARY AND CONCLUSIONS

From the pianist's locations and comments several points are apparent: i) the performer has specific ideas about the important expressive moments of the pieces; ii) these locations are connected with structure (for instance a particular harmonic progression) and the technical execution of these structures, though many of the structural moments are chosen for an emotional or programmatic effect they may elicit (for instance, an evocation of bird song or the long limbs of a dancer); iii) the performer recognises that he approaches each expressive location differently; therefore, it seems that he is aware that his body is a powerful communicative force for expressive intention, but he is only able to guess at his movements at the time of performance; iv) the hypothesized movements show an implicit knowledge of his actual body movements (for instance, he is aware of moments when he makes hand lifts - rests); vii) these pianist locations have some correspondence with the observer locations.

This section of work helps to put the findings of the previous studies of this thesis into perspective. For instance, it shows that (in part) the movements which communicate expressivity to the audience occur at locations where the pianist has specific expressive intentions. The fact that the performer has both technical and emotional intentions makes it somewhat difficult to assess what contribution each of these features makes to the physical formation of the movements at a specific location, though it is clear from the pianist's comments that emotion is often the underlying feature of the whole performance. Indeed, when expressive locations were discussed, it seems that the apparent function of many of them was to make some particular <u>structural</u> feature of the music clear so that the <u>emotion</u> of the piece could be understood. For example, the pianist felt that it was vital to accurately execute bar 14 of the Chopin so that the major 3rd interval in the right hand could be heard against the major 6th interval in the bass in order to communicate the "*erotic fascination*" of the moment.

The fact that the pianist possesses an implicit knowledge of his movements at the expressive locations is also significant, for it indicates that the movements of the expressive locations are not deliberate or self-conscious ways of communicating information to the observers. It is interesting that the performer is aware that he uses his body to expressive effect, however. This suggests that he perceives his body to be an essential tool in the communication of all the musical sound information (technical and emotional). The fact that the implicit knowledge of the movements is accurate in the direction and quality of the movements (for instance, the weight behind some hand movements) suggests that there is a body movement vocabulary used by the performer, and that this vocabulary is a consistent way of producing these intended effects in the performance.

This study has revealed that the performer may have had an intention behind the locations that could be expressed in a number of movement ways, so long as the quality of the movement is preserved. For instance, there is the hand movement that was mentioned earlier which turned out to be a lift in performances, but which the pianist predicted may have been a hand rotation: when the lift is examined it does indeed have a rotational aspect to its form. However, it is possible that this discovery highlights a problem with the method of movement categorisation. Indeed, it is feasible that this particular movement is in fact a combination of the lift and the rotation and it has been categorised according to only one of its components. If so, this has some implications for the overall findings of these studies since it suggests that there is some interchangeability of the movements at the expressive locations. This point will be discussed in full in chapter 6.

Another point which needs to be raised is the pianist's clear conception of the emotional intentions of the piece in terms of body imagery - certainly all of the Chopin, a major part of the Brahms and then specific moments within all the other pieces. This shows that the pianist thinks of the musical language and meaning in terms of physical sensations.

Here the issue of the swinging movement needs to be discussed for this study shows that the performer is not aware that he sets up this movement in the metrical pieces, although, it is interesting that he has such an explicit idea of the movements used in the unmetrical and atonal music. An explanation of this explicit expressive movement aim may be found by drawing a movement analogy with Clarke's (1989) proposal that where there is a lack of a relatively comprehensible structural framework (for example, music that lacks a tonal framework) expressive features of performance are brought more sharply into perceptual focus. It could be that the movements are not only brought more clearly into perceptual focus, but that the performer becomes more self-conscious about the types of movements he will employ. It could be his difficulty in understanding the musical structure which leads him to focus on the expressive movements.

Given the above, it should mean that for this pianist all his metrical performances should include swinging movements. The only exception would be if the pianist performed with a different, inexpressive performance intention - as was the case in the deadpan performance of chapter 4.

With the evidence to suggest that the performer has strong expressive intentions for specific locations as well as a whole work which are often based in body imagery, and that the expressive locations are performed with a certain degree of knowledge about movements used to convey these intentions, it was decided that a further test was necessary. This additional test was to investigate whether the expressive movements and locations which occurred in the normal piano keyboard performances would remain if the material conditions of the performance were dramatically altered. This was to determine: i) whether the physical sensation of playing the notes on the keyboard is in itself a significant factor in producing expressive locations; ii) or whether there is something in the intention (that is some factor independent of the physical act of note production) which underscores the expressive movement.

5.6 TABLE TOP PERFORMANCES

5.6.1 INTRODUCTION

In order to investigate whether the common sequences of body movements are used by the performer to expressive effect regardless of performing context, and to investigate whether expressive locations remain constant when an imagined performance is attempted, the performer was asked to simulate projected performances of all six pieces (Beethoven, Bach, Chopin. Brahms, Debussy and Schoenberg) by attempting to *"play"* the pieces on a table top.

5.6.2 METHOD

Observer, Stimuli, Apparatus and Procedure

Video recordings were made of the table top performances of the six pieces of music noted in section 5.2. For these recordings, the pianist sat in an upright position with his diaphragm touching the front of an ordinary desk/table and with his hands placed in the centre of the table. He sat on a piano stool and, with the scores in front of him, was asked to give table top performances of the six pieces in as realistic a projected manner as the table permitted. The camera was set at a semi- profile/full frontal viewpoint in order to get a maximum view of all the movements (see video example 36 for an illustration of the angle at which the pianist was viewed). The analysis of the movement shapes was undertaken using the VHS editing suite described in section 5.2. The expressive locations were recorded in two stages: firstly, using the frame memory to give an approximate real time location of the expressive movements; secondly, according to their locations in the score, identified by following the finger taps on the table top. These combined methods of data collection meant that both the durations and the locations of the expressive movements could be recorded.

5.6.3 RESULTS AND DISCUSSION

The observation task was not simple, for although the motions themselves were easily observed and recorded, it was more difficult to locate the movements in the score. In order to cross refer between the table top performance locations and the original locations, figures showing the locations and movements of the table top performances have been displayed on acetates. Beneath the acetates and the intersecting blanking sheet, the locations made by observer 1 in the previous study are shown. Observer 1's locations are used because he provided the most detailed set of locations and he was the most experienced of the observers. These figures can be seen in supplementary booklet two, figures sb2.16 to sb2.21.

Looking at these figures together a number of general features are apparent: i) the repertoire of identified expressive movements found in the original performances is maintained in these artificial performance circumstances; ii) the table top locations are less numerous than the original performances, though they tend to correspond with those identified by the observer; iii) certain expressive movements disappear altogether in the table top performances: the hip roll which appeared in the ordinary Bach, Chopin, Brahms and Debussy performances, and the *"squashed torso"* of the Schoenberg performance. Similarly, in the main, the hand movements in the table top performances are limited to hand lifts; finally, iv) the swinging movement is preserved in the performances.

A selection of expressive movements from the table top performances can be seen in video examples 37a to 37d.

Of these findings, one or two differences between the table top and the ordinary performances are not surprising. For instance, the difference in the types of expressive hand movements is not unexpected since the absence of a keyboard prevented the hand from being able to press into the keys and the wrists from depressing below the keyboard height. However, it is to be noted that the wrist rotation which is totally absent in the Beethoven, Bach and Chopin pieces appears in the Brahms, Debussy and Schoenberg performances. One explanation of this finding is a simple learning effect (the pieces appear here in the order in which they were played): the pianist plays on the table three times, and by the fourth occasion, he finds a way of rotating his wrist.

The absence of the hip roll and the squashed torso may also be accounted for by the performing surface. There are two reasons for this: i) there are no keys to press; ii) the pianist is not obliged to move to a specific point on the keyboard, he can simply move his hand to any arbitrary location from which he wishes to begin a note sequence. Indeed, amongst the occasions that the hip roll occurred in the ordinary performances is the huge shift of register at bar 29 in the Debussy, and it is clear that in the table top the pianist does not make a large physical adjustment for the register shift. However, it is important to note that the hip roll of this location is replaced by a surging movement in the table top performance, and if video examples 38a and 38b which show the original movement and the table top movement are observed, it is evident that a certain quality of the hip roll has been preserved in the table top surge in that there is still a dramatic shift of body weight. All the hip roll locations of the original performances are preserved as expressive locations, though other movements replace them: in bar 15 of the Bach, and bar 48 of the Chopin an expressive forward swing occurs; in the Brahms at bar 5 there is a shake, in bar 9 a forward and backward swing, and in bar 48 a nod; in the Debussy at bar 5 there is a series of nods, and at bars 25 a nod. For the majority of these locations it appears that the surge (the particularly expressive swing) has taken the place of the hip roll. It is important to note that in all the table top performances the expressive movements were not as large in amplitude as the original performances, and it may be that the swinging movement was a less extreme expressive version of the hip roll. As for the *"squashed torso"* movement of the Schoenberg, an expressive movement remained at its former location, but, on this occasion the movement became a nod. This discovery fits well with the earlier discussion (section 5.4) that the *"squashed torso"* movement seemed to have an origin similar to that of the nod.

The persistence of the expressive locations at the former hip rolls and squashed torso moments suggests that the intentions of these locations have persisted irrespective of the performing surface. However, there are some expressive locations which appeared in the performer's own locations but which disappeared in his table top performances. It is feasible that the locations which disappear in the table top performances are less significant in some sort of rank ordering of expressivity and its significance. For instance, in the Bach, the missing pianist locations from the table top performances were bars 3, 9, 25, 27, 33, and 42. These five locations all involved the melody line (leaping intervals and rests). Therefore, it could be that melodic locations are not as important as say cadences, all of which are preserved in the table top performances. However, it is equally feasible that since the melody line is dealt with by the right hand there was simply no opportunity for the expression to manifest itself in the hand which was occupied by note playing.

The fact that the pianist relies on his imagination for any conception of sound in the table top performances may also help to explain why some locations disappear in the table top performances. For instance, video examples 39a and 39b show bars 11-12 in both the original and the table top performance of the Schoenberg piece. In the table top performance, the pianist seems to become increasing uninvolved with the music over the duration of the location, indeed, at the end of bar 12 his movements look mechanical. In the ordinary performance, however, his movements clearly show that attention is being paid to the sounds and the final silence at the end of bar 12. It appears, therefore, that the important juxtaposition of the sound and silences in this piece is lost without the correct performance material and, of course, the produced sound.

Lack of sound may also account for the finding that in the Brahms table top performance there are far more expressive hand movements from bar 17 to bar 23 than pianist locations. This is the section of the piece which moves into "*Allegretto grazioso*." In the performer locations, the first of every four bars contained an expressive location, but in the table top performance, there is a location every bar. It may be that without the keyboard the pianist is unable to inject the table top performance with any sense of link between musical phrases, and since each bar in the section from bar 17-23 is of very similar thematic material, it could be that the pianist needs to restate the expressive message of the section at every new bar, as opposed to every phrase.

It is worth underscoring that the swinging appears in all but the Schoenberg table top performances, so that it seems that even without the correct performing materials, this component of the performance is preserved. Thus, the hypothesis that metricality elicits swinging may have some substance.

In all, there are striking similarities between the expressive locations of the table top performances, the pianist's own locations, and as the discussion of the previous study revealed, the ordinary performance locations too. However, little has been said about the movement types at the expressive locations, apart from mentioning that some types of movements have disappeared from the repertoire established in the ordinary performances study (section 5.3). There are two additional findings which must be discussed: i) table top performances lose certain types of movement which dominated some pieces in the ordinary performances; ii) table top performances have different ratios of head and hand involvement at the expressive locations compared with the ordinary performances.

Dealing with the types of movements first, the many examinations of the Beethoven performance, and the observer locations of the repeat performances of the Debussy and Schoenberg in the previous study indicate that a variety of movements can be used at the expressive locations across performances. This variety has been explained in terms of the different movements having the same expressive source. In the previous study, however, it was discovered that in the Bach, Chopin, and Brahms performances the pianist tended to use one type of movement almost to the exclusion of all other types of movement. In the table top performances of these three pieces it was discovered that the single movement types were still dominant, but that in certain locations the single movement was replaced by another movement type. For instance, in the Chopin performance, the forwards and backwards surge occurred where there had formerly been shakes (see figure sb2.18 and compare the observer and table top locations for bars 1 to 22). In the Bach, as figure sb2.17 shows, although the shaking movements found in the observer locations (beneath the acetate sheet) have remained at the locations in the first 30 bars of the piece in the table top performance (the acetate sheet), the final 4 bars of the table top performance have become nods where there were originally shakes. As for the Brahms, although the movement types have been largely preserved from the ordinary to the table top performances (Figure sb2.19), bars 17-44 show that whilst the wiggle remains the dominant expressive movement, bars 21, 24, 26, and 30 have become shakes in the table top performances. In sum, these results indicate that the finding that the specific movements that were identified in the ordinary performances as perhaps being the best movements to convey the expressive intention of the piece still applies in the table top performances. The few exceptions to this finding indicates one of two things: i) these locations did not contain information that had to be expressed in one specific way; or ii) these were locations that the pianist could not convey with the preferred type of movement expression because of the performing surface of the table top. From the observations, it is impossible to know which of these explanations applies.

The finding that the ratio of head to hand movements at some of the locations varies between the two sets of observations also needs to be discussed. It has already been established that some of the hand movements could not be produced on a table top. It seems feasible, therefore, that some of the hand movements may have disappeared from the performances. In fact, this can be seen in bars 6-9 of the Bach performance (figure sb2.17) where the wrist rotations disappear. However, in the Chopin performance (figure sb2.18) it seems that locations that were head locations in the ordinary performance have become hand locations in the table top performance (bars 12, 15 and 19, for example). Therefore, what seems to have happened is that the hands have become the expressive source. An explanation for this transfer of expressive information from the head to the hands may be that since the amplitude of the expressive movements is greatly reduced in the table top performance, the expression is transferred from the larger movement type to the smaller movement of the hand. If this scaling down of expression is possible, it would certainly explain why so many of the expressive locations disappear from the table top performances.

5.6.4 SUMMARY AND CONCLUSIONS

It is evident that although the materials of the table top performances have had constraining influences on the pianist's movements at the expressive locations (smaller amplitude movements, fewer movements and locations than the ordinary performances), overall, these performances show that the locations and vocabulary of movements used at these locations persist. This finding suggests that this pianist has expressive intentions which are literally embodied in a number of particular performance movements which appear in projected performances irrespective of the performing surface. Also, the movements themselves are, although flexible in the order in which they appear at expressive locations, fairly stable aspects of his performance. The fact that some of the same movements at specific locations persist even in the table top performances suggests that these movements are somehow intrinsic to what the pianist's image of the piece is. The evidence that there is a certain amount of transfer of expressive information from the head to the hands at certain locations between the table top and the ordinary performances suggests that there may well be one movement source for all the expressive movements, with one body area being more appropriate than another at certain times. The fact that the pianist's own expressive locations were preserved as expressive locations in the table top performances when some of the locations of the ordinary performance disappeared suggests that these locations were perhaps the most significant to the pianist.

5.6 OVERALL SUMMARY

A large number of techniques have been used to collect a wide range of information. Although some of the techniques have not been as empirically rigorous as others, the overall results of this chapter help to draw together several issues: i) there is confirmation that the pianist used a movement vocabulary which preserved the same expressive qualities when the performances were repeated consecutively, but when performances were six months apart, qualitative similarities were greatly reduced. When music of different styles was performed the expressive movements came from essentially the same range of movements. Even the few movements that were new to appear were found to have similar physical origins (somewhere between the head and hands) and similar features (direction and some of the shape attributes); ii) since the pianist's own expressive locations coincide with observer locations there is some evidence to suggest that the expressive intentions of the pianist are communicated to the observers; iii) the pianist's intentions are musical (structure and emotion, for instance: a need to get the correct weight behind a chord in order to communicate the eroticism underlying the structural content); iv) the pianist is aware that he uses his body to produce these intentions, and he knows that he uses his body in different ways; v) although the pianist has no explicit idea about the shapes of these movements, his movement hypotheses are very similar in shape to those detected by the observer; vi) since these movements persist irrespective of the performance surface (table top) it seems that the movements of the vocabulary are movements essential to the performance.

APPENDIX TO CHAPTER FIVE

Note that in the following transcription any unrelated comments are excluded (general conversation with the experimenter). Squared brackets are used to indicate precise locations or any other important information provided in either vision or silence (for example, particular kinds of body movements or salient pauses).

BEETHOVEN BAGATELLE No 11 Opus 119 in Bb major

Figure sb2.10 shows the Beethoven Bagatelle. Here it is evident that there are many moments the performer regards to be expressive. In all performances of the Bagatelle the pianist did not repeat the opening four bars, therefore all his comments are limited to a non-repeating performance of those bars.

Comments about the expressive locations

[Talking about the first bar] *"The interval of the fourth between the Bb and Eb in the soprano voice is particularly expressive, indeed it urges the music forward with both the quaver rhythm and the leaping interval. The third chord of the bar is noteworthy because of the way in which the C and F in the bass create a pseudo chord V: the effect is to imply a I-V cadence. The link between bars 1 and 2 in the rising C to F leap in the soprano voice is another moment of urgency and movement in the phrase. In fact, the dotted F is particularly significant: it causes a sense of excitement for the performer. These dots are just for the benefit of the performer, however. For instance there is a dot at bar 13: I would suspect that the audience would hear a minim because of the two minims in the two preceding bars.* [Refers back to bar 2], *the gentle rise over the high G (which is, of course, on the quaver after the dotted crotchet) is a very pleasant moment and should be savoured. As for bar 3, the sheer repetitiveness of the rising fourth (now on its fourth playing) creates a need to move on to different ideas whilst the Ic - V cadence in bar 4 confirms this sense.*

The next bar is extraordinarily powerful with the E ♮ adding depth with the shift to F major. Also, the falling interval of the sixth at the end of the bar creates a generous mood, for it is the first interval to fall more than a third, and is indicative of the harmonic transition in its falling as opposed to rising interval. The thickness and dissonance of bar 6 is a rather obvious dramatic moment in which the speed of the following phrase is brought into mind. This prepares the attack on the next chord (first in bar 7). This chord, with its brief flirtation into G minor and its leap into a slightly higher register, causes a moment of surprise. Then, the contrary motion chords at the end of bar 7 increase the sense of puzzlement and intensify the mood. In bar 8 the drama of the shift from G minor, through Bb, to the controlled climax at the end of the bar on the V7 chord is particularly worthy of attention during performance. Bars 9 and 10 are both extraordinary and crazy because a cadenza is so unexpected in such a tiny piece! Anyway, I feel that they should be played extremely "straight faced" and I would try to let that filigree of semiquavers unfold as if, from giving a general discussion of issues, I became extremely perceptive, personal, even intimate; then at bar 11, I would disappear back into the general issues again. In bar 11 the proportionally long value of the minim in the soprano voice requires poised attention as it leads back to the tonic on the flippant quaver Bb at the bar end, whilst the quaver/quaver rest pattern in the left hand gives space and light in the music. In bar 12, the trill is an added filigree which must be enthusiastic and forward moving. Bar 13 has been discussed, but I would add that the sudden drop of pitch into bar 14 is important, as are the sudden short silences in the left hand rests. The rests are special because they counterbalance the intensity of what amounts to four chords in half a bar in the left hand part of bar 13. Then everything comes to rest in the most honest of the Bb major V - I cadences with its sudden drop in register in the bass line at the end of bar 14. The imitation here [points to *bar 15] is great because it's the first time we've heard that sort of thing* [...] *The importance of getting the trills right at bar 16 is almost too obvious to mention.* [Looks at bar 17] *There should be a sudden intensification of speed to give an even greater sense of note-crowding here. Both bars 17 and 18 should be like 13 and 14, though now there is much more drive and drama. In the first half of bar 17 the alto needs to be "sung" quite emphatically. The importance of the rising and falling intervals in the voices must be intense - so should the space in the silences. Indeed, the total silence at the end of bar 18 needs to be really joy-filled so that the final chords can be correctly paced. The final bars of the piece are strangely chorale-like and therefore for me, must be played with dynamic variation and, above all, a sense of earnest commitment must be translated into the performer. The first chord of bar 20 is vital for it gives stimulation and movement to the calm of the previous bar. Whilst the silence at the end of bar 20 needs much intensity of thought, especially since it precedes the shift into G minor at bar 21. The moment between G minor and the return to Bb major across the bar 21-22 bar line needs attention to make sure that the balance of the chord is maintained whilst the volume surges forward. The final silence at the end of bar 22 gives proportion and balance and needs to be heard.*

Comments about the types of movements the performer might make at the expressive locations

I have no idea about my body movements, but I guess that at bar 8 I would use my body to its full height (may be forwards and up?) to get the correct amount of weight behind those substantial chords. I can not afford to be too body conscious because I search for body relaxation in performance (occasional I suffer from debilitative tensions in my fingers), so I do not plan the formation of such movements because they could make the whole performance stiff or even "too controlled". As you know, between bars 9 and 10 I would like to create a pleasant casual remark, therefore I would probably lean to my right side so as to share the intimacy with the audience. In bar 12 there would most definitely be a tension between the neck and the right shoulder, but I would try to make the trill as precise as possible by using my concentration not to think about it (the same would apply for bar 16). At bar 17 I would most certainly press hard into the keys in order to squeeze the sound. Then for the final choral-like section, I would draw my body together and I'm sure I would give off a priestly look! No, seriously, I would try to be sincere with the sounds, therefore I'm quite sure that my gestures would be totally straight forward. Again, as I mentioned earlier, I would certainly listen for the cessation of the final chord of the piece.

C.P.E BACH SONATA, SECOND MOVEMENT (ANDANTE) in G minor

The andante movement is shown in figures sb2.11a&b.

[In reference to the boundary between bars 2-3, the pianist begins his commentary saying:] *"Oh well, this is a large rising interval in the soprano voice. It is important because this is a leap to the highest note of the piece to this point: in fact, this remains a high note in the context of the whole piece. Movement wise, I might conceivably do something with my trunk to move either towards or even away from that high note."* [What kind of movement do you envisage?] *"Oh, I'm talking about a sideways motion, though sideways thoughts are often interpreted as forwards or backwards movements."* [Long pause.] *"In a lot of Baroque music the silences and motions run into one another, that's why I've marked so many of them as important moments here. That one* [bar 8] *is noted simply because it balances this one* [bar 4] *and therefore attention should be paid to perform these silences in a comparable manner. This* [the bass line on beat 3 at bar 8] *is marked because it leads to a very deep level of bass involvement which is dramatic because it should be at the beginning of a phrase rather than at the end. The silence in the soprano line might be marked by a slightly excessive hand lift in the right hand and in counter-balance, there might be a slight bulge of the left hand over the keys perhaps* [he raises and rotates his left wrist in demonstration]. *"The high D and C in the soprano voice at bar 9 are special because of their height and distance away from the bass. As this moment is primarily a re-run of ideas in the opening bar, so it shouldn't be overstated. Bar 12 gives tension in the soprano voice with the use of the held Bb across to the A - it is the first occasion the whole piece has taken a crotchet as the primary motion. I suppose it's a moment of "arrival" or even "escape" tension because of the shift to Bb. In stark contrast to the slowing Bb crotchet, the semiquaver upbeat in the left hand parts creates a mood of urgency. However one is to interpret the music in performance, this is a relatively sharp rhythm, also it's the first dyad of the piece. This* [bar 13] *is important because it is a second beat accentuation followed by a silence. In order to repeated the sixth interval differently on this second playing, I might have done something to stiffen my spine so that the chord could be played more firmly.* [Pause.] *This* [points to bars 15 and 16] *is sort of important as there is rather a lot going on in a very short space of time. I have marked bar 17 for a very different reason: the F ♯ in the right hand is sharply seductive as we wind between the minor and relative major keys. Bar 18 has a fundamental importance because it is the first first beat to be missed and that should provoke a very special moment in the right hand rest which follows on. This right hand silence should be particularly wonderful as there are virtually no silences in the right hand. At the beginning of bar 19 the Ab is striking: we are meandering around.* [Bar 20] *these kinds of moments are very special for the obvious reason that the performer should extend the sense of yearning for the* *resolution, therefore the minim dyads should be a long as possible. Also it is very important to divide this bar end off from the new start at 21. The three Abs in the bass at bar 22 are rather affecting, the first should be played quite calmly and the other two rather more intensely, similarly the hint of C minor at 23 with the B = entry should be dramatic. All things considered, this small section from bar 21 to bar 24 is a low-point for me.* [Looking at the underlined bass entry in bar 24:] *In the beginning of the piece these little chain-like bass lines were falling by step; now this little chain rises and is immediately taken over in bar 25 by imitation in the soprano line - we've not had that before, therefore it's really important. The link between bars 25-26 is important for there is no bass to re-introduce the tonic key, therefore the F ♯ must be played with poise to lead in the G. (I know it's just a harmonic minor pattern, but its effect should be one of intensity upon the audience.) In bars 27 and 28 the rests on the first beats create moments of focus on the single voicing (so much of the expression of this piece rests with the rests!). Bar 32 is marked, again because there is too much information packed into a short musical space. It is an almost clumsy way of getting back to the opening idea. For clarity, each line must be played with precision. Of course this bit is just like bars 15 and 16. It is interesting that there are exactly 16 bars between these two bars, but that is possibly coincidence rather than the composer's intention, oh, who knows?! Anyway, this crowding of ideas at 32-33 is an almost clumsy way of getting back to the opening material. These bars* [still 32-33] *might be achieved by leaning forwards towards the audience. I might try to show the audience that I was in control of the situation* [he leans out towards the audience]. *Yes, yes, the trunk wouldn't sway too much towards the audience because that would defeat the purpose of feeling that one was facing them.*

In bar 35 the mild chromaticism and the first beat rest in the bass need to be differentiated in terms of ideas. The right hand must ebb and flow over the leaping intervals, whilst the silence in the bass must prepare the drama of the chromatic movement. In 36 the rest is important. In bar 38 the semiquaver upbeat needs attack just like in bars 12-13, but because there is a dissonance here too (the A against the Bb) I suppose the moment ought to be even more stringently attacked. In bar 41 the B ♮ sidestep into Bb in bar 42 is important for it heralds the activity of the right hand which provides a highly expressive "anti-climax" to the crotchet tied to a quaver in the middle of bar 41. All through bar 42 there is so much going on in the right hand that I might be tempted to make a lot of hand movements which force the sound out of the keyboard, in fact, I wouldn't be surprised if my fingers were very tight from bar 42 to the end of the piece. Bar 44 provides an interrupted cadence which, in its conventionality, indicates an eventual resolution. Thus, in this bar, the mood is one of anticipation. Finally, the V - I cadence in the penultimate and final bars has its own sense of tension/relaxation which brings the work to its evenly paced conclusion."

Comments about the types of movements the performer might make at the expressive locations

"For this piece, I believe that legato playing is vital. I would be really careful not to rush. In order to get the feeling of flow, I would play this piece as if nothing was happening, though there would be a physical direction. That physical direction would flow with the rising phrase. You know, I may not move, but my thoughts would be with the direction of the pitches. As for specific moments within the piece, at bar 8 I would crescendo through the bass run, so my body may be quite intense at that moment. I would leave bar 9 to float so that it could be even more airy than the former material. I really would like the upbeat at

bar 12 to be a musical embrace, so I would try to give a sense of intimacy at that moment (especially because the hands are so close to one another). Between bars 13 and 19, I would let the pace move on slightly, though as I said earlier, I would try to prevent any sort of rushing. My aim would be to say something extraordinarily profound in a totally matter of fact manner, so that the musical content threw out information, not my personality. Though if I felt particularly angry on the day of a performance this is the kind of moment where my discontent would shine through to the audience. Oh yes, I would try not to anticipate the missed beat in the bass at bar 18. I might do something with the A at the end of 18 to delay the resolution to the Bb in 19 for as long as possible [he waves his hand in a circular motion]. *The very long resolution at bar 20 might be approached by some sort of body movement which slows with the rallentendo I would execute. Since these movements are all hypothetical, I suppose that I might move sideways towards the audience. Bars 21 to 24 would be approached with alertness, but I would be decidedly cheeky in my execution of the bass line at 24. Through bars 25 to 32 I would be careful not to make anything protrude into the sense of legato. In fact it is worth remembering that on a period instrument volume would not be a consideration, therefore I might make this section rather quiet. I would most definitely slow at bar 32 to lessen the crowding of notes and ideas, but I've no idea how I would do that. I suppose that ideally I should not be aware of my body at all. The piece should have been synthesised into my body as a well rehearsed performance piece. The performance is the moment of enjoyment and sharing, therefore I think about these factors rather than the technique or the musically important moments, I just savour the performing time, nothing else. As for the final line of the music* [bars 44 to 48], *I suppose that I might be both tentative and tender. Once the piece was finished, I might turn towards the audience in a quizzical way: did they get the message?"*

CHOPIN ETUDE (ALLEGRETTO), No 3 in Ab major

The expressive moments are shown in the figures sb2.12a,b&c.

"I resent your premise here because this is very French stylistically, and it's really the variegation you get out of staring into somebody's eyes for as long as it takes to play the piece. So, if I circle anything, I ought to encircle the whole piece. I know that I could say this of all the pieces, but, there are many things to note. However, I would say that in the context of this piece, all my comments are about subsidiary expressive moments. O.K., the first location at bar 5 is included because the height of the right hand chords. There is a very different height issue at the end of bar 8/9: time to metaphorically peek over the high notes because they occur at the end, rather than the beginning of a phrase. The mild dissonances at bars 9-10 are very different to what has happened previously (with the exception of bar 4) in that there is an intense and explicit leaning on the bass. In bars 12 and 13 there is a typical Nineteenth Century French melodic line with its unattainable and erotic fascination for the major 3rd. This is particularly evident in bar 14 when the major 3rd interval in the right hand is heard against the major 6th in the bass. [Bars 16 and 17] *all this is wonderfully obsessive especially across the key change: indeed, that E ♮ rather than a F at the bottom of bar 17 is quite a surprise. At bar 18 all the obsession can be brought out with the crescendo through those leaping notes in the right hand. Really, as far as I'm concerned, this piece has an erotic disposition which communicates a sense of languish rather than straight forward fulfilment. You see there again at bar 21 that move into C major amounts to an anti-climactic moment - quite wonderful! Well, I ought to (even though I'm looking at moments of subsidiary importance) encircle the bars 25 to 28, but the bar at 25*

serves its purpose for the moment. This bit is really like the start of an unexpected erection that doesn't get anywhere...What more can I say! [...] *Bar 33 is harsh (in context) and wonderfully tragic, as is bar 34 when the Gb creeps in. Bar 38 is of importance not only because it provides yet another harmonic sidestep, but also because of its contrast to the rising third interval in the soprano line in bar 39. The shift of a third gives a poised preparation for the return of the opening which is finally heralded in the falling third and subsequent falling fourth intervals in the soprano line at bar 40. The ever increasing intervals and the approaching resolution back into Ab must be delayed as long as possible, so there should be a huge feeling of tension across the bar line of bar 40 before the release into bar 41. Here, I think that the tie mark on the first quaver in the right hand at bar 41 is fascinating - I hope it's an original marking. The tie between the bass at 41-42 is a conventional "hand-shake" musical gesture which was not so noticeable at the opening of the piece. The discovery that it is there makes it really important. I hope that I would be able to play it as though I were a steel-rimmed spectacle-wearing German professor. That is, I would let the music makes its own point, rather than saying* [stabs the air with his hand]*: "tied note here!" After that, it's mainly a question of resolutory voicings. For instance, in bar 45 it is the simple awareness of the leading voice resolution which must be sung out and the shift into Db major is a motion the performer must permit to flow. Again, the tied bass needs to be a strong effect. Oh yes, I must point out that the silence in the left hand at bar 56 creates a magical moment. Finally, the penultimate minim is extremely long and makes the moment of resolution stretch forever."*

Comments about the types of movements the performer might make at the expressive locations

"Musically, I would like to keep the left hand rather

steadier than the right. In fact, I would not worry about dislocations too much. It's all a question of gravity really: when the thing goes down a bit, you speed up; and when the thing goes up, you take a bit more time. I would certainly try to radiate the sense of pleasure I feel from playing this kind of music.

BRAHMS ROMANCE Opus 118, No 5 in F major

The pianist's expressive moments are shown in figures sb2.13a,b&c.

"From the upbeat this piece must be absolutely poised. The movement of the music suggests a sarabande, therefore there is a fussy power conveyed in the hemiola at bar 4. This is then lyricised in the alto and tenor quavers in bar 5. One gets increasingly aware of the wonderfully androgynous nature of this piece in the doubling, especially across bars 6-7. Bar 8 is almost excessively formal in its rendition of the V-I cadence. The suspension in the bass at the beginning of bar 10 should be noted for it did not occur at its thematic parallel in bar 2. The big leap in the bass at bar 11 is of itself highly dramatic, and I'm quite convinced that it was put there for solely expressive purposes as it heralds the leaping nature of the left hand at bar 12. There is a "stiff upper lip" feel about bar 13 by virtue of the fact that it is a repetition of bar 5. The ritenuto in bars 15-16 is quite heavy and is a wonderful moment as it provides an absolute contrast to what is coming in bar 17.

Bar 17 introduces material which is teasingly exciting in the new key of D major. The new time signature and "gracious" tempo is electrifying. The entire section is a great tease and I've marked every time a G ♯ orientated chord resolves to G major. You know, it's like a lively long-established relationship in which the other partner *can't understand why you refuse to make love. Of course, all this refusal is explained in bars 40 onwards because it is made apparent that what you really wanted to do was make love in the subdominant, and not the dominant! The only bit I want to pick out of this section is the accentuation of the quavers across bars 29-30. These curiously teeter between the apparent dominant 7th and A major. They're great!*

At bar 46, it is the trill involving the Bb which is the clue to the move back to the original key. In bar 47, however, there is a wonderfully subtle up-turn in the trilled B ♮ which must be sustained for as long as possible. In bar 49 the crescendo deserves special attention for it is not present in its parallel bar 2. Bars 52-53 are the absolute climax of the piece. Once you let that number of quavers run on in succession, all that needs to be done in terms of expression is done. In the final bars of the piece it is the IV to I shifts which create falling gestures especially in the descending soprano line. Again, it is the accidental which gives a moment of mystery - the Eb in bar 55."

Comments about the types of movements the performer might make at the expressive locations

"Physically, I hope that I would be able to achieve a levitated feel in the small of my back. I would want to sit as low as possible and lengthen my back as much as possible. Between bars 9 and 10, I might try to look beautiful if I felt that the moment was sounding particularly good. I would try to be very still between bars 13 and 14. I would want to press quite hard into the keys at the end of bar 15 (a sort of pebbles in mud "squeeze"). I would try to show my surprise at the oat-filled, birds and heather at bar 17. This moment goes right back to Brahms's early obsession with things Scottish, so I would be right in there amongst the heather! Depending on

how I was feeling at bar 20, I might turn towards or away from the audience [...] *By bar 24, I would certainly want a better view. Between bars 36 and 39 (I know I've not marked them, but they're interesting in physical terms) I might try to really flow with the "gurgling brook". In fact I might try to delay the beginning of bar 40. This is all very "Prélude à l'après-midi d'un faune" and should be allowed to fade into nothingness by bar 45. In the final section* [points to bars 47-57] *I would try to exploit the male/female sexuality portrayed in the wide range of registers of the melodic line. The sense of climax across bars 52-53 is very clever with its three octave spread between the parts. I suppose that my fingers might "knead" the keyboard over this last bit."*

DEBUSSY PRELUDE: DANSEUSES DE DELPHES

The prelude locations are shown in figures sb.14a&b

"This is one extraordinary gesture in which long limbs, dancing in slow motion, waft in and out of the viewer's and listener's sensory focus. The first sight of the dancers is at bar 3 and on into the first half of bar 4. The B ♮ in the second chord of bar 3 and the C ♯ with the E ♮ in bar 4 within the key structure of Bb major are effective dissonances. The harmonic movement is interesting in its consecutive I, II, III step. In counterbalance, the I-V cadence at bar 5 conveys a sense of purity. In bar 6 the hands are forced to wave around with the B ♮ s in the dotted quaver figure in the alto part becoming particularly exposed by their separation from the Bb major chord which precedes. At bar 8 the high chords in the right hand are quite surprising. The first time the chord occurs, it could be perceived as an accident, but on its second playing it is evident that it is a chord of significance. This [bar 9] *is the release of the tension for it is the beginning of the descent from the high chords of the previous bar. At*

bar 10 it is simply the first time we've heard a long note, therefore it's significant. I've marked the note itself and the space which spans between the minim and the first beat of the next bar because I think that note should go on forever. Here [bar 11] *the extremes of the hand positions on the first chord are made all the more poignant by the rests in the inner parts. This gives a transparency to the extremes of the chord spread between a low bass and the high placed soprano. The loud crunch into C major at bar 16 is a dramatic high point for the harmonic and metaphorical dance movement. (It's also from this point that the rest becomes a truly significant part of the performance.) At bars 21-22 the doubled medium pitched voicing of a melodic as opposed to a harmonic line is important. It is a very sudden action which brings the dancers so close that every hair on their bodies can be counted. In bars 23-24 I always want to make a lot of the phrasing off so that the chord sequences can just fizzle out into a mist.* [In bar 25] *I almost envisage a portamento to get me down to the low bass first crotchet beat. Bars 27-28 literally squash any erotic tension because of the stillness of the chords. When the tonic chord bursts in at bar 29 it is as if the dancers suddenly come into full view. It is a moment of pure melodrama."*

Comments about the types of movements the performer might make at the expressive locations

"Weight is vital to the performance of this piece, therefore I feel that my hands would be energized and would dominate the expressive appearance of the performance. An improvisatory feel is essential, so I would concentrate on a flexibility in the pace. Also, I would try to avoid any mental concerns related to technique. The piece has got to sound unplanned. The only specific things I can mention are that I would lengthen the two high chords in the right hand at bar 16 and the chords in bars 27 and 28."

The pianist's expressive locations can be seen in figures sb2.15a&b.

[Bar 1] *"The silence in the left hand after that short rush of notes in the upbeat is a moment which should be savoured because it is such a sudden stop. (This applies to both the crotchet and dotted semiquaver rests.) The appearance of the bass chord is another sudden moment which is attention grabbing. Structurally it's vitally important because it's the first time that we've had more than two notes playing together, also it's such a wonderful combination of notes! It should sound like a sudden dark bark. The right hand line just fades and evaporate on the F ♯.* [Bar 2] *this is a moment when the silence is filled with expectation. In fact, if these silences are not kept at a high energy level the whole piece can just dissolve into a fragmented string of notes. The right hand entry* [in bar 2] *is just like someone hitting out into space, so, naturally, there is an immediate heating up of tension. The close pitch proximity of the left and right hand dissonances and the third beat semiquaver quaver rhythm in the left hand are exciting moments. At bar 3, the attacked yet long A ♯ with the trick visual shift between A ♯ and Bb demands performer attention. Then, the very quiet yet tremendously swift right hand entry at the end of the second beat is quite dramatic too.* [Bar 4] *again, the rest is vital here, but it's purpose is not to prepare a surprise, rather it is there to suspend the moment of threat created by the accented quaver-dotted quaver semiquaver figure which precedes it. The dynamic indication on the dyad in the right hand of the second beat in bar 4 is intriguing. Practically, nothing much can be done within the overall piano volume indication, however there is a thought of quiet intensity which can be applied to that moment. The same applies to the single high Ab in bar 5, though on this occasion, the left hand communicates a frustration in its* *messy notation. It seems as though the compositional ideal was unobtainable at this point. In bar 6 there is a definite dislocation between the left and right hands which resolves the moments of frustration in bar 5 into a moment of great fun. In bar 7 the rhythmic figure in the left hand and the interjectory right hand chords simply adds to the sense of the absurd. This is carried through into bar 8 when there is nothing short of a major jolt as the scampering right hand drops in pitch to permit a quietly off balancing left hand to seize the attention. Strangely enough, this bar* [bar 9] *is important because it creates a feeling of pedal as the tremolando notes in the left hand are centred around the G key centre. Then there is an extraordinary little cadence at bar 11. Those slowly swirling quavers are quite wonderful. The crotchet rest in bar 12 is long. The dissonances of bars 13 and 14 grab your attention as the melodic line slowly fades to nothing. The C ♯ bridging bars 15-16 is of an indecent length which manages to recreate a moment of threat rather like that of bar 4. The end must be deliberate, in fact I always feel as thought it should not vanish without a struggle. You know, this entire piece is incomprehensible, but terribly important. When I play it, I feel as though I've learnt a language, but that I don't understand what it means.*

Comments about the types of movements the performer might make at the expressive locations

"I suppose that slight rhythmic distortions will dominate my interpretation of this piece. For instance, I'd play the first few notes too quickly, then I'd make the rests a little too long. With accents, I would feel inclined to hunch over the piano to get a sense of springing surprise. I may well flop and drop my hands on rests. I might snort on one or two occasions to expel any held breaths. I'm sure I would look rather dandy and absurd through much of the performance, but I would certainly be very reverential at bar 11 because it's a serious moment. I suppose the

performance ought to be dramatically tense."

CHAPTER SIX (CONCLUSIONS)

6.1 SUMMARY OF THE EMPIRICAL STUDIES

The aim of this chapter is to draw together the central concerns of this thesis, namely the investigation of the expressive movements of music performances, their organisation and their origins. First, however, the findings of the previous empirical chapters will be summarised.

Chapter 3 investigated observers' abilities to detect different intentions from the visual information of music performances, and showed that kinematics provided useful perceptual information. Indeed, all the studies in the chapter demonstrated that vision provided enough information for observers to distinguish between the three different performance manners. This suggested that the instructions given to performers to play in different manners were transformed into physical differences in their performances which were detectable for observers. The differences detected in vision were similar to those for sound and the sound and vision combination, though the vision scores provided slightly clearer indications of manner than the other stimulus modes. This does not suggest, however, that vision is the most accurate conveyor of intention information; only that in vision mode, the three manners are perceived to be very different from each other. That is, a more extreme percept results from the vision stimulus.

Chapter three also began to investigate what sort of features might contribute towards the make up of a specific manner. Through the use of semantic differential scales, it was discovered that each manner (irrespective of whether it was presented in vision, sound and vision or sound only) had some distinctive qualitative features. For instance, exaggerated manner, besides being perceived to be the most expressive, was also perceived to be jerky, clumsy and wild. Projected manner was perceived to be expressive, smooth, controlled, and dainty; and deadpan was perceived to be the least expressive, yet the most smooth and the most dainty of the manners. Since the basic levels of expressivity were so different across the three manners, it seemed likely that the differentials which were common to two of the manners (for instance, daintiness between projected and deadpan) would be of different types. Although this bipolar rating was a crude indicator, there was some evidence to suggest that each manner had its own set of qualitative features.

More information about the nature of the visual information was found in the final study of chapter 3. The study showed that it was not necessary to have visual information from all body joints for accurate judgements of manner in a pianist's performance. Indeed, it was discovered that the head alone provided sufficient information, but that head and hands in combination produced results which most closely mirrored the all joints kinematic displays.

Another feature to emerge from chapter 3 came from anecdotal discussion of one of the joint display results. In the systematic examination of the information contained in each body area, it was discovered that the hands alone provided kinematic information that was perceived to be highly expressive across all manners; indeed, there was no difference between manners. When the observers were asked to discuss the study, they noted that there was a tendency for the expressivity to be judged on the quantity of movement in a performance. Since the hands were very active in their task of note execution, all the performances were rated as being expressive. This study therefore illustrated that there was some perceptual reliance on movement quantity in the assessment of manner as well as movement quality. It emerged that observers generally equated the deadpan manner with little movement, and exaggerated manner with a lot of movement. The fact that the hands were confusing information sources, yet the head and hands in combination were highly informative sources was a provocative finding, for it suggested that invariant information was not spread evenly across the kinematic display, and that it was somehow able to combine the independently uninformative hands and the informative head to produce information equivalent to the all joints kinematic display.

This chapter also revealed a persistent result: there was always a greater proportional difference between the scores awarded to deadpan and projected manners than between projected and exaggerated manners. One explanation proposed to account for this finding was that it is perhaps easier to withhold performance expression from a piece than it is to exaggerate the expressivity of a piece beyond its normal level. This was taken up in chapter 4, in studies which were designed to address the issue of the relative contribution of movement quantity and quality on the perception of performance intentions.

As an initial step towards clarifying what differentiated the three performance manners, chapter 4 began by simply measuring the movements of a single performer playing in the three manners to see what differences there were between the amplitudes of the movements in the different interpretations. Measuring the head, neck, and hands, the anecdotal claims of the observers in chapter 3 were confirmed; that is, it was discovered that the head and neck moved most in exaggerated manner and least in deadpan manner. For the hands, there was only a difference in the quantity of forward and backward movement in the left hand across manners, with least movement amplitude in deadpan, and most in exaggerated.

A detailed examination of the raw tracking data revealed that despite the overall differences in movement amplitude, some movement patterns, especially between projected and exaggerated manners were of similar amplitudes, and the majority of the movement patterns were common across manner (for instance, a movement feature for deadpan had a corresponding feature in exaggerated), and a minority of patterns were manner specific (for instance, a movement feature for exaggerated did not have a corresponding feature in any other manner). These results indicated that differences in movement amplitude were perhaps only one of a number of movement features which contributed to the perception of a particular manner.

By asking observers to locate moments they perceived to be particularly expressive, the visual identifications study of chapter 4 revealed that there was a persistent forwards and backwards swinging movement in both the projected and exaggerated manners which was perceived to be a constant feature of expression. However, within the swinging movement, there were specifically identifiable locations which occurred at the same points within the music across the projected and exaggerated manners, and although the swinging movement was not a feature of the deadpan manner, the expressive locations of the performance were similar to those of the other performances. These findings suggested that swinging movement may have been a key feature of an expressive performance. Indeed, this finding seemed to account for the chapter 3 result that there had been a larger proportional difference in the expressivity scores between deadpan and projected manners than there had been between projected and exaggerated manners. However, the fact that there were so many common identifications also suggested that there may have been some differences between manners that were not related to the quantity of the movements at each of these locations. The study also revealed that the specific expressive information which could be defined within one location came exclusively from the head and left hand regions of the body. The fact that there was some coordination between the head and the hands suggested that there was an underpinning common element to the physical production and the expressive origin. This indicated that these were areas of the body which readily conveyed the character of the performer's playing and confirmed the chapter 3 finding that head and hands in combination provided accurate perceptual information about manner.

Expressivity ratings of isolated locations revealed that arbitrarily chosen moments of only two seconds duration in any manner (whether there was swinging or not) provided sufficient information for manner to be perceived. Therefore, there was evidence that there was some information in the movements of any location which provided expressive information. Thus, it was concluded that all movements provided expressive information, but the specific locations noted by the observers seemed to contain more readily characterised information than the other locations.

When the specific expressive locations were examined in terms of the musical content, several features of commonality seemed to emerge: i) expressive head movements tended to occur at the beginning of phrases, phase peaks, and cadence points; ii) some of the hand locations occurred when the hand left the keyboard, and these lifts occurred at rests or held notes. There was some indication that these specific locations may have been particularly informative because they dealt with important structural features of the piece but on other occasions, they simply provided an opportunity for expression. This was an interesting finding for it suggested that the performer was both using expressive movements at key structural areas, and also just looking for an outlet in the music to make expressive movements.

Since the amplitudes of projected and exaggerated manners were very similar, and the locations had similar patterns in all three manners, it was decided systematically to examine each location in each manner to investigate what might distinguish the locations. In the study concerned with the extraction of specific movement shapes, it was discovered that in all three manners the performer made distinctive types of head movements that were unique to the expressive locations, and distinctive types of hand movements that for the most part were unique to the expressive locations. An exception to the hand movements were some hand lifts which appeared at locations other than those identified as being particularly expressive. On some occasions the same movement (for instance, a reverse nod) appeared across manners. Examination of these locations suggested that since the amplitudes of these movements were different in each manner, it was perhaps the amplitude of the movement which provided the perceptual information about manner. On other occasions, three different kinds of movements appeared (for instance, a head nod in deadpan, a wiggle in projected and a shake in exaggerated). This led to the conclusion that it may be the different movements which elicited different information about manner. The results also showed, however, that there were some common features between different movements at the same location across manner. For instance, the direction of the movement was common and the speed of the movement was common, despite the shape being different.

The final study of chapter 4 provided some evidence to help explain what features may have linked and differentiated the movements at each of a number of locations across manners. Using ten semantic differential scales, the study showed that: the deadpan excerpts were perceived to be the least expressive, stiff and unnatural; the projected manner excerpts were perceived to be expressive, natural, flexible and poised; and the exaggerated manner excerpts were perceived to be the most expressive, unnatural, and overstated. This finding linked back to the earlier differential study which examined just five bipolar scales to show that there is a number of distinctive qualitative features which separate performances. The result suggested that similar qualities could be put into different movements of the same performance manner and that different qualities could be put into similar movements of different performances. Therefore, the indication was that the movement types identified at the expressive locations could be used in a variety of ways, and that one movement did not have just one meaning. However, it is also important to note that all the location studies shared the qualitative feature of control across manners. This was some substantiation of the earlier finding that the movements of the different manners shared certain qualities. The quality of control seemed to be related to the fact that the musical material itself links locations across manners, since the same degree of movement control is required as far as note production is concerned.

The final experimental chapter (chapter 5) was undertaken with the aim of finding out more about the particularly identifiable expressive movements and the nature of their locations. The first study of the chapter showed that when the pianist who had performed in the earlier expressive locations and movement identification studies was asked to play two performances of the same piece in projected manner some six months later, the expressive locations remained virtually identical, as did the range of movements used, though the specific movements at the specific locations varied. It was discovered that whilst these two performances were very similar, sharing qualities of expressivity, variety, flexibility, control, naturalness, poise, economy, smoothness, overstatement and caution, there were only weak correspondences between the qualities of these performances and the performance of six months earlier. Therefore, it appeared that the expressive qualities of the piece did not remain stable over time. It was concluded, however, that the observers did not use the differentials in a stable way; and the slight modifications made to the differentials for this study may have had an effect on the results.

Support for the finding that the expressive locations persist over repeated performances was found in repeat performances of three different pieces, though there was some flexibility in the performer's use of specific movements between performances.

In order to explore whether the movement types were features of a specific expressive movement vocabulary, the pianist was asked to play six pieces of different musical styles. The examination of expressive locations and the movements used at these locations showed that the expressive movements from the earlier studies reappeared, whilst the locations of these expressive movements bore out the link which had been proposed between certain structural features (the rest and the hand lift, for instance) and the need to express them. These studies also showed that there were perhaps certain music structures which elicited particular types of movement. Indeed, the pianist was found to use certain movements for certain sections of the music (for instance, wiggle movements were used persistently throughout a section of one piece which comprised several four bar phrases: the wiggle was used at the first bar of each phrase). The conclusion drawn was that in certain circumstances one particular movement is more suitable than others for expressing a particular kind of musical idea. This finding, at first, seemed to conflict with the earlier results that movement types varied from bar to bar. However, the original piece for study was very short and contained musical ideas that were quite varied and it seemed that the structural variations may have explained why there was more variation in the types of movements employed by the pianist.

The study of six pieces showed that the movements of the original identification study were not the only expressive movements, however. Two additional upper body movements (a hip roll and depressed upper torso) were used and the right hand appeared as an expressive source in three of the six pieces. The right hand used movements identical to those of the left hand, and the two upper body movements were of a type similar to the other expressive head movements (for instance, the hip roll had similarities with the wiggle, and the depressed torso had properties like the nod). Therefore, the discovery of the additional movements strengthened the case that there was a link between all of the expressive movements.

An additional important outcome of studying the six pieces was the finding that swinging did not persist in all musical styles. The piece by Schoenberg, which is essentially unmetrical, did not contain swinging. Therefore, earlier hypotheses about swinging being a movement characterising expressive playing was rejected, especially since the Schoenberg contained what the observers considered to be the most dramatic of all the expressive locations. Instead, it was argued that swinging was perhaps an expression of musical metre.

In order to extend the understanding of the apparent links between expressive locations and musical structure, the pianist was asked to select his personal expressive locations and to explain his criteria for the selection. Looking at the six pieces together the pianist's locations corresponded to the observer locations. When the criteria for the selection of the locations was examined, it became clear that the performer perceived expression in his performances to serve two purposes: i) to communicate certain structural features of the performance (for instance, particular chords); and ii) to give accurate technical executions of these structures which were often chosen for their particular emotional effects (for example, a cadence had to be played with weight in order to emphasise the erotic potential of the chords). At a fundamental level, this finding showed that there was some connection between structural importance and the pianist's perception of what constituted an expressive location.

Also, the qualities the performer tried to elicit or the qualities he recognised within the score were similar to the qualities the observers identified. Indeed, in the semantic differential studies of earlier chapters it was discovered that projected performances had qualities of poise and flexibility which were terms frequently used by the performer when he spoke about intentions he was trying to give the six different projected performances. It is important to note, however, that when compared with the observer locations of the former study, there were far fewer locations identified by the pianist and it is possible that the pianist may have had just one set of selection criteria for the expressive locations - one based fundamentally on structure - which did not necessarily encompass all that he really knew about the expressive moments of his performances.

The pianist was aware that he approached each expressive location differently, and though he was only able to guess at the specific movements he used, the guesses showed an implicit knowledge of both the type and quality of movement used and also provided some explanation for why such a movement would be used. For instance, he explained that hand lifts would occur at rests to link musical ideas on either side of the rest, and although not all rests were of structural significance, he pin-pointed virtually every one as an expressive location. Also, he spoke of many of the locations and overall intentions of the piece in terms of body imagery. This evidence indicated that the movement vocabulary was indeed an expedient way to convey the performer's intentions to the observers and that it emerged from a desire to convey intentions which had links with physical qualities (for instance, a desire to convey the impression of limb movement or sexual movement).

The final study of chapter 5 which involved asking the pianist to give performances on a table top, showed that there is certainly some underscoring feature of musical structure which elicits the movements of the expressive movement vocabulary, for despite the unnatural performance conditions, many of the movements persisted, as did the movement locations. Indeed, when the locations were compared with the pianist's own expressive locations it was discovered that the locations which persisted were those he had identified. Therefore, it was concluded that the locations that were in excess of the pianist's own locations were possibly of secondary expressive purpose.

Though certain movements of the vocabulary disappeared altogether from the table top performances, this was accounted for by the technical constraints of the performance, as was the finding that the amplitudes of all the movements were reduced. Again, the swinging movement persisted in all performances except the Schoenberg, supporting the idea that metricality may account for the swinging. Some flexibility was shown in the types of movements which appeared at the expressive locations, though in some pieces the same movements persisted. The persistence of these movements strengthened the earlier indications that some movements are most expedient at conveying expressive information at certain structural locations.

To a large extent much of the data collected and analysed in these chapters has provided empirical support for what is known to observers at an intuitive level. It has been difficult to find paradigms to approach some of the specific empirical questions, but the results described above have provided some ways systematically to investigate performance movement. Now that the empirical studies have been summarised, it is essential to discuss what they imply.

6.2 IMPLICATIONS OF THE EMPIRICAL RESULTS

6.2.1 THEORETICAL AND METHODOLOGICAL IMPLICATIONS

It is important to return to the theoretical framework established at the beginning of this thesis to assess which of the concepts are useful in light of the empirical findings.

First, it is essential to look at Gibson's idea of the availability of information. The finding that visual and sound information are useful to the observer of a musical performance suggests that music is an integrated, multiply specified percept. The musical material evidently provides commonly shared information for the performer and the listener which is available in sound and vision. This common experience of musical structure means that both performers and observers have knowledge which is common to both in some way. The performer makes use of this knowledge to do something with her body to produce sounds, whereas the observer uses this same knowledge to pick up and interpret information from vision and sound.

A finding which needs some clarification is the apparent result that there is a difference in the expressiveness of sound and vision. The initial investigations revealed that visual information alone was essentially equivalent to that of sound alone or sound and vision combination, they also showed that vision tended to produce slightly clearer observer judgements of manner. Since the tracking study demonstrated that performers moved far less in inexpressive than in expressive performances, and given that observers said that they used quantitative information in the judgement of expressivity, it could be that the observers tended to use this quantitative visual information in a rather extreme way, the perceptual equation being that little movement makes the performance totally inexpressive, whilst some movement makes the performance highly expressive.

In order to understand the full implications of this finding, it is important to point out that the single stimulus sound results for the different performance manners were slightly more similar to each other than vision only or sound and vision mode. The implication is that music alone is expressive. That is, the actual characteristics of music (tonal and rhythmic) make it expressive. Of course, sound is the intrinsic medium of expression for music, whereas in vision only it is impossible to pick up all the intrinsic expressivity (the tonal features cannot be seen, though rhythmic features may be). This means that the music can be understood in sound only, but not in vision only, though (as the studies have shown) vision is an important source of information about the performer's intentions. Therefore, the more extreme results of vision can be explained by a *"baseline effect"*: the logical baseline for visual expression is the complete absence of movement. By contrast, in sound only the baseline (which would correspond to a perfectly deadpan recording) is higher since the intrinsic expressivity of the music itself is included - regardless of whether it has been transformed by performer expression. This means that the potential range from 0 to maximal expression is greater in vision than in sound. Since the vision and sound combination produced results that were slightly less extreme than vision only and slightly more discriminatory that sound only, and since combined sound and vision is the natural stimulus of the live performance, it is clear that single stimuli are slightly false indicators of intention. This only strengthens the Gibsonian case that under natural conditions information is multiply specified.

Linked to this theoretical point is Runeson's emphasis on the informative nature of kinematic information and its specification of expressive intentions. The work in this thesis supports this notion by finding that intentions can be specified and expressions can be detected. The studies in this thesis show the subtlety of the visual information that is picked up and the complex way in which it specifies its causes.

A further theoretical point which is given support is the Gibsonian notion of invariants - something which remains the same despite being subject to transformation. The swinging movements point towards a centre of moment (as described by Cutting and Proffitt, 1981) as they can be interpreted as transformations which leave invariant a point that is perceived as the origin of a performer's expressive movements. The fact that any arbitrarily chosen two second excerpt provides information about manner suggests that there is a general movement "*tone*" which has qualitative and quantitative aspects which informs about manner and which has no relationship with musical structure.

Given that the overall "*tone*" of the movement of the performance is informative, it is important to know what information permits manner to be detected, but which is not specifically identifiable in a particular movement. Initially, in the Beethoven Bagatelle studies, it was thought that the swinging provided information about expressive as opposed to inexpressive performances, because of the absence of swinging in the deadpan manner. It is feasible that even though the swinging movement itself was not physically manifested, the centre of moment still remains as a "*potential*", rather like a stationary pendulum whose fulcrum is still present but is only revealed through the action of swinging. The swinging explicitly informs about a centre of moment and this centre of moment in turn informs about the overall expression of the performance. To carry the analogy between the centre of moment for the pendulum and the pianist one stage further, it is clear that the pendulum can swing around its fixed point. For the pianist, the fixed point is his bottom which is placed on the piano stool. His hips form the rotation point for the upper body, and thus provide the basic body movement. The hands have the constant constraint of the keyboard around which they must move, though there are a number of ways in which the hands can accomplish the basic requirement of playing the notes. Similarly, the upper body (shoulders and head) seem to be able to move fairly flexibly on top of the basic centre of moment. These proposals, in line with Cutting's work, need a lot more study, yet they do present a case for movement invariants in piano performance.

So far this discussion has ignored the precise nature of the information conveyed in the swinging. It seems that at the most basic level, swinging helps to maintain an evenness of tempo, and thus maintains a continuity of thought about the piece. In the unmetrical Schoenberg, the lack of this swinging shows that there is no evenness of tempo, and in this particular case, little continuity between sections of the piece. This being so, the expressive movements of the Schoenberg seem all the more melodramatic for they appear without any physical link to what has gone before. The lack of swinging in the Schoenberg appears to be another illustration of how the centre of moment, though still present as a potential, is not explicitly revealed.

The transformations of this invariant centre of moment constitute a vocabulary of particular expressive movements. It is also possible to detect manner from the specific movements, despite the fact that every one of these movements can be identified in every one of the three manners. However, the observer and pianist's own discussions indicate that the vocabulary of movements has a strong link with musical structure, and it therefore seems that the movements are used to underscore specific musical information. Indeed, it is to be recalled that the movements appear in all manners. This point needs some clarification, however, for the repeat performances show that there is both constancy and flexibility in the use of specific movements at the expressive locations. Clarification for this can be found in the use a red light analogy: a red traffic light has a different value from that of a red light on a recording studio door. Whilst both alert observers, it is their context which makes their meanings differ. In the case of the traffic light, the driver is alerted to stop, and in the case of the studio door light, people entering the studio are being alerted to the fact that the studio is *"on air"*, and that they must be quiet. Thus, for the movements, each may have a basic expressive function, though it is the context of the movement which provides a particular meaning. This analogy explains why there is both flexibility and constancy in the use of the movements across performance, and also accounts for the fact that all the movements appear to be related.

There are two additional points which need to be discussed which concern the specific movement shapes. In the first case, the hand lifts which are not given expressive locations, in light of the discussion above, might be described as movements which lack the qualities of the *"general tone"*. For in the case of the projected manner performance of the Bagatelle the hand lift occurs at a structural moment (a rest) where there are locations in the other performances. Since one of the observers mentioned that the lift lacked "purpose" (cf. chapter 4, section 4.3.3), it could be that the hand, although it has all the shape characteristics and location of an expressive movement is not one because it lacks the *"tone"* of the manner.

The second point was initially raised in chapter 5. Because the movements of the vocabulary appear to be related (recall the red light analogy), there are some problems in movement shape definition which have not been thoroughly considered. If the movements are related, in certain instances this means that a movement may have components of two or three of the other identifiable movements. Indeed, it is important to recall that the observers' locations of the expressive movements showed that (on occasion) one observer would identify a wiggle, whilst at the same location, another observer would call the movement at shake. This means that the movement vocabulary that has been defined is perhaps too finely divided and does not accommodate this relational aspect of some of the movements. However, the fact that specific movement shapes have been extracted from the overall *"movement tone"* of the pianist's performances indicates that these shapes are well enough established in the pianist's mind for them to have definition. Also, given that variants of the same movement appear on different occasions at the same structural locations there is an indication that the noticeable features of these movements do in fact make them more related to one another than movements which have clearly different shapes. Therefore, even if only one of the potential features of this movement is seen, it is important that it can be identified.

The performer's own comments raise interesting issues about self-knowledge in performance are raised. Although the implicit knowledge of the specific movements and an explicit knowledge of the expressive locations is discovered, it is evident that the performer believes that knowing too much about the precise movements *may be detrimental to* the performance: he could become too tense as a result of trying to make a specific movement at a specific point in the performance. It seems that his aim is to convey his musical intentions, and in order to do this, he deliberately tries to avoid movements which may intrude on the presentation of these ideas. This suggests that the performer's movement vocabulary, even though it may be culturally constructed (like a spoken language) is integral to the natural movement of the pianist. This finding, in combination with the evidence that some of the pianist's hypothesised movements are specifically directed at the audience (he says of a particular moment in the Beethoven Bagatelle that he will make a certain movement to "*share the intimacy of the moment with the audience*"), suggests that the performer may be aware that the observers are able to extract information about his musical intentions by his appearance during the performance.

With all these implications, a theory of expressive performance movement might return to the following question: Where do expressive movements come from and what it their purpose? The picture that has emerged in this thesis is that three broad classes of factor have been identified in relation to expressive movements. First, in terms of pure physics the performer's movements will be determined by the particular characteristics of the instrument and playing stance. Second, human biology is implicated through the idea of a centre of moment and the pendular movements of the human body around this stable point. Third, psychological processes have been clearly identified in the performer's perception of the structural and emotional properties of the music that lead him to behave in certain ways. On top of this, however, it seems clear that a level of social codification must be involved since performers' movements seem to have certain stereotypical qualities.

The reality of human life is that within cultural frameworks conventional movements are established, and these movements continually evolve both within that framework and for the individual. In the case of music performance, large numbers of movements are copied simply by virtue of the way in which performers are taught to play their instruments through imitation, for besides the technique of note execution, the performer inevitably picks up certain movement styles too. In addition to the teacher, other performers influence performing style. Indeed, as figure 1.1 (chapter 1) shows, in Liszt's time, highly "*gestural*" performances were fashionable. The example in figure 1.1 also illustrates that the meaning of the movements can be mediated by cultural convention too (for instance, Liszt gives a *"priestly look"*). For the pianist in this thesis, the specifically identifiable movements (despite their flexibility and the potential links between them) may be part of this convention. Indeed, this could explain in part why the performer is able to guess at the style of movement he uses at specific locations (for instance, *"something which involves looking at the audience"*).

Whilst there is social mediation, however, the demonstration that intentional information is contained in pure kinematic displays suggests that information is directly available too - both direct and indirect information coexist. Therefore, these studies suggest that the social and individual processes of cognition and awareness are mixed. As Gibson said: *"mediated apprehension gets combined and fused with direct apprehension"* (In Reed, 1988: 307, and taken from an unpublished manuscript written by Gibson in 1976). To develop this discussion further along Gibsonian lines, it may be argued that observer and performer detect meaning through the affordances offered up by the movements of the vocabulary.

In similar Gibsonian vein, it is important to recall that the pilot study demonstrated that although both naive and experienced observers of music performances could detect different performance intentions, the more experienced observers were slightly more assured in their judgements. This result is supported by Gibson's concept of perceptual attunement which suggests that experience permits the observer to differentiate more finely between percepts. This is certainly the conception of the affordance Zebrowitz (1990) has in mind when she discusses the case for an ecological social psychology.

Methodologically, this thesis has shown the value of using a pluralistic approach to the study of musical performance. The different techniques generate complementary evidence relating to different facets of a complex activity. The point-light technique was useful in showing that even under conditions of reduced visual information observers were highly attuned to subtle differences in performance manner. The tracking technique was able to highlight the precise physical movements which characterize performances differing in their intentions. The semantic differential scales were useful as a way of pin-pointing some of the more qualitative rather than quantitative features of these movements. And finally, the intense involvement of a single performer in playing a variety of pieces of music, providing his own analyses of them and his own comments about the use of expressive movement in his performances provides rich information about a performer's expressive intentions and the way in which they are manifested under different musical and physical conditions. In general, these different techniques provide convergent information, but inevitably with such pluralism there may also be some divergences.

6.2.2 PRACTICAL IMPLICATIONS

A number of practical implications emerge from the work described in this thesis, since it is clear that vision must be studied just as much as sound in order to understand fully the nature of music performances. Music is best experienced in the context of live performance, though with the huge boom in popular music and classical music videos, combined aural and visual information can also be experienced in other circumstances.

One interesting anecdotal follow up to this point can be found by considering the career of Glenn Gould. Delalande (1990), having observed video recordings of Gould from early and late in his career, has noted a marked difference in the pianist's movements. Early in his career, Gould played in public, while later he confined his performances to the recording studio. The early performances show a fluency yet a degree of unpredictability in his movements, whereas the movements from the recording studio performances are found to be far more fixed into a repetitive series of movements which recur in a predictable fashion. It must be assumed that years of performing without the presence of an audience affected the pianist's performance presentation. It is feasible that in the latter performances he was not motivated by communicative movement concerns at all, and his movements took on a purely structural character.

This observation points to a whole range of issues about the way in which performances are experienced. For instance, general questions about the expressive impact of music which is presented on record are brought into focus. Clearly given Gould's movement variations, the audience perceive the performer's music to be of a different expressive intensity when they see as well as hear the performer.

This point brings with it many issues which must be brought to the attention of the musicians. Amongst these are questions about how the performer should be taught, bearing in mind that there is no formal emphasis on the movements of performance, and the player spends many hours alone without feed-back about what is being communicated in his performance. The irony of the current cultural situation is that the performer spends hours working alone, and as a social activity, perhaps more time ought to be spent in social situations when practising for concerts.

One teaching strategy might be for students to perform as regularly as possible in workshops and seminars in order to experience the audience and also to have their performances videoed so that they may observe the impact of their own visual information. Working on the finding that there is common information for both performer and audience, this visual information may be modified by the performer in order to produce a particular message.

This raises the issue of whether particular movement strategies ought to be taught. Given the role of movement, it is perhaps important to assess whether the performer ought to consider applying specific strategies to enhance observer understanding of the expressive content of the performance by making certain musical movements - though there is the danger, as this thesis has pointed out, that movements which are not expressive of genuine intentions may be detected as such and perceived to be false.

Finally, in the light of Winold, Thelen and Ulrich's (1990) work (see chapter 2, p72) there is a need to consider the separation of technique and expression with regard to the movements of music performance. The technique of accurate note playing and the expressive element of the performance should be fused since their work indicates that the physical movements involved in musical performance are different under different conditions of tempo (and by implication, intention). This suggests that it is counter productive to learn technical instrumental movements as fixed components in isolation from their expressive context. In instrumental tuition there is often a separation between technique and interpretation which in the light of this evidence seems potentially damaging.

6.3. IDEAS FOR SUBSEQUENT STUDIES

It is important to conclude this thesis by discussing some of the work which might be done to immediately follow the investigations of this thesis.

Given that the findings about the expressive movement vocabulary and overall movements of performances are based on only one performer, it is essential to make more detailed investigations of different performers. Initially, it is essential to study other pianists to see if there is any relationship between the expressive information sources of the head and hands, and also to see if the movements identified for the single performer have any features which appear in other pianists' movements. Then, it is important to study performers of many different kinds of instruments to discover if there are certain areas of the body which are more informative than others, and to see if movements have any common features even when the instrument is different.

Also, given the potential difficulties of acted behaviours (see chapter 3, p78), it is probably worth reevaluating the use of the three particular manners. Although useful, the deadpan, shows that it is impossible to remove all expression; indeed, if the video examples of the cellist in the pilot study are viewed, it is interesting to observe that there is virtually no difference between her deadpan and projected performance.

Although the three performance manners have been useful, there is a need to define these intentions more clearly in an attempt to extract any differences between the specific movements and styles which are different from one performance to the next. Discussion of the importance of the visual information in performance links back to the early anecdotal example of this claim - the note that Liszt's performance movements conveyed information to his audience. It is important to focus on this example for it included the comment that some observers perceived Liszt's movements to be melodramatic and excessive. Bearing in mind the results of the empirical studies which looked at the three performing manners, and which showed that the exaggerated manner was perceived to be overstated and unnatural whilst, at the other end of the scale, deadpan performances were perceived to be understated yet equally unnatural, it seems that not only can the intentions of the performance be detected in movement, but if the movements are not consistent with the musical content of the composition, the movements are perceived as being unnatural. This finding is supported by the claims of Runeson and Frykholm (1983) that intentions which are not natural can be readily detected in movement.

It is important to use performers of a very high calibre so as to be confident about the level of control in their performances. An alternative might be to include a pre-test in which a number of performers produce replications of each performance intention from which the most stable performances could be selected. The danger with this is that it may lead to unnaturally rigid performances: much of the work in this thesis has shown just how flexible realistic performance is.

In the same vein, it is important to keep the observer stimuli as naturalistic as possible, and for that reason, there should be less emphasis on using point-light displays, for although they were very effective at illustrating that kinematics contain important perceptual information, the overall results showed that the normal displays were more informative. (Rather like the tracking study in which only the amplitudes of the movements of the performance could be seen, in the point-lights, the overall movements could be seen, but small specific movements like the wrist rotation could not be discriminated in the displays.) However, that is not to say that point-light displays do not have their uses. One application of point-light technique might be to make some systematic study of the invariants which contribute towards the perception of expressivity in performance.

Cutting (1978a) was able to make computer generated simulations of walkers in point-light display and compare them with human point-light displays until he produced simulations that were perceived to be equivalent to the human motions. This work was undertaken to isolate the centre of moment for walking. It is possible that such a method might isolate the centre of moment of the pianist. Additionally, it would be important to study the locations of expressive movements, to examine whether there are any structural features of the music which elicit specific kinds of movements (the nods at cadence points, for instance). Such enquiries would bring the discussion of cultural convention, natural body formations and expression more clearly into focus.

Also, it is important to investigate the movements of performers when they are asked to perform with a range of specific emotional intentions to see if these affect the locations and the movement styles (for instance, to play in an angry manner, or to play in a sad manner).

The report of the pianist's comments, although difficult to present in an empirical way, provided such useful information that attention must be turned towards developing a more systematic way to analyze the content of such interviews. A more structured interview may be a way of extracting information about the performer's intentions, knowledge of the musical structure, and self-knowledge, and the semantic differential scales method could be re-examined to see whether it might be used for performers so that their opinions can be recorded more rigorously.

The above mentioned points will certainly aid to expand the information collected in this thesis, and hopefully assist in the development of a theory of expressive movement in music performance.

This thesis has primarily been an attempt to develop empirical methods that will reveal something of what is at present an almost totally unknown field. While some of the methods have fallen short of their ideal, at the very least they have shown that an important aspect of how musicians communicate can be investigated in a way that is both revealing and brings with it certain practical implications.

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