A photogrammetric technique for measuring human interaction distances

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In recent years, field studies in the area of human ecology have been concerned with investigations of interpersonal distance patterns. Some researchers, for example, find wide differences in spatial behavior among culture groups (e.g., Aiello & Jones, 1971; Watson & Graves, 1966), others find only slight variations (Willis, 1966) or none at all (Forston & Larson, 1968). Many of the past studies have relied on eyeball techniques, often obtrusive and imprecise (Aiello & Jones, 1971; Hall, 1955); very little attention has been paid to the use of photographic recordings.

One of the reasons for the present paucity of photographic studies is that it is difficult to obtain good photographs of dyadic groupings in the horizontal plane which are free from obstructions by other persons in the immediate vicinity; it is also difficult to remain unobtrusive. Another problem seems to be the inadequacy of present photogrammetric methods to take into account the S's angle of orientation in determining the physical distance between interacting members.

Because of existing inadequacies in interpersonal distance measurement techniques, a photogrammetric method was developed to help overcome some of the problems involved. The method has been recently utilized, with considerable success, in two independent cross-subcultural studies of proxemic behavior of black and white primary school children, observed in school playground settings (Scherer, 1972).

PHOTOGRAMMETRY

A measure of the true separation, D_t , between two interactants can be obtained from a photographic image of the pair if exact distances to each member of the pair are known. In order to remain as unobtrusive as possible, and because interactants to be observed are generally spread over a fairly wide area, the determination of exact distances is considered to be undesirable and impractical. Instead, proxemic distance scores can be obtained by using the ratio D_t/H as a measure of proximity, where D_t is a measure of average separation between members of a dyad, and H is their average height on the photographic image. This ratio is independent of the average distance of the dyad from the camera. It is, however, not independent of the orientation of the dyad to the camera. A method for taking the orientation into account is described below. Note that the ratio D_t/H is an unbiased measure of any

differences between members of any two culture groups, provided that members of one group are not markedly different in average height from the other. This assumption seems to be justified.¹

The procedure for determining the ratio D_t/H is as follows. Using 35-mm frames of the (negative) film, the image of a pair is projected onto the bed of an enlarger, and curves and lines carefully drawn. Figure 1 depicts one example. The curves, T_1G_1 and T_2G_2 , designated here as "skewer" lines, are drawn to represent imaginary curves in a vertical plane (or nearly vertical plane) centrally located within the body of each S, extending from the tip of his head to a point between his feet. In drawing these curves, the positions of the arms need not be taken into account. In practice, there is little doubt as to where a skewer curve should be drawn, regardless of the orientation of a S to the camera. The curve is localized by the tip of the head and the neck, and is drawn ventral to the spine and parallel to it through the trunk. It tends to come nearer the leg on which most of the weight of the S is resting.

Points G_1 and G_2 are the intersections of the skewer curves with a line joining the midpoints (A' and A'') of the arches of the feet. G_1 and G_2 mark the intersections of the skewer curves with the ground. The angle which the line G_1G_2 subtends from a horizontal line $C'C''$ gives the orientation of the pair of Ss with respect to the camera. D_a is the apparent average distance between the skewer curves, measured parallel to G_1G_2 . When the two skewer curves are very nearly parallel, then D_a may be taken simply as the distance between them. Otherwise, D_a is calculated by dividing the area $T_1T_2G_2G_1$ by the average height of the Ss ($H'H''$).

The apparent separation, D_a , has to be corrected for the true angle of orientation, α_t , of the line, $C'C''$. $C'C''$ is at right angles to the line of sight of the camera.²

The true separation, D_t , is given by $D_a/\cosine \alpha_t$. The angle α_t can be determined approximately from the apparent angle α_a (as measured from projected images such as that depicted in Fig. 1) by the relation,

$$\tan \alpha_t = \frac{R_d}{R_h} \tan \alpha_a,$$

where R_d is approximate distance (to the nearest 50 ft) from the camera to the Ss, and R_h is the height of the camera above the ground. R_h should be fixed and not altered throughout the data collection stage. R_d is free to vary, and should be estimated from each photographic shot by reference to objects of known distances in the field of view.

Although reference above has been made to dyadic groupings only, this photogrammetric procedure can be used to study proxemic behavior patterns of groups of any reasonable size, provided that clear images can be obtained of all of the interactants of interest.

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