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The framing effect with rectangular and trapezoidal surfaces: Actual and pictorial surface slant, frame orientation, and viewing condition

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Abstract. The perceived slant of a surface relative to the frontal plane can be reduced when the surface is viewed through a frame between the observer and the surface. Aspects of this *framing effect* were investigated in three experiments in which observers judged the orientations-in-depth of rectangular and trapezoidal surfaces which were matched for pictorial depth. In experiments 1 and 2, viewing was stationary-monocular. In experiment 1, a frontal rectangular frame was present or absent during viewing. The perceived slants of the surfaces were reduced in the presence of the frame; the reduction for the trapezoidal surface was greater, suggesting that conflict in stimulus information contributes to the phenomenon. In experiment 2, the rectangular frame was either frontal or slanted; in a third condition, a frame was trapezoidal and frontal. The conditions all elicited similar results, suggesting that the framing effect is not explained by pictorial perception of the display, or by assimilation of the surface orientation to the frame orientation. In experiment 3, viewing was moving-monocular to introduce motion parallax; the framing effect was reduced, being appreciable only for a trapezoidal surface. The results are related to other phenomena in which depth perception of points in space tends towards a frontal plane; this *frontal-plane tendency* is attributed to heavy experimental demands, mainly concerning impoverished, conflicting, and distracting information.

1 Introduction

Studies in which observers estimate the slant-in-depth of surfaces relative to the frontal plane have produced a wide range of results. If the observer views binocularly and moves freely, slant may be judged more-or-less veridically (eg Reinhardt-Rutland 1990), although this is not invariably the case (Gehringer and Engel 1986; Stevens and Brookes 1988). In restricted stationary-monocular viewing, pictorial information is important. For example, a slanted rectangular surface elicits a trapezoidal retinal image: the pictorial slant of visually matched rectangular and trapezoidal surfaces is correctly estimated, or even overestimated (Reinhardt-Rutland 1993, 1995a). In contrast, slant is underestimated in other studies, sometimes to the extent that the surface appears to be nearly frontal (eg Clark et al 1956a, 1956b; Eby and Braunstein 1995; Eriksson 1964; Reinhardt-Rutland 1995b, 1996a, 1996b).

Two components of this underestimation can be identified. One component concerns restricted depth information regarding both the display and the viewing conditions. For example, the slant of unpatterned triangular surfaces in an otherwise empty visual field is underestimated during stationary-monocular viewing: in contrast to rectangular and trapezoidal surfaces, pictorial information from unpatterned triangular surfaces is minimal (Reinhardt-Rutland 1996a, 1996b). In this case, potential information for depth derives from ocular adjustments, such as accommodation; however, except for the crudest of depth judgments (Roscoe 1985), such information seems to be ineffective (Foley 1978; Sedgwick 1986). Gogel (1956, 1969) has described two phenomena in detecting the absolute and relative distances of discrete objects in restricted conditions that are consistent with the underestimated slant of unpatterned triangular surfaces. One phenomenon concerns the judgment of an individual object along in the visual field: judged distances are highly variable, but nonetheless tend to a particular distance—the *specific-distance tendency* (Foley 1977; Gogel 1969). The second phenomenon is the underestimated separation-in-distance of two discrete objects—the *equidistance tendency* (Gogel 1956, 1965; Wade and Swanston 1991). The underestimated slant of an unpatterned triangular surface seems particularly akin to this latter. The various phenomena might be understood as cases of a general *frontal-plane tendency*: points in space tend to be perceived as lying in a frontal plane in impoverished scene and viewing conditions.

The second component of slant underestimation prompts the present study. Surfaces have sometimes been viewed through a frame between the observer and the experimental surface. Eby and Braunstein (1995) have identified a *framing effect*: the perceived slant of the surface is reduced by the presence of the frame. Eby and Braunstein's surfaces were triangular, but—in contrast to Reinhardt-Rutland (1996a, 1996b)—they conveyed appreciable pictorial information: surfaces were patterned with equally spaced horizontal or vertical stripes, and the visual angle of the bottom edge of the surface depended on surface orientation. Viewing was stationary-monocular, with the frame—rectangular in form and in a frontal plane—visible on half the trials. The presence of the frame systematically reduced slant estimates over a range of surface orientations.

Eby and Braunstein relate the framing effect to *pictorial perception*. The three-dimensionality of the experimental stimulus is reduced because the frame prompts the observer to interpret the whole display as two-dimensional, like a picture. They refer to Sedgwick's (1991) suggestion that observers can attend to either the objective (three-dimensional) or the projective (two-dimensional) characteristics of a scene, but that there is 'cross-talk' between the two modes of perception.

However, other explanations are possible. For example, the framing effect may be a case of *assimilation*: the perceived orientation-in-depth of the surface is assimilated to the orientation-in-depth of the frame. Assimilation might also operate at the level of the retinal image. Eby and Braunstein's surface with a texture of horizontal stripes evinced a greater framing effect than their surface with a texture of vertical stripes: because their surfaces were slanted about a vertical axis, the horizontal stripes according to linear perspective would be visually slanted with respect to the horizontal. These visual slants might assimilate to the horizontal edges of the frame. Assimilation phenomena are reported with many visual properties, including linear extent, colour, and motion (Crovitz 1976; Goldstein 1984; Murakami and Shimojo 1993).

Finally, the framing effect might relate to the frontal-plane tendency outlined above. While impoverished conditions are important in the frontal-plane tendency, other factors can be identified. One factor concerns the chosen procedure: more taxing procedures increase the specific-distance and equidistance tendencies (Foley 1977; Reinhardt-Rutland 1995b). For example, Foley compared two procedures in the distance estimation of discrete objects: one entailed verbal judgment of the distance and the other entailed an unseen motor response relating to the distance. The presumably more complex motor response elicited a greater specific-distance tendency than the verbal judgment. Also, competition in depth information affects the equidistance tendency. Eriksson's (1972) monocular observers judged the distances of small objects in darkened conditions; some objects were varied in size to manipulate the pictorial distance cue of visual size. The equidistance tendency most affected objects in which visual size competed with actual distance. Extrapolating from such evidence, one can conclude that the frontal-plane tendency reflects heavy experimental demands on the observer in judging depth. In this context, the frame would increase experimental demands by introducing distracting information to the scene.

The present experiments are concerned with the framing effect as it may apply to pictorially matched rectangular and trapezoidal surfaces which are unpatterned. Beyond demonstrating the framing effect with different surfaces from those employed by Eby and Braunstein, the three experiments were designed to investigate a number of issues with explanatory implications: the nature of the stimulus information that might influence the framing effect, the influence of different orientations of the frame, and the influence of more informative viewing than stationary-monocular viewing.

2 Experiment 1

In the first experiment, the framing effect was examined with three surfaces conveying different information for slant to the frontal plane. The first surface was slanted and rectangular: the slant of this surface may be perceived because of its actual slant—monocular information such as accommodation would be involved—or because of its pictorial slant. The second surface was trapezoidal: it was actually frontal but pictorially slanted, so a perception of slant depended on pictorial information. The third surface was also trapezoidal: it was actually slanted but pictorially frontal, so a perception of slant depended on actual slant. Since pictorial information is the main determinant of the perceived orientation of a rectangular or trapezoidal surface when the surface is alone visible and viewing is stationary-monocular (Reinhardt-Rutland 1993, 1995a), the framing effect is most likely to apply to the surfaces conveying pictorial slant.

2.1 *Method*

2.1.1 *Stimuli.* The experimental stimuli were surfaces made of fine-textured matt white card, supported at their backs to be vertical. The texture of the surfaces could not be perceived during experimental viewing, so pictorial information was restricted to the overall shapes of the surfaces. The luminance of surfaces approximated 0.2 cd m^{-2} (Hagner S1 photometer). The left vertical edge of each surface was 100 mm high, subtending 5.9 deg of visual angle at the 1.0 m viewing distance. The horizontal extent of the rectangular surface was 150 mm (subtending 7.2 deg) and it was slanted at 30° to the frontal plane about a vertical axis—the right edge was behind the left edge; it is labelled p30a30 to indicate that pictorial orientation (p) and actual orientation (a) were both 30°. One of the two trapezoidal surfaces, p30a0, was actually facing, but matched p30a30 pictorially; horizontal extent was 125 mm and right vertical extent was 93 mm. The other trapezoidal stimulus, p0a30, had an actual slant of 30°, but matched the rectangular surface pictorially when the latter was viewed in the frontal plane; horizontal extent was 180 mm (8.6 deg) and right vertical extent was 108 mm. The experimental surfaces are illustrated schematically in figures 1a and 1b.

The frame was rectangular and located in a frontal plane between the observer and experimental surface at 0.2 m ahead of the left edge of the experimental surface (figures 1c, 1d, and 2). Like the experimental surface, the frame was made of matt white card and supported at the back to be vertical. Dimensions were 320 mm (22.8 deg) long by 200 mm (14.0 deg) high; the width of the frame was 40 mm (2.9 deg). One difference with Eby and Braunstein's study was that the present frame was three-sided while their frame was four-sided. The reason for the present choice of a three-sided frame is that it permits a close comparison between the present study and the earlier research with rectangular and trapezoidal surfaces (Reinhardt-Rutland 1993, 1995a).

The experiment took place in a light-tight cubicle. Experimental stimuli were viewed one at a time along a horizontal table top. A rigid horizontal strip of wood extended across the width of the table, below the level of the table top at the viewing end. The height of the strip was adjusted so that, with the chin supported on the strip, the line of sight just cleared the table top. Two Philips TLGW08 8 W ultraviolet tubes above the observer provided illumination. Except for the frame and the experimental stimuli, surfaces were matt black and of luminance below measurable limits: observers reported no visible patterning in these surfaces. There was no control for the additional luminance due to the presence of the frame; this factor was found to have no effect in Eby and Braunstein's (1995) study.

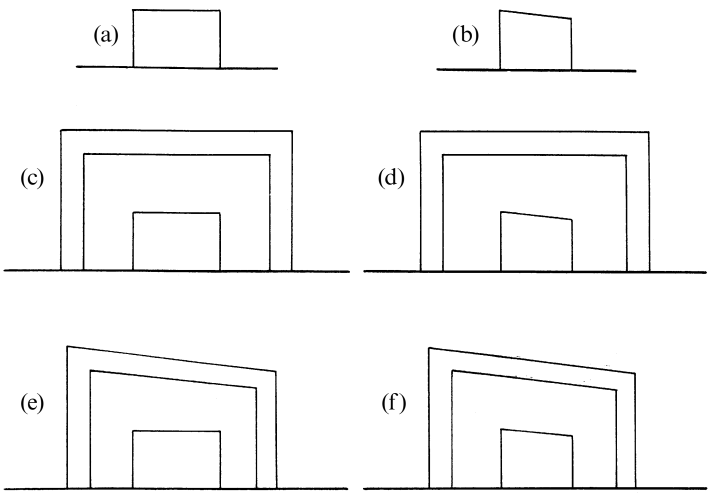

Figure 1. The appearance of the experimental displays: (a) and (b) represent the experimental surfaces with no frame in experiments 1 and 3—(a) represents p0a30, and (b) represents p30a0 and p30a30; (c) and (d) represent these experimental surfaces viewed through the frontal rectangular frame in all experiments, along with p0a0 in experiment 2; (e) and (f) represent the surfaces viewed through the slanted rectangular frame or the frontal trapezoidal frame in experiment 2.

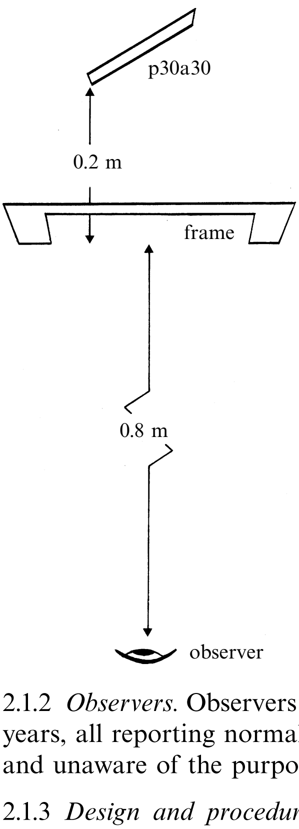

Figure 2. View of one of the displays from above the observer. The observer is viewing stimulus p30a30 through the frontal rectangular frame.

2.1.2 *Observers.* Observers were forty-eight female and male undergraduates aged 18 to 38 years, all reporting normal, uncorrected vision. All were psychophysically inexperienced and unaware of the purpose of the study.

2.1.3 *Design and procedure.* Each observer viewed in random order all experimental surfaces with the left eye occluded. Choice of right-eye viewing is arbitrary: the reported eye dominance depends on procedural factors (Wade 1976). Half the observers viewed with frame present and half the observers viewed with no frame present.

As in previous studies (eg Reinhardt-Rutland 1993), judgment of orientation-in-depth exploited analog time. The observer considered the table top along which he/she was viewing as a clockface; each experimental surface was the minute hand with the left of the surface representing the clock centre. Responses were in minutes past the hour to whatever accuracy was achievable. As examples, responses of 5 min and 14.5 min represent respectively 60° and 3° to the frontal plane. Observers were given a preliminary trial with a surface not used in the experiment to check that they appreciated the procedural instructions. Observers were encouraged to take time in responding.

2.2 *Results and discussion*

Judgments of orientation-in-depth were converted from minutes of time to degrees of angle relative to the frontal plane by applying the formula $6(15-x)$, where x is the judgment in minutes. Means and standard errors of judged orientation-in-depth in degrees are shown in figure 3.

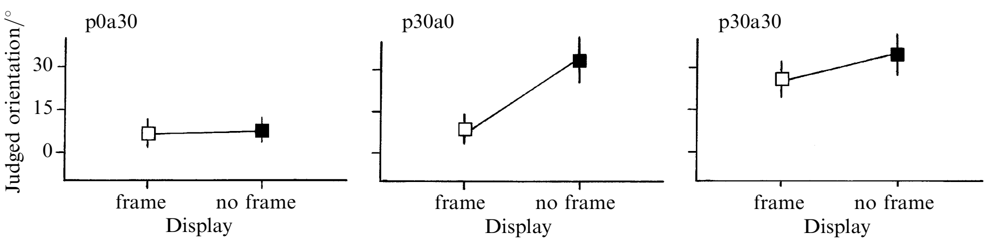

Figure 3. Means and standard errors of judged orientations relative to the frontal plane in experiment 1. From the left, graphs are for stimulus p0a30, stimulus p30a0, and stimulus p30a30.

As predicted, experimental surface p0a30 appeared nearly frontal when viewed without the frame; the same applied when the frame was present. However, both p30a0 and p30a30 were perceived as fully slanted without the frame—indeed, slant was overestimated—which is consistent with previous evidence (Reinhardt-Rutland 1993, 1995a). With the frame present, the slants of both p30a0 and p30a30 were reduced in comparison with the no-frame results; in the former case the reduction are large—about 70%—while in the latter case the reduction was about 20%.

Confirming these impressions, a two-way analysis-of-variance revealed that there were significant differences between experimental surfaces ($F_{2,92} = 12.07$, $p < 0.01$), between presence and absence of the frame ($F_{1,46} = 5.39$, $p = 0.025$), and for the interaction between the two independent variables ($F_{2,92} = 4.33$, $p = 0.016$).

It can be concluded that the framing effect extends to rectangular and trapezoidal surfaces viewed through a three-sided frame. That a trapezoidal surface evinces a stronger framing effect than a rectangular surface parallels Eriksson's (1972) data from discrete objects: the equidistance tendency was greatest when the visual sizes of the objects competed with their actual distances.

The reduction in perceived slant of p30a0 is within the range that can be inferred from studies in which surfaces were viewed only through a frame (eg Clark et al 1956a), but is rather larger than the framing effects reported by Eby and Braunstein (1995): the latter were between about 10% and 30%. Probably the major reason for this is that actual slant matched pictorial slant in Eby and Braunstein's surfaces; their results were comparable with the relatively modest framing effect obtained from p30a30.

One feature of Eby and Braunstein's results that is in contrast to the present results is that the former all indicated underestimation of slant, whether the frame was present or not. It may be that Eby and Braunstein's no-frame underestimation is explained by weak information for surface slant. Slant in the present experiment was conveyed by the overall shape of the stimuli, while Eby and Braunstein's slant was largely conveyed by texture gradient. The evidence regarding the relative importance of texture gradient and overall shape is not easy to interpret, in part because these properties are difficult to disentangle in many studies (Sedgwick 1986). Nonetheless, studies in which surface texture is added to overall shape to cue depth show that perceived slant is little greater than when no texture is present (Clark et al 1956a; Epstein 1962).

In addition to these differences in pictorial information between the two studies, two differences in methodology may be noted. First, Eby and Braunstein employed a repeated-measures design in which each observer viewed both with and without the frame. This may entail some carry-over between frame and no-frame judgments which would diminish no-frame judgments; however, Braunstein (personal communication) reports that there was no evidence of any order effect in their study. Second, Eby and Braunstein employed two procedures which probably entailed memory for the perceived orientation or shape of the surface: both procedures involved matching to a comparison stimulus displaced from the experimental stimulus. As noted in the introduction, experimental load imposed by the chosen procedure affects the specific-distance and equidistance tendencies (Foley 1977; Reinhardt-Rutland 1995b).

3 Experiment 2

The three possible conceptualisations of the framing effect considered in the introduction—in terms of pictorial perception, assimilation, and a general frontal-plane tendency—suggest predictions regarding a slanted frame. Pictorial perception implies that perception of the surface tends to the same orientation as the frame; if a framed picture of the surface is viewed at a slant, the surface should appear to have the frame's slant.

Assimilation entails the same prediction: at a global level, perception of the surface orientation is assimilated to the frame orientation, whatever the frame orientation might be. In addition—at the level of the retinal image—assimilation might affect the discrepant visual orientation of the top edge of the experimental surface in relation to the visual orientation of the top of the frame. This latter possibility is supported by Eby and Braunstein's study, since the framing effect was stronger for their surface pattern of horizontal stripes, than for their surface pattern of vertical stripes. As in the present study, Eby and Braunstein's experimental surfaces were slanted about a vertical axis and the frame was rectangular and in a frontal plane; the horizontal stripes conveyed linear perspective, so they were not visually aligned with the horizontal edges of the frame.

The frontal-plane tendency, which argues that the frame provides distracting information which increases experimental demands, suggests a different prediction. It is plausible that the frame will be equally distracting no matter what its orientation: the framing effect should not be influenced by the frame orientation, so the perceived slant of the experimental surface should be reduced no matter what the frame orientation.

To examine these predictions, experiment 2 was designed to examine the influence of the rectangular-frame orientation on the framing effect. Also, to indicate if assimilation might be operating on the visual orientation of the top edge of the surface, a frontal trapezoidal frame was included.

3.1 *Method*

The procedure generally followed that of experiment 1. The three experimental surfaces from experiment 1 were employed, along with an additional stimulus, p0a0, which was the rectangular surface with a frontal orientation. Observers were thirty-six female and male undergraduates aged 18 to 20 years, all reporting normal, uncorrected vision. All were psychophysically inexperienced and unaware of the purpose of the study.

Each observer viewed the experimental surfaces in a random order in one of three frame conditions. In the first condition, the frame was frontal and rectangular, as in experiment 1 (figures 1c, 1d, and 2). In the second condition, the rectangular frame was at 30° to the frontal plane; the left edge of the frame was 0.2 m ahead of the left edge of the experimental stimulus. In the third condition, a trapezoidal frame was presented in the frontal plane. To match visually the dimensions of the rectangular frame at 30°, the horizontal extent of the trapezoidal frame was 267 mm and the height of its right-hand edge was 186 mm. The width of the frame decreased from 40 mm to 34 mm from left to right. As with the rectangular-frame conditions, the left edge of the frame was 0.2 m ahead of the left edge of the experimental stimulus. Visually, the horizontal extents of the slanted rectangular frame and the frontal trapezoidal frame subtended 19.0 deg, while their right-hand edges subtended 13.1 deg; the width of frame subtended from 2.9 deg (left edge) to 2.4 deg (right edge) (see figures 1e and 1f).

3.2 *Results and discussion*

The results from each frame condition, shown in figure 4, are broadly similar. Judgments of experimental surface p0a0 were near-veridical with little if any evidence that the slanted and trapezoidal frames elicited a perception of slant. The actual slant of p0a30 was much underestimated; again there is little if any evidence that perceived slant was increased by the slanted and trapezoidal frames. The pictorial slant of p30a0 weakly determined estimates with all frames—in contrast to the no-frame results of experiment 1; there was little if any evidence that perceived slant was increased by the slanted and trapezoidal frames. The slant of p30a30 was slightly less than veridical when viewing through the frontal rectangular frame and the trapezoidal frame; estimates with the slanted rectangular frame were marginally higher. However, all estimates for p30a30 were lower than in the no-frame condition of experiment 1.

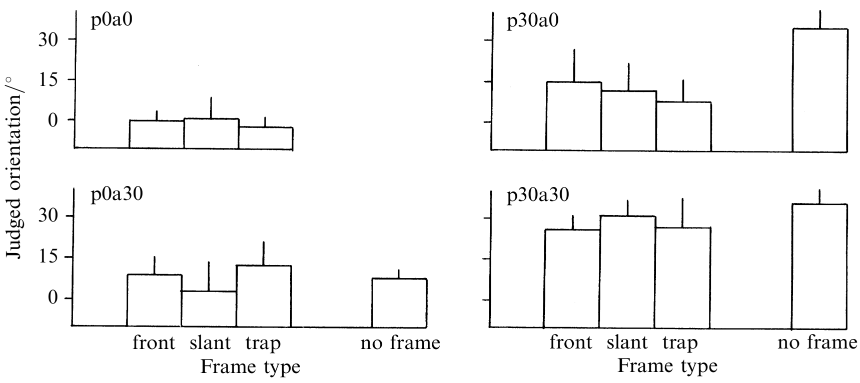

Figure 4. Means and standard errors of judged orientations relative to the frontal plane in experiment 2. Graphs are for p0a0 and p0a30 (left), and p30a0 and p30a30 (right). The frontal rectangular frame is indicated by "front"; the slanted rectangular frame is indicated by "slant"; the frontal trapezoidal frame is indicated by "trap". To assist comparison, the results of experiment 1 for viewing without the frame—'no frame'—are shown to the right.

A three-way analysis-of-variance revealed that there were significant differences between the pictorial orientations of experimental surfaces ($F_{1,33} = 11.52$, $p < 0.01$), between the actual orientations of experimental surfaces ($F_{1,33} = 7.15$, $p = 0.012$), but not between frame conditions ($F_{2,33} = 0.22$). No interaction was significant.

It can be concluded that the framing effect is little if at all influenced by the frame orientation, whether actual or pictorial. This suggests that the framing effect cannot be explained in terms of pictorial perception and either version of assimilation. Rather, the results are consistent with the frontal-plane tendency.

4 Experiment 3

As in the present experiments 1 and 2, Eby and Braunstein (1995) employed static-monocular viewing. It is possible that the framing effect is diminished during more informative viewing. This would be consistent with a link between the framing effect and the specific-distance and equidistance tendencies: the two latter phenomena are known to be strongest in the most restricted viewing conditions (Foley 1977; Gogel 1956; Reinhardt-Rutland 1996a, 1996b). In the present experiment, observers viewed monocularly while making side-to-side head motions of 30 cm extent to introduce the depth cue of motion parallax. Previous evidence from rectangular and trapezoidal surfaces shows that perceived orientation-in-depth is broadly determined by actual orientation-in-depth under these moving-monocular viewing conditions (Reinhardt-Rutland 1993, 1995a); unlike experiment 1, framing effects—if they exist—might be restricted to the actually slanted surfaces (p0a30 and p30a30).

4.1 *Methods*

Methods mostly followed those of experiment 1. A similar group of forty-eight observers viewed the same three experimental surfaces; for half the observers the rectangular frontal frame was present and for half the observers there was no frame.

The main difference from experiment 1 was that two small blocks were mounted on the horizontal strip of wood under the observer's chin to determine the 30 cm extent of head motion during monocular viewing. The observer moved the head from side to side with chin skimming the horizontal strip to the fullest extent within the blocks, at any rate that he/she thought might maximise veridical responding. The observer was encouraged to take time in responding. Previous instructions (eg Hell 1978; Hell and Freeman 1977; Reinhardt-Rutland 1993) have been similar; Hell and Freeman showed that the rate of lateral head motion above extremely slow values does not affect depth judgments.

4.2 *Results and discussion*

The results are shown in figure 5. For both trapezoidal stimuli, orientation judgments were close to veridical with no frame present: pictorial information had little effect (Reinhardt-Rutland 1993). The effect of the frame was minimal for p30a0, presumably reflecting the near-zero slant judgments without the frame. However, the effect of the frame was also minimal for p30a30. The only stimulus for which appreciable reduction in slant judgment was elicited with the frame present was p0a30: the reduction was about 30%. An important point is that p0a30 conveyed competing information for orientation—in this case, monocular and motion information competed with pictorial information—and was perceived as strongly slanted when no frame was present; the same applied to p30a0 in experiment 1, for which the framing effect was the greatest.

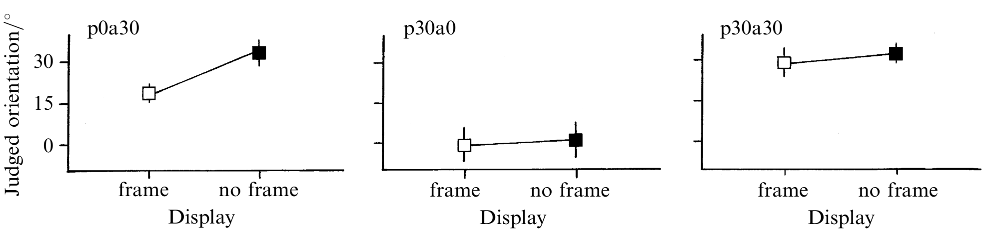

Figure 5. Means and standard errors of judged orientations relative to the frontal plane in experiment 3. From the left, graphs are for p0a30, p30a0, and p30a30.

A two-way analysis-of-variance reveals a significant difference between the experimental surfaces ($F_{2,92} = 17.36$, $p < 0.01$). No other main effect or interaction was significant. However, extracting the data for experimental surface p0a30 and subjecting them to an unprotected t-test shows a significant difference between no-frame and frame conditions for p0a30 ($t_{46} = 2.18$, $p = 0.034$, two-tailed). It can be concluded that the framing effect is much diminished during moving-monocular viewing, but that the stimulus conditions in which it is elicited are consistent with the results of experiment 1: a surface perceived as strongly slanted with no frame, and conveying competing depth information.

A further comparison can be made, this time with results from Reinhardt-Rutland (1995a). Viewed against a grid of stripes located behind the surfaces, slant estimates of a slanted rectangular surface and actually-frontal and actually-slanted trapezoidal surfaces *increased*. The results were explained by contrast based on motion parallax (Graham and Rogers 1982) and by pictorial complexity (see Gehringer and Engel 1986). A frame is not the only display factor that can influence slant perception during moving-monocular viewing.

5 General discussion and conclusions

To summarise the outcomes, experiment 1 showed that framing can diminish the perceived slants of rectangular and trapezoidal surfaces. A large framing effect—about 70% in magnitude—can apply to a surface perceived as slanted but conveying competing information for orientation. A smaller framing effect—about 20%—was reported for a surface conveying both actual and pictorial slant: the size of the latter was consistent with Eby and Braunstein's (1995) results for a surface conveying both actual and pictorial slant. In experiment 2 the orientation of a rectangular frame was facing or slanted, and a trapezoidal frontal frame conveyed pictorial slant; the different frame conditions had little or no effect on the results. Experiment 3 showed a diminished framing effect when the viewing condition was made more informative by the observer making side-to-side head movements. The only appreciable framing effect during head movement—about 30%—was with a surface perceived as strongly slanted without the frame but conveying competing information for orientation; this is consistent with the larger framing effect in experiment 1 and confirms that competition in depth information is an important contributory factor to the magnitude of the framing effect.

The results have implications for the explanation of the framing effect. Two explanations can be excluded. The results of experiment 2 were not consistent with assimilation, whether based on the whole surface or on the top edge of the surface. Assimilation suggests that the perceived orientation of the surface should tend towards the frame orientation: there was little if any evidence of this when the frame was actually or pictorially slanted.

Likewise, the results of experiment 2 argue against Eby and Braunstein's suggestion that the presence of a frame makes the display picture-like: the three-dimensionality of the experimental stimulus is reduced because the frame prompts the observer to interpret the whole display as two-dimensional. If the frame is slanted, then the pictorial hypothesis suggests that the surface should also appear slanted, to be perceived as within the picture. The pictorial hypothesis would need to be elaborated to overcome this problem. One possible component in this elaboration might refer to Cutting's (1987) observation that perception of a film viewed from a side seat at the front of a cinema is not explained by reference to optical considerations alone: the direction of gaze is far from perpendicular to the orientation of the screen, but moving objects in the film do not appear grossly distorted as they move. Nonetheless, there are obvious differences between Cutting's research and the research with the framing effect. If nothing else, the latter does not entail moving objects. Also, Cutting's observations apply to mainly unrestricted viewing conditions; the framing effect is most prominent in restricted viewing conditions, as a comparison between the present experiments 1 and 3 shows. At present, the pictorial hypothesis remains unsupported.

That the framing effect elicits results that compare with those of the equidistance and specific-distance tendencies (Foley 1977; Gogel 1956, 1965, 1969; Reinhardt-Rutland 1996a, 1996b) argues that the various phenomena are related—a general frontal-plane tendency can be invoked. The various phenomena can be understood as reflecting the high experimental demands in depth perception entailed by impoverished scene and viewing conditions, by competition in depth information, and by choice of procedure. Impoverished viewing conditions and competition in depth information are pertinent to the present experiments. The equidistance and specific-distance tendencies are at their most potent when viewing is stationary-monocular; like the framing effect in the present experiment 3, the equidistance and specific-distance tendencies are weakened by more informative viewing conditions (Foley 1977; Gogel 1956; Reinhardt-Rutland 1996a, 1996b). The equidistance tendency is also at its most potent when pictorial depth information competes with actual depth, as is demonstrated in judging the separation-in-depth of discrete objects in which the pictorial depth cue of visual size is manipulated (Eriksson 1972); this is consistent with each of the present experiments. At present, therefore, the framing effect is best understood in terms of the proposed frontal-plane tendency in depth perception.

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