Log of Meeting

Subject: Escalator Information Systems

Date of Meeting: October 21,1997. 2pm-3pm

Place: U. S. Consumer Product Safety Commission, 4330 East West Highway, Bethesda, MD 20814, Room 410A,

Log Entry Source: Scott Snyder, ESME (x1317)

Date of Entry: October 27, 1997

Commission Attendees: See Attendance List

Non-Commission Attendees: See Attendance List

Summary of Meeting:

The meeting commenced at 2:00 pm. The attendees were asked to introduce themselves.

Terry Viccars explained that his company's name was Escalator Information Systems.

Andy Stadnik discussed the U.S. petition process, and explained that anyone can petition a U.S. Federal Agency. Scott Snyder described that he had been attending ASME A17 meetings. Debbie Tinsworth explained that the U.S. CPSC had become involved in escalator safety as the result of a petition to make escalators safer.

Terry Viccars began the presentation by stating that he did not wish to discuss the injury issues. Then he and Keith Sutton presented information and several studies (see attached) about their EIS System™. They also answered several questions about their product.

The meeting ended at approximately 3:00 pm.

U.S. CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, D.C. 20207

October 21, 1997

List of Meeting Attendees

	Company/Name	Phone Number
(1)	Scott Snyder - CPSC	301-504-0494 X1317
(2)	Debbie Tinsworth CPSC	301-504-0470, X1276
(3)	Bill Rowe	301-504-0470 X1271
(4)	MARCIA RUBINS	301 504-0962 x 1324
(5)	Sandy Inkster CPSC-Health Sci	301 504-0994 x 1198
(6)	Andrew Stadnik CPSC-ES	301 504-0504 x1290
(7)	LAURA WASHBURN CPSC-CRM	301-504-0400 X1452
(8)	Keith Sutton Sutton Mfg Co Ltd	011.64.4.473.3386
(9)	Terry Viccars Escalator Info Systems	011.64.9.3005384
(10)	Tim Smith	301-504-0468 x1283
(11)	JEAN SMITH - SCHINDLER ELEVATOR	201-397-6231
(12)	NICK MARCHICA CPSC-ES	301-504-0494 X-1415
(13)		
(14)		
(15)		
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ESCALATOR INFORMATION SYSTEMS

IMPROVING PASSENGER SAFETY

Escalator Information Systems has conducted extensive research into the impact of the EIS System™ on the public and its ability to improve passenger safety.

Studies have been carried out at various North American locations by respected independent bodies such as The Behavioural Team of Toronto, Canada and Airport Interviewing and Research of White Plains, New York to determine answers to questions such as:

- Do passengers actually notice step messages when riding escalators
- Is the step messaging still effective in busy environments such as airports
- To what extent do riders recall the EIS System™ safety messages mounted on the risers of escalators steps compared with the existing code safety notice attached to escalator balustrades
- Can messages be recalled freely without prompting by researchers
- Are the public favourable to this method of displaying messages
- Is there a positive change in passenger behavior when the EIS System™ safety messages are installed
- Does the introduction of signage into the escalator step riser itself present any safety hazard to passengers
- Does passenger awareness increase with repeated exposure to the product

Full copies of all studies conducted so far are available upon request. A summary of highlights from the results of each study follows.

Study - **Effectiveness of Escalator Riser Signs for commercial and Safety Messages**

Location - **L. B. Pearson International Airport, Toronto, Canada**

onducted by - **Ben Barkow, Ph. D. Behavioural Team**

During the three study phases the highest passenger free-recall rate for the mandatory code escalator safety notices located at escalator entry points was 4% and the highest passenger free-recall rate for any stationary sign in close proximity to the escalator was 7%.

The highest passenger free-recall rate for EIS System™ safety messages was 48% rising to 80% when prompted by a researcher.

A very favorable response was received to the question 'Did passengers think EIS safety messages were a good way or poor way to convey safety information to the public'. Positive rates ranging from 63% to 87% were recorded for the three separate phases of the study.

People gave the following reasons for their favorable response to EIS safety messages:

- 'The messages are at eye level'
- 'You have to look down and watch your feet when getting on'
- 'Gets attention, animated'
- 'The more information provided, the more good it can do'

In the 'Conclusions' section of his report Ben Barkow writes:

.n the public's best interest, the most gratifying results of the test were the recall numbers achieved by the escalator safety warning messages. The greatest increases in unaided to aided recall rates occur with safety messages, signifying that once reminded, riders are now more aware of escalator safety'.....

'Add to this the noted change for the better in rider behaviour, ie. an 18% reduction in baggage cart usage on the escalator and a 22% reduction in persons at risk on the escalator by not holding the handrail, it can be concluded that escalator step messages are an effective means to modifying rider behaviour for the better'.

Study - **Accidents and Proto-Accidents following Installation of the EIS System™ at a MARTA Station**

Location - **Peachtree Subway Station, Atlanta, USA**

Conducted by - **Behavioural Team**

- 'The MARTA escalator, which showed minimal safety mishaps before installation (of the EIS System™), showed no change after'.
- 'A number of individuals with visual or motor impairments were observed using the escalator after modification. No problems were observed'
- 'Given the representativeness of conditions of observations, the number of events noted, it is concluded that there has been no increase in accidents on this installation'

In the 'Conclusions' section of his report Ben Barkow writes:

'It can be readily observed on the videotape that some riders appear to be looking at the messages and that the length of their fixation suggests they are taking time to read the message'.

Study - **Impact of EIS Safety and Commercial Messages**

ocation - **Dallas/Fort Worth International Airport, Texas**

Conducted by - **Airport Interviewing and Research**

- 'Messages delivered by the EIS System™ have an immediate and high impact on air travelers and airport users'.
- 'Prior to the escalator being modified by EIS only 6% of users identified the mandatory safety messages located on the escalator balustrade'.
- 'After modification, the safety messages delivered by the EIS System™ provide strong impact awareness. 51% of users recalled one or more safety messages - a very significant increase'.
- 'Safety messages delivered by the EIS System™ are very well received by the public. 65% thought they were excellent or very good'.
- 'Messages did not detract from the attractiveness of the escalators'.
- 'This unique method of signage has high impact and strong recall value'.

Optical Research and the EIS System™

Escalator Information Systems introduced the EIS System™ to Professor Theodore Cohn of the School of Optometry at the University of California. Professor Cohn has published a number of papers on what he has termed the 'Wallpaper Illusion', a phenomena believed to cause disorientation and falls on escalators. Professor Cohn, who estimates that the 'Wallpaper Illusion' is responsible for an average of 2 falls per escalator per year, is of the opinion that the EIS System™ has the potential to 'break up' the effect by allowing passengers to clearly identify the profile of each step.

Professor Cohn writes:

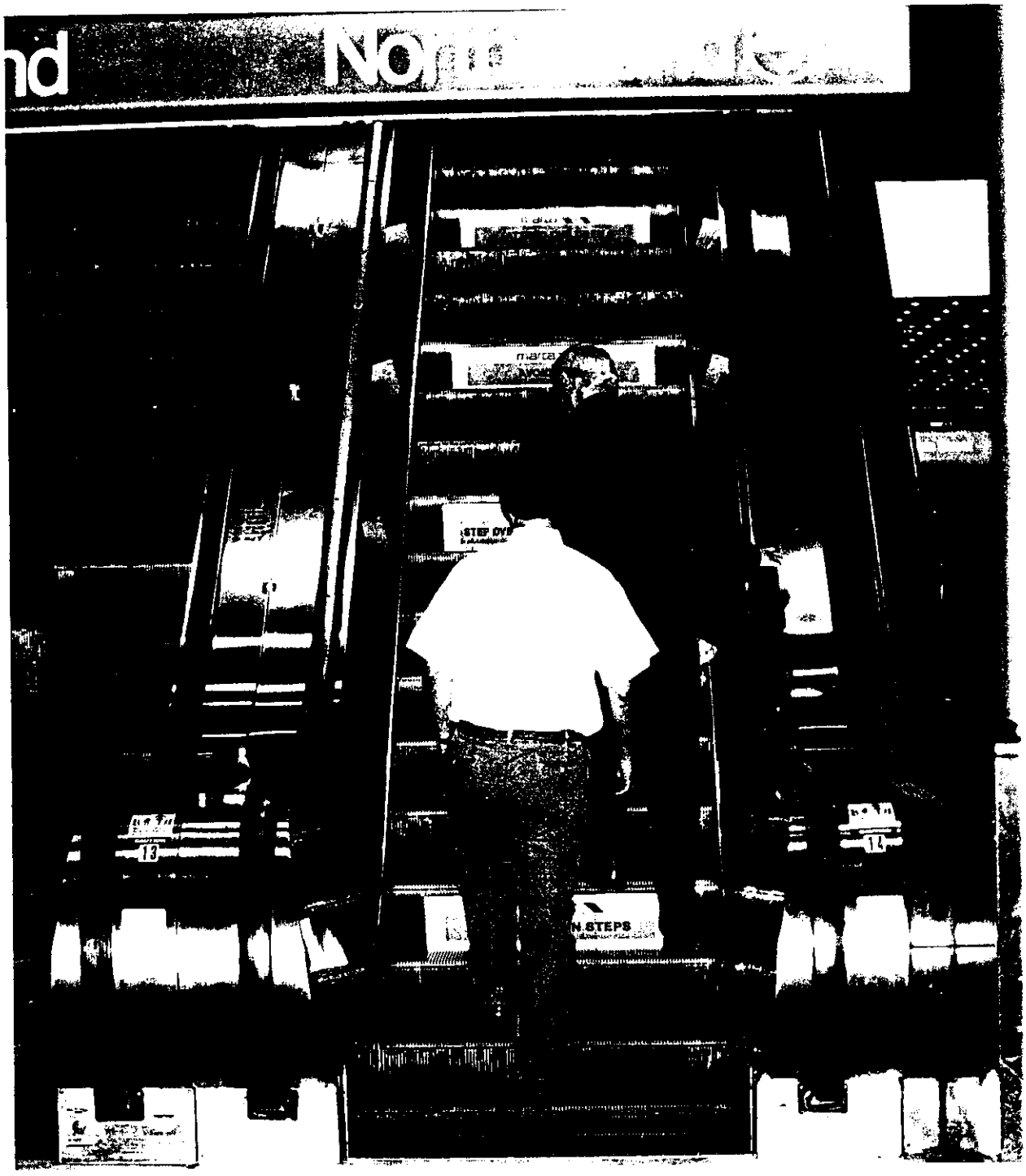
'I was fascinated to read of your progress in improving escalator step risers. The economic advantage to users in retrofitting your device ..... seems very clear. You may appreciate then that your invention may potentially have another advantage. It may actually interrupt the chain of events that leads to some falls on escalators.

I would like to elaborate on that idea.

The 'wallpaper illusion' arises when physically periodic structures (such as the step riser or the tread itself) are seen by a binocularly normal individual. Because of the periodic structure, adjacent or even separated similar points on the target can be mistakenly fused ('false fusion') by the binocular coordinature apparatus. The result is a visual illusion that misinforms the viewer as to the location of the target. A subset of the normal population cites disorientation as a manifestation of this illusion. But worse can happen. If the target is a step riser and if the viewer is using distance to gauge his or her own vertical orientation in space, a fall may be precipitated by such an illusion.

Your invention, brought about for quite different purposes, might actually interfere with the illusion and thereby prevent falls'.

Theodore E Cohn PhD, Professor of Vision Science, School of Optometry, Berkeley, California



Metropolitan Atlanta Rapid Transit Authority, Atlanta, Georgia

Safety Messages every third step

INSTALLED: FEBRUARY 1994

O'Hare International Airport, Chicago , Illinois

Safety Messages every fourth step

INSTALLED: JULY1995

Dallas / Fort Worth International Airport, Dallas, Texas

Advertising Signage with Safety Messages every sixth step

INSTALLED: MAY 1995

Dallas / Forth Worth International Airport, Dallas, Texas

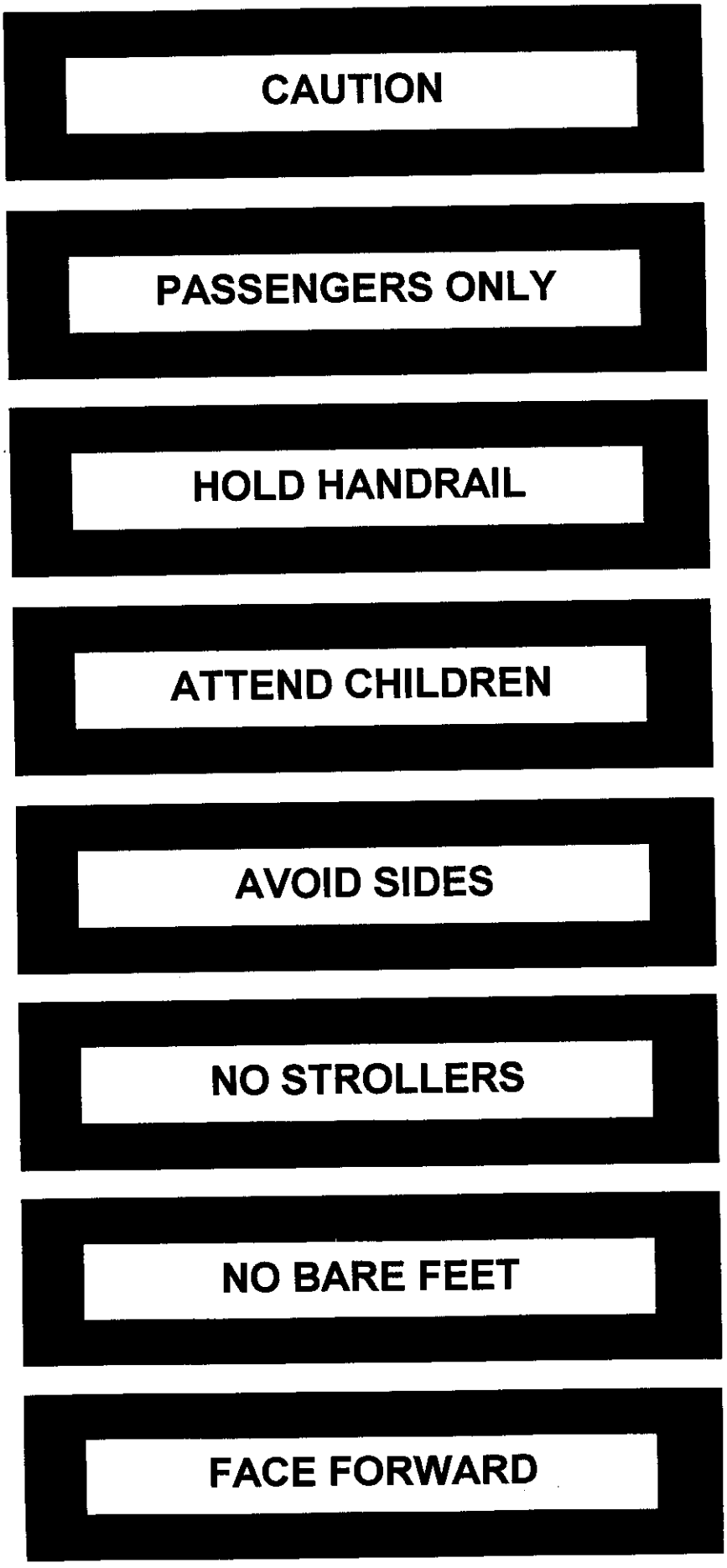
Advertising Signage with Safety Messages every sixth step (blank steps for emphasis) INSTALLED: MAY 1995

Dallas / Forth Worth International Airport, Dallas, Texas

Advertising Signage with Safety Messages every sixth step

INSTALLED: MAY 1995

SAFETY SIGNAGE AVAILABILITY



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VISUAL DETECTION LABORATORY

SCHOOL OF OPTOMETRY
BERKELEY, CALIFORNIA 94720

November 10, 1993

18 NOV 1993

Mr. Terry Vicars
Escalator Information Systems
Level 17, Bank of New Zealand Tower
125 Queen Street
P.O. Box 3683
Auckland, New Zealand 1001

Dear Mr. Vicars:

I was fascinated to read of your progress in improving escalator step risers. The economic advantage to users of retrofitting your device, whether to display advertising or safety messages, seems very clear. I gather that Jack Fruin has mentioned my research related to the wallpaper illusion. You may appreciate then that your invention may potentially have another advantage. It may actually interrupt the chain of events that leads to some falls on escalators. I would like to elaborate that idea, as it bears on my reply to your generous offer to provide an assignment.

The wallpaper illusion arises when physically periodic structures (such as the step riser or the tread itself) are seen by a binocularly normal individual. Because of the periodic structure, adjacent or even separated similar points on the target can be mistakenly fused ("false fusion") by the binocular coordinative apparatus. The result is a visual illusion that misinforms the viewer as to the location in space of the target. A subset of the normal population cites disorientation as a manifestation of this illusion. But worse can happen. If the target is a step riser and if the viewer is using its distance to gauge his or her own vertical orientation in space, a fall may be precipitated by such an illusion. One might quite reasonably ask whether your invention, brought about for quite different purposes, might actually interfere with the illusion and thereby prevent falls.

Another issue is relevant here. Your documentation leads one to assume that only risers have been the focus of your work. An important question is whether you are also at work on a comparable retrofitted tread. Of course the tread will become soiled more easily than the riser, but the tread is seen as much or more. On downgoing machines, risers are not seen by riders.

My research, which is recapitulated in the enclosed reprints, examined three related issues, all pertinent to treads only. First, we asked whether the wallpaper illusion might gives rise to visual disorientation. Our results are consistent with that idea, for treads. We did not test risers. Second, we asked whether it would be possible by some strategy to modify the look of the tread and so reduce disorientation. We have been successful at that and have developed a prescription for adopting other tread marking strategies. Finally, we have measured postural instability and have been able to show that tread marking can lower instability. We have not studied falls except insofar as we have categorized them. A sizable fraction of escalator falls

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can be attributed to a disorientation-like scenario, based upon victim's reports. Of these, some may be attributable to viewing an escalator tread. Some might also occur due to viewing the riser. The relative amounts of each can only be speculated on at this time. However, it is interesting to note that the incidence of falls on upward moving escalators exceeds that for downward moving machines. (This is not the case for stairs). Hence, there is some evidence for a potential role of escalator risers in inducing falls.

There are a number of assignments that I would consider. They are listed in order of complexity. Generally, one would not move to an elaborate study unless results from an earlier study warranted taking the next step.

1) Examine an implementation of your invention so as to estimate its likely impact on disorientation as might arise from step risers. Such a study would involve some photometric measurements on your product (for which a sample from you would be required) and would attack the question of whether it might reasonably be expected that the invention would have a beneficial effect as regards visual disorientation. Color would be considered. This project would have a duration of about 1 month and cost about $4,500 if conducted as a grant to the University of California.

2) Study visual disorientation with plain and marked risers for normally-sighted individuals. This study would involve a laboratory examination of a sample of normally-sighted persons. Subjective disorientation would be estimated with both marked and unmarked risers using techniques developed for earlier studies (e.g. Perception article). The study would answer the question as to whether marking, as supplied in your invention, lessens disorientation. Color alternatives can be examined experimentally. One hazard here for you is that the number of color choices is virtually limitless. On the other hand, if color does make a difference it should be possible to gain a first order idea of directions to pursue with a minimum of testing. This project would require about two months and cost about $15,000.

3) Postural instability and a marked riser. This study would examine postural instability while observers viewed both marked and unmarked risers in a laboratory setting. The study would answer the question of whether the marking system specified by your invention beneficially affects postural stability. Color can be incorporated as a separate independent variable here if desired. This project would require the purchase or lease of a postural stability measuring apparatus. The project would require about three months time and cost about $22,000 plus cost of postural sway equipment.

3a) This study repeats (3) in the field. It thus requires an escalator facility with an without your system installed. If you plan an installation at some future point one would be tempted to test before and after so as to minimize extraneous influences. The cost would be the same as for (3).

4) Basic studies of superimposed patterns. This study would supply basic information related to a question that is central to applied issues that are of more direct interest to you. The question is this. If two patterns are superimposed, (in your case the two patterns are the cleat structure of the riser and the advertising or messaging insert) how much influence does each exert over the incidence of "false fusion". What does it take to defeat false fusion? Such questions would be attacked in the laboratory using images displayed on a high resolution video monitor and human observers whose binocular eye positions were monitored. Then an objective endpoint could be used as a proxy for subjective disorientation and for the more difficult to measure postural instability. Color issues could be attacked in such a setting. At this time it is difficult to estimate the cost of such a study.

5) Escalator falls. This is the most ambitious and time consuming project. It requires identifying a sample of at least one dozen machines fully equipped with your invention plus a matched sample (matched on especially the distribution of ridership ages) of untreated machines. Accident statistics would have to be kept for as much as a year and accident reporting might have to be refined in advance so as to objectively record the pertinent details. Before/after monitoring would be a slightly inferior alternative to the matched controls. The question posed in this study is whether the invention lessens the incidence of falls. I cannot at this point predict whether it would or would not. The color issue could be examined in a subsequent study. A key factor is that only falls on upward bound machines could be affected by the marked risers. Marked treads would greatly extend the power of such a study to demonstrate an outcome should the effect exist. It may be appreciated that a positive finding would have important public health and safety implications. It will require some work to plan and estimate the cost of such a study. In any event it would not be prudent to consider such work unless and until the foregoing smaller projects yield results that are favorable.

You may be aware that transit properties, which are majors users of escalators, suffer their most significant economic losses on the escalators themselves. Rolling stock, station fires, muggings, and the myriad of other possibilities are far less numerous and far less costly.

You may select from amongst three different ways of arranging the assignment. You can engage me as a consultant, paying me directly for whatever work is done. I view this as the least desirable means because I would have no access to the University facility for subject testing, should you consider projects beyond the first. In addition the results would not ordinarily be published. A second choice is to supply a gift to the University earmarked for my research in this area. This is the most convenient approach for me, but it has the disadvantage for you of not supplying you any means of control over the questions that I choose to study. The final choice would be for you to respond to a grant application, written by me and formally transmitted by the University, describing in whatever detail you seek, the research, the approach and the cost and schedule. This affords you maximum control over direction. It would be however, the most expensive, because the University imposes an overhead charge of just under 50% of the direct costs of conducting the research.

I would be most pleased to discuss these possibilities with you further. If you find an agreeable way of granting an assignment, I would be enthusiastic to begin work as early as April of next year. In addition, I would propose to involve my colleague, Dr. David Lasley. You will note that he co-authored several of the relevant publications. He also brings a special expertise to the situation having served as an expert witness in a successful liability case related to an escalator fall likely to have been caused by disorientation. Please let me hear of your perspective on these possibilities.

Sincerely yours,

Theodore E. Cohn, Ph.D.
Professor of Vision Science

Perception, 1990, volume 19, pages 573-580

Wallpaper illusion: cause of disorientation and falls on escalators

Theodore E Cohn, David J Lasley
School of Optometry, University of California, Berkeley, CA 94720, USA
Received 29 March 1988, in revised form 3 April 1990

Abstract. The wallpaper illusion, first described over a century ago, can occur when a person with normal binocular vision views a pattern that is periodic in the horizontal meridian of the visual field. Escalator treads present such a pattern. Evidence is presented favoring the view that disorientation experienced by escalator riders is caused by this illusion. Possibly some of the estimated 60 000 escalator falls occurring in the United States each year are linked to it.

1 Introduction

Stairs, elevators, and escalators are the most common ways in which people travel vertically. Escalators are unique in that they all provide essentially the same visual stimulus to the human observer. Consider the visual stimuli available to an escalator rider poised to board the machine from the top. Ahead and down are the treads. To each side of these are the featureless buffed stainless steel skirts. The tread surface is marked by alternating cleats and grooves, each about 3 mm wide. Usually, though not always, the grooves are painted black at the time of manufacture. The cleats are initially polished and retain a bright appearance due to continuous abrasion from users' footwear. We have made measurements showing that this stimulus is approximately a triangle-wave grating.[1] If the rider is looking at nearby treads and is of average height, the grating has a spatial frequency of about 6 cycles deg^{-1}, which has been shown (Campbell and Green 1965) to be the most visible spatial frequency in the fovea of the light-adapted eye. Contrast of a target is defined by the maximum deviation from average brightness. It is a parameter that strongly determines stimulus visibility (Stromeyer and Klein 1974). The contrast of this grating (about 0.98) is uncommonly high compared to the contrast of other targets most usually encountered in our environment. The escalator skirt with its far broader spectral content and far lower contrast can scarcely compete with the powerful visual stimulus provided by the escalator tread.

Now consider the conditions likely to lead to the 'wallpaper illusion', an illusion of depth described first by Helmholtz (1909/1962). It occurs when the two eyes adopt an angle of convergence that is inappropriate to the actual distance of the object but which, because of periodicity in the object, allows fusion to take place. The illusion is described as 'disorienting' (Blakemore 1970) and has been recorded for periodic stimuli other than wallpaper (Ittleson 1960). It would seem that the escalator tread[2],

[1] Luminance measurements were made with a Spectra Pritchard Photometer. Wear round the cleats tends to sharpen the reflectivity function away from a square wave, that might be expected on geometrical grounds, towards a sawtooth pattern. Luminance measurements reveal strong periodicity under a variety of commonly encountered lighting conditions.

[2] The periodic structure of the cleat-groove arrangement of the escalator tread is necessitated by the presence of comb plates at upper and lower thresholds, mandated by code A17.1-1981 [*Safety Code for Elevators and Escalators* 1981 (New York: American Society of Mechanical Engineers)]. Interdigitation of comb-plate and tread allows for smooth, safe transition from moving to stationary surfaces. These same considerations apply to the step riser of the escalator, to the surface of certain moving walkways, and to varieties of flooring that contain periodic patterns.

with its strong periodic nature, might give rise to the same illusion. Figure 1 illustrates this viewing situation. If the two eyes fixate a common point b then the images to both eyes will be fused. Under these conditions of viewing a normal percept should result because the angle of convergence of the eyes is appropriate to the distance of the object. If, on the other hand, the left eye fixates b and the right eye fixates b' there is fusion with an inappropriate angle of convergence. Under these conditions the object appears to lie in a plane passing through the point labelled a (Ittleson 1960). This latter perception competes with other cues that portray the correct distance of the object. The ambiguous sensation is probably what causes observers to report that such stimuli make them dizzy or disoriented.

The sensation of dizziness or disorientation on escalators has long been known. The cause has generally been ascribed either to movement of the machine or to viewing from a height although no evidence has been advanced in support of either possibility. A depth illusion has not heretofore been examined as a possible cause of disorientation on escalators. The purpose of this paper is to present evidence consistent with the hypothesis described above that disorientation on an escalator can be due to a visual depth illusion. We have concentrated on subjective reports of disorientation under different viewing conditions chosen either to support or to abolish the depth illusion. We find that the disorientation measured in this way is correlated with the depth illusion.

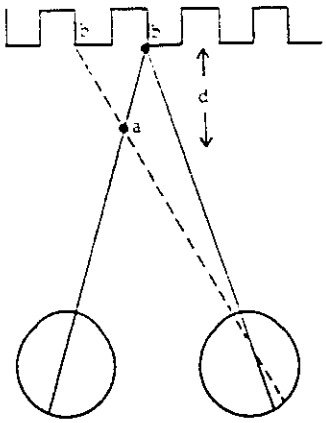

Figure 1. Schematic representation of eye misalignment on viewing a periodic target. If the observer fixates point b with both eyes, the angle between them is appropriate to the distance of the object from the observer. If the observer fuses adjacent similar features, such as the cleat corners shown at b and b', the eyes adopt the wrong angle of convergence for the distance of the object. In this case disparities of points on the object lead to a sensation that it is closer. For the viewing conditions cited in the text, the misalignment leads to a depth illusion of 6% error for each integral number of periods of misalignment. Thus, fusing cleats that are separated by one period of the pattern would lead to a depth error of 6%, by two periods to a 12% error, and so on.

2 Methods

In order to examine this illusion we chose to elicit subjective reports of disorientation while subjects looked at an escalator under the test viewing condition (binocular viewing, fixating the center of a tread about seven feet distant). Since other factors such as the escalator movement or its height could also lead to a report of disorientation, we designed control tests where two alternative viewing conditions were used, neither of which could support the wallpaper illusion but which controlled for movement and height, respectively. These were (i) monocular viewing and (ii) viewing

with the head tipped. Under monocular viewing (one eye occluded by the observer's hand) the depth illusion is abolished since the sensation of depth (stereopsis) requires two eyes. The second control condition, tipping the head about 45° towards the shoulder but viewing with two eyes, removes the periodic structure of the tread from the horizontal meridian at leading and trailing edges of the tread. This too should abolish the wallpaper illusion. If the wallpaper illusion causes disorientation, then we predict that subjects will report disorientation more often under the test condition of normal viewing than under the control conditions. If a report of disorientation is due to a factor other than the wallpaper illusion, no effect would be predicted because all three viewing conditions would be disorienting. Moreover, the judgement should be quite difficult.

2.1 *Subjects*

Observers included fifty-five students of optometry and eight employees of the Bay Area Rapid Transit District (BART). All were naive as to the purpose of the experiment. A binocular vision screening test was administered so as to exclude observers with clinically important binocular anomalies who would not be expected to experience a depth illusion. Phoria and tropia were subjectively assessed using a standard optometric clinical test (cover test). Observers who showed detectable tropias, as well as hyperophoria, were excluded. On this basis, four observers were excluded, leaving fifty-nine subjects. Subjects ranged in age from 21 to 36 years with a mean age of 25.4 years and a standard deviation of 3.2.

2.2 *Procedures*

Observers were allowed a brief view, under each of the three viewing conditions, of an empty down-moving escalator while standing on the stationary platform at the top of the machine. The three viewing conditions were presented always in this order: monocular, binocular (normal), and binocular with the head tipped. Each condition was employed for about 10 s. Observers were instructed to rank the viewing conditions from least to most disorienting (disorienting was not defined for participants). The ranks were assigned numerical labels from 1 to 3. Observers were also asked to categorize the judgement as 'easy' or 'difficult' to make (these terms were also left undefined). Reports from observers who categorized the task as easy were analyzed separately from those who found the task difficult. This was thought to have the effect of minimizing the influence of (i) observers who did not experience the illusion; (ii) observers who experienced disorientation under all viewing conditions, which might have been due to viewing height, stimulus movement, or other unknown factors; and (iii) observers who experienced no disorientation.

3 Results

The results of this experiment were consistent with the idea that the escalator does lead to a depth illusion like the wallpaper illusion and that this illusion is a cause of disorientation. For those subjects who found the task easy, we found a clear effect in the direction predicted and this is shown in table 1a. We also show the results for subjects who found the judgement difficult displayed separately. For subjects who found the task easy, binocular viewing was ranked most disorienting more often than it was ranked in the other two categories, and it was ranked more disorienting than were the other two viewing conditions. The association between viewing condition and disorientation rank is statistically significant ($\chi^2_4 = 15.9$, $p < 0.0025$). It appears that some individuals experience a depth illusion while viewing an escalator even if the stimulus is present for as little as 10 s. We found that when subjects who found the task difficult and those who found it easy were combined, the significance level for the disorientation effect rose to about $p < 0.10$. This does not necessarily mean

that subjects who found the task difficult were unable to experience the illusion and its potential disorienting effects: it may only mean that our measurement technique (which depended upon comparison of two other viewing conditions which in themselves may be disorienting to some subjects) lacked the sensitivity to detect the effect in many subjects. Or it may mean that height and/or movement, common features of all three viewing conditions, can also cause disorientation.

The data for those subjects who found the judgement easy were examined more closely by pairwise comparisons of viewing conditions. Normal binocular viewing is both more disorienting than monocular viewing ($\chi_1^2 = 4.28$, $p < 0.025$) and more disorienting than viewing with the head tipped ($\chi_1^2 = 5.57$, $p < 0.01$). These results also serve to reject, for those who report disorientation, two commonly advanced hypotheses of escalator disorientation cited above, namely that it may be due either to the movement of the machine or to viewing from a height. Since movement and height are constant features of the test, they cannot explain what makes normal binocular viewing seem the most disorienting of the three viewing conditions. On the other hand, these results do not exclude these other causes as contributory factors to feelings of disorientation. The perceptions of height and movement, which in this instance do not depend upon stereopsis, and which are largely a consequence of the monocular visual cues, are present in all three experimental conditions.

A second test, performed on the same observers a week after the first test, was designed to serve as an additional control for the first. This test was performed upon fifty-three of the fifty-five optometry students, but not the eight BART employees. We wanted to ensure that normal binocular vision was not intrinsically disorienting irrespective of what was being looked at. In this test many of the observers were required to render the same judgements as in the first test while looking down into a lecture hall from a height. The same three viewing conditions were employed. Table 2 displays only the results for binocular viewing of the lecture hall scene plus the comparable figures for viewing the escalator from table 1. It should be noted that for the data in this table subjects were not asked to compare the escalator scene with

Table 1. Number of observers assigning indicated disorientation rank to a given viewing condition, categorized into subjects who judged the task as easy and difficult.

Viewing condition	Disorientation rank			Disorientation rank		
	1 (least)	2	3 (most)	1 (least)	2	3 (most)
	Easy			*Difficult*		
Monocular	16	7	8	7	8	10
Binocular, tipped	7	17	7	11	6	10
Binocular, normal	8	7	16	8	12	6

Table 2. Number of observers assigning indicated disorientation rank to binocular viewing for the given scene who judged the task as easy and difficult.

Scene Viewed	Disorientation rank			Disorientation rank		
	1 (least)	2	3 (most)	1 (least)	2	3 (most)
	Easy			*Difficult*		
Escalator	8	7	16	8	12	6
Lecture hall	10	4	4	17	4	5

the lecture hall scene, but only to rank what they saw under the available viewing conditions. It is inferred that the escalator would have been judged distinctly more disorienting than the control scene when comparison was made from the two independent samples and the result is also significant ($\chi_1^2 = 8.00$, $p < 0.0025$). This table shows that simply viewing a scene from a height is unlikely to evoke a response of disorientation when the scene is viewed binocularly.

The subjects were also asked to retrospectively compare the lecture hall scene with the escalator scene. By comparing the two scenes when viewed binocularly, twenty-five of the observers found the escalator more disorienting than the lecture hall and three found the opposite (ten subjects found the two scenes equally disorienting and were excluded as 'ties'). This result (not displayed in a table) is also significant ($p < 0.001$, binomial test).

Observers who found the judgement difficult nonetheless exhibited more disorientation looking at the escalator than when looking at the lecture hall. Table 3 shows the results of comparing normal, binocular viewing ranks in the lecture hall and escalator scenes, separated by the criterion of judgement difficulty. The t-test[3] was applied to the algebraic difference between the binocular ratings for the two viewing conditions, and the correction for continuity was applied. While subjects who found the judgement easy produced larger differences in the two viewing conditions, a significant effect was found also in subjects who described the task as difficult.

Table 3. Statistical summary for results of comparisons in table 2.

Subjects	t-values with continuity correction		
	t-value	df	p-value
Subjects judging easy	3.27	21	0.005
Subjects judging difficult	2.58	26	0.02
All subjects	4.32	48	0.00001

3.1 *A test altering the stimulus configuration*

Since it is the periodic nature of the escalator tread plate that is capable of inducing the wallpaper visual illusion, we conducted a final test by comparing subjects' responses to the standard escalator and to an otherwise identical escalator which had been treated by painting a high contrast, black and white, nonperiodic pattern designed to disrupt the binocular illusion. For this test, a separate group of optometry students was recruited. Subjects viewed the bottom tread plate of nonmoving escalators, alternating the viewing conditions (binocular, monocular, and binocular with the head tipped) every 10 s. Subjects were asked to judge whether the treated escalator or the untreated escalator was more disorienting. The order of viewing (treated, untreated versus untreated, treated) was randomly chosen, along with the manner in which the judgement was obtained. Roughly half the subjects were asked which was 'less disorienting', while the other half were asked which was 'more disorienting', giving rise to a 2×2 contingency table. The results of this experiment are shown in table 4. As before, subjects who found the judgement 'difficult' were excluded. Table 4 shows that most subjects found that the untreated escalator was more disorienting than the treated escalator, and the results were significant ($p < 0.05$, χ_1^2 test). In addition, since the stimulus escalator was viewed from the

[3] The t-test was employed upon the comparison of ranks, following the recommendations of Snedecor and Cochran (1980). For large sample sizes ($N > 12$), the t-test gives tail probabilities very comparable to those provided by Fisher's randomization test, which is a nonparametric alternative.

bottom and was not moving, this test, unlike the first, establishes that reported disorientation can be due solely to the wallpaper illusion.

In a further effort to characterize the visual characteristics of those subjects who found the judgement easy and difficult, we examined the relationship between the disorientation ratings under binocular viewing and phorias. We reasoned that the existence of phoria might increase the likelihood of binocular dissociation and false fusion. Figure 2 shows the disorientation rating versus phoria, separated by task difficulty. Regressions, which were separately calculated, showed a slight though not significant negative correlation between disorientation rank and phoria, the correlation being most pronounced for subjects who found the judgement easy. These limited data suggest that phoria is a poor predictor for the wallpaper illusion.

In sum, the escalator is a disorienting visual stimulus, under conditions that favor the binocular depth, or wallpaper, illusion. The next point to be examined is the consequence this might have for untoward occurrences on escalators.

Table 4. Binary judgements of observers viewing treated and untreated stationary escalators from the bottom tread plate. Subjects in the first column identified the escalator (treated or untreated) that was 'least disorienting' while subjects in second column identified the escalator that was 'most disorienting'.

Viewing condition	Disorientation rank	
	'least'	'most'
Treated painted	8	1
Untreated unpainted	1	14

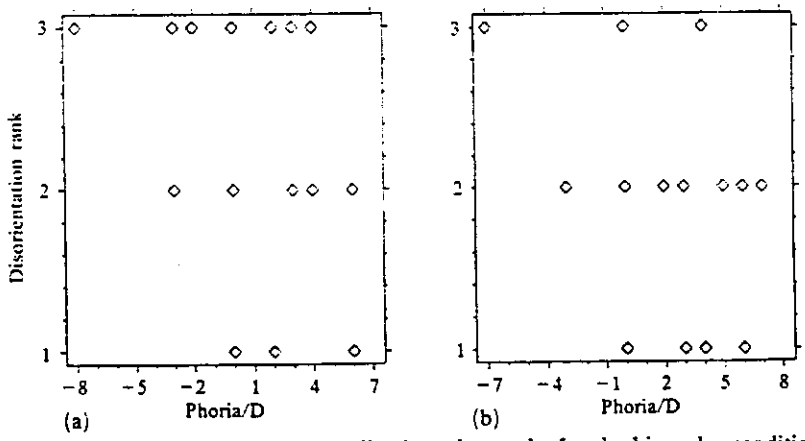

Figure 2. Plot of relation between disorientation ranks for the binocular condition of escalator viewing versus phoria. Phoria was estimated with the use of the cover test. Exophoric values were given negative signs. The panels show the relation for subjects who described the task as (a) easy, and (b) difficult. There was an almost significant association between phoria and rankings in subjects who found the task easy.

4 Discussion and policy implications

Escalator falls may be caused by the depth illusion. It is estimated that 8 out of 10000000 escalator rides result in a fall. For the Bay Area Rapid Transit District (which operates some 135 escalators) a recent two year accumulation of incidents reveals an average of two falls per year per machine that may be linked to disorientation. When that is extrapolated to a nationwide figure, the number becomes 60000

year^{-1} in the USA. Not all falls are debilitating, but as many as 10000 escalator incidents are estimated to lead to emergency room attention each year and the great majority of these are falls.[4]

4.1 *Proposed link between disorientation and falls*

By its nature a visual illusion is a private sensation that has external correlates. It is known that maintenance of one's normal posture is imperfect, exhibiting random variation (Dornan et al 1978). Moreover, the error in posture is greatly increased when the eyes are closed (Dornan et al 1978) indicating that posture depends upon the information available from the eyes. One could assume that the error might also increase in the presence of a depth illusion.

We have tested this idea both with laboratory and with field tests of postural stability and the results all tend to support the view that the escalator tread can worsen postural stability (Lasley et al 1991). Factors that would exacerbate such events would then be expected to worsen the risk of falls. Indeed, the elderly and individuals under the influence of alcohol may be more likely to be involved in escalator falls (Fruin et al 1978).

Disorientation, even without falls, may present a problem of public policy in its own right. The escalator is the most efficient level-change conveyance available (Strakosch 1967), and it thus plays a pivotal role in modern urban mass transit systems, for it is the principal means of entry and egress for such systems. Yet many individuals are afraid to use the escalator because of disorientation, and so disorientation may limit access to transit. Further study of disorientation, including means of preventing it, seems warranted.

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[4] Police and station agent reports were summarized and coded by BART safety staff and a summary listing was provided. Incidents were deemed falls if 'fall' was used as a descriptor. Disorientation was suspected if it or related words ('dizzy', 'lost balance') were used. Falls resulting from collision, interaction with other passengers, etc were excluded. The estimate of emergency room use came from the Consumer Product Safety Commission, National Injury Information Clearinghouse, "Elevator and escalator accident and injury report", 1970 - 1980.

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Postural Stability and Stereo-Ambiguity in Man-Designed Visual Environments

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***Abstract*—Our modern rectilinear visual environment contains visual stimuli for which evolution has not had time to optimally shape visual processing. One such stimulus, periodic stripes, is known to lead to visual depth ambiguity. In this paper we show that postural instability, as measured by the variance of fore and aft sway, is increased by viewing such stimuli. This instability may be the precursor of falls. Designers must evaluate the visual impressions conveyed by their systems in order to avoid postural instability due to visual ambiguity.**

I. Introduction

WE have been investigating effects of stereoambiguous visual stimuli, and in particular, of the stimulus provided by an escalator tread. In a prior paper [1] we showed that such stimuli cause subjective disorientation and we hypothesized that the cause lay in the "wallpaper illusion." We offered the conjecture that such disorientation is a manifestation of a chain of events that can, albeit rarely, culminate in a fall. Briefly, the stereoambiguous stimulus gives rise to false fusion, a stable but inappropriate angle of visual convergence. This leads both to disorientation and to postural instability, the latter possibly leading to a fall. The main focus in this paper is measurements of postural stability in the presence of a stereoambiguous stimulus. We show here, for the first time, the existence of several elements of the theoretical chain of events: a) inappropriate binocular convergence consistent with false fusion and the wallpaper illusion, b) heightened postural instability, and c) correlation between subjective disorientation and postural instability.

Background

Many take for granted that humans can stand upright on two legs with "correct posture." But the orientation of the human body with respect to gravity is an active skill involving years of learning and coordination of dozens of muscles, of our vestibular nervous system, and of our sense of sight [2]. As with other human skills, the standard of perfect posture is rarely, if ever, achieved. The residual minimum level of random activity is called postural sway [3], [4]. Under some circumstances postural sway can be increased to the point where we "lose our balance" and fall [5], [6].

Role of Vision in Postural Stability

Lee and Lishman [6] (and others [7], [8]) have demonstrated that posture can be manipulated in the laboratory by controlling the visual stimuli. They created a moveable room which could be viewed from a stationary platform. The observer was not informed that the room was suspended from above and could be controlled to swing or oscillate left-right with respect to his frame of reference, with chosen amplitudes and frequencies. Despite the constancy of the gravitational cues, the observer's postural center of gravity was observed to vary with the same frequency as the swinging room. As the amplitude of the sway of the swing was increased, the amplitude of the observer's postural sway increased to the level that subjects occasionally lost their balance. Clearly visual cues are afforded great importance in the maintenance of posture, and may even supercede the sensing of gravity [7].

Normally, as we move about the world, we need not worry about swinging rooms or other artificial manipulations of the visual environment. However, as visual patterns in our environment have become increasingly rectilinear (lines and edges), we have been confronted with visual stimuli that increase the demands upon our capacity for interpretation. The central question asked here is: can an interaction of the visual system with certain visual patterns modify our postural stability?

Visual Patterns and Stereo-Ambiguity

Visual space can be thought to have three dimensions: up-down, left-right, and fore-aft. It is in the latter dimension, mediated in part by the perception of depth (stereopsis), where ambiguities can potentially cause changes in postural stability.

In some cases, stereo-ambiguity arises with visual stimuli occurring in common everyday situations. One example of this is the "wallpaper" illusion. The "wallpaper" illusion was first described by Meyer [9] about a

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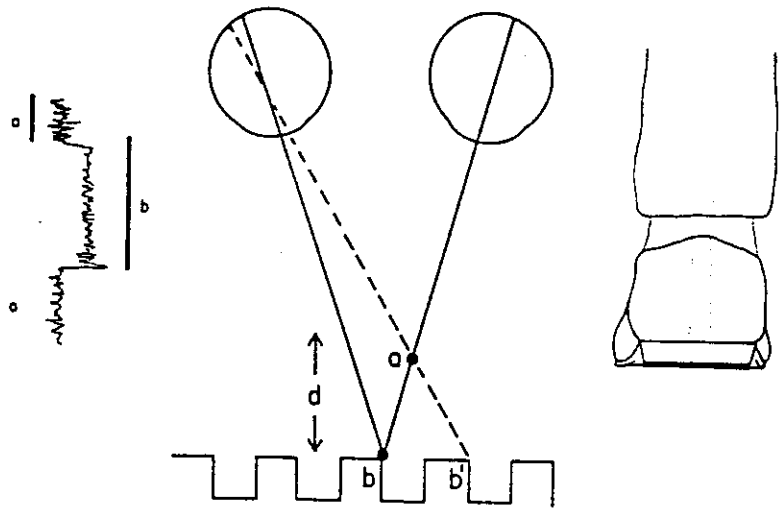

Fig. 1. Schematic representation of eye misalignment while viewing a periodic target. If the observer fixates point *b* with both eyes, the angle between them is appropriate to the distance of the object from the observer. If the observer fuses adjacent similar features, such as the cleat corners shown at *b* and *b'*, the eyes adopt the wrong angle of convergence for the distance of the object. This state is termed "false fusion." In this case, disparities of points on the object lead to a sensation that it is closer. Inset: binocular eyemovements of an observer viewing a striped pattern. The difference of the two eye position signals estimates the binocular convergence of the subject. The right-most deflection (*b*) shows a 4 s period during which the observer fixates a small fixation target at 2 m. Prior and following deflections (*a*) occurred when the fixation was removed to 1 m in front of the target plane and then entirely withdrawn. The subject could only see a large striped pattern during this time. His subjective report was of a wallpaper-like illusion. The stable difference signal indicates an inappropriate angle of convergence for the distance of the target.

century and a half ago. It occurs when a person with normal binocular vision views a pattern that is periodic in the horizontal meridian of the visual field. When viewing such a pattern, the two eyes may adopt an angle of convergence that is inappropriate to the actual distance of the object, but which, because of the periodicity of the object, allows fusion to take place. If this occurs, the object may appear to be substantially closer to (or farther from) the viewer than it really is, binocular and monocular depth cues are not in accord, and disorientation is commonly reported.

This is illustrated by the diagram in Fig. 1. If the two eyes fixate a common point *b*, then the images to both eyes will be fused in the brain into single unitary perceptual "image." Under these conditions a normal percept should result because the angle of convergence of the two eyes is appropriate to the distance of the object. If, on the other hand, the left eye fixates *b* and the right eye fixates *b'*, there is fusion with an inappropriate angle of convergence. This is termed "false fusion" [10]. The falsely fused object appears to lie in a plane passing through point *a* [10] which is closer to the eyes in this example. This latter perception competes with and sometimes dominates other visual cues to the actual distance of the object.

When there is a conflict in sensory information available from the different sensory modalities, disorientation can result. It seemed to us likely that such disorientation may be related to postural instability [1], [2], but so far a direct link has not been established.

Escalator as an Ambiguous Stereo Stimulus

False fusion engendered by wallpaper is not likely to be hazardous to the viewer. However, escalator tread plates also have the repeating periodic pattern intrinsic to the "wallpaper" illusion. The escalator is of considerable importance in this context since, unlike wallpaper, near which falls are relatively uncommon, it is an altitude-translating device encountered by most urban pedestrians, which is the site of thousands of debilitating falls annually [1].

The visual stimuli available to an escalator rider consist centrally of the moving surface, called the treads. These are flanked by featureless, reflective, buff-polished stainless steel skirts. The tread surface consists of alternating cleats and grooves about 1.5 and 5 mm wide, respectively. The cleats are usually highly polished while the grooves are painted black, giving the tread a luminance profile that is periodic [12]. For an observer of average height viewing the tread, this repeating pattern has a spatial frequency of about 6 cycles per degree of visual angle. This spatial frequency is very close to the peak spatial frequency of the contrast sensitivity function of the human visual system [11], [12]. The contrast of the tread is measured [12] to be about 0.995, which is higher than that of most other visual patterns in the visual environment, which typically measure far less than 0.90. Hence, the tread presents a highly visible visual pattern to the viewer.

The purpose of the present study is to establish some additional links among the various sensory and motor system behaviors discussed above. First it was necessary to establish that the stereo-ambiguity of repeating visual patterns causes observable inappropriate convergence, as described above, for this has not heretofore been shown. Second, we sought to establish whether the postural system is affected by visual stimuli that cause both inappropriate convergence and the associated "false fusion" both in the laboratory and in the field. Finally, we looked for evidence linking postural effects to the disorientation previously shown to occur with false fusion [1].

II. Methods

A. Eye Position Measurements of an Observer Viewing Stimuli with Stereo-Ambiguity

We first sought to establish objective evidence of inappropriate convergence during periods of erroneous depth perception, for without such evidence the theory linking stereoambiguous stimuli to falls would have no basis. Binocular eye movements of an observer viewing a vertically striped pattern were measured with a Stanford Research Institute (Model IV) Eyetracker. The Eyetracker monitors the position of reflected (Purkinje) images from the optical surfaces of the eye (cornea and the lens, front and back surfaces) formed from an infrared light source [13]. The image positions, which are converted into voltage signals, indicate the rotational angle of the two eyes. The difference of these is formed to give a signal proportional to the angle of binocular convergence of the subject. The voltage signals were sampled at a rate of 500 Hz (12 bit precision) and displayed on a chart recorder.

The subject was positioned in the Eyetracker by clamping the mouth around a bite bar fitted with dental impression compound. The target was a vertically striped 50° wide by 30° high black-on-white pattern, and was viewed at 2 m distance. Each period of the striped pattern subtended 0.25°. The luminance of the background was 10 cd/m^2 and the contrast of the striped pattern was about 90%.

The observer was instructed to fixate the end of a pointer, held alternately in the plane of the target or up to 1 m in front of it. In this way the subject was encouraged to alternately fixate the target plane or in front of it. He was asked to indicate when he experienced false fusion. Example eye movement recordings are shown in the inset of Fig. 1, which shows a voltage amplitude recording corresponding to difference of the two eyes' positions as function of time. The epochs labeled *a* occur when the subject was asked to fixate the pointer held briefly 1 m in front of the target plane after which the target was immediately removed. During *b* the two eyes accurately fixate the target. The entire sample lasts about eight seconds. Calibration of the voltage signal confirmed that the subject was fixating almost 1 m in front of the true objective plane that contained the striped pattern. In addition, verbal report indicated that false fusion, and the wallpaper illusion, occurred during that period. From this it may be inferred that inappropriate convergence of the eyes can be elicited from such repeating patterns, and the resulting sensory fusion is supportable by such repeating patterns.

B. Posturographic Measurements

1) Subjects: Nine subjects were selected from the University student population and ranged in age 20–30 years for the laboratory test. Three additional student subjects were utilized in the field test. All subjects had normal visual acuity and stereoacuity.

2) Visual Stimuli for the Laboratory Study: The visual stimuli were back-projected upon a translucent glass plate that subtended 40° × 60° using a Kodak Carousel projector. Lenses (subject's correction plus 2.5D) and prisms were placed before the eyes in a trial frame so that the subjects' eyes were at physiological rest (unconverged and unaccommodated, the visual state when viewing a target at optical infinity). The experimental pattern consisted of a high contrast set of vertical stripes of 1.23 cycles per deg, a pattern known to elicit the wallpaper illusion because of its periodic nature. The control pattern was identical to the experimental pattern, except for the addition of five superimposed black letter patterns whose presence was intended to prevent false fusion. In viewing the control pattern, misalignment of the superimposed letters in the two eyes would have given rise to diplopia [14], or double images, which would be readily perceivable by normal subjects. Each letter was approximately 17° square. The stimuli were viewed in a darkened room, and viewing distance was 40 cm.

3) Visual Stimuli for the Field Test: We used two otherwise identical escalators owned and maintained by the Bay Area Rapid Transit District (BART). The treads of one of these had been painted as follows: first, white paint was used to lower the cleat-groove contrast. Next, a black pattern consisting of nonperiodic elements including the BART logo at the center, was applied. During our tests, both escalators were unoccupied and stationary, and were viewed while standing on the sway transducer positioned on the bottom platform.

4) Postural Sway Measurement: The postural sway of each subject was transduced as follows: a 40 × 40 cm steel platform was supported by two orthogonal cantilevered steel torsion bars. Strain gauges mounted on these measured the deformations of the torsion bars as the subjects' center of gravity changed position. Signals were amplified and displayed on a Tektronix 564B oscilloscope equipped with a bridge amplifier, and then were digitized (12 bit precision) and statistical calculations were performed. The sampling rate was 50 Hz.

5) Procedures: Subjects were positioned upon the sway platform and were instructed to stand upright and to attempt to remain motionless. Subjects were instructed to look at the center of the stimulus pattern, in order to minimize edge cues. Nine 1 min trials were run on each subject with striped and control patterns alternated.

We analyzed the spectra of measured signals with both test and control patterns in two of the subjects. Fig. 2 shows examples of such spectra obtained using chart sam-

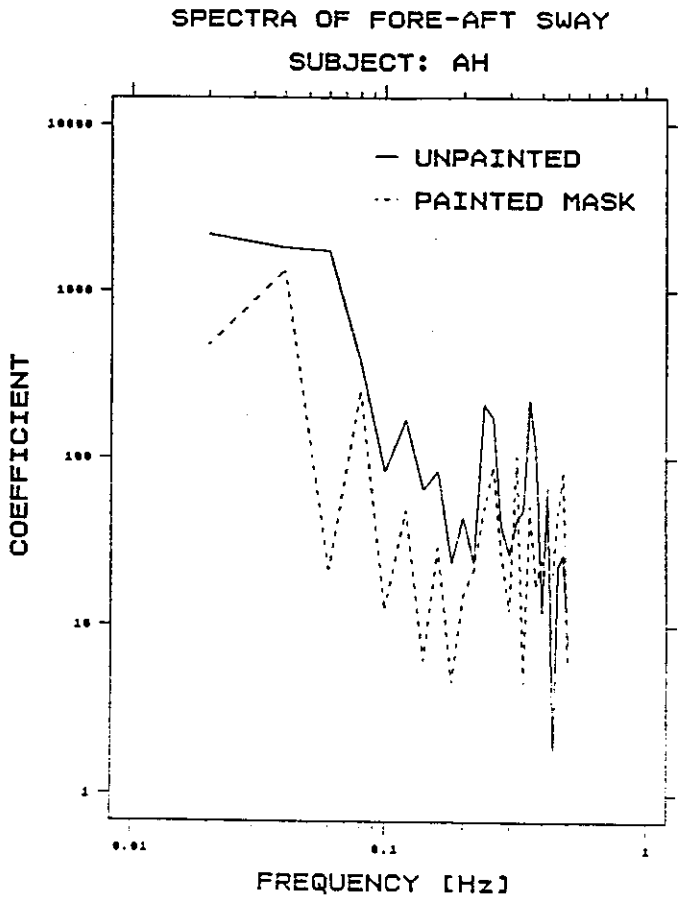

Fig. 2. Spectra of fore and aft sway. Spectra were estimated from samples obtained during the field test. These samples gathered at 1 s intervals. Ordinate is the amplitude coefficient. Abscissa is the frequency specified hertz. There is a great deal of variability from sample to sample. These examples are typical of several other samples examined. Generally, the spectrum peaks at lowest frequencies and stimulus effects are to increase power. This provides a rationale for using postural variance to quantify stimulus effects.

ples entered into a statistical data analysis package (Statgraphics Ver. 2.6, Statistical Graphics Co.). The postural signal exhibits most power at frequencies below 0.1 Hz. This is consistent with earlier results of Scott and Dzendolet [15]. The only consistent difference between signals measured during the two viewing conditions is that power increases in the test condition (unpainted escalator).

Hence, following Dornan *et al.* [7], we chose to estimate the mean squared deviation from the mean position of the center of gravity as the dependent measurement of postural sway. This statistic is chi-square distributed, but was approximated by the Gaussian distribution, for statistical testing, since the number of samples was large.

C. Measurement of Subjective Disorientation

This study was conducted in the field. Subjects were 21 normally sighted students. Test and control escalators (see Section II-B.2) above) were each observed for a 30 s period with order randomized. After viewing was complete subjects were asked to retrospectively identify which of the two escalators was "more disorienting" and whether such a judgment was easy or not.

III. Results

Postural Stability

The results of the laboratory posturographic measurements are summarized in Table I where they are expressed as the variance of the voltage signal. Our interest was in the effect of the visual stimulus on the variance of posture towards and away from the target. The table shows that the striped pattern, without the superimposed control targets, increases the variance of the fore–aft sway, which is predicted by our hypothesis of stereo-ambiguity. Six of nine subjects showed individual effects in the predicted direction, although the effects were generally less than a factor of two. The pooled results from all subjects show a statistically significant increase in postural instability when viewing the test (stripes only) pattern. This constitutes the first demonstration that a static visual stimulus can engender increased sway.

Table II shows the results of an experiment which relates stereo-ambiguity to a nonlaboratory stimulus, the escalator. Subjects viewed stationary escalator treads, with the typical 6 cycle/deg viewing surface, in the field. One

TABLE I
POSTUROGRAPHY MEASUREMENTS OF CHANGES IN THE OBSERVER'S CENTER OF GRAVITY WHILE VIEWING EXPERIMENTAL AND CONTROL PATTERN. POSTURE VARIABILITY EXPRESSED AS MEAN SQUARED DEVIATION FROM THE MEAN (VARIANCE).

Subject:	Pattern: Experimental (Vertical Stripes)	Control (Vertical Stripes with Letters)
D. F.	983	1455
L. X.	1619	1848
J. E.	1403	889
L. B.	708	799
D. D.	1596	831
R. X.	1439	1385
J. L.	1308	603
J. W.	4114	1468
A. H.	1548	973
Pooled Variances	1413	1137
3 Sigma Confidence Intervals	(1384, 1445) N = 18000	(1114, 1163) N = 18000

TABLE II
POSTUROGRAPHY FOR THREE SUBJECTS VIEWING TREATED AND UNTREATED ESCALATOR

	Unpainted (Normal)	Painted (Treated)
Pooled Variance (scaled)	1.21	0.65
3 Sigma Confidence Intervals	(1.07, 1.35) N = 1002	(0.59, 0.71) N = 687

set of treads was standard appearance, while the other had been treated with a superimposed painted pattern designed to minimize the stereo-ambiguity. Example spectra for these two viewing conditions are shown in Fig. 2 described above. The results of the field test show that less sway variance was measured, by about a factor of two for the pooled data, for the painted escalator, e.g., when the visual target's tendency to lead to the wallpaper illusion was minimized. This result is also statistically significant.

Subjective Judgements

An early finding in this series of investigations showed that disorientation experienced by escalator riders could be attributed to stereo-ambiguity [1]. We sought in this study to determine whether the extent of disorientation reported by observers could be related to the amount of stereo-ambiguity presented by escalator treads. We asked 21 unaware subjects to view the first step of two different stationary escalators from the bottom platform. The steps of one escalator were painted with a high contrast pattern (described above) that was intended to prevent the wallpaper illusion. The other escalator was untreated and was thus typical in appearance, although it did exhibit the usual scratches, mars and foreign substance spots. After viewing the steps of the treated and untreated escalator, the subjects were asked to judge whether the treated escalator step was more or less "disorienting" than the untreated escalator step. For this subjective judgement of treated and untreated escalators, 17 out of the 21 subjects judged the painted escalator step to be less disorienting than the unpainted step. Of the 17 subjects who reported the comparison "easy" to make, 15 judged the painted step to be less disorienting. These are statistically significant results ($p < 0.003$ and $p < 0.001$, respectively, binomial test) which show that masking the ambiguous features of the tread pattern, while not materially reducing its visibility, reduces the disorientation reported by subjects. Subjective disorientation and postural stability are thus linked, and we suggest that the link is due to a common dependence upon the existence of stereo-ambiguity in the visual stimulus.

IV. DISCUSSION

Lee and Lishman [6] have shown that the external modification of the visual impression of the world in a left-to-right direction can cause a compensatory left–right sway in the posture. It has also been shown that closing one's eyes increases the amplitude of postural sway [6], [7] which attests to the importance of vision in maintaining upright stable posture. Our research extends these findings by showing that a fore–aft modification of postural variance can be caused by an appropriate manipulation of the stereo-depth cues in visual space.

Plainly, there are complex interactions amongst the visual sensory system and two related motor systems, those of binocular convergence and postural control. Fig. 3 summarizes relations amongst these entities as they relate to the narrow problem addressed here. Visual stimulation impinges on two eyes. Responses lead to the generation of binocular convergence control signals. Manifestations of these signals are measurable as the angle of convergence (4), which can be erroneous for stereoambiguous stimuli, and, if so, which define the state termed "false fusion." When false fusion occurs, the central apparatus for computing depth is faced with discordant input, with monocular cues and binocular cues at odds as to the actual distance to the stimulus. These lead to two responses, both measurable: first, subjective disorientation occurs, and second postural instability increases. We speculate that increased instability may be the precursor of falls.

Our assessment of subjective reports of disorientation and its relationship to stereo-ambiguity runs counter to the usual reasons advanced to explain disorientation and falls on escalators. Height has been suggested as a cause and so has escalator motion. Our subjective test provides evidence that it is the striped pattern of the treads per se, and neither escalator movement (it was stationary) nor viewing from a height (it was viewed from the bottom platform) causes the disorientation reported by our subjects.

The problem of periodicity in visual targets is not restricted to escalators. Stairs, steps, carpets, and tile-flooring can create the same type of visual ambiguity. Visually ambiguous patterns should be avoided in designs for any walking surface. In the case of the escalator this is of particular importance since the surface is moving, which may tend to aggravate the effects of postural instability.

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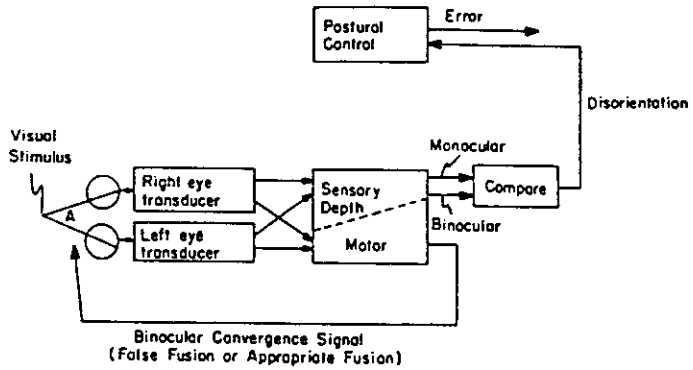

Fig. 3. Hypothesized relationships between binocular convergence signal, false fusion, disorientation, and postural instability.

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David J. Lasley was born in Lafayette, IN, in 1948. He graduated from the University of California from the College of Letters and Science in 1972. He received the Ph.D. in physiological optics from the University of California in 1977, and the M.S. degree in statistics from California State University in 1987.

He became a postdoctoral fellow at the University of Miami School of Medicine in 1978. Since 1983 he has been a Research Psychologist at the School of Optometry.

Dr. Lasley has held memberships in the Optical Society of America, Sigma Xi, Association for Research in Vision and Ophthalmology, American Association for the Advancement of Science, and Phi Beta Kappa.

Russell Hamer was born in New York City, NY, in 1946. He received the bachelor's degree in biology from the City University of New York (CUNY), New York City, in 1971 and the Ph.D. degree in sensory science from Syracuse University, in 1979. His dissertation involved a study of vibrotactile masking between sensory channels.

He was a postdoctoral researcher at the University of Washington from 1979 until 1982 studying infant visual development. He was a Postgraduate Researcher at UC Berkeley from 1982 to 1985 and then moved to his present position of Research Associate at the Smith Kettelwell Eye Research Institute where he is conducting behavioral studies of infant and adult vision.

Dr. Hamer is a member of the Association for Research in Vision and Ophthalmology and the Optical Society of America.

Robert Dister was born in Cleveland, OH, in 1953. He graduated in 1980 from Boalt Law School, Berkeley, CA, with a doctorate in jurisprudence. He received a Doctor of Optometry degree in 1987 from the University of California at Berkeley.

He currently is on the clinical faculty of the School of Optometry at the University of California, Berkeley, and has private practice in Alameda, CA.

Dr. Dister is a member of the California State Bar.

Theodore E. Cohn (S'63–S'67–M'69–SM'80) received the S.B. degree in electrical engineering from the Massachusetts Institute of Technology, Cambridge, in 1963; the M.S. and M.A. degrees in bioengineering and mathematics in 1965 and 1966, respectively; and the Ph.D. degree in bioengineering in 1969, all from the University of Michigan, Ann Arbor.

He was first appointed at the University of California, Berkeley, in 1970. He is now Professor of Physiological Optics. He was a Visiting Fellow at the John Curtin School for Medical Research, Australian National University in 1977 and Visiting Scholar at University of California, San Diego in 1989–1990. He has served as Faculty Assistant to the Vice Chancellor for Research at UC Berkeley. His research interests mainly concern physiological and psychophysical studies of the limits of visual sensitivity.

Dr. Cohn is a member of EMBS, the Association for Research in Vision and Ophthalmology, AAAS, Sigma Xi, and the Neuroscience Society. He is also a member of the Optical Society of America in which has has served as Chair of the Technical Group in Vision.

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From page 5

Escalators

disorientation is a serious enough problem by itself to warrant industry attention.

Falls outrank entrapment accidents as the principal untoward incident concerning escalators. There has been a natural concern in the industry to find the cause of falls and eliminate them if possible. Certainly I have not presented any evidence here that allows an answer to the question of whether or not disorientation leads to falls, but I have experiments both planned and underway which are aimed at finding an answer. Only preliminary results are available thus far.

Conclusions and Recommendations

One of the most promising strategies for future progress in the study of disorientation on escalators is to begin to scrutinize data concerning falls. A number of agencies cumulate data of this sort for a variety of purposes. Unfortunately the diversity of purposes leads to quite different content and format from one data set to another. There is enormous potential for better delineating the causes of unfortunate occurrences such as falls if a uniform, carefully planned data-gathering effort could be mounted. Moreover, once the problems are better understood, a variety of proposed solutions will emerge. Properly designed data gathering will aid immeasurably in the task of evaluating these solutions.

Perspective on Performance

At the invitation of Kenneth W. Butler, Associate Administrator for Budget and Policy for the Urban Mass Transportation Administration (UMTA), ITS Statewide Director G.J. (Pete) Fielding participated in an UMTA staff retreat in Washington, D.C., on June 8. The objective was to identify policy initiatives that can be taken by the federal agency over the next year.

Among the issues examined were the extent of private participation in transit and how such participation can be encouraged, the use of federal block grants for financing transit, methods for improving transit productivity, and the use of rewards and penalties in UMTA's funding programs.

Also participating in the retreat were Jack Gilstrap, Executive Vice President of the American Public Transit Association; UCLA graduate Don Pickrell, now on the faculty of Harvard's Kennedy School of Government; Ken Orski, who will assist ITS-Irvine in the development of a workshop on transportation in major private developments; and Anthony U. Simpson, President of DAVE Systems, Inc., and a frequent lecturer in ITS extension programs.

At the retreat, the changing circumstances of American transit were discussed in detail. "Transit is now a mature endeavor," reported Fielding. "Governmental assistance has leveled off and new problems must be addressed with existing resources and within existing frameworks."

Participants recommended that UMTA narrow its attention to the prudent administration of ongoing investments. Policy analysis must be taken more seriously, especially in the evaluation of capital investments. It was also suggested that the Short Range Transportation Plan/Transportation Improvement Program and the Section 15 data reporting requirements could be better utilized. UMTA does not need more regulations; rather, existing regulations must be used more effectively.

Prospects for private sector participation in transit appear to be most promising at the "margin": operating peak-period commuter service, operating suburban and small city systems, and contracting out functions such as station cleaning and vehicle rebuilding. Contract management is another important component of private sector participation in transit. About 44 percent of U.S. fixed-route transit systems are privately owned or managed by contract management firms. Many more demand-responsive and special-service systems are managed by private firms.

"It is unlikely that there will be a change of ownership for the major publicly owned and operated metropolitan systems," said Fielding. "Research results suggest that private firms and contract management firms are not more efficient operators of large urban transit enterprises. Selected privatization strategies can help control costs, however, and should be encouraged."

Discussion on methods to improve transit performance ranged widely. Considerable attention was devoted to labor relations and new attempts to involve labor in decision making. Conferees agreed that agencies must be encouraged to become more efficient by reducing service in ways that cut the cost per passenger and the cost per unit of service; the focus should be on economies in administrative costs, maintenance, work rules, and on ways of reducing absenteeism.

Availability of Section 15 data and the performance measures developed at ITS-Irvine will help UMTA to assess transit performance. The challenge will be to insure that these measures are used intelligently to avoid the skewed results that can occur when a single measure of performance is emphasized.

Results of university research programs and Section 6 demonstration grants were cited as powerful tools for shaping transit policy. ITS research on privatization of public transit, development of performance measures, and the forthcoming workshop on "Transportation in Major Private Developments" were used as examples of ways in which university research can assist federal policy formulation.

Photo by Sinon Donnelly

Escalators: the Visual Illusion

Theodore E. Cohn is an Associate Professor in the UC Berkeley School of Optometry. The research described below was carried out with "seed money" from ITS.

For a number of years it has been apparent to escalator operators, manufacturers, and safety authorities that riders are sometimes disoriented when on the escalator. The phenomenon has been difficult to pin down for a number of reasons. First and foremost it does not always occur; that is, individuals who are disoriented on escalators are not always disoriented, and some individuals seem never to become disoriented. A second factor that has increased the difficulty of studying this phenomenon is that there appears to come with experience a sort of immunity to the problem. My own case is an example. I first experienced disorientation on an escalator in 1976. At that time I developed a keen interest in understanding the problem. Over the intervening years the problem has "self-corrected" to the point where presently I no longer experience the disorientation sensation despite a somewhat more extensive recent exposure to escalators. Finally, reports from individuals who experience disorientation have been vague and difficult to interpret.

In this article I will attempt to describe the cause of disorientation experienced on escalators. A subsequent report will suggest appropriate design alterations for relevant sections of the American National Standards Institute A-17 code.

Early Theories of Disorientation

Persons interested in the safe operation of escalators have guessed that the escalator's prominent feature, its movement, might lie at the heart of the disorientation problem. To be sure, the human observer's visual field is rarely presented with such a massive continuously moving object. Nonetheless this inference has no logical basis: no one has suggested why movement should be disorienting. Moreover, it is then hard to explain why disorientation occurs when the observer is riding the moving machine. Possibly, it is because then the rest of the world is moving—but London Transport has found that placing interesting posters alongside the machine greatly cuts down on disorientation. Perhaps most significant is the observation, already known by many, that disorientation also occurs on a stationary machine.

Another early theory likens disorientation to the vertigo experienced by some individuals when looking down from a height. If this comparison were accurate, then individuals bothered by the problem would probably have the same difficulty with stairs. My informal observation is that persons who report disorientation on escalators are not similarly troubled by stairs. This fact casts doubt on the theory. What disproves the theory entirely is that disorientation is experienced on the upward-bound escalator as well as the downward-bound one.

Vision through Two Eyes

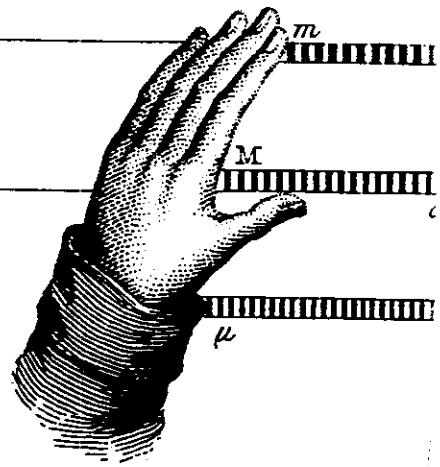
It is not possible to describe a successful theory of disorientation on escalators without first describing some features of the visual system—the sensory system through which, it turns out, the information that leads to disorientation must be processed. As will be seen below, unique properties of the visual system, coupled with equally unique characteristics of the appearance of the escalator, combine to produce disorientation.

The most important feature of our visual apparatus, in the context of this discussion, is that the visual process begins with two independent and slightly different views of the world—one provided by the left eye and another provided by the right eye. Connections in our nervous system have developed in a special way to combine the two images available in the two eyes into the one image that we "see."

How are the images combined? The earliest philosophers had ideas, based on limited evidence, that were essentially correct. Descartes propounded the view that signals from two eyes in the form of "humors" simply met and combined at one particular location in the brain. Results of neurophysiological studies from the laboratories of Peter Bishop of Canberra and from David Hubel and Torsten Wiesel of Harvard (who both recently received the Nobel Prize) have led to the present view that the images present in the two eyes are indeed added together in the neural apparatus of the brain. The resulting sum forms our single view of the world. The interesting problem that the brain must solve to accomplish this summation is where to point the eyes so that, when the images are added together, the sum is meaningful.

What Happens When Signals Don't Add Up

It would not do for the right eye to be trained on the right edge of this page while the left eye looked at the left edge—the resulting sensory impression would be quite confusing. You can demonstrate this for yourself by pushing (very gently please!) the side of one eye with your finger on the lid. Suddenly the single view of the world that you are used to will disintegrate into two images that slide across one another and which are, to say the least, quite difficult to make sense of. If you let go of the eye you have been pushing against, the images will jump quickly back to one as the brain redirects the eyes into appropriate alignment. The brain seems to know when the images in the two eyes are in register. Visual scientists call this very sophisticated ability the process of *fusion*. Before examining how this relates to disorientation, it



is necessary to consider the intimate relationship between the process of fusion and the perception of depth, or the perceived distance away from the object being viewed.

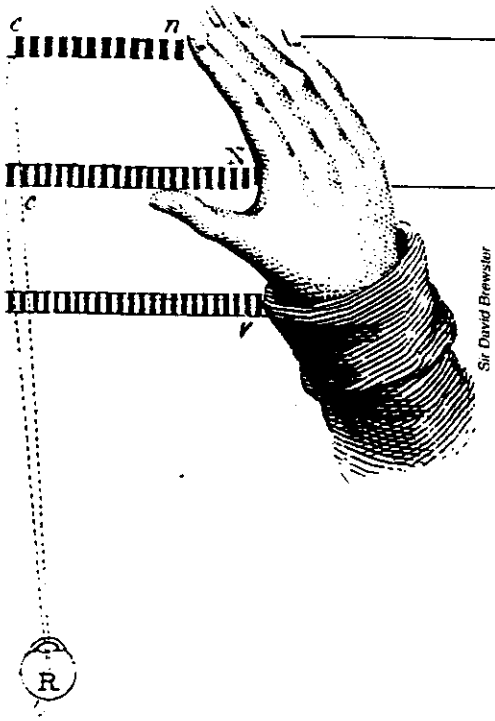
Stereopsis: the Sense of Visual Depth

If one looks at a point on the distant horizon, the lines of sight from the two eyes are essentially parallel to one another. If, instead, one looks at this page, the lines of sight make an acute angle. In fact, if one imagines a line connecting the centers of the pupils of the two eyes to be the base of a triangle, the lines of sight form the other two sides and the apex rests on the spot at which one's attention is directed. From birth, experience has taught us that objects are close by when the angle at the apex is sharpest, and objects are far away when the angle is more oblique. The ability to sense depth provided by this geometrical relationship between the two eyes is termed *stereopsis*. What is pertinent here about stereopsis is that it can be fooled—and nothing can fool it better than an escalator tread.

Fooling the Brain: the Visual Illusion

If the visual sense sends an erroneous message to the brain, the resulting percept is called a "visual illusion." Over 100 years ago, upon the introduction to Europe of the Chinese invention called wallpaper, scientists of the day discovered and described an illusion of depth that has come to be called the "wallpaper illusion." It occurred when an observer looked straight ahead at some nearby wallpaper exhibiting a repeating pattern. Consider these lines from Sir David Brewster in the *London Philosophical Magazine* of 1847, where the effect is described of looking from a distance of three feet at wallpaper on which the pattern repeats every 12 inches: "Hence the whole papered wall, with all its flowers, in place of being seen in ordinary vision, at a distance of *three* feet, *is now seen suspended in the air, at a distance of six inches from the observer.* In maintaining this view of the wall, the eye will at first experience a disagreeable sensation; but after a few experiments the sensation will disappear [emphasis added]."

The illusion comes about because the brain, in its search for similarities in the images to the two eyes, can instruct one eye to point at



Sir David Brewster

by Theodore E. Cohn

one feature of the pattern and the other eye to point at a different position *that contains the same feature*. The rules necessary for fusion are thus satisfied, but now the angle between lines of sight of the two eyes provides an erroneous impression of the actual distance of the target. The result is that the stimulus appears to swim fore or aft of its real position, which is very disorienting for the observer. It may be noted that this depth illusion is not restricted to wallpaper. It occurs in relation to perforated acoustic tile, picket fences, rows of postage stamps—in short, for any visual stimulus that exhibits a repeating structure across the pattern.

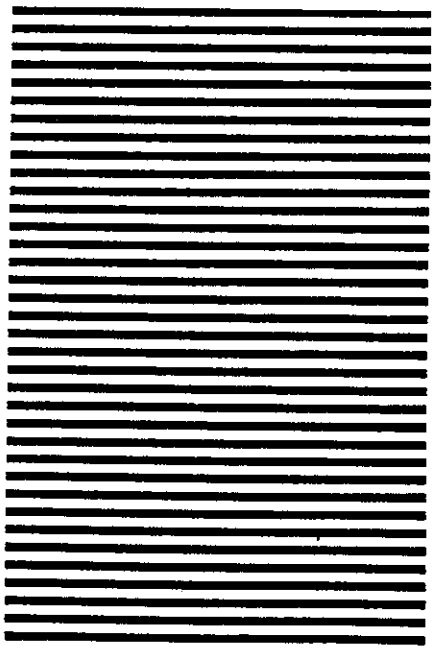
The Escalator as a Visual Stimulus

If a rider is about to board, or has already boarded, an escalator (whether or not it is moving), the act of looking straight down at nearby steps (or straight ahead at nearby step risers on the up-going machine) leads to a visual depth illusion. The escalator tread has a repeating structure: alternating cleats and grooves are prominently visible. Their special visibility stems from several unique features. First, under most commonly encountered lighting conditions, the great depth of the groove as compared to its breadth causes the groove to be in shadow, giving it a dark appearance. Second, most manufacturers paint the bottom of the groove black, heightening its contrast with the polished cleat face. (Schindler-Houghton has abandoned groove-painting on the grounds that this seems to lessen disorientation. Below we shall see why this strategy works.) Psychologists know that the visibility of a visual stimulus is greatest when the greatest light-dark contrast—in painting called *chiaroscuro*—exists in the pattern.

The first two factors give the striped pattern of the tread surface a contrast higher than that of almost any commonly encountered reflective target in the visual world. Third and finally, it is known from the recent research of Andrew Watson and his colleagues at Cambridge University* that the rate of repetition of light and dark stripes across the tread at the right viewing distance (about seven feet) just happens to approximate the stimulus that our visual nervous system sees best. In sum, no reflective visual target could be more visible. This is probably why the brain sometimes errs in its attempts to properly align the eyes to produce one image of the escalator. Other stimuli nearby, such as the escalator skirt, which could be used by the brain to achieve proper alignment, simply cannot compete with the tread for the brain's attention. (Recent research by Arnold Wilkins and colleagues, also at Cambridge University, suggests that these patterns are so compelling that they can produce, in susceptible individuals, epileptic seizures.†)

Why Disorientation?

If the reader has followed the argument this far, it will be a simple step to understand how the escalator can be a disorienting visual stimulus. Because of the repeating pattern upon the surface of each tread, the brain may direct the eyes to erroneously fuse adjacent, or even well-separated, cleats. If so, the angle between lines of sight of the two eyes is not appropriate to the distance of the tread. The result is that the tread will appear to be where it isn't—above the step surface, for example. This fusion error can be expressed in terms of the number of cleat-groove pairs that separate the two features that are fused. Each such pair leads to a depth error of six percent, or five inches at a seven-foot viewing distance. In other words, the tread surface can appear at least five inches above or beneath its actual location. It's no wonder that people become disoriented under these conditions.



*Nature *302*, pp. 419-422, 1983.

†*Progress in Neurobiology*, Vol. 15, pp. 85-117, 1980.

Tests of Escalator Disorientation and Depth Illusion

I have engaged in a number of tests of these ideas to see if further evidence could be brought to bear on the situation. Perhaps some of these tests will already have occurred to the reader. If disorientation on escalators is due to a depth illusion, then it ought to be possible to abolish the illusion, and thus the disorientation, by neutralizing the sense that springs from having two eyes. I have tried this myself and, with the cooperation of Ralph Weule of the Bay Area Rapid Transit District, on dozens of other individuals, and the result is always the same. Closing one eye while viewing an escalator turns off the depth illusion, and disorientation does not occur. The reader will note that this simple demonstration also rules out vertigo and movement as possible causes of disorientation, since both are constant features of the test.

Another way to test the theory is to view the escalator tread in such a way that the repeating structure does not appear in the horizontal meridian of the field of view. In that instance a fusion error is far less likely to occur, because the brain will not find suitable alternative sites for fusion.

A pair of goggles with optical prisms arranged properly can direct the lines of sight of the two eyes to be essentially coincident. In this way the sense of depth due to the different perspective of the two eyes is lost, and so too is the disorienting depth illusion that the escalator tread otherwise produces.

Nature of the Problem

What is the prevalence of disorientation on escalators? In my view every individual with sound optics and visual nervous system (perhaps 85 percent of the population) is at risk for disorientation. But disorientation does not necessarily occur every time such an individual looks at an escalator. My own experiments indicate that the chance is about one in four that a given individual will become disoriented in a ten-second observation period. In practice, ten seconds is a longer time than most riders have for an unobstructed view of the tread surface. Other riders, and other features of the nearby world, may command the rider's attention and so decrease the incidence of disorientation.

Nonetheless, my informal observations suggest that a significant fraction of the population, especially among the elderly, is deterred from making full use of this otherwise very efficient transport system because of disorientation and the fear it produces. The deterrent of visual

see page 8

EXPOUNDING

by D.A. Swarr

OCTOBER 1993

ESCALATOR FALLS

The item that follows was clipped from the San Francisco Examiner & Chronicle, Sunday, August 22, 1993.

> THEY BLAME bifocals mostly, those 60,000 people who fall on escalators every year.

There, you have it. Falls -- the leading cause of accidents on escalators. And now we know why? Why, mostly? Or do we? But, how about that number? 60,000! Every year!

I wear tri-focals and to date have not had any mishap on an escalator. Of course, I, as do most of us in the trade, do not stare at the steps. However, I do have to admit that I was quite hesitant about getting on and off of escalators immediately following my hip replacement. Crutches or cane to be moved at the same time as stepping on (or off) and grasping (or turning loose of) the handrail was almost more than I could synchronize. All that, and at the same time not to stable on my feet and in fear of falling! Try it! You won't enjoy it either.

Theodore E. Cohn, PhD, at the School of Optometry, University of California at Berkeley, has a theory about why many of those that fall, do so.

Dr. Cohn's explanation gives plausability to the claim so often heard that, "All of a sudden the stairs jumped up", or, "All of a sudden the steps seem to fall away". Both claims have been made, and made by people who believe it happened. When asked why the steps are still there, in place, and running properly?, they have no explanation. Dr. Cohn has an explanation. In fact, grant money has been awarded Dr. Cohn in the past so he could attempt to prove or disprove his ideas. To qualify for the grant(s), Dr. Cohn spoke (wrote) of such things as disorientation due to steropsis, ambiguous illusion, optimum intervention, binocular vision, posturographic measurement, and more.

In my words, it is Dr. Cohn's contention that because of the step design (repeticious ridge groove ridge groove expanse from side to side) the brain is fooled by what the eye perceives. The eye may focus somewhat beyond the step surface when looking down, or it may focus somewhat short or above the step. It will do that as there is no set characteristic on which to focus. The focus of the eyes, both on the same object, is what gives humans their depth perception. Therefore focus short (or far), and then have some outside influence occur that causes our eyes to quickly adjust to reality, voila!, the steps jump up! - or down!, the rider reacts!, and often a fall results, and the poor victim never knows what happened, or why. If asked, the victim will say the escalator jerked, or the stairs jumped up, or dropped down, or moved, or whatever."

(Cont'd on overside)

Dr. Cohn did use part of his grant money to paint designs on all the escalator step threads of a given escalator at one of the BART Stations in San Francisco. Many claimed it helped alleviate the problem. Just as many pooh-poohed the whole thing. I do not have any figures one way or the other on the results. But it was an interesting test. And it did make for an unusual looking escalator.

Then there is that thing called, "vertigo". At times we all suffer from it. Dizziness for some, unknown to victim at the time, reason. A person staring at the moving steps, will, all of a sudden become dizzy, and often fall. I had the experience of watching it happen to a woman. She came to the top of the escalator and stopped. She was watching the stairs move out and down, and to all appearances, getting herself set to step aboard. All of a sudden, a man standing near her grabbed her arm and led her to a nearby bench on which she could sit. After a few minutes during which he talked to her, he again took her by the arm and led her to the elevators. A short time later I was able to speak to the gentleman and asked him what had happened. He told me that he was watching her expression as she stood looking at the escalator when he became aware she was about to fall. His support of her arm prevented it. While sitting on the bench she told him that she had become extremely dizzy and nauseated, that she had no recollection of his help, and that in just a moment of two she felt quite able to continue. That is when he took her to the elevator.

Stop and think a moment about how hard it is, as an inspector or an investigator, to count escalator steps, to check side of step clearances, to look for broken step treads, and the like.

So, what's the purpose of this piece? What should we, as inspectors or possibly consultants be doing to overcome the problem?

Do?... As inspectors there probably is little that we can do -- but be aware that people do fall. Purpose?... To share information. That there are various reasons for falling. To help us empathize with the individual who may be hesitant to ride or step onto an escalator. To help develop compassion for those who do fall. To help us understand when some one tells us what they think happened. And to know that there are individuals thinking about the problem, and that hopefully, someday someone will come up with an acceptable solution.

It's

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PROGRESS

OCTOBER 1993

Behavioural Team

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ACCIDENTS AND PROTO-ACCIDENTS FOLLOWING AN INSTALLATION OF THE EIS SYSTEM AT A MARTA STATION

1994 June 2

Prepared for:

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ACCIDENTS AND PROTO-ACCIDENTS FOLLOWING AN INSTALLATION OF THE EIS SYSTEM AT A MARTA STATION
1994 June 2

Ben Barkow, Ph.D.[1]

Purpose

The conservative goal of this analysis is to detect and catalog all instances of accident-events, comparing rates *before* and *after* the EIS installation. The approach has been to err on the side of *detection* of mishaps rather than *overlook* any.

Accidents and proto-accidents arising from the behaviour of other persons (such as when bumped by a passer-by) are to be considered separately in this analysis unless the event is chained to the first person's accident or proto-accident. This distinction is assumed in the definitions to follow.

Unit description

The escalator under observation was located at a major downtown subway station of the Atlanta rapid transit system (MARTA) and is characterized as follows.

Location	Peachtree Stations
Unit designation	#14, south end of platform
Manufacturer	Westinghouse
Model	B
Number of steps	62
Rise	13 feet, platform → mezzanine concourse
Year of initial installation	1982
Direction of travel	up
Operating speed	90 F.P.M.

Passenger behaviour was videotaped simultaneously from the top and the bottom of the unit using attended video cameras in VHS-S format in colour. The location of video cameras is shown on the attached figure.

[1] President, Behavioural Team, A Corporation. Ontario Board Certified Psychologist, #1075

Definitions

Accident event

Contact made between the person and the structure other than in a planned or natural way which includes contact with parts of the body not meant to touch the escalator, or touching with a force or at an angle which could be injurious.

Proto-accident event

(1) Loss of balance indicated by the person taking quick action or showing reflex action to achieve a desired posture, (2) close encounter (but not contact) between the person and the structure other than in a planned or natural way, or (3) the person re-places a foot or hand abruptly, evidently to forestall a loss of balance.

Other-person-originated event

Accidents and proto-accidents caused by the behaviour of other people.

While the term "accident" is in disfavor among Human Factors professionals whose work it is to seek *causes* to such events, it is employed here simply for want of a more generally accepted and familiar term.

Methods

16 videotapes of riders using the MARTA escalator were coded. These represent (1) morning and evening peak periods, (2) two successive days before and two successive days after the installation, and (3) views taken from below and from above the escalator. The shots taken from above the escalator were aimed either at (a) riders boarding the escalator or (b) riders alighting from the escalator. The *below* and the *above* cameras were run simultaneously.

Observation during peak loading represents a worse-case scenario for travel by sober MARTA customers. That is because distraction, visual and aural interference, and the adjustment of gait and behaviour to accommodate others is greater than it would be at uncrowded times.

The *below* view shows behaviour and posture related to boarding and to riding for about a space of six or seven steps as well as handrail use. The *above/alight* shot provides a good image of the last step or two as well as rider behaviour approaching the end of the escalator.

However, the *above/boarding* view shows only the upper torso of the person and their right hand access to the handrail. While this view would reveal loss of balance and efforts to forestall an accident by abruptly grabbing the handrail, it does not show how feet are placed, the main focus of observations.

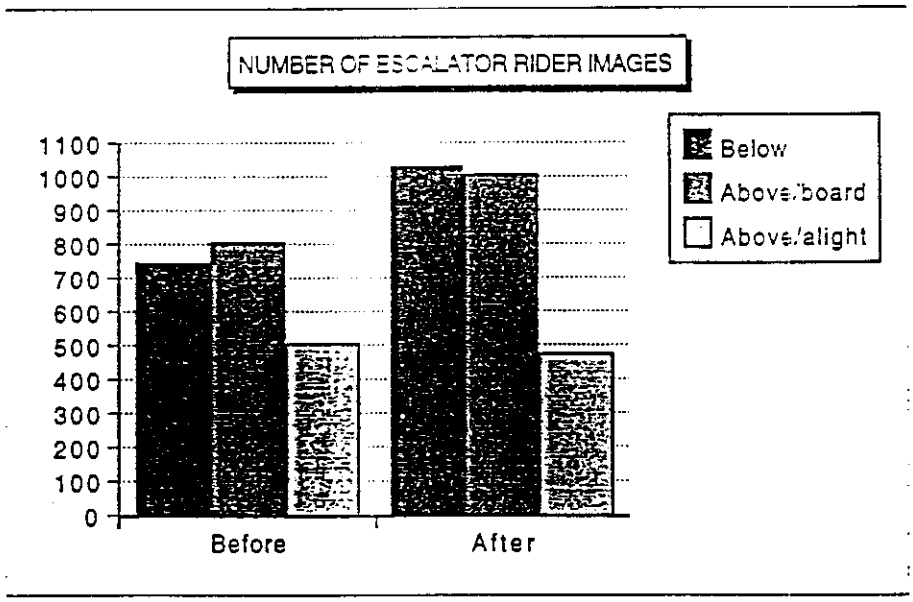
Still pictures were also taken to document the setting.

A reliable and experienced Project Officer on permanent staff was assigned the tasks of viewing, tallying, and analysis. The work was closely supervised by the author, a Board-certified Applied Psychologist and Human Factors specialist. Every significant event was personally examined by the author, and parts of each video were viewed on a sampled basis.

Observations and conclusions

The basic conclusion of our observations is as follows: the MARTA escalator which showed minimal safety mishaps before installation, showed no change after.

A total of 4585 images of riders were observed on the tapes. But, since two cameras ran simultaneously, many of the images taken at the *bottom* are of the same person as taken at the *above* camera location. A total of 2800 people were counted in all of the *above* tapes. These images were divided as follows.



Altogether three events were noted. All were categorized as proto-accidents. All three occurred *before* the EIS installation but it would be incautious to suggest that the EIS riser messages *caused a reduction* in mishaps.

Allowing for a degree of subjectivity in the narrative, the three events may be described as follows.

Event 1: before, lower, Day 1, evening peak

A 3 year old girl who walks poorly, rejects her mother's offer to take her hand, has a mis-step on boarding from comb plate; re-gained balance without injury.

Event 2: before, lower, Day 2, morning peak

A middle aged man, engaged in an animated conversation, slightly repositions his feet; nor all analysts would deem this a notable event.

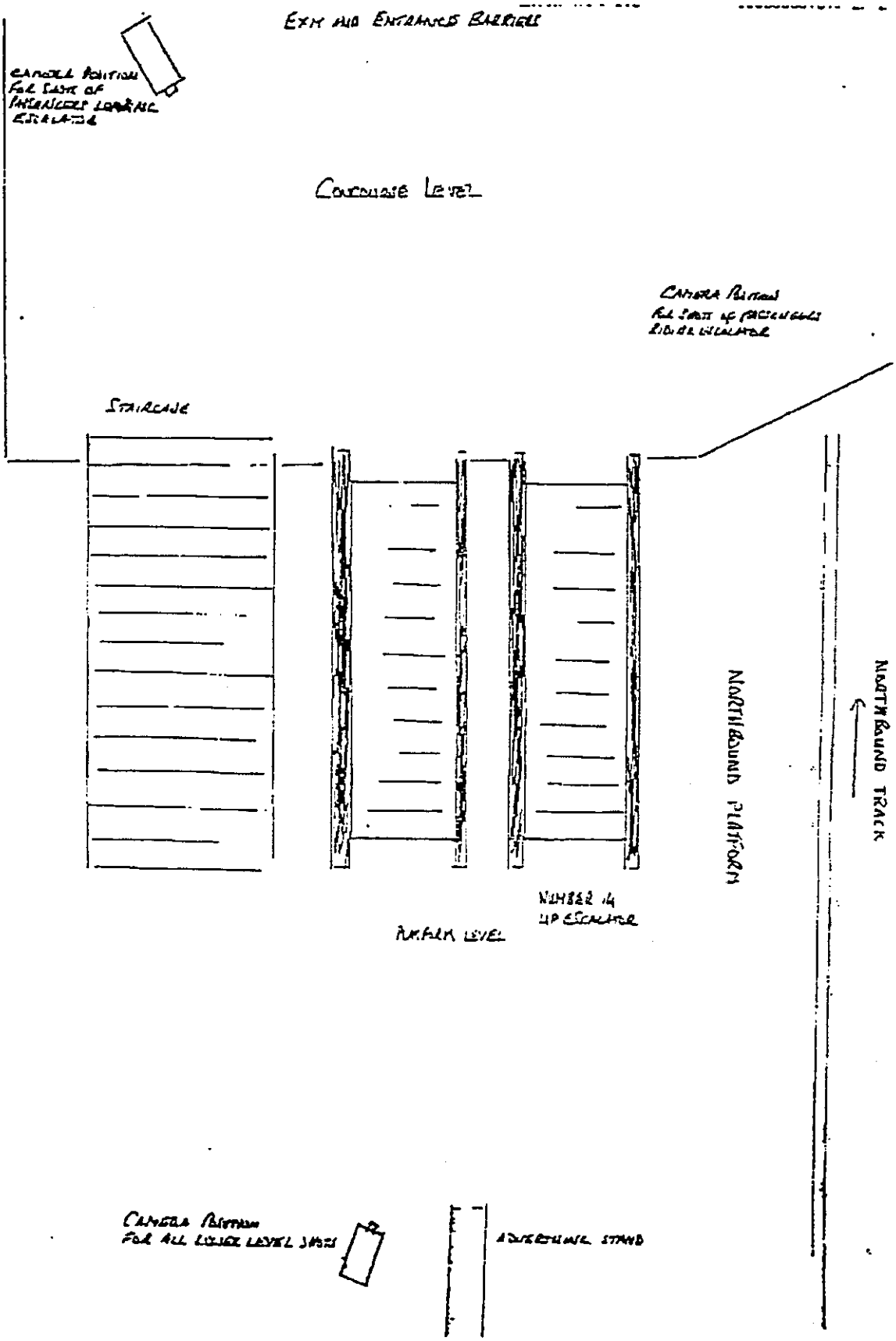
Event 3: before, lower, Day 2, evening peak

A man in a hurry in his 30's, carrying a large briefcase and using the handrail, attempts to take two steps at a time, but starting to do so on the expansion phase of the escalator and has a clear mis-step although he does not lose his balance entirely.

A number of individuals with visual or motor impairments were observed using the escalator after modification. No problems were observed.

Given the representativeness of conditions of observations, the number of riders observed (somewhat more in the *after* condition), and the number of events noted, it is concluded that there has been no increase in accidents on this installation.

Do riders appear oriented to the riser messages? At this point, we are not able to offer a quantitative assessment of this. It can be readily observed on the videotapes that some riders appear to be looking at the messages and that the length of their fixation suggests they are taking the time to read the message.


EXIT AND ENTRANCE BARRIER
CAMERA POSITION FOR EXIT OF PASSENGER LOADING ESCALATOR
CONCOURSE LEVEL
CAMERA POSITION FOR EXIT OF PASSENGERS FROM ESCALATOR
STAIRCASE
NORTHBOUND PLATFORM
NORTHBOUND TRACK
NUMBER 14 UP ESCALATOR
PLATFORM LEVEL
CAMERA POSITION FOR ALL PLATFORM LEVEL EXITS
ADVERTISING STAND

EXECUTIVE OVERVIEW

Messages delivered by the E.I.S. System have an immediate and high impact on air travelers and airport users.

Prior to the escalator being modified by E.I.S. only 6% of users identified the manufacturer installed safety messages on the escalator balustrade.

After modification, the safety messages delivered by the E.I.S. system provide strong impact awareness. **51%** of users recalled one or more safety messages - a very significant increase.

Safety messages delivered by the E.I.S. system are very well received by the public:

Excellent or Very Good - 65%

Improves Attractiveness of Escalators - 30%

The E.I.S. signage system in both the continuous and separated formats was equally successful in projecting the advertising messages.

Awareness and recall scores ranged from 65% for unaided to 70% for aided.

E.I.S. delivers to an upscale airport audience of college educated, frequent business travelers with an average H.H.I. of $63,000.00 +.

Test Objective

- **Continuous** - Safety and one advertiser with all risers modified.
- **Separated** - Safety and one advertiser with unmodified steps located above and below each safety message.
- **Multi** - Safety and three advertisers with unmodified steps above and below each safety message.

Measurement Criteria

To Measure the penetration of safety and advertising messages and their impact on airport users and travelers.

Type of Measurement

Recall playback of safety and advertising messages by unaided and aided methodology.

Location

On leaving up direction escalator carrying safety and advertising messages.

Scope of Research

- **720** Completed Interviews
- **102** Pre-Modification (51 at each gate, 5 and 37)
- **314** Continuous (Gate 5)
  - (106) Coca Cola
  - (105) Intel
  - (103) GTE
- **203** Separated (Gate 37)
  - (102) Samsonite
  - (101) Coca Cola
- **101** Multi (Gate 37)
  - GTE
  - ASU
  - Coca Cola

Research Site

Dallas/Fort Worth International Airport

Terminal 2E - Gate 5
Terminal 3E - Gate 37

- **Timing**
  - April/May 1995
  - Morning, Noon and Evening
  - Representative of airport passenger traffic patterns

Pre-Test Conditions on Unmodified Steps

- No safety messages or advertising on escalator risers.
- Manufacturer installed safety message delivered by yellow sticker at base of escalator.
- Virtually invisible to escalator passengers. Only **6%** saw message and were able to play back some content.

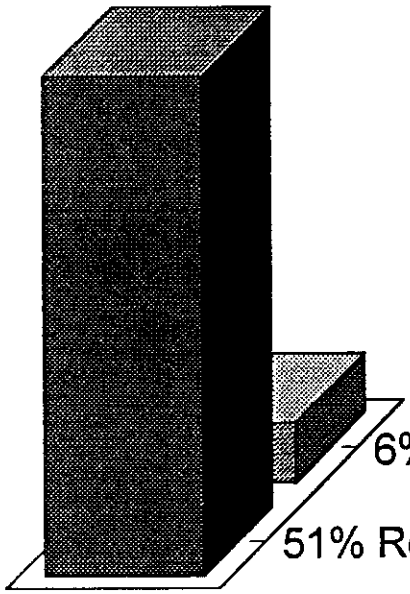
Safety Message Awareness and Recall

Safety messages delivered by the E.I.S. system have immediate and high impact on travelers and airport users:

- Travelers recall multiple safety messages.

- Safety messages recalled differ from the yellow (manufacturer installed) labels at the base of the escalator.

Passengers Recall One or More Safety Messages



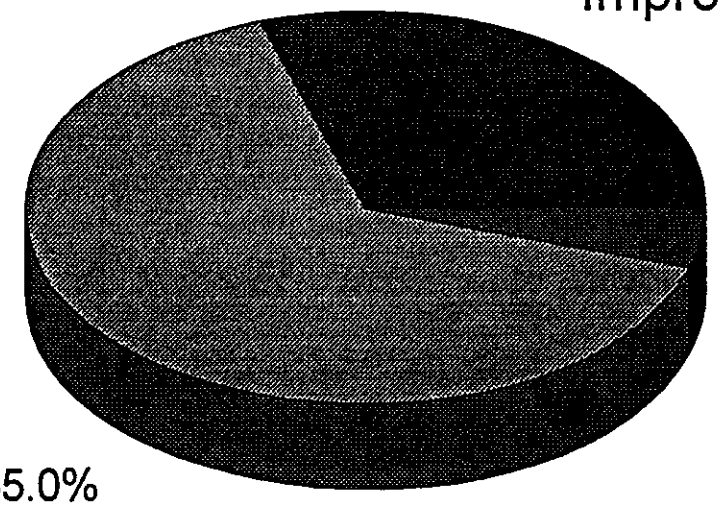
6% Recall Manufacturer Messages

51% Recall E.I.S. Messages

Delivery of Safety Messages by E.I.S. is Well Received by the Public With a Positive Reaction

- **Two in three** think highly of E.I.S. safety messages.
  - **Excellent or Very Good - 65%**
  - **Fair or Poor - 6%**
- Does not detract from the attractiveness of escalators at the airport

The Effect on Attractiveness of Escalators



Improves- 30.0%

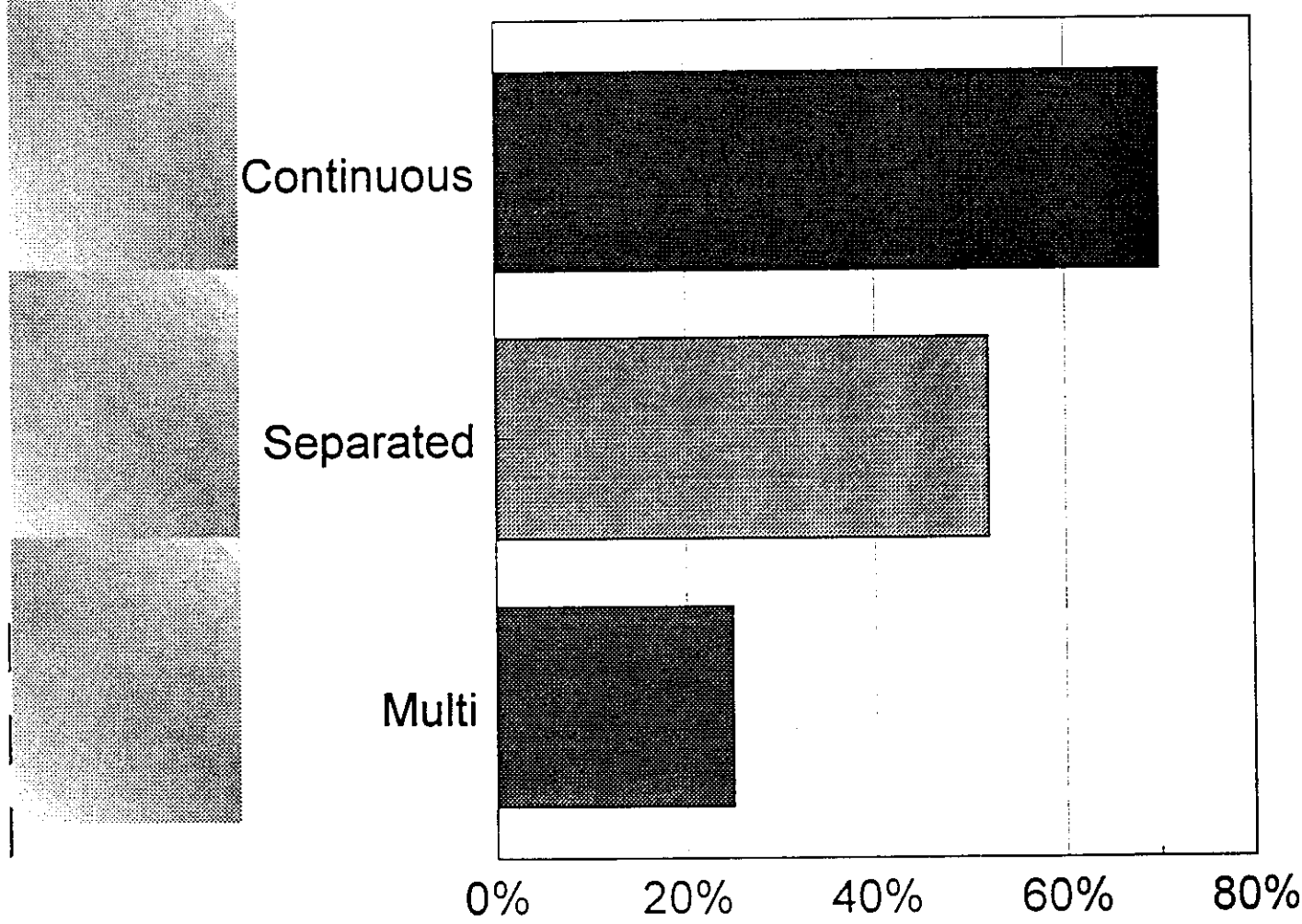
Less- 5.0%

No Effect- 65.0%

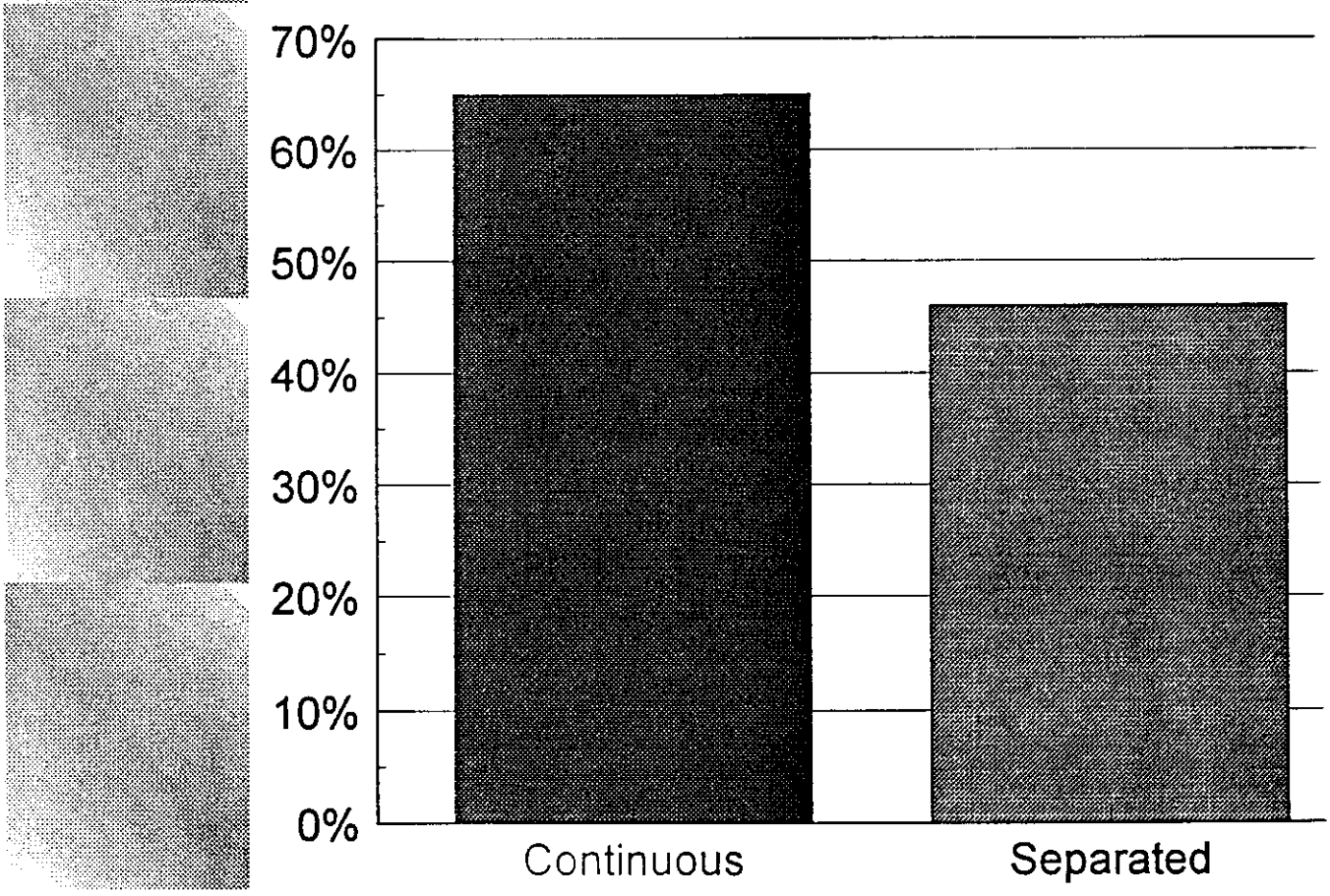
Advertising Message Delivery

- E.I.S. "continuous" and "separated" formats were equally successful in projecting advertising messages.
- The advertising was recalled by well over one half of travelers using the escalators with the "continuous" and "separated" pagination format.
- 25% recall was obtained by the multi format pagination.
- This unique method of signage has high impact and strong recall value.
- Almost complete spontaneity is achieved with little or no prompting.

Measured Success of Three Formats of Advertising



Unaided Recall



Behavioural Team
21 VAUGHAN ROAD, SUITE 202, TORONTO, ONTARIO M6G 2N2 (416) 656-6676 (FAX 658-6878)

EFFECTIVENESS OF ESCALATOR RISER SIGNS FOR COMMERCIAL AND SAFETY MESSAGES

—

1995 September 6

Prepared for:

William H. Parkes
President, Escalator Information Systems (Canada)

Prepared by:

Ben Barkow, Ph.D.
President, Behavioural Team

John Ashwood, M.Eng.
Formerly, President, Market Information Services of Canada, Inc. (MISC); currently with Cansult

BTEA

Behavioural Team, A Corporation
21 Vaughan Road, suite 202, Toronto M6G 2N2
Voice, 416-656-6676; Fax, 416-658-6878
1995 September 6

William H. Parkes
President
Escalator Information Systems (Canada) Inc.
110 King Street West, suite 780
Hamilton, Ontario L8P 4S6

Dear Mr. Parkes:

Attached is our report, *Effectiveness of Escalator Riser Signs for Commercial and Safety Messages*, on the research conducted at L. B. Pearson International Airport, including all three phases of the project.

The work was done entirely by Behavioural Team staff and I closely supervised all aspects of the project. I can attest that results are completely representative of the situation which was under study.

The main body of results are for Phase 1 because it had the largest sample, namely 252 respondents. Results for this sample have a worst-case tolerance of ±6.2%, 95% of the time.

The report indicates that the EIS approach results in levels of recall which are far superior to the levels possible with other media.

Thank you.

Sincerely yours,

Ben Barkow, Ph.D.
President
Reg., Coll. of Psych., #1075

Behavioural Team, A Corporation
21 Vaughan Road, suite 202, Toronto M6G 2N2
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EFFECTIVENESS OF ESCALATOR RISER SIGNS FOR COMMERCIAL AND SAFETY MESSAGES

—

A research project on behalf of Escalator Information Systems (Canada)

1995 September 6

—

Ben Barkow, Ph.D.[1] and John Ashwood, M.Eng.[2]

CONTENTS

[1] President, Behavioural Team, A Corporation

[2] Formerly, President, Market Information Services of Canada, Inc. (MISC); currently with Cansult.

Purpose

The main purpose of this study is to determine the extent to which riders recall messages which are mounted on escalator risers using the Escalator Information Systems (EIS) technology.

Methodology

The study was conducted in three phases by interviewing and videotaping escalator riders so as to measure and compare the effects of escalator signage and changes in signage. Phase 1 acted as the base case with all riders being exposed to all messages. Phase 2 measured the effect of a change in sequencing in the signage and the change resulting from colour and message content. Phase 3 again produced a measure of the effect of a change in signage sequencing.

A graphic comparison of the three phases is shown in Appendix A. The signage utilized in each phase is summarized as follows:

Phase	Signage	No. of Signs	Sequence
1	SAFETY: "No Baggage Carts"	11	every 6th step
	Air Canada	20	cyclical
	Coke	22	cyclical
	Zuni (fictitious product)	15	cyclical
2	SAFETY: "Hold Handrail"	11	every 6th step
	Air Canada	20	blocks of 10, 5, and 5
	Coke	20	blocks of 10, 5, and 5
	Zuni (fictitious product)	17	blocks of 7, 5, and 5
3	SAFETY: "Hold Handrail"	8	approx. every 8th step
	Air Canada	15	blocks of 5, 5, and 5
	Coke	15	blocks of 5, 5, and 5
	Cathay Pacific	15	blocks of 5, 5, and 5
	Diners Club	15	blocks of 5, 5, and 5

The first measure required was to ascertain whether or not riders actually noticed step messages in general when riding the escalator in a busy international airport. Once this measure had been established, it was then appropriate to compare the recall of existing stationary signage in the surrounding area of the escalator to see whether a significant impact had been created with escalator step signage.

Next, the basic indicator of how effective the messages are in reaching the attention of riders is the ability of people to recollect the message without any prompting - the "free-recall" or "unaided-recall" statistics. In addition, respondents can be aided in their recall by a prompt such as "Do you recall seeing an 'Air Canada' message?"

In order to substantiate the integrity of the data from respondents, certain factors were designed into the research as control measures. To test for exaggeration in response, riders were asked in Phase 1 aided-recall if they saw the message about Christie cookies, a leading Canadian brand. No such message actually appeared on the escalator, but it was asked as a trick question to see if respondents were being agreeable to inquiries beyond the strict letter of the truth.

Also, to ensure a true measure of escalator step recall, a fictitious product was "invented" for this research study only. "Zuni non-alcoholic beer" does not exist, but "Zuni" signage was displayed on the steps in Phases 1 and 2. Thus, the only source for any recall of "Zuni" by respondents must be from the escalator steps.

Another important factor to measure was whether or not escalator riders were favourable to step message display as a new advertising medium. In addition to fostering good recall, it is desirable for the medium to be socially and esthetically acceptable to the public. In this study, as well as the "bottom line" measurement of successful recall, the acceptability of the medium was asked of all respondents.

Assuming that riders would actually notice and recall the step messages, the study also examined whether rider behaviour was altered after reading the step messages. This was accomplished with regard to the escalator safety warning signs. Videotaping was conducted of riders both before and after the signs were installed.

With the data obtained, a final statistical analysis was done to establish the effects of repeated exposure to the escalator step messages, and thus, a correlation between frequency and recall.

Unit description

The escalator unit under observation was located at a major Canadian airport (L. B. Pearson International Airport, in Toronto) and is characterized as follows.

Location	Terminal Two
Unit designation	mid-concourse, *Arrivals* to *Departures* level
Manufacturer	Montgomery
Model	5E
Number of steps	68
Rise	17 feet
Year of initial installation	1972
Direction of travel	up
Operating speed	90 F.P.M.

Research activities and sample

Phase 1

In February, 1995, the escalator under study was modified by EIS (Canada) in such a way as to introduce messages on the vertical (or "riser") portion of each step. Prior to modification, 8 hours of video were recorded during busy times as a "before" or baseline standard. This footage captured approximately 1,470 riders.

While the camera was visible to pedestrians, it was set up so as to blend with the background as far as possible. The camera was mounted on a tripod at the foot of the escalator and, hence, to the rear of riders. The operator sat approximately 12 meters away and all camera pilot lights were taped over so as to reduce the likelihood that riders would be cognizant of the camera. A bilingual sign indicating that taping may occur was affixed to the wall.

After modification, 252 riders were interviewed after being intercepted at the top of the escalator. A copy of the questionnaire appears as Appendix B.

The interviewer was bilingual and prepared to administer the questions in English or French. Interviewing began in the afternoon of the second day of operation after modifications to the escalator. Participation was entirely voluntary. Procedures conformed to the guidelines of the Canadian Professional Market Research Society. The interviewer was identified as an employee of Behavioural Team.

A further 8 hours of video were recorded after approximately two weeks of operation. 1,655 riders were recorded.

Potential interviewees were identified by a no-biased process. Of those identified, a total of 165 men and 87 women agreed to stop for interviews. This sex ratio is reasonably typical for this setting as for many other urban work settings.

	Count	Percent
Male	165	65.5
Female	87	34.5
Total	252	100.0

The age distribution of respondents is shown on the chart below. Ages run from 15 to 70 years, with an average age of 40 and a median age of 35.

The sample consisted of 40% travelers, 40% workers at the airport, and 20% people in the terminal to see off or to greet travelers. The workers were a mix of blue- and white-collar airport occupations.

With regard to "role," this sample had more workers than might be found in other locations because of the proximity of this escalator to the staff cafeteria and other heavily used staff routes. This is fortunate in that the sample represents both tourist/visitor and worker populations and provides a broader spectrum of experience — lots of one-time riders and lots of multi-trip riders — than another location might provide.

The total in the table below is 251 (out of a complete sample of 252 Phase 1 respondents). For one person, their role (whether they are a Traveler, Meet/Greet, or Worker) was not recorded into the data-set although the remainder of their data is reasonably intact. Totals in some other tables throughout this report may vary for the same reason.

	Count	Percent
Traveller	101	40.2
Meet/Greet	50	19.9
Worker	100	39.8
Total	251	100.0

Phase 2

After installation of the Phase 2 messages, 152 riders were interviewed after being intercepted at the top of the escalator. A copy of the questionnaire appears as Appendix C. No one was included who was interviewed in an earlier phase.

The data which follows are based on the entire sample of respondents. While none had been previously interviewed, some people had some exposure to the messages during Phase 1. The effect on memory results is minor and thus is not further addressed in this report.

A further 2 hours of video were recorded for documentation.

The distribution of men and women is as follows:

	Count	Percent
Male	91	60.3
Female	60	39.7
Total	151	100.0

Ages run from 18 to 70 years, with an average age of 38 and a median age of 35.

The distribution of roles was similar to that found in Phase 1, and is shown in the table below.

	Count	Percent
Traveller	63	41.4
Meet/Greet	33	21.7
Worker	56	36.8
Total	152	100.0

Phase 3

After installation of the Phase 3 messages, 154 riders were interviewed after being intercepted at the top of the escalator. A copy of the questionnaire appears as Appendix D. No one was included who was interviewed in an earlier phase.

The data which follows are based on the entire sample of respondents. While none had been previously interviewed, some people had some exposure to the Coke and Air Canada messages during Phases 1 and 2.

A further 2 hours of video were recorded for documentation.

The distribution of men and women is as follows:

	Count	Percent
Male	80	51.9
Female	74	48.1
Total	154	100.0

Ages run from 18 to 65 years, with an average age for respondents of 39 and a median age of 35.

The distribution of roles was similar to that found in Phases 1 and 2, and is shown in the table below. The number of workers has declined somewhat from 37% in Phase 2 to 29% in Phase 3 since individuals previously interviewed were excluded from later samples, thus narrowing the available worker population.

	Count	Percent
Traveller	72	46.8
Meet/Greet	37	24.0
Worker	45	29.2
Total	154	100.0

The Phase 3 sample agrees closely with those drawn in Phases 1 and 2.

Ridership and message exposure

Based on the observed number of riders captured on videotape during specific hours, it is possible to estimate the average number of riders over fixed periods of time for this escalator unit. Performing these calculations using 1994 Transport Canada data results in the following estimates.

Time period	Estimated number of rides
average per hour, 7:00 AM to 7:00 PM	160
day	2 545
per month	77 000
per year	925 000

It can also be estimated that...

43 800 travelers or greeters will use the escalator, averaging 12.7 times a year,

235 workers will use the escalator, averaging 1580 times a year, and

44 000 users of all sorts use the escalator, averaging 21 times a year.

Existing stationary signage

A variety of word and pictograph signs are mounted on or near the escalator for purposes of modifying behaviour or in compliance with governing code requirements. In all phases of the study, escalator riders were asked about the existing stationary signage to determine the recall of the messages.

The existing stationary messages are as follows:

- a pictogram sign showing the prohibition of baggage carts, wheelchairs, and red-cap-dollies on the escalator,[3]

[3] Messages such as these could be falsely recalled in the aided situation. In order to be counted as a correct recall, respondents also had to be able to answer that this sign was mounted on the wall near the escalator, a simple effort if the memory were genuine.

- a mandatory yellow pictograph sign relating instructions about holding the handrail, not allowing toes to be pinched and avoiding the sides of the escalator steps, and attending to children,[4]
- a small sign about stopping the escalator in an emergency,
- any information related to Bell Canada (which could include noticing the bank of phones at the base of the escalator or the new card vending machine), and
- a wall poster about drugs.

Results

Do riders notice escalator step messages?

Phase 1

Of the 252 individuals who consented to be interviewed, 7 (2.8%) could not think of "anything unusual about this escalator" even if their memory were directed (probed) to think about "...on the steps." These 7 were not interviewed further although their demographic characteristics were documented.

The magnitude of this number of no-notice riders (2.8% of the sample) has to be assessed against benchmarks such as the number of individuals in an international airport who can not read Roman-alphabet words, who are illiterate or dyslexic, whose vision is obscured because they are minding large pieces of luggage, who might wish to dissemble in the interest of skipping past an interviewer and getting on with their trip, or for that matter, who do not find messages on escalator risers in any way unusual.

In light of these factors, the true incidence of riders who do not notice the riser messages is some smaller fraction of the 7 who opted-out.

Phase 2

Of the 152 individuals who consented to be interviewed, all (100%) acknowledged that they knew something was new about this unit.

[4] Respondents also had to reply where the sticker was mounted.

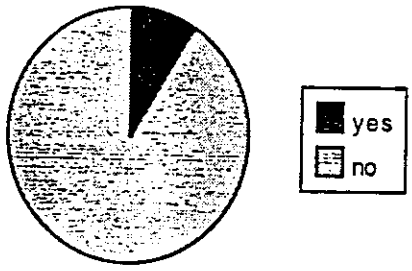
Phase 3

Of the 154 individuals who consented to be interviewed, all (100%) acknowledged that they knew something was new about this unit, as in Phase 2.

Can riders recall the existing stationary signage?

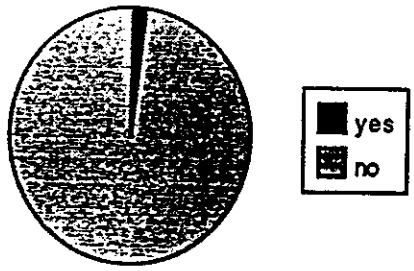
Phase 1

240 riders were asked which conventional stationary signs they could remember using the free-recall format. Only 23 people (9% of this sample) could remember *any* stationary sign despite the fact that 40% of the sample worked in the terminal building, used the escalator frequently, and many had done so for a long time.

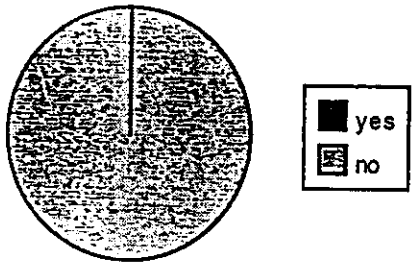


The free-recall for any of the stationary signs was quite poor. These results are shown in the following data.

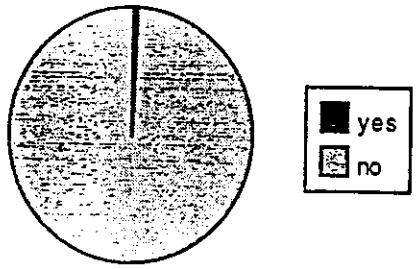
- 2% of the sample could recall the large wall-mounted panel showing three pictograms prohibiting various sorts of carts on the escalator,



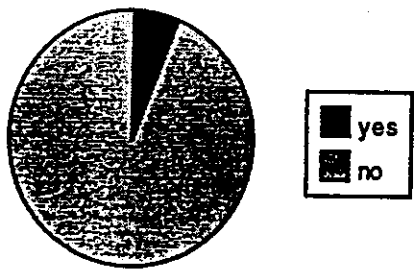
- 0.4% of the sample could recall the mandatory yellow sticker on the base of the escalator.



- 0.8% of the sample could recall the emergency warning without being prompted.

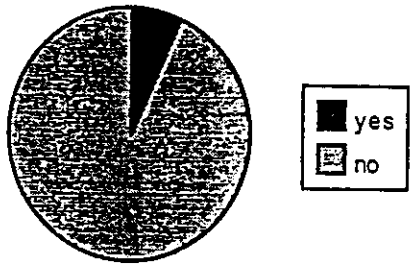


- 6.0% of the sample when aided could recall the Bell Canada material such as the bank of phones at the foot of the escalator or the new card vending machine nearby.



Phase 2

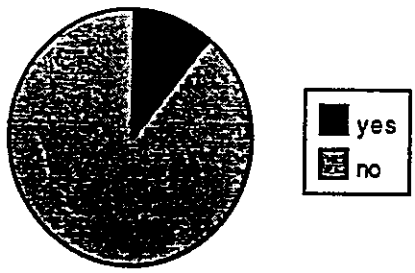
- Only 7% of the sample could recall *any* of the stationary signs in free-recall.



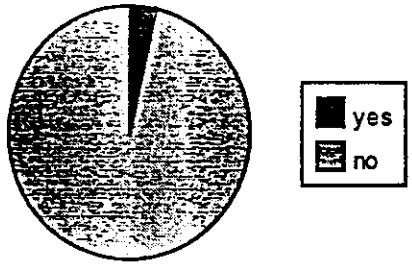
When reminded of the stationary signs by being prompted with some specifics of each sign one at a time, aided-recall of most of the stationary signs increased as compared to the free-recall levels noted in the preceding section of this report. These levels remain, however, far below any level of consciousness which might be deemed adequate for the promotion of safety or compliance to airport rules.

The recollection of the Bell Canada material — including a prominent bank of phones and a new vending machine — did increase substantially to 71%.

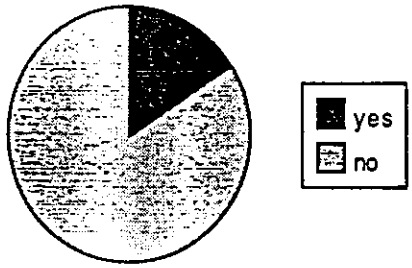
- 11% of the sample could recall the large panel with three cart prohibition pictograms when aided.



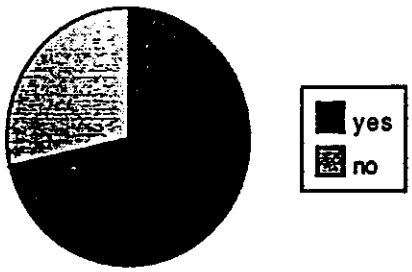
- 4% could recall the mandatory yellow sticker.



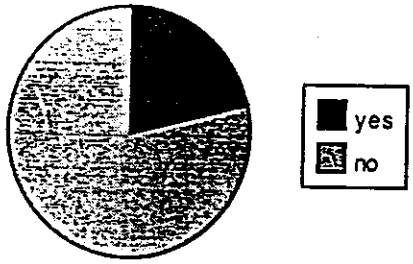
- 16% could recall the emergency warning under aided-recall.



- 71% of the sample could recall the Bell Canada material such as the bank of phones and the new card vending machine.

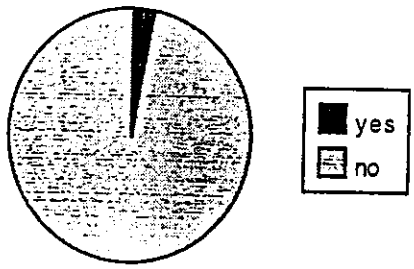


- 21% could recall the drug poster when helped.



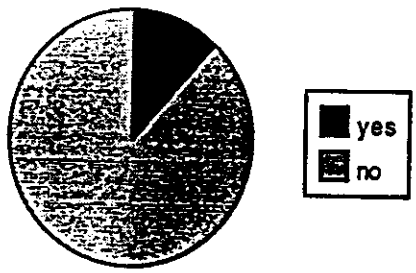
Phase 3

- Only 3% of the sample could recall *any* of the stationary signs in free-recall.

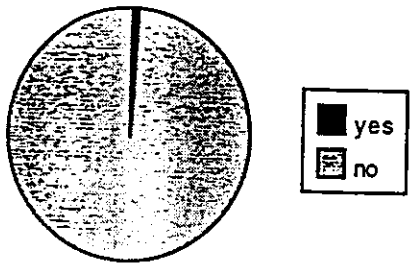


When reminded of each of the stationary signs by being prompted with the specifics of each sign, aided-recall of the stationary signs increased marginally.

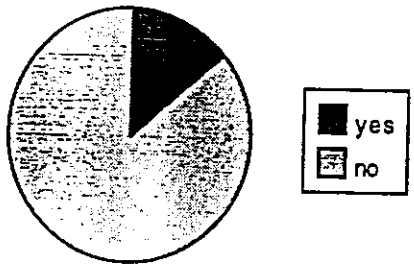
- 12% of the sample could recall the large wall-mounted panel showing three pictograms prohibiting various sorts of carts on the escalator.



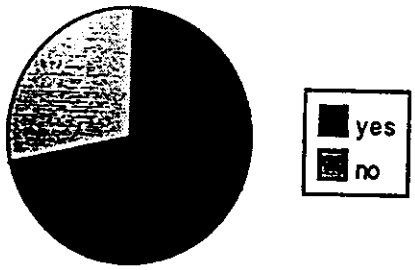
- 1% of the sample could recall the mandatory yellow sticker on the base of the escalator.



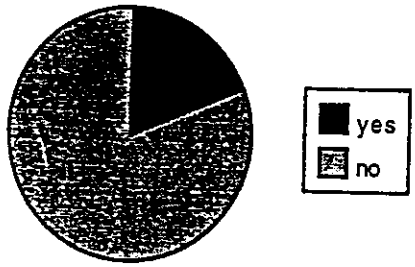
- 14% of the sample could recall the emergency warning when reminded.



- 71% of the sample when aided could recall the Bell Canada material such as the bank of phones at the foot of the escalator or the new card vending machine nearby.



- 19% of the sample could recall the drug poster when helped.

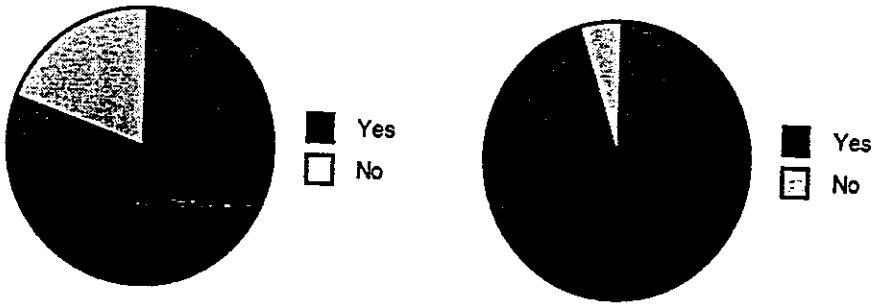


Can riders recall the messages?

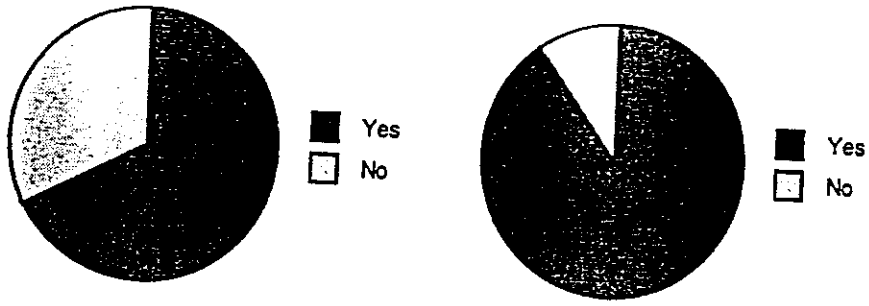
Phase 1

For the 245 riders who noticed the messages without any prompting, the data below show their free-recall and their aided-recall performance.

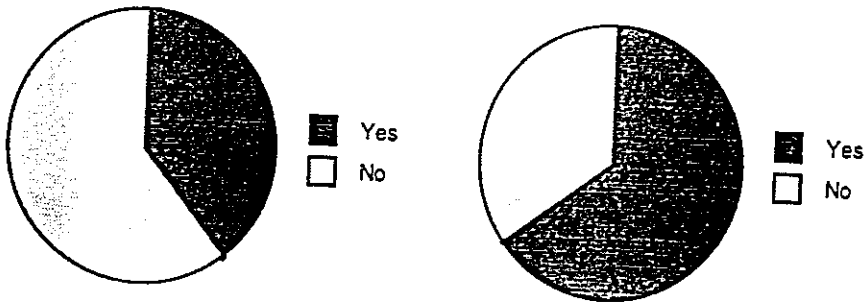
- 81% remember Air Canada, rising to 95% when aided.



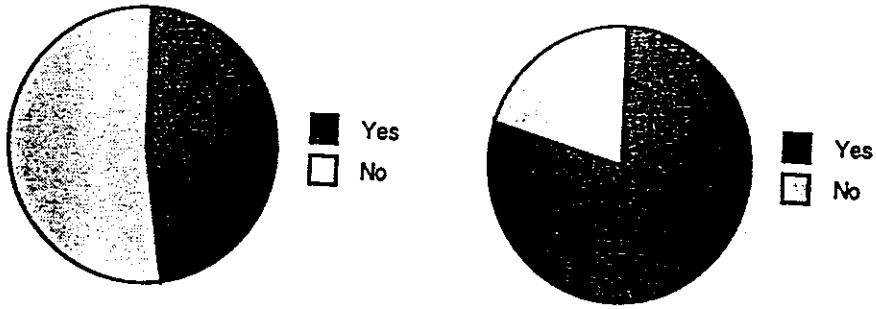
- 68% remember Coke, rising to 90% when aided.



- 39% remember Zuni non-alcoholic beer — despite being a brand invented just for this test, rising to 65% when aided, and



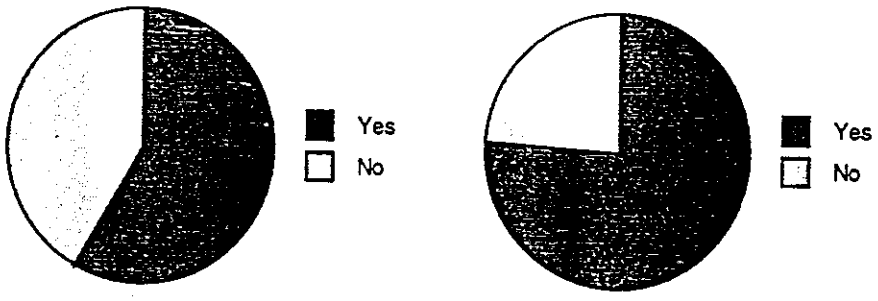
- 48% remember the warning against taking baggage carts on the escalator, rising to 80% when aided.



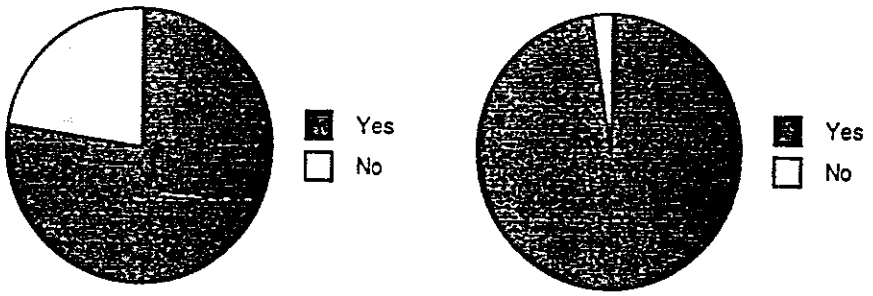
Phase 2

For the 152 riders, the data below show their free-recall and their aided-recall performance.

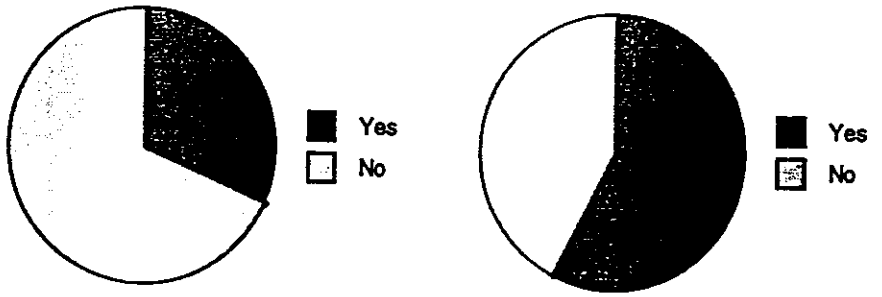
- 59% remember Air Canada, rising to 76% when aided.



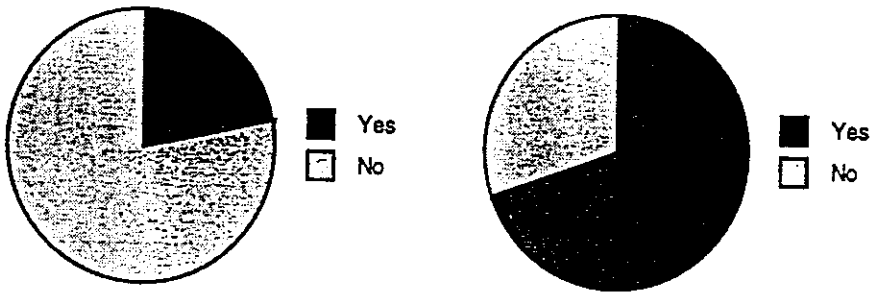
- 78% remember Coke, rising to 98% when aided.



- 32% remember Zuni non-alcoholic beer, rising to 58% when aided. and



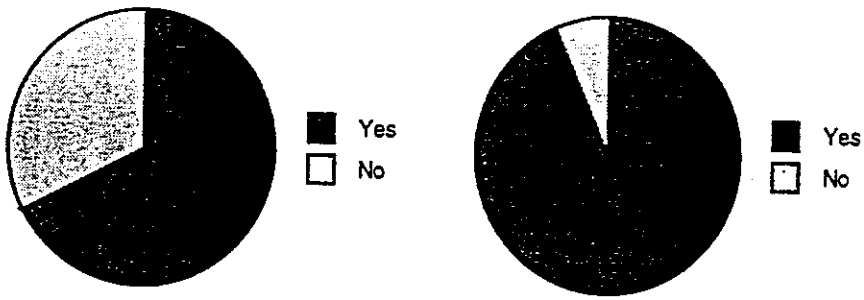
- 22% remember the warning to grab the handrails on the escalator, rising to 70% when aided.



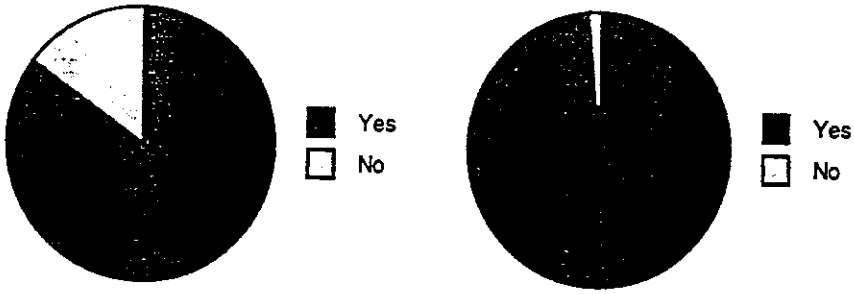
Phase 3

For the 154 riders, the data below show their free-recall and their aided-recall performance.

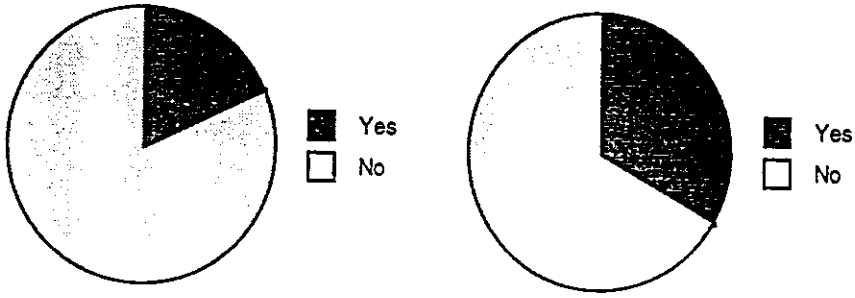
- 68% remember Air Canada, rising to 94% when aided.



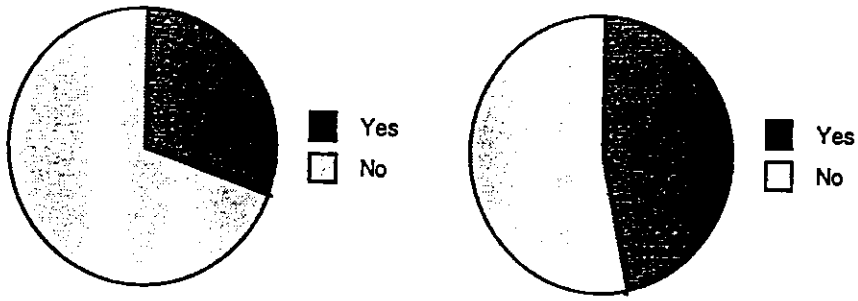
- 85% remember Coke, rising to 99% when aided.



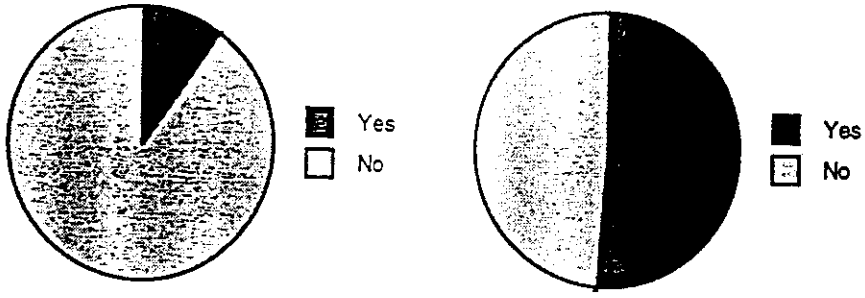
- 18% remember Diners Club, rising to 33% when aided,



- 31% remember Cathay Pacific, rising to 47% when aided, and

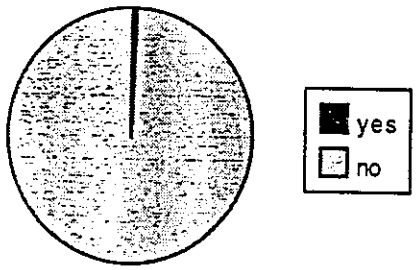


- 10% remember the warning to grab the handrails on the escalator, rising to 51% when aided.



To what extent are riders exaggerating their aided-recall?

2 of 245 (<1%) of the individuals in Phase 1 claimed that they *did* see the Christie cookie message when prompted in the aided-recall question even though no such message appeared on the steps.



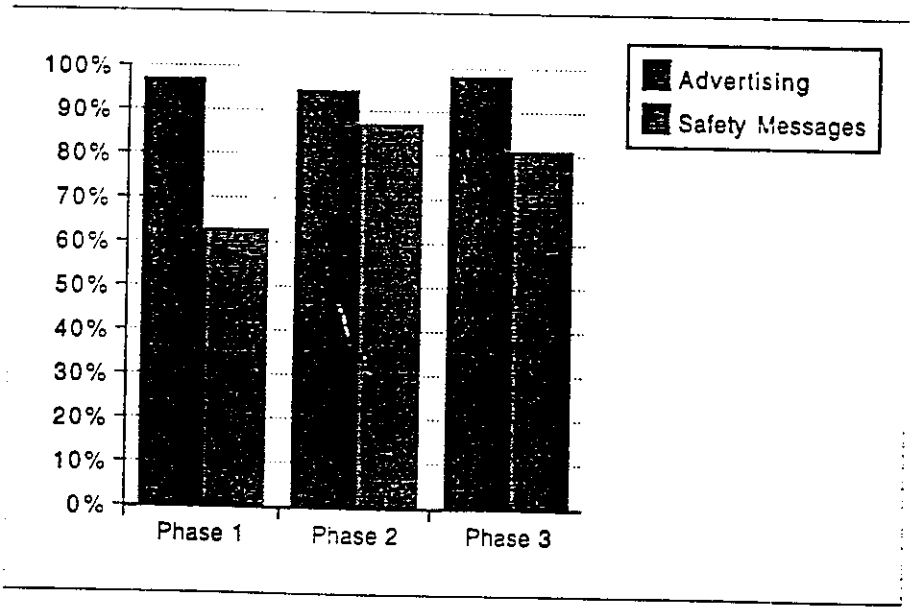
Are people favourable to messages presented in this manner?

Respondents were asked if they thought such EIS messages were "a good way or a poor way to convey *advertising* information to the public," and separately for *safety* information.

Percentage of Riders Favourable

	Phase 1	Phase 2	Phase 3
Advertising	97%	95%	98%
Safety Messages	63%	87%	81%

These figures are graphed in the chart below.



Advertising

Reactions to step advertising, as can be noted from the table and chart above, are exceedingly favourable. When the sample of 250 or so were queried in Phase 1, the reasons people gave for liking this form of advertising are...

- new, original (71 people),
- at eye level (69),
- the audience is captive (65),
- people look at their feet on an escalator (23),
- and various comments about being eye-catching (12).

Other than comments offering general reservations about advertising per se, 8 people found step advertising distracting. In view of the purposes of advertising, this type of remark can not be considered an entirely adverse point of view.

Safety messages

We asked for reactions to the EIS approach for "safety warnings." Over 60% are favourable towards safety messages displayed in this manner, as shown in the chart below.

Riders felt the safety messages had the same advantages as the advertising messages. However, certain messages relating to safe behaviour on escalators — such as "No carts" — are best delivered *before* boarding. The EIS Canada approach in Phase 1 *for this particular message,* was thus compromised by sometimes being noticed half way up the escalator, a point at which a prohibition about carts is less valid.

Reactions to safety messages were queried in Phase 1. Some of the reasons people are favourable to the EIS approach for safety messages are similar to those for advertising messages...

- at eye level (55 people),
- need to watch feet when getting on (31),
- gets attention, animated (22),
- and a general appreciation that the more safety information provided, the more good it can do (6).

And the some of the unfavourable reasons are similar too...

- adds to clutter (45 people),
- message may be seen too late (35),
- and messages can be distracting (10)

Was rider behaviour altered by contact with the escalator step signs?

Did use of baggage carts decline?

The total number of roll-on items (baggage carts, baby buggies, dollies, wheelchairs, etc.) did not show a reduction after the installation of the riser messages, as revealed on the videotapes in Phase 1.

	All Wheeled Aides	Baggage Carts	Riders	Baggage Cart Fraction
Before	34	25	1468	1.7%
After	38	24	1656	1.4%

The percentage frequency of all wheeled aides (including carts, buggies, and dollies) is stable before and after the installation of riser messages. Before the installation, 2.3% of riders take a wheeled aide up the escalator. After the installation, it is the same percentage, 2.3%.

But a closer look at the percentage frequency of baggage carts — the only item *specifically* identified in the prohibition message — is reduced from 1.7% to 1.4%, a reduction of 18%.

Did use of the handrail increase?

The safety message in Phases 2 and 3 was "Hold handrail." Was there a change in handrail use as a result of this message over the base rate before any EIS messages were installed?

In Phase 2, there were 11 hold-the-handrail messages. In Phase 3, there were 8.

Handrail use was observable on videotape from the moment of boarding until passengers reached the level of the second step-side lamp, roughly 10 steps.

	# of HR Users	Total # Riders	% of HR Users
Before	195	381	51%
After, Phase 2	221	355	62%
After, Phase 3	180	318	57%

The percentage frequency of handrail use increases by somewhere between 6% and 11%. This is most likely related to the frequency of the message of 8 or 11 times.

It is also correct to say that the percentage of non-users, persons at risk, decreased by 22% and 12% in the sequential phases as a result of the EIS sign.

How many trips on the escalator does it take to be able to remember messages?

Phase 1

1. Other than the 7 riders who claimed to not notice the riser messages, only one person could name under free-recall no messages. Under aided-recall probing, this person did remember seeing the Air Canada and the cart safety messages.

2. 130 riders were interviewed after just one trip up the modified escalator. In *a single trip* on the escalator, these riders on average recalled 1.7 messages and when aided, 2.9 messages. Five of these riders, 2% of the whole sample, could freely recall all four messages after a single trip!

It can be asked "How many trips are taken by those who can recall, say, three messages?" From the point of view of the researcher, all we know is that these people report three messages but they may be *close* to remembering four messages. So for those who recall three messages, it would be more precise to say they remember "between three and four" messages, not just three.

The statistic we are using in this section is the "median." In other words, half the group require more trips than the median and half require fewer. Using the common "average" would not be helpful because a single individual with say, 200 trips, would falsely weight an average calculation. This weighting does not happen with medians.

Able to recall no messages...

Only a single individual can freely recall <u>no message</u>. He had taken a single ride.

Able to recall 1 message...

63 individuals can freely recall only <u>one message</u>. Of these 63, the great majority, 55, have taken only a single trip. Therefore the median is 1.

Able to recall 2 messages...

The median number of rides to freely recall two messages is also 1. In other words, of the 87 individuals who can recall two messages, 56 have only taken a single ride up the escalator. This is 23% of the whole sample.

Able to recall 3 messages...

The median number of rides needed to freely recall three messages is 12. Of the 36 who recalled three messages, 13 were able to do so in a single trip. This is 5% of the whole sample.

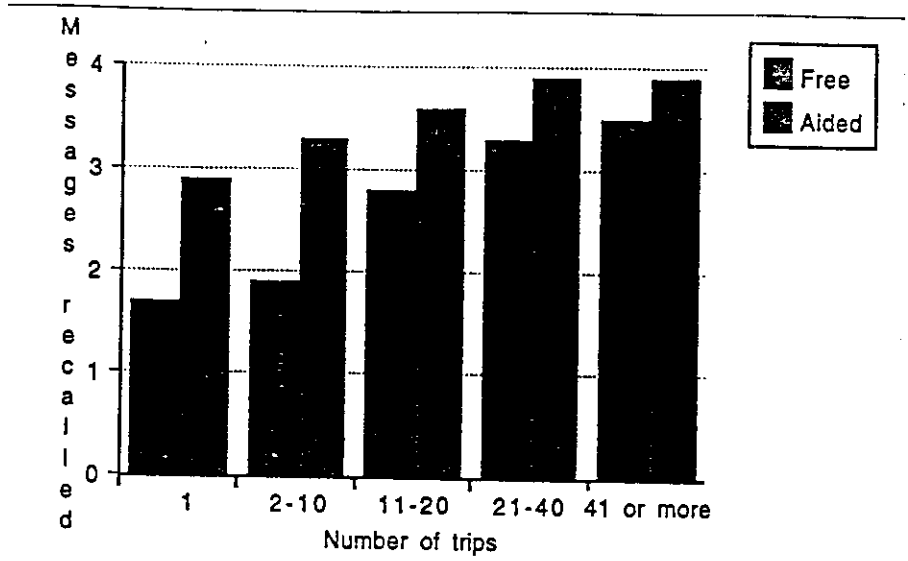
Able to recall 4 messages or more than 4 messages...

There is no simple way to establish within this methodology how many trips are needed to recall four messages. Some 6 riders in the sample made more than 120 trips and *some time* within that number of trips, four of them achieved a memory for all four signs and possibly could have remembered more... if more had been present. 58 individuals mentioned four signs.

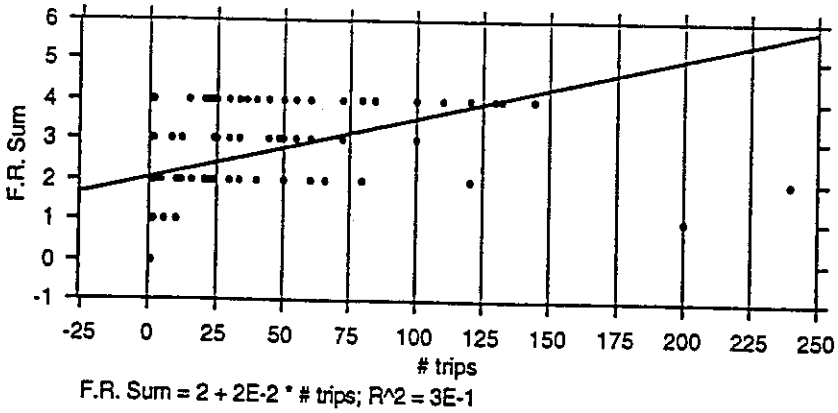
The median number of trips to freely recall four (or more) messages is 50 trips or roughly the number of trips a worker would take in a five week period of work when also counting his/her return trip to their workplace after lunch.

As mentioned above, five riders — 2% of the sample — were able to mention all four signs after a single trip.

3. The question of how much exposure to the messages is necessary to build up a memory for them can be addressed in another way. We can ask, "Looking only at those who had 2 to 10 trips on the escalator, how many messages can they recall?" The chart below shows the growth of recall over an arbitrarily selected set of trip frequencies.



4. A scattergram with a regression line predicting the number of messages which can be freely recalled as a consequence of the number of trips taken on this escalator is shown below. The mathematical prediction that you can recall messages before taking *any* trips should not be taken too literally!



CONCLUSIONS

1. Impact

In all three phases of the study, virtually all escalator riders noticed the step messages in some level of detail. This is even more remarkable considering that fewer than 10% of riders can freely recall the pre-existing *stationary* signs mounted in the vicinity of or on the test escalator, even though 40% of the sample are employed at the airport, use the escalator frequently, and have done so for a considerable period of time.

ESCALATOR STEP SIGNS vs. STATIONARY SIGNS
(UNAIDED-RECALL CONDITION)

	Phase 1	Phase 2	Phase 3
Escalator Step Signs	97.2%	100%	100%
Stationary Signs	9.0%	7.0%	3.0%

2. Recall

A chart comparing successive phases of the study is shown in Appendix E. The following conclusions can be made:

a. In Phase 1, where all messages were exposed to all riders, step messages on escalators result in free ("unaided") recall rates up to about 80% for individual messages. With a memory prompt ("aided-recall"), recall goes up to about 95% for individual messages.

b. Step message sequencing (exposure frequency and pattern) is a major factor in determining recall rates. For example with the Air Canada step messages, unaided-recall rates dropped from 81% to 59% in Phase 2, even though the total number of sign facings stayed the same. The same is true for Air Canada aided-recall rates where the percentages dropped from 95% to 76% in Phase 2. Thus, to effectively reach a target audience riding an escalator, the greater the exposure frequency the better.

RECALL RATE vs. EXPOSURE FOR "AIR CANADA"

	Total Signs	Sequence	Escalator Exposure	Unaided Recall	Aided Recall
Phase 1	20	Cyclical	Entire unit	81%	95%
Phase 2	20	Blocks of 10, 5, and 5	1/3	59%	76%

c. The message format of the step signage is another important factor in maximizing recall rate performance. In Phase 1, the familiar Coke logo was intermingled with an image of a Coke bottlecap (of 22 steps, 13 showed the Coke logo and 9 showed the Coke bottlecap). In Phase 2, the bottlecap was replaced with the familiar logo in contiguous blocks.

While the total number of facings for Coke actually decreased from 22 to 20 and the Coke logo alone appeared in a sequencing frequency similar to that of Air Canada, recall rates of both unaided and aided improved materially. This is further illustrated in Phase 3 where the total facings again decrease. Impact can best be achieved by a simple, recognizable message in contiguous format.

IMPACT FOR "COCA COLA" LOGO AND BOTTLECAP IMAGE

	# of Signs Coke Logo	# of Signs Coke Bottlecap	# of Signs Total	Sequence	Unaided Recall	Aided Recall
Phase 1	13	9	22	Cyclical	68%	90%
Phase 2	20	0	20	Blocks of 10, 5, 5	78%	98%
Phase 3	15	0	15	Blocks of 5, 5, 5	85%	99%

d. Repetitive exposure over an extended period of time maximizes recall performance rates. Both Air Canada and Coca Cola showed excellent results in Phase 3 when compared to Diners Club and Cathay Pacific. While survey respondents were only interviewed once, some respondents from Phase 3 had been exposed to the Air Canada and Coke messages for a longer period of time because those messages had been installed on the steps since Phase 1.

e. In spite of the shorter time frame, both Diners Club and Cathay Pacific scored relatively high recall rates even though their logos and messages may not be as recognizable as Air Canada and Coca Cola. Diners Club may have suffered to some degree because their logo is constrained by the size of the step facing and their "En Route" image may have been confused with the Air Canada similar usage of the name and appearance.

f. As with commercial messages, recall performance of safety messages proves that the message format and the frequency of exposure are both important to retention. In Phase 1, the safety message "No Baggage Carts" with an accompanying pictogram appeared every sixth step and achieved an unaided-recall rate of 48%. In Phase 2, the safety message "Hold Handrail" appeared on the same number of steps (every sixth step), but the unaided-recall rate declined to 22%. In Phase 3, with the safety message frequency further diluted to every eighth step, the unaided-recall rate declined to 10%. Thus, the more signs the more often, the better.

g. The colour and colour contrast of the step messages also plays a role in recall performance. In Phase 2, the background colour of the Zuni step messages was changed from turquoise to white because given the available lighting at the test site location, the white background provided better contrast for the black "Zuni" lettering. With the reduced step facing frequency in Phase 2, it was expected that recall rates would decline. In fact, Air Canada unaided-recall rates declined from 81% in Phase 1 to 59% in Phase 2, a reduction of some 27%. However, the unaided-recall rate for Zuni with its improved colouring declined only 18%, meaning the colouring had made a strong difference. This is further reinforced with the aided-recall comparison where Air Canada declined 20%, while Zuni declined only 11%.

3. Integrity of the Study Data

In Phase 1, only 2 respondents out of a total of 245 (0.8%) responded positively to a deceptive prompt suggesting the presence of a Christie cookie sign that did not, in fact, actually appear on the escalator. It can be concluded that the respondents to this study provided truthful answers that can be relied on.

4. Zuni Beer

The remarkable recall rates achieved by Zuni Beer prove most conclusively that escalator step messages are effective. Zuni is a fictitious product whose name appeared only on the steps of the test site escalator. Yet, in Phase 1 an unaided-recall rate of 39% was achieved, with an aided-recall rate of 65% with prompting. In Phase 2, with less numerous exposure, the unaided-recall rate was 32%, and the aided-recall rate was 58% with prompting.

FICTITIOUS PRODUCT RECALL OF "ZUNI NON-ALCOHOLIC BEER"

	Total Signs	Sequence	Escalator Exposure	Unaided Recall	Aided Recall
Phase 1	15	Cyclical	1/4	39%	65%
Phase 2	17	Blocks of 7, 5, 5	1/4	32%	58%

5. Level of Acceptability

In all three phases, social acceptability of this new advertising medium was extremely high. The percentage of respondents being favourable to advertising in this manner were 97%, 95%, and 98% in the three phases.

6. Safety Messages

In the public's best interest, the most gratifying results of the test were the recall numbers achieved by the escalator safety warning messages. The greatest increases in unaided to aided-recall rates occur with safety messages, signifying that once reminded, riders are now more aware of escalator safety. Add to this the noted change for the better in rider behaviour, ie. an 18% reduction in baggage cart usage on the escalator and a 22% reduction in persons at risk on the escalator by not holding the handrail, it can be concluded that escalator step messages are an effective means to modifying rider behaviour for the better.

7. Correlation Between Frequency and Recall

Other than those who claimed to notice nothing extraordinary about the escalator in Phase 1, only one rider could *not* freely recall a single message.

In *a single trip* on the escalator, riders on average freely recall 1.7 messages, and when aided, 2.9 messages. Of the sample of one-trip riders, 4% could remember all 4 messages.

The median number of trips needed to freely-recall one or two messages is one single trip. To recall three messages, the median is 12 trips. To recall four messages, the median is 50 trips (roughly the escalator travel time in five work weeks). Thus, an educational process is evident here with greater the number of trips, the greater the recall.

APPENDIX A

STEP SEQUENCING CHART

APPENDIX B

QUESTIONNAIRE PHASE 1

APPENDIX C

QUESTIONNAIRE PHASE 2

APPENDIX D

QUESTIONNAIRE PHASE 3

APPENDIX E

CHART COMPARING SUCCESSIVE PHASES OF THE STUDY

APPENDIX A

STEP SEQUENCING CHART

ESCALATOR INFORMATION SYSTEMS (CANADA) INC.
STEP ADVERTISING LAYOUT

BLDG: TERMINAL 2, LBPIA
UNIT: T2B2EM

DATE: 30-Jun-95

STEP	"PHASE 1 CONFIFGURATION" INITIAL LAYOUT		"PHASE 2 CONFIFGURATION" SECOND LAYOUT		"PHASE 3 CONFIFGURATION" THIRD LAYOUT
1	COCA COLA	1	COCA COLA	1	COCA COLA
2	AIR CANADA	2	COCA COLA	2	COCA COLA
3	FOR ALL THE WORLD	3	COCA COLA	3	COCA COLA
4	AIR CANADA	4	COCA COLA	4	COCA COLA
5	POUR LE MONDE ENTIER	5	COCA COLA	5	COCA COLA
6	NO BAGGAGE CARTS	6	HOLD HANDRAIL	6	HOLD HANDRAIL
7	COCA COLA	7	AIR CANADA	7	AIR CANADA
8	BOTTLE W/COKE LOGO	8	FOR ALL THE WORLD	8	FOR ALL THE WORLD
9	COCA COLA	9	AIR CANADA	9	AIR CANADA
10		10	POUR LE MONDE ENTIER	10	POUR LE MONDE ENTIER
11		11	AIR CANADA	11	AIR CANADA
12	NO BAGGAGE CARTS	12	HOLD HANDRAIL	12	HOLD HANDRAIL
13		13	POUR LE MONDE ENTIER	13	DINERS CLUB EN ROUTE
14	AIR CANADA	14	AIR CANADA	14	DINERS CLUB EN ROUTE
15	FOR ALL THE WORLD	15	FOR ALL THE WORLD	15	DINERS CLUB EN ROUTE
16	AIR CANADA	16	AIR CANADA	16	DINERS CLUB EN ROUTE
17	POUR LE MONDE ENTIER	17	POUR LE MONDE ENTIER	17	DINERS CLUB EN ROUTE
18	NO BAGGAGE CARTS	18	HOLD HANDRAIL	18	CATHAY PACIFIC
19		19	ZUNI BEER	19	THE HEART OF ASIA
20		20	THE SOUTHWEST DRY.....	20	CATHAY PACIFIC
21	COCA COLA	21	ZUNI BEER	21	LE COUER DE L'ASIE
22	BOTTLE W/COKE LOGO	22	THE SOUTHWEST DRY.....	22	CATHAY PACIFIC
23	COCA COLA	23	ZUNI BEER	23	HOLD HANDRAIL
24	NO BAGGAGE CARTS	24	HOLD HANDRAIL	24	COCA COLA
25		25	COCA COLA	25	COCA COLA
26		26	COCA COLA	26	COCA COLA
27	AIR CANADA	27	COCA COLA	27	COCA COLA
28	FOR ALL THE WORLD	28	COCA COLA	28	COCA COLA
29	AIR CANADA	29	COCA COLA	29	HOLD HANDRAIL
30	NO BAGGAGE CARTS	30	HOLD HANDRAIL	30	AIR CANADA
31	COCA COLA	31	COCA COLA	31	POUR LE MONDE ENTIER
32	BOTTLE W/COKE LOGO	32	COCA COLA	32	AIR CANADA
33	COCA COLA	33	COCA COLA	33	FOR ALL THE WORLD
34	BOTTLE W/COKE LOGO	34	COCA COLA	34	AIR CANADA
35		35	COCA COLA	35	DINERS CLUB EN ROUTE
36	NO BAGGAGE CARTS	36	HOLD HANDRAIL	36	DINERS CLUB EN ROUTE
37		37	AIR CANADA	37	DINERS CLUB EN ROUTE
38	AIR CANADA	38	POUR LE MONDE ENTIER	38	DINERS CLUB EN ROUTE
39	POUR LE MONDE ENTIER	39	AIR CANADA	39	DINERS CLUB EN ROUTE
40	AIR CANADA	40	FOR ALL THE WORLD	40	HOLD HANDRAIL
41	FOR ALL THE WORLD	41	AIR CANADA	41	CATHAY PACIFIC
42	NO BAGGAGE CARTS	42	HOLD HANDRAIL	42	THE HEART OF ASIA
43	COCA COLA	43	ZUNI BEER	43	CATHAY PACIFIC
44	BOTTLE W/COKE LOGO	44	THE SOUTHWEST DRY.....	44	LE COUER DE L'ASIE
45		45	ZUNI BEER	45	CATHAY PACIFIC
46		46	THE SOUTHWEST DRY.....	46	HOLD HANDRAIL
47		47	ZUNI BEER	47	COCA COLA
48	NO BAGGAGE CARTS	48	HOLD HANDRAIL	48	COCA COLA
49	AIR CANADA	49	COCA COLA	49	COCA COLA
50	POUR LE MONDE ENTIER	50	COCA COLA	50	COCA COLA
51	AIR CANADA	51	COCA COLA	51	COCA COLA
52	COCA COLA	52	COCA COLA	52	AIR CANADA
53	BOTTLE W/COKE LOGO	53	COCA COLA	53	POUR LE MONDE ENTIER
54	NO BAGGAGE CARTS	54	HOLD HANDRAIL	54	AIR CANADA
55	COCA COLA	55	AIR CANADA	55	FOR ALL THE WORLD
56	BOTTLE W/COKE LOGO	56	POUR LE MONDE ENTIER	56	AIR CANADA
57		57	AIR CANADA	57	HOLD HANDRAIL
58		58	FOR ALL THE WORLD	58	DINERS CLUB EN ROUTE
59		59	AIR CANADA	59	DINERS CLUB EN ROUTE
60	NO BAGGAGE CARTS	60	HOLD HANDRAIL	60	DINERS CLUB EN ROUTE
61	AIR CANADA	61	ZUNI BEER	61	DINERS CLUB EN ROUTE
62	FOR ALL THE WORLD	62	THE SOUTHWEST DRY.....	62	DINERS CLUB EN ROUTE
63	COCA COLA	63	ZUNI BEER	63	HOLD HANDRAIL
64	BOTTLE W/COKE LOGO	64	THE SOUTHWEST DRY.....	64	CATHAY PACIFIC
65	COCA COLA	65	ZUNI BEER	65	THE HEART OF ASIA
66	NO BAGGAGE CARTS	66	HOLD HANDRAIL	66	CATHAY PACIFIC
67	COCA COLA	67	ZUNI BEER	67	LE COUER DE L'ASIE
68	BOTTLE W/COKE LOGO	68	THE SOUTHWEST DRY.....	68	CATHAY PACIFIC

APPENDIX B

QUESTIONNAIRE PHASE 1

ESCALATOR INFORMATION SYSTEMS - PHASE 1 **S/N**_____

Did you notice anything unusual about this escalator? [Probe: ...on the steps?]

yes/correct ☐
yes/with probe ☐
no ☐ [if "no," remind person of EIS]

What signs can you recall? [Do not read this list, just tick those where some basic content is uttered.]

Air Canada ☐
Coke ☐
Zuni ☐
No Carts ☐

other, verbatim

1. _____
2. _____
3. _____
4. _____

Can you recall any signs on or near the escalators which aren't moving? What did they say? [Do not rea this list, just tick those where some basic content is uttered without prompting.]

☐ baggage carts, wheelchair, and red-cap-dolly pictogram
☐ Yellow warning sticker about hands
☐ Emergency
☐ Bell telephone stuff

other, verbatim

1. _____
2. _____

Do you recall seeing on the steps of this escalator the sign about... [BE SURE TO SCRAMBLE THE ORDER; pre-tick those already mentioned in earlier Q so you don't have to read them.]

☐ "Air Canada"
☐ "Coke"
☐ "Christie cookies"
☐ "Zuni beer"
☐ "'no carts' on the escalator"

Do you think a sign on the escalator is a good way or a poor way to convey escalator safety warnings? Why do think so?

yes/favourable ☐ no ☐

B T E A M

Reasons favourable_____
_____
_____

Reasons unfavourable_____
_____
_____

Do you think this is a good way or a poor way to convey advertising information to the public? Why do you think so?

yes/favourable ☐ no ☐

Reasons favourable_____
_____
_____

Reasons unfavourable_____
_____
_____

How many times in a typical [year OR workday] do you go up this escalator? ____year OR ___day

Altogether, how many times have you been up **this** escalator since the signs were installed on [say when]? [Probe: times each day x # days, roughly, ... but give an absolute number] ___= tot. # of times

What is your reason for being in the airport today? [Don't ask if obvious.]

☐ traveller
☐ to drop-off or meet someone
☐ worker
☐ other_____

How old are you, please? _____ [Probe: during what decade were you born? {Or your estimate.}]

RECORD BUT DO NOT ASK THE PERSON

Male ☐ female ☐

Did this person take a cart on the escalator...
Yes ☐ no ☐

Date _____ Time _____ Interviewer _____

B T E A M

APPENDIX C

QUESTIONNAIRE PHASE 2

B TEAM

ESCALATOR INFORMATION SYSTEMS (CANADA) - PHASE 2 **S/N**_____

Did you notice anything unusual about this escalator? [Probe: ...on the steps?]

yes/correct ☐
yes/with probe ☐
no ☐ [if "no," remind person of EIS]

What signs can you recall? [Do not read this list, just tick those where some basic content is uttered.]

Air Canada ☐
Coke ☐
Zuni ☐
Hold handrail! ☐ TENEZ LA MAIN COURANTE

other, verbatim

1. _____
2. _____

Can you recall any signs on or near the escalators which aren't moving? What did they say? [Do not re this list, just tick those where some basic content is uttered without prompting.]

☐ baggage carts, wheelchair, and red-cap-dolly pictogram
☐ Yellow warning sticker about hands, toes getting pinched ("avoid sides"), attending to children, and carts. What colour was the sign? [DO NOT TIC UNLESS COLOUR OR "BRIGHT" IS MENTIONED].
☐ Emergency
☐ Bell telephone stuff
☐ poster about drugs

other, verbatim

1. _____
2. _____

Do you recall seeing on the steps of this escalator the sign about... [BE SURE TO SCRAMBLE THE ORDER; pre-tick those already mentioned in earlier Q so you don't have to read them.]

☐ "Air Canada"
☐ "Coke"
☐ "Christie cookies"
☐ "Zuni beer"
☐ "Hold handrail" "TENEZ LA MAIN COURANTE"

Do you think a sign on the escalator is a good way or a poor way to convey escalator safety warnings?

yes/favourable ☐ no ☐

Do you think this is a good way or a poor way to convey advertising information to the public?

yes/favourable ☐ no ☐

I'd like to ask again about the stationary signs on or near the escalator. Do you recall seeing the sign about... [BE SURE TO SCRAMBLE THE ORDER. DO NOT pre-tick if the first two have already been mentioned in the earlier Q because you need to confirm further details.]

☐ The pictogram sign showing baggage carts, wheelchairs, and red-cap-dollies.
  ☐ Where was that sign mounted? [Must say, roughly, on the wall alongside]

☐ Yellow pictograph sign about holding the handrail, toes getting pinched and avoiding the sides of the escalator, attending to children, and carts.
  ☐ Where was that sign mounted? [Must say, roughly at the bottom of the escalator]

☐ The sign about stopping the escalator in an emergency

☐ Any information related to Bell telephone

☐ the wall poster about drugs

Altogether, how many times have you been up this escalator since the signs were installed on Tuesday Feb 21? [Probe: times each day x # days, roughly, ... but give an absolute number] ___= tot. # of times

Altogether, how many times have you been up this escalator since the signs were last changed on Tuesday, March 21? ___= tot. # of times

What is your reason for being in the airport today? [Don't ask if obvious.]

☐ traveler
☐ to drop-off or meet someone
☐ worker
☐ other_____

How old are you, please? _____ [Probe: during what decade were you born? {Or your estimate.}]

RECORD BUT DO NOT ASK THE PERSON

Male ☐ female ☐

Did this person take a cart on the escalator...
Yes ☐ no ☐

Date _____ Time _____ Interviewer _____

APPENDIX D

QUESTIONNAIRE PHASE 3

ESCALATOR INFORMATION SYSTEMS (CANADA) - PHASE 3 S/N_____

Did you notice anything unusual about this escalator? [Probe: ...on the steps?]

yes/correct ☐
yes/with probe ☐
no ☐ [if "no," remind person of EIS]

What signs can you recall? [Do not read this list, just tick those where some basic content is uttered.]

Air Canada ☐
Coke ☐
Diners Club ☐
Cathay Pacific ☐
Hold handrail ☐ TENEZ LA MAIN COURANTE

other, verbatim _____

Can you recall any signs on or near the escalators which aren't moving? What did they say? [Do not read this list, just tick those where some basic content is uttered without prompting.]

☐ baggage carts, wheelchair, and red-cap-dolly pictogram
☐ Yellow warning sticker about hands, toes getting pinched ("avoid sides"), attending to children, and carts. What colour was the sign? [DO NOT TICK UNLESS COLOUR OR "BRIGHT" IS MENTIONED].
☐ Emergency
☐ Bell telephone stuff
☐ poster about drugs

other, verbatim_____

Do you recall seeing on the steps of this escalator the sign about... [BE SURE TO SCRAMBLE THE ORDER; pre-tick those already mentioned in earlier Q so you don't have to read them.]

☐ "Air Canada"
☐ "Coke"
☐ "Diners Club"
☐ "Cathay Pacific"
☐ "Hold handrail" "TENEZ LA MAIN COURANTE"

Do you think a sign on the escalator is a good way or a poor way to convey escalator safety warnings?

yes/favourable ☐ no ☐

Do you think this is a good way or a poor way to convey advertising information to the public?

yes/favourable ☐ no ☐

B T E A M

I'd like to ask again about the stationary signs on or near the escalator. Do you recall seeing the sign about... [BE SURE TO SCRAMBLE THE ORDER. DO NOT pre-tick if the first two have already been mentioned in the earlier Q because you need to confirm further details.]

☐ The pictogram sign showing baggage carts, wheelchairs, and red-cap-dollies.

☐ Where was that sign mounted? [Must say, roughly, on the wall alongside]

☐ Yellow pictograph sign about holding the handrail, toes getting pinched and avoiding the sides of the escalator, attending to children, and carts.

☐ Where was that sign mounted? [Must say, roughly at the bottom of the escalator]

☐ The sign about stopping the escalator in an emergency

☐ Any information related to Bell telephone

☐ the wall poster about drugs

Altogether, how many times have you been up this escalator since the signs were installed on Tuesday, Feb 21? [Probe: times each day x # days, roughly, ... but give an absolute number] ___= tot. # of times

Altogether, how many times have you been up this escalator since the signs were last changed on Tuesday, April 4? ___= tot. # of times

What is your reason for being in the airport today? [Don't ask if obvious.]

☐ traveler
☐ to drop-off or meet someone
☐ worker
☐ other_____

How old are you, please? _____ [Probe: during what decade were you born? {Or your estimate.}]

RECORD BUT DO NOT ASK THE PERSON

Male ☐ female ☐

Did this person take a cart on the escalator...
Yes ☐ no ☐

Date _____ Time _____ Interviewer _____

APPENDIX E

CHART COMPARING SUCCESSIVE PHASES OF THE STUDY

APPENDIX E: CHART COMPARING SUCCESSIVE PHASES OF THE STUDY

STEP MESSAGE	PHASE1 RECALL RATE	PHASE1 LAYOUT	PHASE2 RECALL RATE	PHASE2 LAYOUT	PHASE3 RECALL RATE	PHASE3 LAYOUT
AIR CANADA						
- "Unaided"	81%	- 20 signs	59%	- 20 signs	68%	- 15 signs
- "Aided"	95%	- Cyclical	76%	- Blocks of 10, 5, 5	94%	- Blocks of 5, 5, 5
COCA COLA						
- "Unaided"	68%	- 22 signs	78%	- 20 signs	85%	- 15 signs
- "Aided"	90%	- Cyclical	98%	- Blocks of 10, 5, 5 - 9 Coke bottlecaps replaced with Coke logo	99%	- Blocks of 5, 5, 5
ZUNI BEER (fictitious)						
- "Unaided"	39%	- 15 signs	32%	- 17 signs	N/A	
- "Aided"	65%	- Cyclical	58%	- Blocks of 7, 5, 5 - New background colour	N/A	
SAFETY MESSAGE						
- "Unaided"	48%	- 11 signs	22%	- 11 signs	10%	- 8 signs
- "Aided"	80%	- every 6th step -"NO BAGGAGE CARTS"	70%	- every 6th step - "HOLD HANDRAIL"	51%	- every 8th step - "HOLD HANDRAIL"
DINERS CLUB						
- "Unaided"	N/A		N/A		18%	- 15 signs
- "Aided"	N/A		N/A		33%	- Blocks of 5, 5, 5
CATHAY PACIFIC						
- "Unaided"	N/A		N/A		31%	- 15 signs
- "Aided"	N/A		N/A		47%	- Blocks of 5, 5, 5

2155 Winding Way,
Burlington, Ontario, Canada
L7M 2Y2

VIA FACSIMILE - to (301)-504-0127

November 19, 1997

U.S. Consumer Product Safety Commission,
Office of the Secretary,
Freedom of Information Division,
4340 East West Highway,
Room 502,
Bethesda, MD 20814-4408

Attention: Mr. T. A. Stevenson
Deputy Secretary and
Freedom of Information Officer

Subject: Meeting Summary October 21, 1997 / EIS Systems

Dear Mr. Stevenson,

I acknowledge receipt of your mailing to me dated October 29, 1997, regarding the above-noted subject.

Upon review, I find the information contained to be accurate. I confirm that I have no objection to the meeting summary becoming public record.

I appreciate you providing me the opportunity to comment. Thank you very much.

Yours sincerely,

W. H. Parkes
President

ESCALATOR INFORMATION SYSTEMS (CANADA) INC.

U.S. CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, D.C. 20207

October 29, 1997

AIR MAIL

Mr. William H. Parkes
President
Escalator Information Systems (Canada) Inc.
110 King Street West, Suite 780
Hamilton, Ontario L8P 4S6

RE: Meeting Summary October 21, 1997 / EIS Systems

Dear Mr. Parkes:

The Commission intends to make the enclosed meeting summary a part of its public record. We are sending you the summary so you may comment on the information under the procedures in section 6(b) of the Consumer Product Safety Act (CPSA) (copy enclosed). That section requires the Commission to provide the opportunity to comment on certain information from which the identity of a manufacturer or private labeler of a consumer product may be readily ascertained by the public. The comments you submit pertaining to the information will be considered during our processing of the meeting summary. Prior to disclosure of the meeting summary, the Commission will determine the reasonable steps to be taken, if necessary, to fulfill the requirements of section 6(b)(1) of the CPSA. You may also request confidential treatment of information in accordance with section 6(a)(3) of the CPSA.

To assist the Commission in evaluating the accuracy of the information contained in the meeting summary, your comments on the enclosed material must be specific and supported by documentary evidence, where available. You should also include with your comments all explanatory data or other relevant information for the Commission's consideration. Please note that Commission considers broadly expressed comments that lack specific supporting information insufficient to sustain objections to or comments on accuracy.

If the Commission decides to disclose the meeting summary after its review, taking into consideration your comments, the Commission may also release to the public your comments (or a summary) unless you request that your comments (or portions) not be released. If making this meeting/telephone summary available to the public requires

explanatory statements, these statements may be based, in part, on your comments. Therefore, please be specific, and let us know if there is any other information pertaining to the subject matter of the meeting of which we should be aware.

To permit full consideration, your written comments must be received within 20 calendar days of the date of this letter with three additional days allowed if you receive the material by mail. Comments should be sent to me. Thank you for your assistance.

Sincerely,

Todd A. Stevenson
Deputy Secretary and
Freedom of Information Officer
Office of the Secretary

Enclosures