DIMENSIONS OF PERSON-WINDOW TRANSACTIONS IN THE HOSPITAL ENVIRONMENT

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ABSTRACT: An empirical investigation focused on person-window transactions in the physical medicine and rehabilitation environment. Attributes of windows, view, daylight, and spaces perceived as insufficient in these respects were studied in six hospitals. Preference, environmental documentation, and behaviors associated with windows and windowless rooms were the subject of a two-part interview and questionnaire. The respondent group numbered 250 persons. Nonmetric multidimensional scaling (MDS) was utilized, yielding an array of 21 cognitive dimensions. From evaluations of 56 photographs that sampled a broad spectrum of spaces ranging from highly windowed to windowless, 8 visual dimensions were identified; and 13 nonvisual dimensions distilled from 89 written response items were identified that addressed degree of satisfaction and associated behaviors. Among the findings, ideal window and view conditions frequently contrasted the actual conditions in one's hospital setting; informative views of urban life and nature beyond the hospital, accessible from one's typical viewing angle and position within the room, were desired; minimally windowed rooms were equated with architecturally windowless spaces, and window-view substitutes in windowless rooms were distinguished from similar rooms without such compensatory measures. Implications for hospital planning and design are discussed.

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Windowlessness in the hospital intensive care unit has been found to be a form of sensory deprivation (Wilson, 1972); and reactions to windowless offices (Ne'eman and Hopkinson, 1970; Cooper et al., 1973; Ne'eman, 1974), schools (Larson, 1965), hospitals (Ulrich, 1984), and factories (Manning, 1963) have been studied, indicating the psychological importance of windows to building occupants. The human predilection for windows is timeless. Throughout history the window has provided fresh air, daylight, the sounds of life, view amenity, the change in season, and knowledge of day becoming night. The window connects life indoors with the pulse of the street and community. But in recent years more and more buildings have been designed with few or no windows. This trend has occurred in part due to new building technologies, advances in lighting, and an emphasis on energy conservation.

Windowless spaces in hospitals, in particular, have been of concern to health care specialists (Lavy, 1978; Vaisrub, 1979; Keep, 1980), critics (Lord Taylor, 1979; Huxtable, 1981), design researchers (Collins, 1975; Canter and Canter, 1979), and architects (Zeidler, 1974; Lindheim, 1979-1980). Sophisticated medical technologies have their drawbacks: Architecture becomes reduced to little more than a container for technology; yet throughout history architecture has been an integral factor in the quality of health care and human well-being (Thompson and Goldin, 1975; Beck and Meyer, 1982). In the present discussion, person-window transactions are conceptualized as a continuum characterized by architecturally windowless conditions on one endpoint and highly windowed conditions on the other. The behavioral component is characterized by one's involvement with the external world vis-à-vis the window aperture, comprehension of the environment (Kaplan and Kaplan, 1978), satisfaction (Ludlow, 1972), and behavioral responses of occupants resulting from too little or too much contact with windows (stimulus overload-underload).

Specifically, view content, daylight, sill height, screens, aperture size, degree of exposure to these variables, and

personal factors are the focus of this discussion. The term "windowness" represents an attempt to conceptualize window-person variables. The two objectives of this discussion are (1) to identify an initial array of factors that collectively help in understanding subtleties beyond the windowed-windowless, either-or dichotomies that pervade the literature (Chambers, 1963-1964; Hollister, 1968; Ruys, 1970; Tognoli, 1973) and (2) to explore two user groups who experience the same hospital environment, but in different ways.

This study is rooted, theoretically, in a functionalist-evolutionary theory of human functioning in the physical environment (Kaplan and Kaplan, 1978). It is postulated that humans are biologically predisposed to crave visual information about their environmental surroundings. This predilection leads people to endeavor to perceive effectively and comprehend (make sense of) incoming information to maintain a satisfactory degree of coping with the uncertainty inherent in the environment. It was hypothesized that patients would be critical of insufficiently windowed spaces because they are incarcerated for relatively extended periods of time with few opportunities for respite. Staff, by contrast, would be less critical because they are able to self-select their degree of windowness, and relatively free to come and go. The physical medicine and rehabilitation environment (PMR) was selected as the fieldwork setting because patients are typically in the hospital for upwards of 3 months without respite while undergoing therapeutic treatment regimens, are relatively alert, and often appreciate social contact and because the information provided by windows in the PMR environment may in fact be therapeutic reinforcement of the basic objective of PMR treatment, which is to reintegrate the individual as fully as possible into the mainstream of society.

The rehabilitation process encompasses many subdisciplines. Its purpose is to retrain severely disabled persons—many of whom only narrowly escaped death through acci-

dent or disease—to live and work as independently as possible with their remaining capabilities. The subdisciplines within PMR include physical therapy, occupational therapy, recreational therapy, social and psychological counseling, speech pathology, audiology, rehabilitation nursing, and psychiatry. The PMR unit is typically an internal unit within a community hospital; these programs are augmented by about a dozen freestanding rehabilitation hospitals and regional spinal cord injury treatment centers across the United States. A cross section of six PMR environments served as the fieldwork settings. All hospitals were located in Chicago; some units were far more windowed than others.

RESPONDENTS

Data obtained from 125 staff persons and 125 inpatients are reported below. Male and female patient respondents were roughly equal in number; 62% of staff respondents were female. Generally, patients were wheelchair-dependent (58%), somewhat elderly (mean age = 62), victims of spinal cord injury—quadriplegic or paraplegic—(28%), stroke victims (25.8%), or postacute orthopedic patients (14.6%). The average length of stay in an inpatient ward was nearly 2 months (54.6 days). All were inpatients at the time of the study. The assessed degree of functional independence differed between patients, as did the severity of condition, prognosis for a full recovery, socioeconomic background, general outlook on life, and the type of therapeutic treatment program prescribed.

INSTRUMENTATION AND PROCEDURE

A photoquestionnaire was developed for use in the six PMR settings: 64 color 4 × 5 photographs were presented

that illustrated conditions in 11 hospitals with PMR units; rooms shown ranged from entirely windowless to windowed. This was followed by 10 written questions (89 response items) concerning preference, self-ratings of one's general satisfaction with windows in one's unit, and the extent to which patients and staff engaged in behavior judged to be associated with "windowness." Counterbalancing was used to help avoid response bias. Color photographs were selected for inclusion because they are relatively easy to comprehend and are descriptive (Collier, 1967; R. Kaplan, 1979; Zeisel, 1981), and because a mix of photos and words is more informative than relying on one or the other alone. Initially, 225 slides were taken, controlling for viewing angle (45° left to right, standing versus seated position), distance to aperture (3 feet to 20 feet), window size relative to room size, sill height (Keighley, 1973a, 1973b), view content, consistent weather conditions (clear sky), and screening (closed to completely open).[1] Markus's (1967) discussion of the three compositional layers in a view (ground, inanimate urban, and sky) guided this sampling process (combinations of one, two, and three layers). Three domains were sampled: the patient living unit, therapeutic treatment, and staff office.[2] Efforts to modify windowless rooms were also documented (nature murals, plants, artifacts). No people were shown in the photos.

Two identical sets of color prints were mounted in two black 8½ inch × 11 inch three-ring binders, four photos per page. Each picture was rated along a 5-point scale: column 1 denoted lowest preference ("not at all") and column 5 denoted highest preference ("very much"). Pages 1-3 of the photoquestionnaire contained these items. Questions regarding "ideal" windows and views from each domain, satisfaction, and behavioral responses (disposition, emotional status, privacy needs, and involvement in activities such as watching television, listening to the radio, talking with others, interest in the weather, and reading) were drawn from preliminary interviews and observation; and each was also rated on a 5-point scale.

A pretest was conducted to assess the research instrument and procedure.[3] Staff persons self-administered the tasks during breaks; and patients were interviewed at bedside, in lounges, or in therapy treatment areas. Interviews were conducted between 9:00 a.m. and 5:00 p.m. weekdays, and during evenings and weekends. The format was flexible, tailored to the respondent's capabilities. Questions about the respondent's actual environment were typically phrased as follows:

"How much would you prefer the following?" . . .

"How satisfied are you with this particular aspect of the windows in your hospital?" or

"How often do you engage in the following activities?" . . .

One-half hour was required for completion of the photo-questionnaire. Respondents were instructed to work individually and to think of the question in terms of where they spent the most time during daylight hours. Most found the tasks enjoyable.

ANALYSIS AND RESULTS

Nonmetric multidimensional scaling (SSA-III) was utilized (Lingoes, 1966, 1967; Winter, 1974) to discern an underlying conceptual structure. This multivariate data reduction procedure yielded two sets of factors. However, staff and patient ratings were grouped together to attain greater strength in the SSA-III analyses, and staff and patients were compared as well.

For each dimension, the criterion for item retention was a loading $>.40$. Photographs 1-56 yielded 8 factors; 43 photos loaded among the 8 factors. Due to content redundancies, 13 items were dropped. The coefficient of alienation was .31 for the 8-factor SSA-III solution. Nonphotographic response items were subjected to a separate series of SSA-III

analyses that yielded 13 content dimensions. Due to content redundancies, 18 items were dropped. The coefficient of alienation for the 13-factor solution was .35. In all, the 21 dimensions were found to be internally strong, consistent, and conceptually discrete. However, for purposes of discussion, the 12 preference-based dimensions are grouped together (Table 1) and the 9 dimensions based on respondent satisfaction and associated behaviors are similarly grouped (Tables 2 and 3).

In each table, the dimensions are ranked from high to low, based on patients' responses. The "coherence" statistic is Cronbach's alpha coefficient of index reliability, computed for each dimension based on the combined responses of staff and patients. For each dimension (and item) Student's t-tests were performed to compare staff with patients. Also, for each of the three groupings of dimensions, an Analysis of Variance (one-way ANOVA) was performed to detect significant differences. Table 1 dimensions did differ significantly between groups ($F = 4.98$, $df = 11, 234$, $p < .001$), as did Table 2 dimensions ($F = 2.21$, $df = 3, 239$, $p < .01$), whereas the dimensions reported in Table 3 did not. Each consisted of either photo representations or written items, but not a combination of both.

PREFERENCE

In Table 1, dimensions are rank-ordered based on mean preference ratings of patients. For photos, the most desired views from therapy rooms were of trees and lawns, the surrounding neighborhood, people outside, and near and distant vistas (Views of Cityscape, mean = 3.74), and particularly those that afford information about activity outside (Views of Streetlife, mean = 3.61). Photographs of windows with sill heights from 30 to 36 inches above the floor, and taken from an angle that allowed a view of two or three compositional layers (Markus, 1967) clustered together

TABLE 1
Preference Dimensions

	Number of Items	Staff $\bar{X}$	Staff Variance	Patients $\bar{X}$	Patients Variance	Reliability
1. Preferred Views from Treatment Areas[a]	6	4.08	.52	3.96	.37	.77
2. Views of Cityscape	7	3.43	.33	3.74	.33	.66[b]
3. Views of Streetlife	3	3.88	.53	3.61	.70	.61[c]
4. Nature Content[a]	4	3.99	.40	3.45	.46	.63[b]
5. Appropriate Sill Height	3	3.27	.67	3.40	.72	.67
6. View Surrogates[a]	5	3.60	.58	3.37	.45	.72[d]
7. Sunlight	8	3.15	.41	3.10	.52	.76
8. View Surrogates (Nature)	6	2.89	.41	2.78	.50	.65
9. Disliked Views from Treatment Areas[a]	4	2.03	.48	2.47	.43	.61[b]
10. Disorienting Views	2	2.09	.78	2.21	1.07	.78
11. Windowlessness (Architectural)	6	1.94	.44	2.02	.37	.74
12. Windowlessness (Psychological)	8	1.58	.17	2.00	.33	.74[b]

a. Composed of written response items only.
b. $p < .001$.
c. $p < .01$.
d. $p < .05$.

TABLE 2
Satisfaction Dimensions

VARIABLE	LOADING	STAFF $\bar{X}$	STAFF VARIANCE	PATIENTS $\bar{X}$	PATIENTS VARIANCE
1. Hospital Environs (.76)[a]					
A. Open space	-.63	3.01	1.58	2.97	1.08
B. Security and Safety	-.62	3.37	1.16	3.38	1.06
C. Location within city	-.60	3.91	1.31	3.41	.76
D. Appearance	-.55	3.94	1.02	3.52	1.50
E. Trees and Vegetation	-.51	2.86	1.32	2.98	1.26
F. Satisfaction with neighborhood	.44	2.51	1.74	2.64	1.26
G. "Home away from home"	.42	2.19	1.31	2.27	1.36
2. Windows at Home (.72)[a,b]					
A. Views from windows	-.83	3.80	1.40	3.46	.88
B. Contact with outside	-.81	3.44	1.56	3.47	.96
C. Amount of Vegetation	-.73	3.75	1.20	3.22	1.44
D. Number of windows	-.70	3.54	1.49	3.44	.89
E. Satisfaction with neighborhood	-.50	1.35	.26	1.35	.60
3. Exposure (.83)[a].					
A. Use of curtains and blinds	.74	2.81	1.78	2.97	1.64
B. Privacy (visual)	.66	2.58	1.55	2.81	1.51
C. Size of therapy rooms	.61	3.08	1.68	3.03	1.38
D. Distance from beds to therapy rooms	.60	2.83	1.89	2.75	1.49
E. Talking with others	.56	3.67	1.32	3.25	1.49
F. Opportunities for caring for plants	.49	2.47	2.25	1.96	1.36
4. Actual Views from Treatment Areas (.90)[a]					
A. Views of nearby Buildings	-.84	2.44	1.82	2.40	1.60
B. Views of trees and vegetation	-.77	2.09	1.56	2.24	1.46
C. Visual contact with outside	-.76	2.53	2.05	2.45	1.57
D. Views from your eye level	-.72	2.56	2.36	2.58	1.70
E. Views from street	-.71	2.19	1.74	2.49	1.79
F. Distance from window	-.65	2.79	2.35	2.60	1.45
G. Sunlight level	-.64	2.87	2.59	2.97	2.12
H. Window size and shape	-.61	2.99	2.45	2.60	1.65
I. Proximity to lake	.40	3.45	2.10	3.47	1.47

a. Cronbach's alpha coefficient of index reliability.
b. $p < .001$.

(Appropriate Sill Height, mean = 3.40): nearby buildings, auto traffic, pedestrians, and views of Lake Michigan and the Chicago lakefront.

A second group of preference-based photo dimensions focused on substitutes for meaningful view content from windowless and minimally windowed rooms within the PMR environment and on windows that allow daylight and

TABLE 3
Associated Dimensions

VARIABLE	LOADING	STAFF $\bar{X}$	STAFF VARIANCE	PATIENTS $\bar{X}$	PATIENTS VARIANCE
1. Psycho-Emotional Successes (.78)[a,b]					
A. done things important to me	.67	3.47	.84	3.08	1.24
B. closest to dear ones	.58	3.61	.82	3.29	.97
C. kept spirits up	.51	3.50	.60	3.45	.61
D. reached my personal goals	.49	3.56	.61	3.10	.70
2. Social Contact (.77)[a,c]					
A. belonging to a group	.69	3.68	1.05	3.67	.98
B. treatment by others	.65	2.56	1.98	2.94	1.30
C. range of activities	.62	3.21	1.39	2.38	1.11
D. quality of counseling	.61	3.56	1.28	3.04	1.19
E. freedom to choose	.60	3.77	1.01	3.23	1.08
F. friends	.58	3.36	1.45	2.99	1.48
G. size of hospital	.54	3.54	1.26	3.11	.94
3. Psycho-Emotional Problems (.60)[a]					
A. feeling depressed	-.68	2.35	.68	2.64	.91
B. feeling unsure of oneself	-.55	2.53	.69	2.58	.94
C. feeling isolated	-.50	3.99	.91	3.52	.73
D. irratibility	-.49	2.95	.84	2.57	.54
E. fatigue	-.47	3.07	.72	3.22	.47
F. frustration	-.46	3.10	.79	3.00	.88
G. unable to make decisions	-.42	2.30	.64	2.82	.78
4. Media Connections (.53)[a,b]					
A. reading	-.61	2.44	1.24	3.03	1.65
B. listening to radio	-.47	2.40	2.06	2.97	1.11
C. going outdoors to check weather	-.42	2.05	1.02	2.01	1.02
5. Refuge Seeking (.69)[a,b]	.65	1.88	.91	2.78	.88
A. close curtains to keep out sun	.61	1.36	.44	1.92	.79
B. close curtain to avoid bad weather	.49	1.42	.67	1.93	.79
C. close curtains-poor view	.43	1.51	.70	3.08	1.16
D. watching TV					

a. Cronbach's alpha coefficient of index reliability.
b. $p < .001$.
c. $p < .01$.

sunshine to transmit into the building interior. Items clustered into View Surrogates-Nature (mean = 2.78), which contained examples of windowless rooms into which users brought plants, pictures, calendars, and other personal artifacts.

In hospitals, the representation of nature—be it ocean, sky, or forest—appears to help satisfy human informational needs. In addition, staff persons and patients cared for

potted plants in many rooms. The predilection among respondents for visual contact with nature was pronounced. Nonetheless, artificial "views" were nearly always less preferred than real views. Representations of brightly daylit therapy rooms clustered (Sunlight, mean = 3.10), indicating the importance of direct natural light.

A third group of photo dimensions represented spaces disliked by the respondents (Disorienting Views, mean = 2.21; Architectural Windowlessness, mean = 2.02; and Psychological Windowlessness, mean = 2.00). Rooms with large windows that offered a direct view of a concrete building 25 feet away with circular windows were disliked. This was perhaps due to the single compositional layer (building only) and subsequent lack of meaningful content. These rooms had fluorescent ceiling fixtures and were appointed in dull, institutional colors. However, rooms with small and poorly positioned apertures were even less preferred, with sills high above the floor, and monotonous views—sky only, a wall, or of autos parked at grade next to the building. Windowed, in literal terms, they were nonetheless assessed as windowless in cognitive terms. Here, windows were small (less than 15% of wall area), long, narrow, whether vertical or horizontal in orientation. The interior and exterior environment became visually disconnected: closed curtains, a poor view, and/or sills that were too high (above 80 inches). This is an interesting, but not entirely unexpected finding. Nearly windowless and architecturally windowless spaces in hospitals are regarded as being nearly identical.

Four preference-based dimensions based entirely on written questions also emerged (Table 1). The first, Preferred Views from Treatment Areas (mean = 3.96), contained assessments of "ideal" conditions: a full view containing all three layers. This pattern was clearly echoed in Nature Content (mean = 3.45), with its emphasis on elements in nature—trees, water, gardens, and sky, and View Surrogates (mean = 3.37) extended and amplified one of the photo dimensions. A fourth non-picture preference dimen-

sion, Disliked Views from Treatment Areas (mean = 2.47) reiterated the subjects' negative feelings about poor views from the hospital. Interestingly, across the 12 dimensions reported in Table 1 staff ratings were more negative than patients' but overall, staff and patients disagreed to a significant degree only half of the time. The t-tests identified six differences at or below .05 (dimensions 2, 3, 4, 6, 9, and 12).

SATISFACTION AND ASSOCIATED BEHAVIORS

Nine written-item dimensions addressed window-associated degrees of satisfaction (Table 2) and behaviors (Table 3). Here, respondents evaluated their own PMR units. It was found that respondents were not particularly satisfied with the views in their own hospital (Hospital Environs, mean = 3.01); were somewhat dissatisfied with the views through the windows at home (Windows at Home, mean = 2.98);[4] were unsatisfied with one's ability to cultivate and maintain social relationships while in the hospital, the sense of personal control over the operation of windows, screens, and curtains, and control over one's personal privacy (Exposure, mean = 2.79). Respondents in hospitals with poor views from treatment rooms or no windows at all were unsatisfied (Actual Views from Treatment Areas, mean = 2.64).

Psycho-Emotional Successes (mean = 3.23) and Psycho-Emotional Problems (mean = 2.90) were based on this question: "In the time that you have stayed or worked in this rehabilitation unit, how often have you experienced the following . . . ?" "Successes" involved doing things considered important, being near to dear ones, keeping "one's spirit up when the going gets roughest," and most important, being able to reach personal or therapeutic goals. In contrast, "problems" involved daily frustrations, disappointments, and stress resulting from one's job or disability.

Social Contact (mean = 3.07) addressed fears associated with the prospect of being discharged from the hospital, the perceived sense of group cohesiveness while in the PMR unit and being treated as an independent individual, the quality of care, activities, and feelings about the hospital itself. Patients and staff engaged in reading, watching television, listening to the radio, and talking to others to obtain information about events in the world beyond the hospital (Media Connections, mean = 2.68). Finally, and understandably, patients desire privacy (Refuge Seeking, mean = 2.42) much more than staff. In this context refuge seeking manifests by closing curtains to avoid being viewed by others. The most preferred screens and curtains were self-controlled; this suggests the therapeutic benefits of both privacy and functional independence.

The test for significant differences in the responses of staff and patients relative to these nine dimensions yielded five results at or below .05 (dimensions 2, 5, 6, 8, and 9). Collectively, the 21 tests of significance reported in Tables 1 through 3 yielded two differences at or below .05, two at or below .01, and seven at or below .001. Because this represents over half the total number of tests, the hypothesis that staff and patients react to the same hospital environment in different ways is supported, although not overwhelmingly.

DISCUSSION

Three types of dimensions emerged in the MDS analyses: degree of preference, degree of satisfaction, and associated behaviors. Sufficiently informative views of the external environment were preferred, thereby allowing one to "project" into the scene. By contrast, insufficiently windowed spaces were characterized by sills high from the floor, distant from the viewer, and views obscured by nearby walls, screens, furnishings, and so on. Even when minimum construction standards are met in technical

terms, the dysfunctionality of such windows appears to be the equivalent of having no windows whatsoever.

Degree of satisfaction dimensions focused on emotional status during rehabilitation (or tenure as a staff member), social patterns during hospitalization, and the visual appearance of neighborhoods surrounding the hospital. Other factors concerned behaviors associated with the "use" of windows in the unit: "How often do you do the following . . . ?" Many watch television, read, and talk to others, which may be, in effect, respites—not unlike being able to look out a window at a nice view.

CONCLUSION

This has been the first study on windowless environments to measure comparatively staff and patient responses to the same hospitals. The array of windowness dimensions constitutes a continuum of architectural conditions (completely windowless to perceptually windowless to highly windowed). The results indicate that the absence of meaningful contact with the external world vis-à-vis windows poses an unwarranted architectural barrier, despite major advances in other aspects of "barrier-free design" achieved in the past decade. Minimum code requirements may need to be revised accordingly, based upon additional research on this subject (see Ulrich, 1984). The research has distilled an array of factors that can help in improving functional design in hospitals, in terms of the basic human predilection for information and how windows and views help satisfy informational needs in the hospital environment, and by comparison of differences between occupants with different perceptual and physical abilities. The findings support Markus's (1967) categories of view content and extend work by Wilson (1972) and Keep (1980). Parallel work in office environments has also identified dissatisfaction with poor views and windowless work areas (Ludlow, 1972; Cooper et al., 1973).

Design recommendations based on the larger study of which this is a part have been reported elsewhere (Verderber, 1982, 1983). As in any multidimensional scaling structure, one gets out of it what one puts in. Measures to ensure the validity of the instrument were taken, although different assumptions and stimulus items might have yielded a somewhat different dimensional structure. In this sense, this research is a foundation upon which further work can occur. What if a broader array of pictures of interior spaces were included? How much of this conceptualization transfers to other user populations and building types? On a fundamental level, the window symbolizes freedom—a release, however brief, from the immediate world to a different, more expansive world. It is for the hospitalized person a constant reminder of the society to which one belongs and hopes to return as fully as possible.

NOTES

1. Each slide was scrutinized in terms of legibility, internal consistency, and the need to capture representative conditions. The editing process was performed by four independent advisors, this investigator, and staff and patients of the Rehabilitation Medicine Service Unit, Veterans Administration Medical Center (VAMC) Ann Arbor, Michigan.

2. The patient housing domain encompassed residential and social activity areas. The therapeutic treatment domain encompassed the following departments: Physical Therapy, Occupational Therapy, Speech Pathology, Audiology, Recreational Therapy, and social-psychological counseling areas. The staff office domain encompassed offices, lounges, and labs.

3. The VAMC Rehabilitation Medicine Services Unit served as the setting for the pretest: 16 staff persons and 14 inpatients participated. The composition of this sample closely paralleled that of the other hospitals. The initial set of 64 visual items was reduced to a tighter set of 56. This eliminated items judged to be redundant or unclear.

4. Satisfaction with one's neighborhood at home was ranked lowest of all written response items. This may have been because a sizable number of patients (and staff) lived in densely developed, older urban neighborhoods.

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