of non-contact-inhibited cells, and the acquisition of transplantability in this line needs further study.

That there exists a strong correlation between the ability of cells to continue dividing in the presence of extensive cell-cell contact in vitro and the ability of the same cells to produce tumors in the animal has been demonstrated above. The nature of the cellular changes involved are as yet not understood. They may include, for example, surface alterations that decrease the requirement for adhesion to the plastic substrate (*13*), the loss of ability to produce and/or respond to short-range inhibitory molecules (*14*), or a decreased dependence under conditions of cell crowding for a factor present in normal serum (*3*, *15*). Whatever the basis for the relationship between the ability of the cells to grow in crowded cell cultures and their ability to produce tumors in the animal, the availability of simple means to select both for and against these properties by using cloned cell lines should permit a more systematic approach to the study of carcinogenesis.

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Pattern Perception: Integrating Information Presented in Two Modalities

Abstract. *Subjects were required to organize and identify temporal patterns composed of either (i) two stimuli in one modality; (ii) two stimuli in each of two modalities, with the pattern alternately presented in the two modalities; or (iii) one stimulus in each of two modalities. Patterns (i) and (iii) are organized as structured patterns, but (ii) is organized by modality, not by pattern structure. When elements of a pattern appear in two modalities, the auditory-tactual combination produces the poorest performance.*

Fraisse (*1*) suggested that elements in different modalities could not be organized into a single pattern, and that the elements in each modality are perceived separately. In his work, the individual elements in each modality were the important perceptual variables, not the pattern formed by the individual elements. However, it has been argued (*2*) that to study perception one must use stimuli in which the pattern formed by the individual elements is the important perceptual variable. This means that individual elements can produce only sensations, whereas the patterning among the elements creates perception. Our results demonstrated that (i) temporal patterns of two modalities were organized into a structured pattern, although temporal patterns of two elements in each of two modalities, alternately presented in the modalities, were organized by modalities, not by pattern structure; and (ii) the particular pair of modalities used to present the pattern affects the ease of identification of patterns.

The stimuli consisted of a sequence of dichotomous elements generated by a repeating pattern of eight dichotomous elements. Since a pattern is continuously repeated, it may be started at any one of the eight elements and still generate the same sequence (with the exception of the first few elements). Thus, for any given pattern, there are normally seven equivalent patterns.

It has been shown (*3*) that all such sequentially equivalent patterns are not perceptually equivalent; subjects generally identify and describe the sequence beginning at selected elements in the pattern (preferred start points) regardless of the actual element at which the pattern started. Also, pattern organization is essentially the same for the auditory (A), tactual (T), or visual (V) modalities (*3*, *4*). Thus, the pattern of the stimulus (rather than the specific elements of the pattern, or the particular arrangement used to start the pattern) determines perceptual organization.

In our study, equivalent patterns of eight elements were produced in the A, T, and V modalities by the use of identifiably different left and right stimuli as the dichotomous elements. The A stimuli were a 1200-hz tone and a 3000-hz tone equal in loudness. The T stimuli were a pair of vibrators (*5*), one held in each hand (6 volts, 30 hz and 12 volts, 60 hz, respectively). The V stimuli were a red and a green panel light.

Three different methods of pattern presentation were used. In the first method, patterns were presented in either the A, T, or V modalities. In the second method, the entire pattern of eight elements was presented first in one modality, then in another modality. The alternations were continued every eight elements. Three pairs of modalities were used: auditory-tactual (A-T), auditory-visual (A-V), tactual-visual (T-V). The stimuli of each modality were identical to the stimuli described above. In the third method, the dichotomous elements of a pattern were modalities, rather than a left- or right-stimulus element within a modality. Again, the three pairs of modalities were used. The tone (3000 hz), the vibrator (source, 12 volts, 60 hz), and the red panel light were the modality elements. The stimuli were placed directly in front of the subject.

To give an example of these methods, suppose a pattern of four elements was selected that is represented as 1100.

The pattern presented in the A modality (as in the first method) would be the repeating sequence left tone, left tone, right tone, right tone. If the modalities were alternated (as in the second method), the pattern would be presented in the A-V combination as the repeating sequence left tone, left tone, right tone, right tone, left light, left light, right light, right light. If the modalities were elements of the pattern (as in the third method), the pattern presented in the A-V combination would be the repeating sequence tone, tone, light, light.

Eight different patterns were used. Each pattern was started at a preferred start point or at a nonpreferred start point (*3*) (Table 1). In addition, two rates of presentation were used; one element per second and three elements per second. At each rate of presentation, the stimulus was presented for the first one-third of the interval between elements.

Fifty-four subjects were used, 18 subjects for each of the three methods of presenting the pattern. Each subject was presented one-half of the experimental conditions, so that over all 18 subjects the performance and organization of every pattern at each modality, start point, and rate of presentation was based on nine subjects. The order of presentation was counterbalanced.

The subject's task was to observe the presentation of the stimulus until he thought he could identify the pattern, whereupon the subject stopped the presentation and verbally described the pattern in terms of either left-right position or modality sequence of elements.

The measure of pattern organization was the percentage of pattern organizations beginning at the actual starting point of the pattern. Analysis indicated that only the start point and the method of presentating the pattern affected organization. Therefore, the percentage of organizations of patterns beginning at the actual starting point was averaged across rates of presentation and modalities for each start point and method of presenting patterns.

When patterns were presented in individual modalities, those starting at preferred start points were usually organized beginning at that element (87 percent). But, when patterns started at nonpreferred start points, only 20 percent of the organizations began at that element. When modalities were the pattern elements (method three), patterns starting at preferred start points were usually organized beginning at that element (87 percent). But, when patterns started at nonpreferred start points, only 17 percent of the organizations began at that element. For both of these methods, the patterns started at nonpreferred start points were reorganized by subjects so that 70 percent of the organizations began at a series of identical elements (for example, 111) or at a series of alternating elements (for example, 1010). When the complete pattern was alternately presented in two modalities (method two), those starting at preferred start points were nearly always organized beginning at that element (99 percent), and patterns starting at nonpreferred start points were nearly always organized beginning at nonpreferred start points (96 percent); thereby organizing the patterns at modality alternations.

The number of elements presented before the pattern was correctly identified (delay) was the measure of performance. The median delay until identification of the pattern was calculated for each pattern at each condition. Since the rank-order of difficulty of the patterns was nearly identical (*6*), the median delays could be averaged across patterns (Table 2).

Differences in the rate of identification of the patterns within each method of pattern presentation were tested by analysis of variance and *t*-test on the logs of the median delays. Patterns presented in the A and T modalities were easier to identify than patterns presented in the V modality [$F(2, 6) = 5.2$, $P < .05$]. When patterns were alternately presented in two modalities, the T-V and A-V combinations produced better performance than the A-T combination [$F(2, 6) = 9.8$, $P < .05$]. When modalities were elements of the pattern, differences among combinations of modalities were not significant since the rank order of the combinations of modalities differed at the two start points.

Performance with the use of the A-T combination was poorer for both methods of pattern presentation than performance with either the A or T modality. In only one of the eight experimental conditions (modalities alternate every eight elements, nonpreferred start point, three elements per second), was the performance when using the A-T modality combination not poorer than the performance with the use of either the A or T modality. By contrast, performance with the use of the A-V and T-V combinations was approximately equal to the average performance of the component modalities for both methods of pattern presentation.

Differences in organization and identification of patterns illustrate two independent aspects of pattern perception. Differences in organization of patterns are determined by method of presentation of the pattern. Sequences of modalities are perceived as structured patterns and are organized in the same manner as left-right patterns presented in one modality. However, left-right patterns alternately presented in two modalities are organized as a sequence of elements in one and then another modality. The subjects do not reorganize the pattern to begin at a preferred start point if this forms a pattern that mixes modalities. In addition, subsequent experiments in which modalities were alternated every two or four elements (so that only half the

Table 1. Binary representation of patterns used, with preferred and nonpreferred start points. The patterns are placed in the rank-order of rate of identification of pattern, with pattern 1 easiest.

Pattern	Start point: Preferred	Start point: Nonpreferred
1	11110000	11100001
2	11101000	10001110
3	00110111	11001101
4	11110100	10011110
5	11101100	10110011
6	00101111	11001011
7	01010011	10011010
8	11011010	01101011

Table 2. The average number of elements presented before identification of patterns. Abbreviations: A, auditory; T, tactual; V, visual.

Modality	Rate of presentation (element per second) start point: Preferred 1	Preferred 3	Nonpreferred 1	Nonpreferred 3	Average delay
Individual modalities					
A	18	50	32	76	44
T	17	55	30	92	50
V	21	62	36	95	54
Modalities alternate every eight elements					
A-T	29	75	37	88	57
A-V	27	64	35	68	49
T-V	26	57	32	72	47
Modalities are pattern elements					
A-T	23	70	37	114	61
A-V	21	65	36	81	51
T-V	24	78	35	76	53

pattern was presented in each modality) show less than 15 percent reorganization of the pattern when patterns began at nonpreferred start points. Therefore, sequences of either left-right or modality elements were perceived as structured patterns, but sequences in which the left-right elements were 'embedded' in an irrelevant alternation of modalities (every two, four, or eight elements) were organized by modality, not by pattern structure.

Differences in the rate of identification of patterns are determined by the modality or pair of modalities used to present the pattern. The rate of identification of patterns presented in pairs of modalities is not necessarily slower than identification of patterns presented in one modality. Only the A-T combination produced poorer performance than its component modalities, and for this combination, performance was poorer whether the elements of the stimulus were organized by modality (method two) or by pattern structure (method three). The physiological similarity of the A and T modalities (*7*) may cause confusion when the pattern elements presented in these modalities must be integrated. Alternating between the T and V modalities, and especially between the A and V modalities, seems to produce a sensation of "snapping back and forth" between modalities which is absent when alternating between the A and T modalities.

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Effect of Mass on Frequency

Sadeh, Knowles, and Au have postulated (*1*) an effect of mass upon frequency. This effect, a lowering of the frequency of an electromagnetic wave in the presence of mass, reconciles the data of two experiments with theory. They mention a round-trip experiment wherein signals were reflected from Venus and Mercury which showed no frequency shift as the line of sight approached Sun. They also mention the need for additional data.

A similar experiment was performed by the Jet Propulsion Laboratory with the Mariner IV spacecraft when its path approached the sun in March 1966. This, also, was a round-trip experiment. Pure monochromatic waves were beamed toward Mariner IV, which, after frequency translation to 2295 Mhz, were rebroadcast toward Earth. The frequency spectrum of the received signals was measured.

Altogether, 17 spectrograms were taken as the Mariner IV–Earth–Sun angle varied from 0.9° to 2°. Although the spectra were considerably broadened by the double passage through the solar corona, the central frequency could be estimated easily to better than 2 hz.

Within that accuracy, no anomolous frequency shift was detected, hence our data do not present confirming evidence for the mass-frequency effect.

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Rotating Membrane Cell

The technique of Litt and Smith (*1*) which depends on the use of an unsupported rotating membrane as a more accurate means of assessing permeability of dialysis membranes of the artificial kidney has been used in this laboratory (*2*).

Some objections to the technique raised by Litt and Smith, such as complexity, thermal control, and limiting speed of 55 rev/min are not encountered in our cell (Fig. 1). Our cell consists of two 65-ml chambers on either side of a vertically mounted membrane. The chambers are filled with 50 ml of fluid, and a 15-ml air space is left. The entire cell is clamped to a rotating shaft and allowed to spin. Because the chambers are not filled, the fluid remains stationary with respect to the angular direction while the membrane and cell rotate. We have operated at speeds up to 300 rev/min with no problems of leaks, heating, or "carryover" of the fluid. Calculations showed that above 75 rev/min the permeability did not change with increased rotational speed.

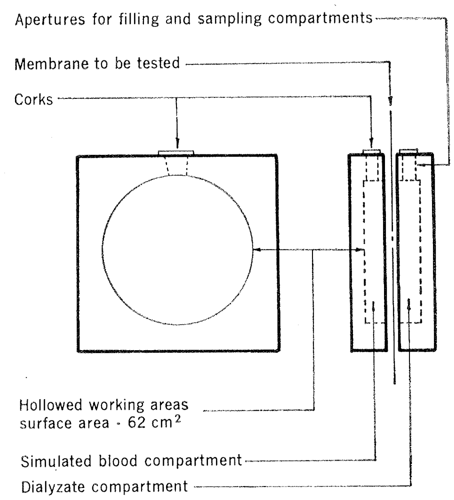

Fig. 1. Schematic diagram of rotating membrane test cell.

Outstanding features of the cell (Fig. 1) are its simplicity, low cost (under $10), and ease of operation (1 hour per membrane determination). We use this cell routinely to test the permeability of new lots of membrane received from the manufacturer.

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