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THE EFFECT OF TONE ON THE SUCCESSIVE COMPARISON OF BRIGHTNESS

by

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(I) PROBLEM

In the previous paper[1] (1956), we have studied the effect of tone on the successive comparison of lifted weight. In the present study, we want to investigate further the effect of tone on the perception of brightness. There are three big problems to study: (1) the intersensory relationships, (2) the effect of interpolated stimulus in the successive comparison and (3) the time error.

(1) Through the previous weight experiment, it has become clear that the acoustic stimuli influence the perception of weight. Do the acoustic stimuli influence the visual sensation also, which is the most objectified and organized sensation?

Kravkov[2] has found that, when the black figures are given on the white ground, the visual acuity about the black figures is facilitated by 2100-cycle tone, while, when the white figures are given on a black ground, there is a decrease in acuity for all 7 subjects. He has reported further that the acoustic stimulation (2100 cps, 100 db) affects color thresholds as well as visual acuity[3], the maximum increase in sensitivity being from 520-530 mμ and the maximum decrease from 580-600 mμ respectively, and that in general, green-blue sensitivity is increased and orange-red decreased. These results are supported by Yakovlev[4]. He measured the limits of visual field for different colors during the presentation of the 780-cycle tone or noise. It is interesting to notice that one kind of tone has a different effect upon the visual stimuli when these are varied in the construction of test square or in colors.

There are, however, several negative reports to this. For example, Serrat & Karwoski[5] have obtained the negative results of the effect of 410-cycle tone on the visual thresholds of red and green spectrum lights. Again, Pratt[6] and Cason[7] used the method of successive comparison of brightness, whereby tried to make sure the Lauenstein's assimilation hypothesis of memory trace[8] in the successive comparison of which the back ground was interpolated with heteromodal stimuli, with the result that the 512-cycle tone, whether it was loud or soft, did not have effect on the brightness comparison at all.

On the contrary, Cason showed the positive results. He presented the brightness, whether as standard stimulus or as comparison stimulus covered by the sound of an electric bell. The one covered by the sound was judged "brighter" than the other not covered. In other words, the sensitivity of brightness was facilitated by the sound. He did not, however, clearly decide the characteristics of the sound of the electric bell. So we can not understand what kinds of attributes of the sound produced such a facilitation effect.

In the Canadian Journal of Psychology, Ogilvie[9] has reported the effect of auditory flutter on the visual critical flicker frequency. He has found that the CFF appears higher when the auditory flutter is given in the in-phase with the visual flicker than in the out-of-phase. He has explained these results not by the attention but by the summation and the inhibition of nervous mechamism : In the condition of in-phase, he concludes, the temporal resolving power of the visual nervous system is facilitated by the heteromodal summation of the auditory system.

From what has been stated above, we can infer some effect or another of tone on the visual sensation. Therefore we want to investigate such an effect systematically first by the successive comparison method of brightness[10].

(2) In the previous experiment of weight perception, we proposed the conception of the "retroactive" and the "proactive" effect of tone. When the interpolated tone was temporarily near the first weight stimulus, the tone influenced not the second stimuli but the first stimuli retroactively, while when the interpolated tone was near the second stimulus, the tone influenced the second stimuli proactively.

Will such an effect of tone as stated above occur in this brightness experiment also? In order to ascertain it, we have prepared the design of this experiment in a similar way to that of the weight experiment, and tried to ascertain the pro- and retroactive effect of tone.

(3) Finally in the present experiment, we designed the time interval of successive comparison at 6.5 sec. What kind of time-error can we expect at the 6.5 sec. time interval of brightness comparison? According to many papers we can expect the negative time-error.

(II) APPARATUS AND PROCEDURE

a. Light Stimuli

The white neon tube lamp made by Tokyo Neon Co. Ltd. was used as the light source because of the fact that the said lamp is accompanied by no noise, and has a moderate light intensity, fluorescent light, stable light flux, and little heat radiation, and besides the light can be switched on and off in a moment.

This neon tube lamp about 30 cm. in length was bent like U letter, and settled in a dark wooden box. In the ceiling and the back of the box, ventilation windows were constructed. The ventilation windows were made of three crossing shelves, so that the light did not stream through them. In the back of the box, a 2000V transformer was settled, on which the neon bulb was operated. The on- and off-time regulation was operated on the side of 100V.

The light flux starting from the U letter type source was collected through the condenser lens at first. Next, the lights were diffused by the frosted glass and we obtained the standard and the comparison brightness through several neutral filters. Finally, the lights were diffused again through the frosted glass and projected on a circular aperture 1 cm. in diameter of black paper, and through this circular aperture was thrown an image on the back of a dark box (50×40×52 cm), which was made of tin, through a lens.

On the back of the dark box, we cut a hole 3 cm. in diameter, on which was put an opal glass on a level with S's eyes. On this opal glass screen,

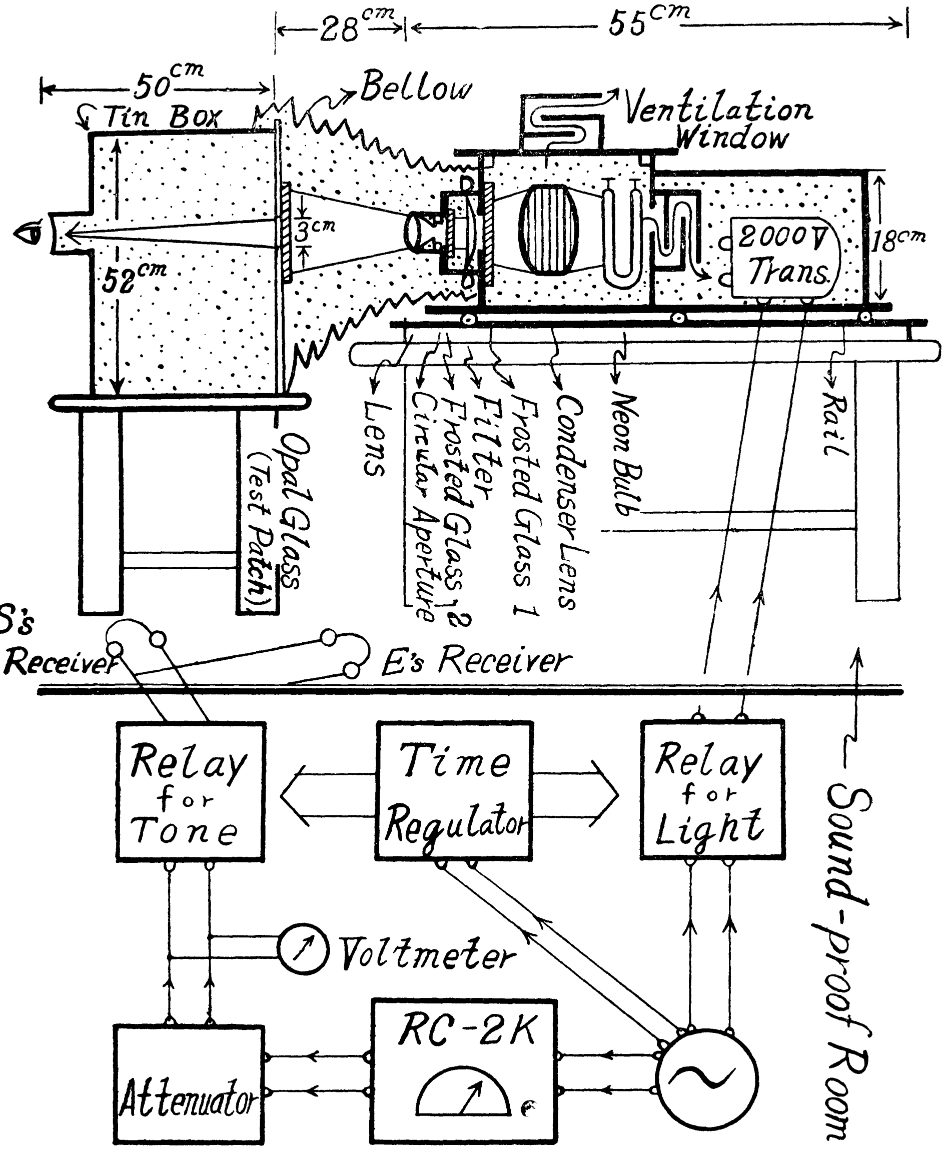

Fig. 1
Block Diagram of Experimental Apparatus

the circular aperture was imaged and Ss compared this brightness. This image was, consequently, the test patch. The space between the dark box and lens was covered by bellows lest the stray light should come in.

On the front of the tin box, we fitted up the peep window and through this window Ss fixed their eyes on the test patch 50 cm. in distance.

These optical systems of the transformer, the neon bulb, the condenser lens, the frosted glasses, the filters, the lens and the stopes were set on one board that could move on a rail. Therefore, it was convenient to control the image on the opal glass (Fig. 1).

The diameter of the test patch was 3 cm. and the distance from the eyes of Ss was 50 cm., the visual angle of the test patch being 3.4°. The series of stimuli were made of the several filters interpolated between two frosted glasses. The brightness of standard stimulus was 2.78 mL. The comparison stimuli were the five brightnesses of 3.22, 3.00, 2.78, 2.56 and 2.34 mL. The brightness was calibrated by the Martens Photometer.

b. Tone Stimuli

The tone stimuli were the 1000-cycle, 2000-cycle and 100-cycle 80 phon pure tones, produced by a low cycle oscillator RC-2K, provided with an attenuator and a voltometer which were situated in out side of the sound-proof room. The receivers were the SF-48, 4000Ω.

c. Time Regulation

The standard stimulus lasted 1.5sec., and after the time intervalof 6.5sec. the comparison stimulus was also presented for 1.5 sec. At various positions of this time interval the tones were interpolated. For these time regulations, the present writer used a time regulator which was made by him.

Both of the alternative currents in the 100 V side of the input of the 2000 V transformer and in the side of the output of the oscillator were led into the relays which were operated by the time regulator. These are shown in Fig. 1.

d. Procedure in General

All the experiments were carried out in a dark sound-proof room. Ss put on the receiver, sat down on the chair and waited until the eyes were adapted to the darkness. After the instructions, the experimenter interpolated the filter of standard stimulus. When the pilot lamp on the desk was lighted up, the experimenter said "Ready". After the 1.5 sec. interval, the standard stimulus was presented for 1.5 sec. automatically. Ss memorized carefully the brightness of this stimulus by both eyes. After the 6.5 sec. time interval the comparison stimulus was automatically presented for 1.5 sec also. In the 6.5 sec. time interval, the experimenter changed the filter to one of comparison stimuli as fast as possible. The order of presentation of five comparison stimuli was at random. Ss verbally described the brightness of the comparison stimuli as "brighter", "more or less doutful" or "darker" than the standard stimuli (the method of three categories). The rest interval of each trial was 11 sec. Then, at various positions of 6.5 sec. time interval or at the front of the standard stimulus, the tones were presented for 1.5 sec. About the impressions of these tones, Ss reported in the rating scale after the experiment.

e. Rating Scale about the Tone Stimuli

How Ss heard the tone stimuli? At the end of each of the experimental series, Ss were required to tell the rating scale about the tone impressions whose items are shown Table 3.

(III) EXPERIMENT I

PROBLEM

In the weight experiment the 1000-cycle tone was interpolated in the following way:

(1) Just after the 1st stimulus for 3 sec.

(2) Just before the 2nd stimulus for 3 sec.

In the (1) case, the 1000-cycle tone made the 2 nd stimulus overestimate as if the tone influenced the 1st stimulus retroactively. In the (2) case, the tone made the 2nd stimulus underestimate as if the tone influenced the 2 nd stimulus proactively. In other words, the impressions of the interpolated tone connected to the temporarily nearer weight. Do these connection effects occur in the case of light stimuli as it did in the case of the weight stimuli?

EXPERIMENTAL DESIGN

The designes were similar to those of the weight experiment. The interpolated tone was a 1000-cycle 80 phon. The 3 conditions are classified as follows, according to the interpolating positions of the tone;

(1) No interpolated tone (Control Series)

(2) Interpolated for 1. 5 sec. soon after the standard stimulus (After)

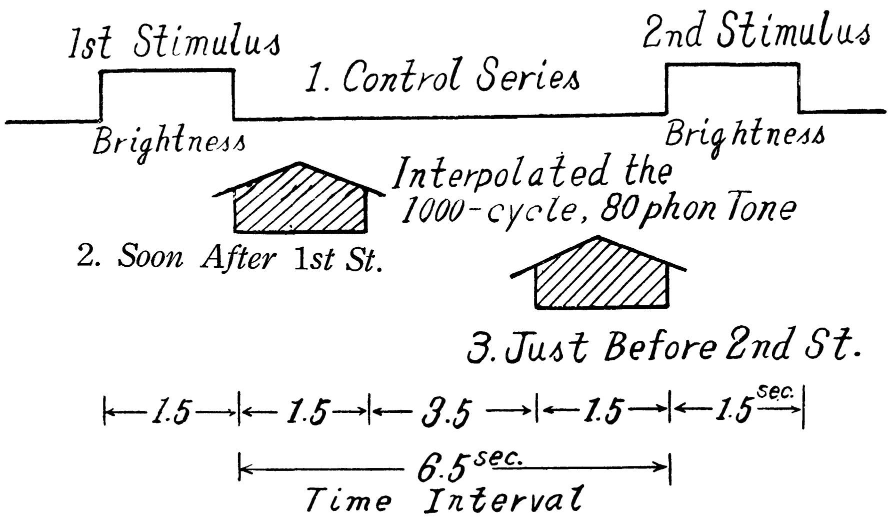

Fig. 2
Schematic Diagram of the Experimental Series of Experiment 1.

(3) Interpolated for 1.5 sec. just before the standard stimulus (Before)
These are shown schematically in Fig. 2.

The order for carrying out these 3 conditions were 6 kinds. To each of 6 kinds, the 6 Ss were assigned. Namely, this design was the block design method of agriculture. Five male and one female Ss who were students of psychology with normal hearing ability. The number of judgments for a pair of stimuli was 10, namely, 50 in total for one series. But the 50 trials were divided in half (25) and one series (50 trials) have been carried out for two days. Ss were required to tell the rating scale at the end of each of one series.

RESULTS

The index of measurement was expressed by the D%[11] (Percent Difference). In the equation form, $D\% = \frac{100(L-G)}{L+G}$, where L denotes the number of judgments of "less" (darker), and G the number of judgments of "greater" (brighter). The number of "doutful "or "equal" judgments was divided into two categories "greater" and "less" in proportion to the number of these two categories of iudgments Ss had given already. The positive values of D% show the positive time errors, and the negative values the negative time errors. The results of D% are shown in Table 1.

Table 1.
Results of D%of Experiment 1

Ss \ Series	Control	Interpolated Soon After 1st St.	Interpolated Just Before 2nd St.
T. I.	15.80	37.16	0.00%
T. K.	15.00	45.44	1.80
K. O.	15.80	−16.68	−29.66
K. I.	31.04	30.68	− 6.68
Y. N.	41.92	33.32	−20.00
I. S.	25.72	15.00	8.56
$\bar{x}$	24.21	24.15	− 7.66

We transform the raw scores of percentage to the angle = arcsin $\sqrt{\text{percentage}}$ and apply the analysis of variance. The summary are shown in Table 2.

Table 2.
Summary of Results of Analysis of Variance for D% of Experimen I

Source of Variation	Sum of Squares	df	Mean Square	F
Series	4992.40	2	2496.20	9.524**
Individual Difference	2647.20	5	529.44	2.02
Residual	2620.83	10	262.08	
Total	10260.43	17		

** $F^2_{10}(0.01) = 7.56$

According to Table 2, the differences of average values between the three conditions are significant at 1% level. However, if we test the differences between the average values of the control series (24.21%) and the "After" series (24.15) by t-test, we can not obtain the significant difference (t=0.483).

Consequently, we can conclude that the effect of tone on the successive comparison of brightness is clear only when the tone has been interpolated just before the second stimulus, namely, the second stimulus is overestimated by the 1000-cycle tone. When the tone is interpolated soon after the first stimulus the second stimulus seems to be slightly over-estimated than the control level in the average value; however, we can not say so by statistical testing. And the individual differences don't appear. It is necessary to compare these results with rating scales of tone. The results of rating scales are shown in Table 3.

These scales coincide very well with the results of the psychological attributes of 1000-cycle tone which many authors have measured. Especially, it is important that the scale "brighter "shows 83.3% in ratio.

It is contrary to our expectations that the amount of time error has appeared positive in the 6.5 sec. time interval. The individual differences do not appear.

Table 3. Resuts of Rating Scale (For example, the figures show the percentage of members judged "high pitch tone" etc.)

Items \ Tone	1000 cps
High Pitch	100·
Bright	83.3
Loud	75.0
Dense	83.3
Heavy	16.7
Exciting	83.3

CONSIDERATION

Let us arrange the D% (the amount of time-error) of each series.

	D%
Interpolated the 1000-cycle tone just before the 2nd stimulus........	−7.66
Interpolated the 1000-cycle tone soon after the 1st stimulus	24.15
No interpolated tone (Control Series)	24.21

When the 1000-cycle tone was interpolated just before the 2nd stimulus the negative time-error appears. In other words, the 2nd stimulus is overestimated —— judged brighter, by the 1000-cycle tone.

We can consider that the sensitivity to the brightness of the second stimulus was facilitated (heightened) by the interpolated tone of 1000 cps. (According to my experiment which is now going on, the effect of tone is likely to facilitate even the visual thresholds).

By what kind of mechanism did these facilitation effects occur? We can not tell whether or not there is any relationship between the acoustic system and the visual system.

However, it may safely be said that the relationship mentioned above can be developed or differentiated through learning, even though man has this mechanism innately. Therefore, this experiment means that we have investigated the relationship between the acoustic system and the visual system which has been developed through learning for a long time. What parts of the visual system produce such an effect, then? It may be that dilatation or the contraction of the pupils are changed by the tone, the sensitivity of the retina is influenced and so on. However, these peripheral changes would perhaps be very slight ones. It would be more probable that the excitability of the higher visual systems is changed by the acoustic stimulation.

In the case of an adult, it is naturally expected that the integration and association mechanism in the central system are well completed through long learning. So that, the effects of acoustic stimuli are not limited only to the acoustic area. We must also consider that the excitation of the acoustic area spreads over the visual area through the integration and association mechanism. We really know a paper telling us that the α-wave of the visual area was inhibited by the acoustic stimuli[(12)]. In the synaesthesia or the color hearing, this relationships of the two areas may be strong.

That is to say, the impulse of the tone of 1000 cps first excites the acoustic area. The excitation of the acoustic area is integrated in the association area and in the higher central area and then, the tone can be impressed as the "brighter" tone. At the same moment, the excitation in the acoustic area may spread to the visual area and the higher association area of vision. We assume that such influences will play the most important part.

It is also possible to assume that the temporal increase of the sensitivity of the visual system caused by the tone is the occurrence of something like a supernormal phase in the visual system. The moment the above-mentioned phase occurred, the second stimulus was given; this is probably the reason why the brightness of this stimulus was overestimated and the negative time error appeared. These results are contrary to the expectations of Pratt. He expected that the assimilation hypothesis of Lauenstein would be applicable to the heteromadal interpolation and that when the loud heteromodal tone was interpolated, the trace of the first stimulus of brightness would assimilate to the tone, and would be felt stronger, the second stimulus being underestimated. According to this supposition, the second stimulus ought to have been underestimated in this experiment, because the 1000-cycle, 80 phon tone was scaled "louder" and "brighter". On the contrary, however, the second stimulus was overstimated. This result shows that the assimilation hypothesis, according to which the trace of the first stimulus would be assimilated into the interpolated stimuli, is not wholy applicable to the heteromodal interpolation.

According to the assimilation hypothesis, the underestimation of the second stimulus must also occure, when the1000-cycle tone was interpolated just after the first stimulus. But the result showes no effect. We expected the retroactive effect of the tone in this condition. But the result does not show such a trend, either. It may be assumed that this means the fact that the retroactive effect of tone does not appear in the brightness comparison, because the second stimulus was given when the supernormal phase in the visual system had passed away. However, it is unaccountable that the retroactive effect does not occur in the brightness while it appeared in the weight experiment. Furthermore, this effect seemed to be an important subject, so that it is necessary to assertain this effect later.

(IV) EXPERIMENT II

PROBLEM

From the results of Experiment I, it has become clear that the 1000-cycle tone has the facilitating effect on the sensitivity of brightness. But the tone of 1000 cps is comparatively high pich.

(1) If we use the tone of pitch lower than 1000 cps, what kind of effect will occur?. In Experiment II, we used the 100-cycle tone for the lower pitch and the 2000-cycle tone for the higher pitch. We can expect that the effects of both tones will occur in the opposite direction tc each other.

(2) In Experiment I, the tone of 1000 cps which was interpolated just before the 2 nd stimulus facilitated the sensitivity of the 2nd stimulus of brightness. According to this result, if the tone was presented just before the 1st stimulus, we can easily expect that the sensitivity of the 1st stimulus will be facilitated or inhibited. The percepted image of the 1st stimulus which is transformed by the tone will remain as the trace in the central processes and this trace will have the functional relationship of the comparison with the percepted image of the 2nd stimulus. If so, such a relationship should appear as a shifting of time-error. Then we present the 100-cycle or 2000-cycle tones just before the 1st stimulus, in Experiment II.

(3) In Experiment I, contrary to our expectations, the time-error showed the positive values in the 6. 5 sec. time interval. We must test this point once more.

EXPERIMENTAL DESIGN

The 100-cycle, 80 phon or the 2000-cycle, 80 phon tones were presented

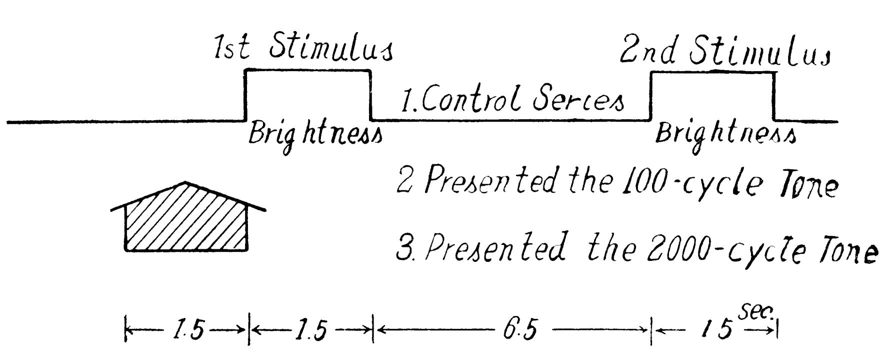

Fig. 3
Schematic Diagram of the Experimental Series of Experiment II.

just before the 1st stimulus for 1. 5sec. (Fig. 3) The loudness of tones was constant and the pitch was varied.

The three series are as follows.

(1) No presented tone ....Control Series
(2) Presented the 100-cycle tone just before the 1st stimulus for 1.5 sec. ....100-cycle Tone
(3) Presented the 2000-cycle tone just before the 1st stimulus for 1.5sec. ....2000-cycle Tone

As in the case of Experiment I, the block design method was applied. Ss were three male and three female students of psychology, with normal hearing ability.

In Experiment I, the number of judgments for one pair of stimuli was 10, that is, 50 for one series, and the judgments were divided into two groups of 25 each and one series was completed in two days. However, when we examine the response in the two series, there were no great differences observed on the first and the second day. Consequently, 25 judgments—— judgments for one pair is enough to know the response tendency. It took 3 days to finish the total series for each Ss.

After one series was finished, the rating scales about the tone impressions were required of the Ss as in the case of Experiment I.

RESULT AND CONSIDERATION

The D% of each series and each Ss are given in Table 4.

Table 4.
Results of D%of Experiment II

Ss \ Series	Control	100 cps	2000 cps
Y. N.	41.92	37.52	50.00%
T. O.	33.36	26.32	64.72
K. F.	5.92	15.76	41.20
I. S.	25.72	−11.12	0.00
H. O.	18.16	14.32	23.20
$\bar{x}$	25.02	16.56	35.82

In Table 4, the one female subject was rejected because her response series was very disordly, the values of D% were extremly nagative and these values had a significant difference from the others by the rejection test.

The raw scores of percentage are transformed to the angle and the 3×5 factorial analysis are applied. The summary of these analysis is shown in Table 5.

Let us arrange the means of D% of each series as follows.

	Means of D%(Time Error)
Control Series	25.02%
100-cycle	16.56
2000-cycle	35.82

Table 5.
Summary of Results of Analysis of Variance for D% of Experiment II

Source of Variation	Sum of Squares	df	Mean Square	F
Series	652.90	2	326.45	8.87**1
Individual Difference	2734.73	4	683.69	18.58**2
Residual	294.36	8	36.79	
Total	3681.99	14		

**1 $F^2_8(0.01)=8.65$

**2 $F^4_8(0.01)=7.01$

From the table of F, it can be seen that these three means differ at 1% level. By the tone of 100 cps which was presented just before the first stimulus the second stimulus is not overestimated than the control level. On the contrary, by the 2000-cycle tone which has been presented just before the first stimulus the second one is overestimated than the control level. In other words, the sensitivity of the first stimulus is inhibited by the 100-cycle tone and facilitated by the 2000-cycle tone.

According to the results of Table 6, the 100 and the 2000-cycle tone are dichotomized in the item of "brightness" of the tone. All Ss scaled the 100-cycle tone darker, the 2000-cycle brighter. The loudness of the two tones was scaled louder because the loudness levels of the two tones were regulated constant at 80phon.

Table 6.
Results of Rating Scale

Items \ Tone	100 cps	2000 cps
High	20.0	100.0%
Bright	0.0	100.0
Loud	100.0	100.0
Dense	40.0	100.0
Heavy	100.0	30.0
Exciting	20.0	60.0
Transition of D% from Control Level	−8.46	+10.80

The "brighter" tone had, accordingly, the facilitation effect on the sensitivity of brightness which followed the tone, the "darker" tone the inhibitory effect. That the effect of tone differs according to the difference of pitch seems to show that the effect of tone is refined and differentiated by learning.

The fact that the sensitivity of brightness is inhibited by the 100-cycle tone, we may regard as the occurence of a kind of refractory period in the visual system. But we do not understand the mechanism of facilitation or inhibitory effect. We expect the future investigations will further clarify the inhibitory mechanism.

The amount of time-error was positive in both experiments (+24.21, +25.02), and we consider that the time-error would be something like that 6.5 sec. time interval.

SUMMARY

This experiment is continued from the previous weight experiment(1956). Does the tone change the sensitivity of brightness sensation which is the most objectified sensation? How much time-error will appear in the 6.5 sec. time interval? In the weight perception, we have ascertained the retroactive as well as proactive effect in the successive comparison interpolated with the tone. Whether we can find the retroactive or proactive effect in the successive comparison of brightness interpolated with the tone?

The light source was a white neon bulb. The visual angle of the light patch was 3.4°. The brightnesses were divided into five degrees in the step of 0.78 mL. Of them the middle degree was adopted as the standard stimulus and presented for 1.5 sec. After 6.5 sec. time interval, one of the five comparison stimuli was also presented for 1.5 sec. Ss compared these two brightnesses. The number of total judgments were 50 in Experiment I, 25 in Experiment II. The index of the measurement was the D% of time error.

In Experiment I, the 1000-cycle, 80 phon tone was interpolated in just after the standard stimulus or in just before the comparison stimulus for 1.5 sec. Ss were six students.

After the experiment, it became clear that only when the tone was interpolated just before the 2nd stimulus, the tone influenced on the brightness perception. The comparison stimulus was apt to be judged brighter by the 1000-cycle tone (facilitation effect). In other words, we could not find the retroactive effect of the interpolated tone, but could find the proactive effect. The proactive effect, we understood as the occurrence of the temporal supernormal phase—the temporal increase of the sensitivity in the visual system caused by the impulse of the acoustic area. Furthermore, we discussed the fact that the assimilation theory of memony trace was not applicable to the heteromodal interpolation, and that the retroactive effect did not appear.

In Experiment II, in order to further ascertain the proactive effect of the tone, the tone was presented just before the standard stimulus for 1.5 sec. In order to confirm the effect of pitch, the tone of 100 cps and 2000 cps, 80 phon tones were used. Ss were five students. As a result, the brightness of the standard stimulus was apt to be judged "darker" by the 100-cycle tone. In the case of the 2000-cycle tone, the result was reverse. In other words, the 100-cycle tone has the inhibitory effect, while the 2000-cycle tone has the facilitating effect. We discussed the different effects of the tones according to the difference of the pitch, and the inhibitory effect as well.

Contrary to our expectations, the amount of the time-error appeared as positive in the 6.5sec. time interval.

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RÉSUMÉ

Cette expérimentation est continuée du précédente expérimentation de poids (1956).

Le ton change-t-il la sensitivité de la sensation de clarté qui est la sensation la plus objectée? Combien de temps-erreurs apparaîtront-elles dans l'interval de temps 6.5 sec? Sur la perception de poids, nous observâmes l'effet rétroactif autant que l'effet proactif dans la comparaison successive interpolée par le ton.

Ia source de lumière fut une ampoule du néon blanc. L'angle visuel de la pièce lumineuse fut 3.4°. Les clartés furent divisées en cinq degrés dans le pas de 0.78 mL. Le moyen degré entre eux fut adopté comme stimulus typique et présenté pendant 1.5 sec. Après l'interval de 6.5 sec., quelconque entre les cinq stimulus comparatifs fut aussi présenté pendant 1.5 sec. Les sujets comparâmes deux clartés. Les nombres de tous les jugements furent 50 dans l'Expérimentation I, 25 dans l'Expérimentation II. L'indice de mesurage fut D% de l'erreur de temps.

Dans l'Expériemntation I, le ton de 100-cycle, 80 phon fut interpolé exactement derrière le stimulus typique ou exactement devant le stimulus comparatif pendant 1.5 sec. Les sujets furent six étudiants.

Après l'expéimentation, il devint claire que seulement quand le ton fut interpolé exactement devant le 2e stimulus le ton s'influença sur la perception de clarté. Le stimulus comparatif fut jugé d'étre plus clair par le ton 1000-

cycle (effet de facilitation). En autres terms, nous ne pûmes trouver l'effet rétroactif du ton interpolé mais pûmes en trouver l'effet proactif. L'effet proactif, nous le comprîmes comme l'occurrence de la phase surnormale temperelle l'accroissement temporel de la sensitivité dans les systèmes visuels par l'inpulsion de l'étendue acoustique. De puls, nous observâmes que la théorie d'asismilation de la trace de mèmoire ne fut pas disponible dans l'interpolation hètèromodale et que l'effet rétroactif n'apparut pas.

Dans l'expérimentation II, afin de vérifier de plus l'effet proactif du ton, le ton ne fut présenté exactement devant le stimulus typique pendant 1. 5sec. Afin de confirmer l'effet de hauteur, les tons de 100 d. v. et de 2000 d. v., 80 phon furent emplyés. Les sujects furent cinq étudiants. Dans le résultat, le clarté du stimulus typique fut enclin à juger d'être plus claire par le ton de 100-cycle. Par le ton de 2000-cycle le résultat fut inverse. En autres termes, le ton de 100-cycle a l'effet inhibitoire, tandis que le ton de 2000-cycle a l'effet facilitatif. Nous observâmes l'effet différent du ton selon la différence de la hauteur et l'effet inhibitoire. Au contraire de notre expectative, la somme de la tempserreur apparut positivement dans l'interval de temps 6. 5 sec.

ZUSAMMENFASSUNG

Dieser Versuch ist die Fortsetzung von einem früheren Versuch über die Gewichtswahrnehmung (1956). Wie wohl verändert die Tonempfindung die Empfindlichkeit der Helligkeit, welche die höchst objective Empfindung ist? Wieviel Zeitfehler trat in der 6. 5 Sekunden Zwischenzeit auf? An der Gewichtswahrnehmung haben wir die rückwirkende so wohl als fortwirkende Wirkung im sukzessiven Vergleich gefunden, wenn man einen Ton hineingefügt hat. Ob wir im sukzessiven Vergleich der Helligkeit auch rückwirkende oder fortwirkende Wirkung finden können?

Die Lichtquelle war eine weisse Neon-bulbe. Der Gesichtwinkel der runden Lichtscheibe war 3. 4°. Die Helligkeit wurde in fünf Grade auf der Stufe von 0. 78 mL. klassifiziert. Der mittlere Grad wurde als Grundreiz aufgenommen und 1. 5 Sekunde lang dargeboten. Nach der 6. 5 Sekunden Zwischenzeit wurde auch einer von fünf Vergleichreizen 1. 5 Sekunden lang dargeboten. Vpn. verglichen zwei Helligkeiten. Die ganzen Urteil waren 50 mal im ersten Versuch gezählt; 25 mal im zweiten Versuch. Die Zeiger der Messung war D % vom Zeitfehler.

Im Versuch I. wurde die 1000 Htz., 80 phon Ton eingefügt nach dem Grundreiz oder eben vor dem Verglichreiz 1. 5 Sekunde lang. Vpn. waren 6 Studenten.

Nach dem Versuch wurde es klar, dass nur wenn der Ton unmittelbar vor dem zweiten Reiz eingefügt, der Ton die Helligkeitswahrnehmung beeinflussen konnte. Der zweite Reiz wurde, in der Regel, als helliger durch die Einfügung von 1000 Htz. Ton (Beförderungs-wirkung) beurteilt. Mit anderen Worten können wir nicht die rück-wirkende Wirkung, sondern fortwirkende Wirkung vom eingefügten Ton finden. Die fortwirkende Wirkung verstand wir als ein Hervortreten der "augenblicklichen übernormalen Phase"

(eine augenblickliche Zunahme der Sensibilität) im Gesichtsnervensystem durch die Erregung des Gehörsnervenfelds. Weiter besprachen wir dass die Assimilationstheorie des Gedächtnisspur nicht gültig in der heteromodalen Einfügung sei und die rückwirkende Wirkung nicht auftrete.

Im Versuch II, um die fortwirkende Wirkung der Töne weiter zu versichern, wurde der Ton unmittelbar vor dem Grundreiz 1.5 Sekunde lang dargeboten. Um die Wirkung von Tonhöhe zu versichern wurden 100 Htz. und 2000 Htz., 80 phon Töne gebraucht. Vpn. waren 5 Studenten. Dem Versuchsresultat nach wurde es klar, dass die Helligkeit des Grundreiz in der Regel als dunkler durch den 100 Htz. Ton geurteilt wurde. In der Fall des 2000 Htz. Tons war das Resultat umgekehrt. Mit anderen Worten hatte der 100 Htz. Ton Hemmungswirkung, während der 2000 Htz. Ton Beförderundewirkung hatte. Wir erörterten über die verschiedene Wirkung des Tons nach der Differenz der Tonhöhe und auch über die Hemmungswirkung. Gegen unsere Erwartung erschien der Zeitfehler als positiv in der 6.5 Sekunden Zwischenzeit.