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THE MECHANISM OF A TENDENCY TO DRAW FIGURES FACING IN THE LEFTWARD DIRECTION

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Summary

Figures of human faces, fishes, or trucks are often drawn oriented to the left. The issue primarily discussed in this paper is why pictures of a certain sort are drawn in a fixed direction. There are two possible hypotheses: One is a handedness hypothesis, and the other is an imagery hypothesis.

Factor analysis was applied to investigate the relation between fixed asymmetrical behavior and rough figurations.

The results show that (1) fixed behavior is accounted for by three factors: forcefulness, meticulousness, and randomness, (2) the figurations of concrete objects are accounted for by three other factors: pointedness, receptiveness, and mobility, and (3) abstract symbols are highly correlated with the factors affecting the fixed behavior. Analysis of data suggested that the direction of the figures of concrete objects is independent of facility of drawing, and is determined by the direction of the images.

Key words: asymmetry, imagery, handedness, factor analysis

Introduction and Background

Human beings receive information from the environment and produce a wide variety of outputs to the external world. In the incoming information and outputs, left and right are not always equivalent. For example, the figures of faces or fishes are often drawn directed to the left. This paper is mainly concerned with the asymmetry in drawing figures like this.

It was pointed out by Arnheim (1954) that pictures are drawn with unconscious consideration for various perceptual principles such as the general tendency to read visual patterns from left to right.[1] But in other studies this figural asymmetry was not focused on as the main theme. For example, studies concerning the direction of figurations are not mentioned in "The Psychology of Left and Right" (Corballis & Beale, 1976) where the authors present an exhaustive review of the problems associated with the difference between left and right in psychology.

Fujisawa (1974) has carried out a preliminary experiment to see if there is a tendency to draw a face or a fish directed to the left. 292 subjects were given three white cards that were 65mm. by 90mm. and were instructed to draw rough figures of a face, a fish, and a truck on each card. The subjects were not given a particular instruction to draw the side view of them. The results are illustrated in Table 1. If there were no tendency to draw the figures in a given direction, the probability of drawing all of them toward the left would be one eighth (12.5%). However, 270 subjects (92.5%) drew all three of the figures facing leftward. This manifests a tendency to draw pictures toward the left.

What kind of mechanisms determine such a tendency? In daily life, we observe human faces, fishes, or trucks from different angles and not from a particular angle in which they are perceived as heading leftward. It is also quite implausible to assume that observation behavior is reinforced only when we perceive objects facing the leftward direction.

Therefore, there are two possible hypotheses. One idea is that the leftward figures are more easily drawn by right-handers. Since the number of right-handers is much larger than that of left-handers, there would be a leftward dominance of the drawn figures (Handedness Hypothesis).[2] The other idea is that most people have mental images of external objects directed to the left so that the expressions of the images are directed to the left (Imagery Hypothesis).

In the experiment by Fujisawa mentioned above, there were 22 subjects who did not draw all of the figures leftward, and all of these subjects drew those pictures with their right hands. Although one of the 22 subjects was forced by his parents to switch to his right hand in spite of his natural predisposition of left-handedness, this is insignificant as compared with the fact that one of the

270 subjects who drew all leftward used his left hand.[3] So, it is difficult to conclude that leftward direction of figures is natural for right-handers and unnatural for left-handers. But this result is not satisfactory evidence that handedness is entirely independent of the direction of the figures. The human laterality must be thoroughly investigated.

Situational and Fixed Lateralization

It is not easy to give a strict definition of left or right dominance in human behavior. As for handedness, it does not seem to be a truly dichotomous variable. Even those who call themselves left-handers show various degrees of right-handedness. For example, some people write with their right hand and use a hammer with their left hand, while others vice versa. Some can use both hands well, while others use them only clumsily. There are also some people who had a natural predisposition to write with their left hand in their babyhood but were forced later by parents or teachers to switch to their right hand. The division into right- and left-handers is, therefore, largely arbitrary. What could be determined is a value of the continuous degree of the dextrality or sinistrality at a particular moment in time. Thus, a large number of the reports that estimate the incidence of left-handedness are insignificant.

It is also questionable if we can locate all human asymmetrical behavior on only a single dimension of handedness. There seems to be two kinds of asymmetrical human behavior. One is organized under specific environment (Situational Asymmetry). The other is a person's behavioral tendency independent of the situation (Fixed Asymmetry). The followings are examples of fixed asymmetry:

(1) Which hand is used in writing?
(2) Which hand is used in using a hammer?
(3) Which thumb is upper in interlocking fingers?
(4) Which wrist is upper in crossing arms?
(5) Which foot supports you while standing still?[4]
(6) Which foot is used in kicking balls?
(7) Which foot is used in taking off for a broad jump?

Eye dominance and ear dominance are also instances of fixed asymmetry.[5] With regard to these examples of behavior, directional dominance is stable within each subject independent of the situation.

In contrast, situational asymmetry is observed in such situations:

(1) Which slot do you drive your car into when they are all vacant in a parking lot?

(2) Which toilet do you use in a public lavatory?

(3) Where do you sit at a table?

In these situations almost everyone always selects a particular spot in a particular parking lot, a lavatory, or a table, while in other places other spots are always selected. For example, it is often observed that a man, who always sits at the right end of the counter in a certain coffee shop, makes it a rule to sit at the left end of the counter in another coffee shop. This spot selecting behavior can thus be categorized into the situational asymmetry.

There are some other types of examples of the situational asymmetry, which appear to be fixed behavior. People often choose left at a T-junction where both the right and the left roads lead them to the same destination. At the same junction, however, many people are observed to choose right if there are no oncoming pedestrians (Fujisawa, 1976). Also, which thigh is placed upper when we sit with our legs crossed is determined by where we sit on a sofa, though it appears to be fixed (Fujisawa, 1977).

There is also other asymmetrical behavior dependent on fixed behavior. For example, the reason why the telephone receiver is picked up by the left hand is because the right hand can be used to write something down by many right-handers. We do not make any mention here of the situational behavior nor the behavior dependent on other fixed behavior. What we will discuss in some detail is fixed behavior.

Fixed Asymmetry

Fujisawa (1979) applied the method of factor analysis to eleven kinds of fixed behavior to see how many dimensions or factors account for most of the data obtained in rating individuals on eleven left-right possibilities. Subjects, 615 university students, were instructed to mark left or right on each of the eleven test items:

(1) Which hand do you write with?

(2) Which hand do you use chopsticks with?

(3) Which hand do you use a hammer with?

(4) Which hand do you throw a ball with?

(5) Which foot do you kick a ball with?

(6) Which foot leaves the ground at the takeoff board when you make your leap in a broad jump?

(7) Which eye do you use when you look at something with one eye?

(8) Which hand is farther from you when you clap your hands?

(9) Which thumb comes to the top when you interlock your fingers?

(10) Which arm is on top when you fold your arms?

(11) Which hand do you use when you count sheets of paper by fanning them out?

It was found here that three factors can account for the intercorrelations of the eleven test items. The three factors can be interpreted as (1) Forcefulness (2) Meticulousness, and (3) Randomness. Therefore, the question, mentioned previously, if there is any relation between the figural asymmetry and handedness, must be modified:

Can the tendency to draw fishes, faces, or trucks oriented to the left be accounted for by the same factors that underly the fixed asymmetry?

If so, which of the three factors for the fixed behavior can account for the figural asymmetry?

the Analysis of Figuration

Fujisawa (1980) carried out research on the fixed behavior and an expriment concerning figuration. Subjects were 333 university students, all of whom had not previously participated in the study by Fujisawa (1979) and were experimentally naive. These are the test items concerning fixed behavior:

(1) a hand for writing

(2) a hand for using chopsticks

(3) a hand for throwing balls

(4) a hand for hammering

(5) the upper thumb in interlocking fingers

(6) the upper arm in crossing arms

(7) a hand farther from the body in clapping

(8) fingers used for counting sheets by fanning them out

(9) the dominant eye

(10) the dominant ear

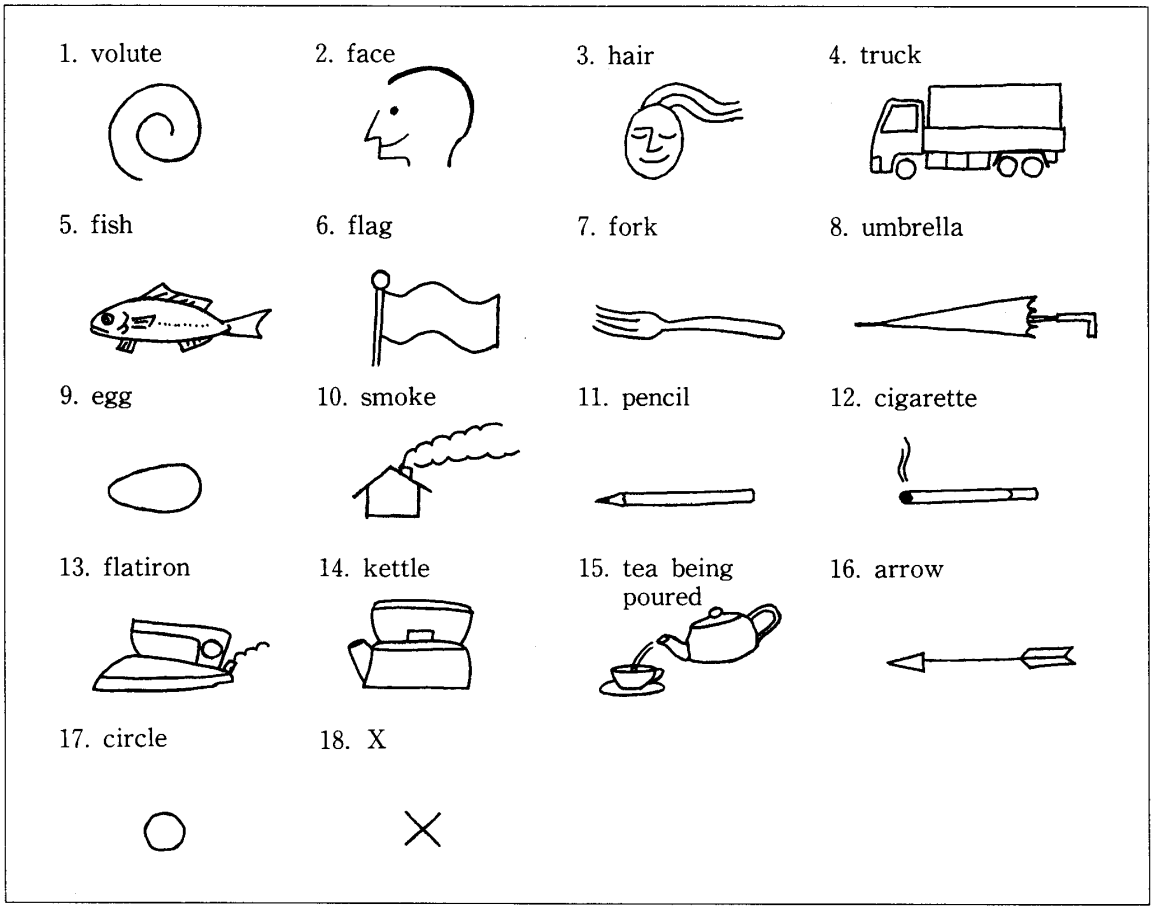
(11) a foot for jumping off the ground

(12) the foot supporting the most weight while standing

Table 1 Orientations of the three figures (a fish, a human face, and a truck)

Distribution of orientations of the three figures				Number of subjects	Percentage
Leftward	Rightward	Frontward	Upward		
3	0	0	0	270	92.5
2	1	0	0	9	3.1
1	2	0	0	7	2.4
0	3	0	0	2	0.7
2	0	1	0	2	0.7
2	0	0	1	1	0.3
1	1	1	0	1	0.3
			Total	292	100.0

Figure 1 Examples of the pictures produced most frequently



This time, the list does not include the foot which is used for kicking balls, but includes the dominant ear and the foot supporting the most weight while standing. Subjects were allowed to try those twelve test performances on the spot if they could not judge from memory. But as for the dominant ear, they had to judge from memory.[6] The dominant eye was defined by a simple test.[7] In the session of drawing figures subjects were instructed to draw one rough picture on each eighteen cards (65mm. by 90mm.). The objects of drawing were selected on the basis of the following properties: (1) familiarity, (2) asymmetry, (3) simplicity, and (4) variety. The eighteen figures were as follows:

(1) a volute
(2) the side view of a human face[8]
(3) hair blowing in a strong wind
(4) the side view of a truck
(5) a fish[9]
(6) a flag fluttering in the wind
(7) a fork placed sideways
(8) a closed umbrella placed sideways
(9) an egg
(10) a house with smoke coming out of its chimney
(11) a pencil placed sideways
(12) a cigarette giving off smoke
(13) an iron
(14) a kettle
(15) tea being poured from a teapot into a cup
(16) an arrow
(17) a circle
(18) an X mark

Each of these eighteen figures was considered to be in the leftward or rightward direction according to each of the following indices:

(1) Is the volute clockwise? If so, it is regarded as to the right.
(2) the position of the nose in the side view of the face (Is it on the right or left side of the

figure?)

(3) the direction of the wind which sways hairs

(4) the direction in which the truck is going

(5) the direction in which the fish is swimming

(6) the direction of the wind which flutters the flag

(7) the direction in which the prongs point

(8) the direction in which the top points

(9) the direction in which the diameter decreases

(10) the direction of the wind which carries the smoke

(11) the direction of the point of the pencil

(12) the direction of the end which is lit

(13) the direction of the sharp-pointed end

(14) the direction of the spout of the kettle

(15) the side of the teapot the cup is on

(16) the side to which the arrow is pointing

(17) Is the circle drawn in a clockwise direction? If so, it is regarded as to the right.[10]

(18) the direction of the loop made if the X is drawn in one stroke not lifting the pencil from the paper[10]

Scores were obtained for each of these twelve fixed behavior items and eighteen figurations, which amounted to thirty test items in all. Table 2 gives the number and percentage of responses of the test items. Here, we can see again the strong leftward tendency in the figuration, especially in the cases of the face, the fish, and the truck. Figure 1 illustrates examples of all the figures in the directions most often chosen. All these scores were then intercorrelated. The phi coefficient was adopted as the correlation coefficient, because every item had a two valued variable.

Then factor analysis was applied based on this correlation matrix. The analysis was made using the principal factor method, and the number of factors was estimated from the variation in eigenvalues. Factors were rotated to simple structure by the oblimin method, one of the oblique rotation methods.

Results

Six factors were found to account for the asymmetries. Table 3 gives the reference factor structure. The underlined loadings in this table show which items are relatively highly correlated with

Table 2 Number and percentage of responses of the test items

Variables	Responces			Percentage	
	Left	Right	Total	Left	Right
the side view of a human face	326	7	333	98	2
the side view of a truck	325	8	333	98	2
a fish	325	6	331	98	2
an iron	288	15	303	95	5
a fork placed sideways	306	27	333	92	8
a flag fluttering in the wind	306	27	333	92	8
a house with smoke coming out of its chimney	299	32	331	90	10
a kettle	297	33	330	90	10
tea being poured from a teapot into a cup	280	52	332	84	16
hair blowing in a strong wind	239	70	309	77	23
a pencil placed sideways	228	105	333	68	32
a cigarette giving off smoke	225	106	331	68	32
an egg	214	102	316	68	32
a closed umbrella placed sideways	212	116	328	65	35
an arrow	178	154	332	54	46
an X mark	116	217	333	35	65
a circle	17	316	333	5	95
a volute	11	322	333	3	97
a hand for writing	3	328	331	1	99
a hand for using chopsticks	12	317	329	4	96
a hand for throwing balls	24	308	332	7	93
a hand for hammering	23	308	331	7	93
the dominant eye	104	228	332	31	69
fingers used for counting sheets	101	226	327	31	69
the dominant ear	57	119	176	32	68
the upper arm in crossing arms	155	178	333	47	53
the foot supporting the most weight	174	159	333	52	48
the uppermost thumb in interlocking fingers	177	156	333	53	47
a foot for jumping off the ground	179	152	331	54	46
a hand farther from the body in clapping	231	102	333	69	31

each of the underlying factors. This table shows that Factor I, Factor V, and factor VI are highly correlated mainly with fixed behavior, and Factor II, Factor III, and Factor IV with figurations.

Factor I is loaded most heavily in hammering, throwing balls, using chopsticks, and writing — it may be interpreted as "Forcefulness", which was also found in the previous study (Fujisawa, 1979). Factor V, if we must find an appropreate name for it, seems to be a kind of "Meticulousness", which is heavily loaded in writing, using chopsticks, clasping hands, and crossing arms. One should pay detailed attention to these actions.[11] Factor VI is loaded in the taking-off foot, the foot supporting the most weight, the dominant eye, and the dominant ear. This factor seems to be "Ran

Table 3 Reference Factor Structure

	F-01	F-02	F-03	F-04	F-05	F-06
volute	**−0.409303**	0.004784	0.109031	−0.186791	**0.296817**	0.059350
face	0.076362	0.060611	**−1.008915**	0.030944	0.097947	−0.081449
hair	−0.076370	0.045098	−0.160559	0.053893	−0.175940	0.166438
truck	0.016043	−0.008544	−0.001861	**0.468088**	−0.221627	−0.040041
fish	−0.049195	0.000414	−0.024261	**0.482867**	0.169046	−0.045751
flag	0.061493	**−0.140256**	−0.045509	−0.013395	−0.054845	0.041399
fork	−0.014305	**0.722765**	0.027199	0.130075	0.110750	0.025437
umbrella	−0.004708	**0.319879**	0.040504	0.093944	−0.089806	−0.023497
egg	0.084001	**0.398590**	0.041895	0.092976	0.006494	0.007584
smoke	0.054570	−0.025045	**−1.023983**	0.003315	−0.120657	0.075462
pencil	−0.019093	**0.816567**	−0.031256	−0.006982	0.084801	−0.003353
cigarette	−0.029697	**0.747791**	0.020312	0.090643	0.011805	−0.043989
iron	0.038464	0.135440	0.000123	**0.585582**	0.190921	−0.006601
kettle	0.164047	0.226622	−0.067645	**0.281363**	0.213789	−0.025833
tea	0.146558	0.154211	0.005487	**0.254906**	0.204663	−0.004010
arrow	0.112554	**0.327905**	−0.046520	0.069934	0.065833	0.100222
circle	−0.023188	0.050105	−0.002326	−0.049955	**0.408410**	0.056507
X	0.021525	0.062011	0.074555	0.032003	−0.063851	**0.104238**
writing	**−0.361669**	0.020715	−0.030141	−0.116929	**0.387113**	−0.100473
chopsticks	**−0.561916**	−0.018413	0.096146	−0.157515	0.180090	0.024202
throwing	**−0.836704**	−0.011724	0.051547	0.041200	−0.067789	0.092653
hammering	**−0.863258**	0.004822	0.058195	0.006848	−0.07950	0.081900
fingers	−0.001169	−0.022828	0.025736	0.045067	**0.211019**	−0.049665
arms	−0.047820	−0.042032	0.060830	−0.051955	**−0.150005**	0.095995
clapping	**0.273118**	0.057256	0.007306	−0.026384	0.123049	0.017801
counting	**−0.169013**	−0.040213	0.030602	−0.018140	0.077441	**0.128191**
eye	−0.067674	−0.046436	−0.011605	0.031953	0.092204	**0.148487**
ear	−0.201618	−0.103387	−0.055799	0.081294	−0.044006	**0.489774**
jumping	0.019920	0.037136	0.046605	0.022682	0.035940	**0.390967**
weight	0.043935	−0.032586	−0.069225	−0.141870	−0.006397	**0.423622**

dom Choice Factor". Regardless of what we do, we can use either side; however, one side will always automatically be dominant, with this factor. These three factors are consistent with the results of the previous studies.

On the other hand, figurations are accounted for by Factor II, III, and IV. The more highly the variables are correlated with factor II, the more acute the angle of the pointed shape of the figure is. And as the correlation decreases the angle becomes wider. Therefore Factor II can be interpreted as "Pointedness". Variables heavily loaded in Factor III are only two figures, the face and the smoke from the chimney. So, it is difficult to identify Factor III. If we focus our attention on the fact that there are many sensory receptors on the face and that a chimney is a passage or an

exit which allows smoke to go out, then we may consider this factor "Receptiveness".[12] Factor IV is loaded most heavily in an iron, a fish, and a car, all of which are mobile. Thus it may be interpreted as "Mobility".

According to the analysis mentioned above, it follows that three figuration factors and three behavioral factors are independent. And each of the correlation coefficients among those six factors is very low, the angles of the intersections of factor axes being nearly 90 degrees. This indicates that all of the six factors are independent.

Additionally, the three variables, a circle, an X mark, and a volute are not very heavily loaded in any figuration factors but loaded in behavioral factors. A circle is loaded in the factor "Meticulousness", an X is in "Random Choice Factor", and a volute in "Forcefulness" and "Meticulousness". A common feature of these three figures is that they represent abstract symbols. Therefore, the figures of concrete substance are accounted for by the figuration factors and the figures of abstract symbols by the behavioral factors. Moreover, this combination supports the imagery hypothesis that the direction of the figures of concrete objects is determined by the direction of the images, and not by the direction in which one can draw them easily. Abstract symbols have no corresponding referents or images, and consequently, a circle and a volute are drawn in the easier direction and an X in a random direction.

The variable of hair blowing in the strong wind is not very heavily loaded in any factor. The hair's blowing seldom happens and is difficult to imagine. After the experiment some subjects reported that this was one of the most difficult figures. Thus, it may be that drawing before forming a mental picture resulted in little contribution of any factors to the variable.

Conclusion and Perspective

To summarize the interpretation of the results, we can state as follows: The direction of the figures of concrete objects were determined not by the facility of drawing (drawing hypothesis), but by the direction of the image (imagery hypothesis). It was also found that concrete figures are drawn in accordance with these three rules:

Rule 1. It is always drawn to the left (or right) if it has the shape of pointedness.

Rule 2. It is always drawn to the left (or right) if it is receptive.

Rule 3. It is always drawn to the left (or right) if it is mobile.

Abstract symbols are considered to be drawn according to the principle of facility.

An assumption, which must be verified by further experiments, can be made in relation to the human information processing system. In the memory system, which is highly organized, mental images, if they represent familiar concrete objects, are not stored facing different direction at random but stored in the best direction to get more information about the object. For example, trucks can be more easily distinguished from buses when viewed from the side than from the front. The silhouette of a fish can be most clearly identified when it is observed from the side. If the object is symmetrical such as a ball, no problem arises when images are stored in the long-term memory. However, if the object is asymmetrical, some principle of arrangement must be necessary. It may be that the principles correspond to pointedness, receptiveness, and mobility. If pattern recognition is accomplished by close correlation of the retinal image and the mental image of an object, the object at different angles would not correlate well with the appropriate mental image. This problem can be overcome by mental rotation before matching is made. That the internal representation of an object can be rotated was demonstrated by Roger Shepard and his colleagues.[13]

Of course what this paper shows is that in drawing simple pictures quickly there are some principles concerning the orientation of the figures. But it is important that those principles are usually independent of the facility of drawing. This is evidence that concrete objects can be coded and stored in long-term memory not only verbally but also in the from of nonverbal imagery.

Footnotes

(1) In his book, he quoted the art historian Wölfflin to show the fact that pictures change appearance and lose meaning when turned into their mirror images, because pictures are read from the left to the right and naturally the sequence changes when the picture is inverted. He also introduced Gaffron's idea that the attention to what goes on at the left would make up for the fact that objects to the right appear more conspicuous, and the eye would move spontaneously from the place of first attention to the area of most articulate vision. If this is true, people can read left oriented pictures in an orderly fashion from the front to the back. However, research in eye movements, including picture viewing, by Yarbus (1967) and Mackworth & Morandi (1967) demonstrated that there is no broad sweep over the picture, nor any global viewing pattern.

(2) Many people have advanced this hypothesis. But the present author simply does not know whether there is any experimental evidence or not. M. Gardner (1964) seems to support this hypothesis.

(3) This subject is a hemiplegic patient (a patient with one-sided paralysis due to contralateral brain damage).

(4) While standing, people tend to add their weight to one foot, which makes one hip stick out. (Morris, 1977)

(5) Concerning eye dominance, see Miles, 1929, 1930; Walls, 1951; Corballis, 1964; Money, 1972; Morris, 1977.

(6) So, no responses were allowed if the subjects could not judge the dominance. Only 176 responded out of 333 subjects. Therefore, the question remains whether or not this result is valid.

(7) Subjects were instructed in the following way: "First, fix your eyes to a distant point, and cover the point with the tip of a raised finger. One blurred finger can be seen in front of each eye (thus, two can be seen at a time). Next, close one eye after the other, and you will find out which eye sees the fixation point. This is because your finger does not move on the line of vision if you see with your dominant eye, but it moves to the side of the fixation point if you see with your nondominant eye." The results obtained from this procedure (left 31%, right 69%) were not significantly different from the results obtained by Fujisawa (1979) (left 33%, right 67%).

(8) In a preliminary experiment (Fujisawa, 1974) one of the responses to the instruction to draw the face was a front view, This is why subjects were restricted to drawing a side view of the face in this experiment.

(9) Subjects were given the following instruction: "First, imagine a fish swimming in the water. Next, draw the fish as you have imagined." The point of such instruction is to see if the results are different from those obtained when the instruction is as follows: "Draw a fish," and to have confidence that this figure is a product of imagery.

(10) After the experiment, each subject was asked in which way he drew the circle and the X.

(11) It may be somewhat strange that clasping hands could be accounted for by meticulousness. However, when clasping hands quickly after stretching arms, difficulty would be found in interlocking fingers smoothly. It may be that some kind of unconscious feedback system is working in clasping hands as well as in writing. When you close your eyes, you can neither clasp your hands nor write letters.

(12) Of couse chimneys rise above the roof of a building. Therefore, smoke and gases must pass upward. But they can move from left to right out of the chimney due to the wind. In most figures of information processing models or of circuit diagrams of electrical apparatus, input is usually drawn left of the output, and the flow of information or energy is from left to right. This may have some connection with the "Receptiveness".

(13) See Shepard & Metzler (1971), and Cooper & Shepard (1973).

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