Psychologische Forschung 27, 337—365 (1964)

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Orange Park, Florida

Patterns of Responsiveness in Chimpanzees Reared Through Infancy Under Conditions of Environmental Restriction

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With 3 Figures in the Text

(Received June 26, 1963)

Contents

A. Introduction

Even if you have watched chimpanzees only casually, you have probably been impressed by their tendency to be doing something nearly all the time. In five minutes time a juvenile will sit, stretch, scratch, wrestle with his cagemate, hoot, run, throw sand at the observer, groom, rock back and forth, pick at the wall, swing on the ceiling, weave a string through the wire, and so on and on. Often the focus of his attention and the nature of his activity change every ten seconds or less (KINDER, cited in NISSEN, 1946). As KÖHLER (1925) remarked, chimpanzees on the whole can do with a little suppression.

It is just about as easy to get carried away by the complexities of chimpanzee behavior as it is to get carried away by human complexities. In the nature and variety of his response patterns, the acuity of his attention to the smallest details of his environment, and the sheer number of objects to which he responds in differential fashion, the chimpanzee surpasses every other nonhuman species and most nearly

resembles man. If we confine our research to observations of unconfined adults or even juveniles, several dozen instincts, motives, or drives — including one to avoid "awful-appearing" objects, another to solve problems, and another to socialize — do not seem sufficient to account for all we see. We are apt to agree with NISSEN (1954a) that "every little movement has a meaning all of its own"; i.e., that every act is autonomously motivated.

Actual experimental data (particularly on infants) are, however, likely to suggest a different and more parsimonious picture of ape behavior (SCHILLER, 1952, 1957). The present paper summarizes our observations and experiments on chimpanzee infants, and traces the way in which we have come to the conclusions that: (a) essentially all behaviors are interrelated, and (b) it is both confusing and misleading to identify *any* driving forces before we understand the mechanics of posture and movement in chimpanzees. We shall argue that it is better to refer to all infant drive behaviors as simply facets of "responsiveness". As used here, responsiveness is a nontechnical expression for the fact that responding is an ubiquitous property, indeed a defining characteristic, of living organisms; it is not intended as an explanation of behavior or as a formalized "unitary drive". By studying the effects of varying types of infant experience upon behavior, but at the same time paying even closer attention to the similarities in behavior across all rearing conditions, we hope to identify certain innate and pervasive patterns of responsiveness in chimpanzee. The adult chimpanzee, particularly the animal in the wild (KORTLANDT, 1962; NISSEN, 1931) emerges as more intriguing a creature than ever; but the number of innately specialized driving forces needed to understand his complexity shrinks considerably. If he *appears* to have so many drives, it is probably only because he has the genetic potential to engage in an enormous variety of behaviors and to be sensitive to a variety of stimuli; and neither behaviors nor stimuli are to be confused with driving forces.

For purposes of brevity, no attempt will be made to review the wealth of relevant research findings and speculations of other workers. We shall concentrate upon those data of our own which bear upon the nature of responsiveness to objects in chimpanzees that were reared from birth to twenty-one months under conditions of severe environ mental and social restriction. However, our interest is in the chimpanzee in general, and responses to objects are chosen as merely a core example of research. The picture presented of responses to objects is intended to generalize to most test situations in which the same responses can be observed. Four problems will be dealt with: (1) the classification of behavior, (2) the effects of experience upon response, (3) the effects of stimulus factors, and (4) responsiveness as a general factor.

Acknowledgments. The research program about which this paper centers was the joint effort of so many individuals that complete credits are impossible. The late HENRY W. NISSEN conceived and initiated the rearing procedures, and examination of the infants was carried to completion by RICHARD K. DAVENPORT, Jr., CHARLES M. ROGERS, and the author. Most experiments were done under the support of Grant M-1005 from the National Institute of Health and a grant from the Ford Foundation. This writing received the assistance of Grant MH-06751 from the National Institute of Health. The drawings were done by HENRY S. KNIGHT.

B. Method

Previous infant studies done at the Yerkes Laboratories have dealt with normative aspects of behavioral and morphological development (e.g., GAVAN, 1953; NISSEN and RIESEN, 1949; RIESEN and KINDER, 1952); with the effects of gross visual deprivation (e.g., CHOW and NISSEN, 1955; RIESEN, 1958) and tactual deprivation (NISSEN, CHOW and SEMMES, 1951); and with the effects of extreme "enrichment" of general experience (HAYES, 1951). The present rearing procedures continued in the same general tradition and were designed to permit analysis of the effects of depriving *S*s of general experience with objects and social stimuli.

Sixteen laboratory-reared and three captive wild-born infant chimpanzees were studied intensively over a period of seven years, and supplementary observations were made on approximately 25 additional young chimpanzees, 14 of which were procured from the wild. Thanks to the careful reporting of previous investigators at the Yerkes Laboratories our infants could also be compared with a large number of mother-reared and nursery-reared chimpanzees on physical health (DAVENPORT, MENZEL, and ROGERS, 1961) and at least tentatively on certain aspects of postural behavior (e.g., DAVENPORT and MENZEL, 1963). We might note at this point that our infants showed no signs of neurological or sensori-motor damage, nor were they grossly retarded in the ability to assume all normal chimpanzee postures.

The 16 subjects (*S*s) born at the Laboratories were separated from their mothers on the first day of life. After about 3 weeks in a neonatal incubator they were housed in illuminated gray cubicles measuring $48 \times 36 \times 24$ in. Diapering and feeding were done with a minimum of interaction between caretaker and infant, an average of about 10 min a day, and during these procedures *S* could see only the mitten-encased arms of the caretaker. At no time until they were 21 calendar months of age and ready to start formal testing did they see out of their cribs, which were enclosed except for a one-way viewing screen in the ceiling. During the weekly weighing and cage cleaning they were transported to and from their cubicles in an opaque cloth bag. Five *S*s (maximally restricted group, or *Kaspar Hausers*) were maintained individually in bare cubicles, with no objects or social stimuli. Three other *S*s (visual-added group) were raised in conditions identical except for the addition of a variety of nonrepresentational designs and objects, none of which could be touched. Four other *S*s (manipulation-added group) were raised in the standard isolation condition except that for a limited time each day they were provided access to manipulanda in the form of switches and a lever. Finally, four infants (social-added group) were given social stimulation in the form of a similarly aged chimpanzee of the same background. Members of each pair were housed individually in a standard cubicle, but two cubicles were abutted and the animals separated by bars. This arrangement prevented passage from one crib to the next but otherwise permitted free interaction.

All four of these groups are henceforth referred to as "restricted" infants, but it should be noted that this designation is largely post hoc and based more on the observed close similarity in behaviors than on anticipated differences.

Three wild-born animals were purchased from an importer when between 3 and 7 months of age (estimated), and were housed together in a large cage in the nursery office area. Human handling and exposure to a variety of objects and situations were encouraged, with the restriction that *S*s see no stimuli to be used in later tests.

The basic testing technique consisted of placing *S* in a selected situation or confronting it with a selected object, and verbally recording an objective account of behavior by dictating machine. Motion picture photography was extensively employed as a supplement to verbal descriptions. For over two years we attempted to secure a "complete" moment-to-moment verbal description of behavior. After that time, we felt that the major response categories in young chimpanzees had been identified, and recorded only selected responses. Most of the tests reported here employed small innocuous inanimate objects as stimuli; however, parallel tests employed foods, human beings, chimpanzees, open fields, and novel environments, and it is our intent to generalize to all such situations.

C. Results and discussion

I. The classification of behavior

The problem of classifying the most meaningful and useful dimensions of behavior might be said to be *the* fundamental problem of psychology generally (NISSEN, 1958). It would certainly be pretentious for us to claim that we have solved this problem for the chimpanzee. Such an accomplishment would involve not only an exhaustive description of behavior patterns, but also a thorough understanding of the function and causal mechanism of most responses.

By tackling this problem through chimpanzees reared in restriction, we hoped to at least begin on a classification system of some generality. The unique advantages of using *Kaspar Hausers* as a starting point can be easily appreciated. The experience factor is controlled, and can be evaluated step by step. More important, the behavior of such *S*s might well be simple enough to be described in reasonably complete fashion.

Three stages of classification were involved. First, we considered specific response patterns separately, defining each in physicalistic terms. Second, we asked how various responses relate to each other and cluster into larger patterns of behavior. Third, we took into account some functional relationships between responses and other variables (experience and stimuli), and attempted a classification of behaviors in a general system of responsiveness. By fragmenting the problem in this fashion we can keep description more clearly distinct from explanations, and avoid the common fallacy of assuming that "no response can be defined apart from its effective stimulus, and no stimulus can be defined apart from behavior" (see J. S. BROWN, 1961). It should be emphasized that throughout this paper I am first and foremost interested in achieving

an accurate *description* — one that will best fit all that I know of the chimpanzee.

1. Discrete responses and simple patterns. At least so far as the description of postures and movements is concerned, restricted chimpanzees are not too difficult a subject matter. A partial catalog of their responses is given below. In it we attempt for the most part to avoid defining a response in terms of the exact nature of the exciting stimulus or the motive influencing response. We concentrate on responses that can be seen in nearly all situations, and with a wide variety of objects. A vast majority of the moment-to-moment behavior changes in all tests conducted at 2 yr. of age could be classed in such units.

1. Changes in gross bodily position: prone, supine, seated, reclining on the side, bipedal, quadrupedal. Each of these positions might of course be subdivided almost indefinitely if desired (HEWES, 1957; RIESEN and KINDER, 1952). There is some evidence that the precise *form* of e.g., sitting, is different in restricted chimpanzees than in feral chimpanzees, but as noted earlier, all our *S*s were capable of assuming all classes of gross bodily positions *per se*.

2. Stereotyped "self-directed" responses. Over 30 distinctive patterns have been identified in the 16 restricted chimpanzees, the major ones involving rhythmical rocking, swaying or turning movements of the body, or repetitive or persistent acts involving parts of the body, such as thumb sucking and eye poking. Many of these acts are similar in form to the autistic activities of human defectives and disturbed patients (DAVENPORT and MENZEL, 1963). There is a growing body of evidence that chimpanzee and human stereotypies are also *functionally* similar, e.g., DAVENPORT and BERKSON, (1963); BERKSON, MASON, and SAXON, (in press). Much of this work is being conducted with the present *S*s. Precise identification of patterns was made on the basis of *S*s bodily position (e.g., erect swaying is distinguished from prone swaying), and the portions of the anatomy involved (Fig. 1). Scratching, autogrooming, and rubbing of the self are usually listed separately from stereotypies. In one test involving 30 hours of observation time the average number of different stereotypies per restricted animal was 4.1, with a range of 2 to 8 patterns in different animals.

3. Locomotor reactions. All restricted chimpanzees showed the ordinary chimpanzee quadrupedal progression, but some unique forms of progression were also seen. Those animals who stereotyped in prone postures (Fig. 1a) sometimes locomoted by "swimming" across the floor, and *S*s who habitually stereotyped in a bipedal posture (Fig. 1b) often traveled the room by sidling along the wall with their backs against the wall. Such reactions seemed particularly prominent when the *S*s

were upset, and as they came to relax in a situation the quadrupedal position was gradually adopted.

Preference for the bipedal posture was much more prominent in about five of the restricted *S*s than in any wild-born animals. Prolonged bipedal standing, i.e., for a continuous half-hour or more, ordinarily

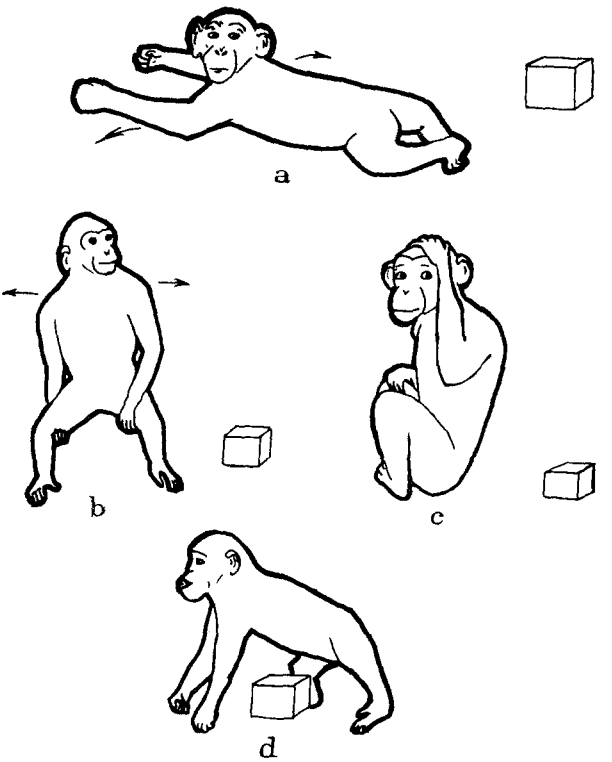

Fig. 1a—d. Initial responses of young chimpanzees toward objects. a Stereotyped prone sway, b stereotyped erect sway, c huddle and peek, d straddle.
Fig. 1—3 drawn from photographs and descriptions

occurred when *S* had its back against a wall and was performing stereotyped movements.

Climbing is a common form of locomotion in the wild, but it was not observed in restricted *S*s until they had lived for a time in cages with wire sides. When they were placed in such cages in the outdoor colony at about $2^1/_2$ years of age, they initially fell or stepped into space if placed on a height of several feet. However, it is not certain that falling

Fig. 2a—e. Manipulations of objects by young chimpanzees. a Discrete "smell", b discrete lipping, c discrete tapping, d lying on object, e supine play
Fig. 3a—e. Manipulations of objects by young chimpanzees. a, b Drape, c inspection or grooming, d clasp or clutch, e simple activity with objects

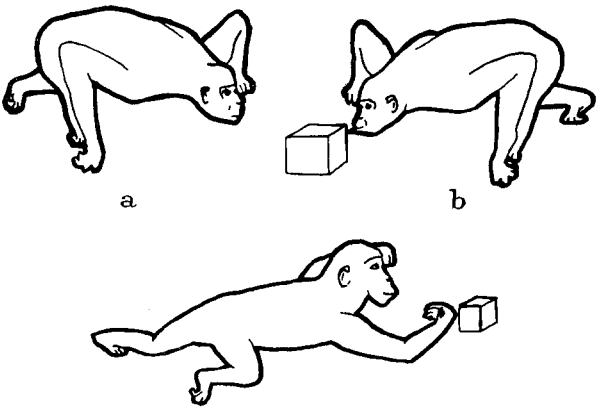

Fig. 2

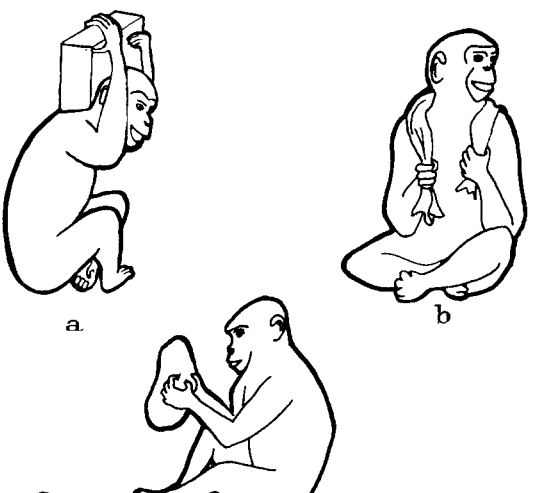

Fig. 3

was due to a perceptual or physical lack. The extreme emotional upset of the strange situation might have contributed to their behavior. At any rate, within a few weeks most of them were fairly proficient at climbing.

Other more specialized forms of locomotion which were seen in the restricted *S*s included the standard *threat or bluff* patterns of the young chimpanzee.

4. Manipulative reactions with objects. The richness of the chimpanzee's response repertoire is particularly evident in manipulative behaviors, and our *S*s were no exception to this rule (Figs. 2, 3). Their manipulative reactions can be described in five general classes: (a) Contacts made with a single part of the body ("discrete contacts"). These were usually performed when *S*s appeared to be timid toward an object. The most common reactions are touching the object with the lip or mouth only (Fig. 2 b), poking it with an extended finger, tapping or nudging it along the floor with the back of the wrist (Fig. 2 c), and striking it with the arm or in some cases with the forehead. (b) Prehending and carrying. The most common prehensions are performed with the mouth, hand, and foot, in that order. However, we have observed up to 15 additional ways in which young chimpanzees carry various types of objects. Carrying in the thigh is common. Prehending the object between the chin and the chest, holding the object under the arm, or holding the object between the heel and the rump are other responses that have been observed. (c) Stimulation of body surface with objects. The most common of these acts are sitting or lying on the object (Fig. 2 d), or wrestling with the object. During wrestling the object is grasped and hit or rubbed against the chest and face. A favorite activity with certain classes of objects is draping, which is defined as any form of stimulation of the back of the neck or the shoulders. (Fig. 3 a, b). Usually the object involved is flexible, e.g., a rope or chain, and it is curled around the neck. However, essentially the same form of behavior has been observed with a large variety of objects including small blocks of wood and a toothbrush. On occasion some *S*s have also clasped or clutched objects, i.e., grasped and held them up to the chest or neck, as a child might hold its clutch-blanket (Fig. 3 a, d). In some cases thumbsucking occurs along with such behavior. A highly favored form of play involves going supine and manipulating the object overhead. Frequently during such play the object is passed from one limb to another, or all four limbs might be involved in manipulation simultaneously (Fig. 2 e). Also the *S* might bite or mouth the object. (d) Inspection and grooming. The component responses seen here resemble those described above as "discrete contracts", but now they are always accompanied with other forms of contact, for example, the object is not merely poked, but held

and poked; i.e., a simple pattern rather than a single response is involved. The *S* is in a seated position or possibly supine while performing these reactions whereas with discrete contacts he is ordinarily in a quadrupedal posture. Specific responses include "smelling" the object, close visual inspection, and poking with an extended finger; lip movements might occur during close inspection. When all of these acts are integrated into a single pattern they obviously constitute "grooming" (Fig. 3c); however, they frequently occur independently. Finally, many of the above responses may occur in patterns in which the object is brought into relation with other features of the environment. To describe this requires another category: (e) Activities performed *with* an object. Examples are: *S* grasps and strikes the object against the wall, drags it across the wire, places it in a specific location, (e.g., a ledge which he has used repeatedly for such purposes before), performs a crude dance, or repeatedly climbs up and down the cage wall carrying the object in hand, foot or mouth. A clear instance of the latter was one *S*'s habit at 3 years of age of placing a paper towel carefully across his chest, climbing to the ceiling, and then traveling all over the ceiling hanging quadrupedally. If the towel fell off his chest, he would immediately climb to the ground, retrieve it, then go through the same sequence again. Simple "instrumental" activities would be scored in this general category also: for example, placing a cube into a tin can, using a stick to hit another animal, etc.

5. Vocalizations. Vocalizations were classified in a relatively crude manner so that they could be reliably recognized by most observers. Clicking, sputtering, smacking, and other *nonspecific vocalizations*, were more frequent in restricted *S*s than in normal chimpanzees. In many cases such noises were a regular accompaniment to stereotyped movements. All restricted *S*s displayed "*food barking*", "*pleasure panting*" and the specific types of *hooting* and *barking* seen in other animals during moments of mild caution toward a stimulus. As in wild-born animals, these vocalizations were specific to given situations, e.g., in several hundred hours observing animals playing with inanimate objects, I never once heard *food-barking* noises made; however, the same calls are almost invariably heard at feeding time. Similarly, *pleasure panting* is closely associated with the whole-body stimulations of play, and never occurs when the animal acts upset. Screaming and whimpering were also observed in the restricted *S*s; however, these animals were less apt to scream or whimper when upset than are wild-born chimpanzees.

6. Miscellaneous responses such as sleeping and specific forms of approaching objects will be described later in the paper. We have fairly clear evidence that sleep can function as a withdrawal response from an upsetting situation in restricted *S*s. While it is plausible that

this might be true for wild-born chimpanzees, we have no evidence on the matter.

2. The organization of responses into patterns. A catalog of bodily positions and movements is a necessity for the understanding of chimpanzees, but by itself it is unsatisfactory. I believe that most of the behavior of any chimpanzee can be recorded in terms of the above categories. Differences between individual chimpanzees are found in the presence or absence of certain responses, but such differences are small by comparison with the differences to be found in frequency of reaction, the circumstances in which a response is seen, or the organization of a response into the larger patterns of behavior. An adequate description requires a thorough analysis of the general problem of response organization, a problem which will be dealt with cursorily at the present time.

Our approach to the response organization of restricted chimpanzees was first to examine what responses were generally most frequent, second to look for responses that tended to occur as elements of the same "pattern", and third, to see how many such patterns were required to account for a major portion of the behavior of the animals in most situations. At this level, a "pattern" of behavior was defined as those postures, movements and activities which tended to occur as a constellation in the same time interval. Stimulus conditions do not enter directly into the definition of a pattern. At 2 years of age the behavior of restricted chimpanzees could be evaluated with reasonable accuracy by considering only two sets of patterns: "autistic" ones and "externally-directed" ones. The major components of the autistic pattern were *S*'s preferred posture and his idiosyncratic movement patterns. (In wild-born 2 yr. olds an analogous pattern might be "huddling" in a seated position, with occasional scratching or rubbing of the self.) Externally-directed patterns involved orientation, inspection, or manipulation of stimuli other than the body.

These two patterns were ordinarily incompatible with each other and were reliably related to different sets of postural, locomotor, and other adjustments. Under most circumstances, "autistic" patterns were by far prepotent. Approximately 85% of the time *S*s performed either autistic acts or externally-directed ones such as object-grasping; it was rare to see both patterns performed in the same 15-sec interval, or to see neither performed in that length of time. By virtue of this reciprocal relationship between patterns, it was possible to get a crude but useful picture of an individual *S*s' general behavior organization in a given situation from a knowledge of a *single* indicator response. As the chimpanzees gained experience outside their rearing environment more specifically defined sub-classes of patterns were required. "Externally-directed" patterns became so diversified that a single term to cover

them all would be an over-simplification. No attempt will be made to catalog all such empirical patterns, but some general principles of patterning will be presented in the final section of the paper in tabular form. The precise elements of a pattern are never completely predictable. Both for a single individual and across groups of individuals, many motor elements seem to be interchangeable or functionally equivalent. The problem of individual differences in motor elements is not reduced by uniform rearing conditions. On the contrary, there is indication that the patterning of motor behavior is *more* rather than less variable among restricted *S*s than among wild-born chimpanzees (MENZEL, DAVENPORT, and ROGERS, 1963 b).

It became a matter of some interest to determine how such an approach to behavior organization related to conventional intuitive descriptions of chimpanzee behavior, which deal with the problems of response idiosyncrasies and equivalences by pointing to hypothetical central states (e.g., fear) rather than to specific responses.

In an unpublished experiment performed with the collaboration of WILLIAM A. MASON, I recorded the behavior of several 6- to 8-year-old chimpanzees toward a variety of objects, using essentially the same objective categories and time sampling technique employed on restricted infants. At the same time, Dr. MASON made intuitive judgments regarding play, fear, object exploitation, and aggression. From approximately 150 such trials, collected on eight animals, I attempted to reproduce Dr. MASON's judgments solely on the basis of the specific responses which had occurred; i.e., without knowledge of either what animal or what object was involved. All classes of judgment could be reproduced with about 85% accuracy, which was better than could be done if one had attempted to predict either from specific objects or from specific individuals. As such this might prove little about *chimpanzee* responsiveness but it does demonstrate that neither a simple tabulation of responses nor an intuitive approach is a blind process[1].

II. Effects of experience

In this section we shall cover two different problems: (a) differences between restricted and wild-born chimpanzees *at 2 yr. of age* and (b) the effects of cumulative experience upon the responses of restricted *S*s, after the termination of the rearing conditions.

1. Restricted vs. wild-born chimpanzees. In a majority of the tests administered when the *S*s were between 21 mo. and 4 yr. of age, differences between the various "restricted" groups were relatively minor. The

[1] See HEBB, 1946. I believe that HEBB exaggerates the complexity of intuitive judgments, just as others have exaggerated their unreliability.

maximally restricted *Kaspar Hausers* were very much like other cubicle-reared chimpanzees given a companion or visual stimuli or a few simple objects during the period of infancy; indeed, both in the organization of motor behavior and in a generalized timidity they closely fit RIESEN and KINDER'S (1952) descriptions of animals raised under standard nursery conditions. The *major* behavioral dichotomy between rearing groups seems to be mother-reared or wild-born *S*s vs. laboratory-nursery-reared chimpanzees, and while laboratory groups can certainly be distinguished from each other in some ways, most of the distinctions are not crucial to the present paper. Consequently most of the descriptions we give of *Kaspar Hausers* or of "restricted" infants in general are probably valid for *all* laboratory infants.

a) Tests with manipulable inanimate objects. One of the first formal tests consisted of presenting the *S*s with a variety of objects, similar to those used in previous primate experiments on manipulatory responsiveness, manipulative skill, and avoidance (MENZEL, DAVENPORT, and ROGERS, 1963a). Although all *S*s did show some differentiation of objects, it was pointless to attempt to identify "play stimuli", "fear stimuli", etc. Patterns of response were found to be specific to individual *S*s and to groups of *S*s, but different objects *per se* had no unique value initially. At 2 yr. of age, novelty rather than physical attributes of the objects seemed to be the prepotent determiner of response and for restricted *S*s novelty produced avoidance. A detailed analysis of factors such as size, color, form, or qualitative characteristics of objects in most *S*s had to await such time as all objects were not avoided.

The 3 wild-born *S*s manipulated nearly every object within a few seconds of its presentation; avoidance was shown only toward a few complex objects such as a doll, and most avoidances were attributable to a single animal[1]. Object contact nearly always included grasping. The nature and level of manipulation varied considerably according to the object; some objects evoked a number of the complex activities described by SCHILLER (1957), and others were contacted infrequently, *S* going to sleep or becoming engaged in activities other than object manipulation. Except for pacing and clasping the arms on the contralateral sides of the chest — acts not seen in restricted *S*s — stereotyped self-directed activities did not occur. The occurrence of stereotypies is apparently a sufficient ethological basis for distinguishing between mother-reared and nursery-reared infant rhesus and chimpanzees (MASON and GREEN, 1962; MENZEL, DAVENPORT, and ROGERS,

[1] It might be remembered that the field-reared or mother-reared infant is less timid of objects than the older chimpanzee (HASELRUD, 1938; YERKES and YERKES, 1936).

1963 b). Scratching or auto-grooming was, however, more common in our wild-born *Ss* than in restricted *Ss*.

In contrast to the wild-born *Ss*, only the boldest of the restricted *Ss* did any grasping to speak of, and then only after considerable exposure to an object. Generalizing from the observed behavior of many *Ss*, a probabilistic account of adaptation was derived. (It will be noted that we can not understand complex object-manipulations without first taking account of the underlying postural aspects of responsiveness.)

Initially, the *S* startled, reverted to his preferred posture, and either "froze" or commenced to perform stereotyped self-directed responses. Screaming or whimpering did occur during initial avoidance, but such vocalizations were significantly less frequent than in wild-born *Ss*. Often *S* covered his eyes, or turned his back to the object. This was unquestionably "withdrawal", but it rarely included the quadrupedal posture, the vigorous overt activity, or the moving away seen in wild-born *Ss*. Rather, activity was at first very low and inhibited, occasionally even leading to sleep. Exact distance of *S* from the object was no clear criterion of distress. Postural preferences at such a time and elsewhere were idiosyncratic in the restricted *Ss*, partly due to the association of posture and stereotypy. (Not one restricted *S* showed the same postural preferences as the wild-born ones, who conformed to the classic picture of earlier chimpanzee investigators: see YERKES and YERKES, 1929.) Generally speaking, however, prone or supine were the prominent postures when the restricted *Ss* were startled or very distressed.

Gradually the *Ss* commenced to change postures more often and to assume a quadrupedal position. Intense picking at the cage alternated with self-directed responses. At such times *Ss* often did not even look at the object. However, later they commenced to jump up and down, "threaten" the object in the normal chimpanzee patterns, and race around the cage. Next, definite but tentative approaches were made. A distinctive pattern here resembled "smelling", i.e., *S* leaned toward the object and brought his eyes and nose almost, but not quite, within touching (Fig. 2 a). The *S* might actually straddle over the object (Fig. 1 d) and spit on it, or make pelvic thrusts — all, however, without touching. These approaches were followed by a precipitous jump backward, and a brief period of stereotyped swaying; subsequently, however, the object came to be touched. Like other young chimpanzees (RIESEN and KINDER, 1952) the restricted *Ss* were very cautious of their hands, and grasping occurred only after a prolonged period of touching or hitting with the extended lower lip (Fig. 2 b), a finger, the dorsal surface of the wrist (Fig. 2 c), or the forehead. After a tentative hand contact, *Ss* might "smell" their hands. Grasping seemed to signal a crucial step in adaptation, for once it occurred, caution seemed to subside and

vigorous play ensued. The most prominent acts here were varied modes of object prehension, using mouth, hand, foot, thigh, etc., "aggressive" biting and hurling of the object, and whole-body stimulations, especially wrestling, draping, lying on the object, genital stimulation with the object (with accompanying penile erection), and lying supine while prehending the object in all four extremities (Figs. 2, 3). The characteristic chimpanzee "smile" and the "pleasure panting" vocalization were most closely associated with whole-body stimulation, and ceased if and when manipulations became slow and relaxed. Object grooming, for example, was seen occasionally (Fig. 3 c), but it was accompanied by sputtering and lip movements instead of panting and smiling[1]. Clear-cut instances of "instrumental" use of objects were not seen in 2-year-old restricted *S*s but were on rare occasions seen later. In play, objects were usually related to the body, and were rarely related to the external environment or to another object. SCHILLER (1952) notes this as characteristic of infant chimpanzees, as contrasted with adults.

In a few cases, where a "bold" *S* was given a simple form of object, manipulations finally became perfunctory and sporadic, and *S* ignored the object in favor of other activities. At such times stereotyped behaviors were almost as frequent as they had been when *S* appeared upset by the object. Thus the final stage of adaptation to certain classes of objects in all *S*s appears to be "satiation" of object manipulation. The major individual differences reside in the rate at which this point is reached and in the form of activities which are alternatives to manipulation. Restricted *S*s seemed incapable of simply sitting quietly.

It should be emphasized that in the first tests a relatively *complete* sequence of the above behaviors was seen in only a very few instances involving the boldest of restricted *S*s. At 2 yr. of age the majority of restricted *S*s stopped at the first steps of the sequence of adaptation. Further evidence, to be described later, was necessary before we could accept the hypothesized sequence as valid and applicable to most chimpanzees. In the extreme case, when an object was introduced the *S* fell prostrate and remained there, spending the whole test performing autistic patterns of response. Some *S*s fell asleep while whimpering, shivering, or showing other symptoms of acute distress. The reactions of a given *S* were similar with nearly every object, whether he was observed in the standard test cages or in his home environment. In general, however, testing in the rearing cubicle facilitated adaptation.

[1] With these *S*s and also with 6-year-olds raised under "normal" nursery conditions, I have obtained correlations between .80 and .90 between intuitive ratings of "intensity of play" vs. scores consisting of the number of different prehensions and whole-body stimulations performed in a given unit of time. This is not much lower than correlations between the ratings of independent observers.

The major differences between 2-year-old restricted and wild-born chimpanzees in object tests could be summarized by two points: (a) the high incidence vs. complete lack of certain responses such as rocking, swaying, and thumbsucking: reflecting general differences in the patterning of motor behavior; and (b) the extremely low vs. the high level of object-grasping (mean percentage of possible time intervals = 0.05, 8.13, 2.33, and 4.03 for the social-added, manipulation-added, visual-added, and maximally-restricted groups, respectively; and 54.37 for the wild-born *S*s), reflecting differences in general level of adaptation. A description of individual differences in terms of emotions or drives is possible, but gratuitous.

The differences between the various restricted groups were statistically significant but very small by comparison with the wild-born vs. restricted comparison. The social-added group was the most timid. Even with their rearing partners present in the test situation they did not manipulate as much as did the isolation-reared groups. The manipulation-added group surpassed the visual-added and maximally-restricted groups (who did not differ from each other), but only in situations resembling their rearing conditions.

b) Tests with some other stimuli. It was no surprise to find that those isolation-reared chimpanzees who played most readily with inanimate objects in the above tests also adapted most rapidly to their first social stimulus, a human being. The borderline between "social" and "nonsocial" behavior was a nebulous one in 2-year-old restricted chimpanzees, even in *S*s who had had a companion during infancy. In general, postures and movements were not fundamentally different with *any* stimulus situation until after vigorous contact activities were in progress for some time. Even the form of play was similar in "social" and "nonsocial" situations, e.g., a favored activity with a passive human was to lie supine and "drape" the person's arm across the neck — much as a piece of cloth might be draped. For that matter, even adult chimpanzees play in similar fashions with both animate and inanimate stimuli.

It is important to note that although play with inanimate objects correlated highly with social *approach* or *play*, it did not necessarily relate to more specialized forms of interaction such as clinging or grooming. Clinging indeed has been observed infrequently and in only a few restricted *S*s even after several years of exposure to social stimuli. An analogous picture is seen with novel foods: From response to a block of wood we could predict how long it would take for a piece of banana to be played with for the first time (see also MASON and HARLOW, 1959), but we could not predict how soon it would be *eaten* as well as simply prehended in the mouth. Indeed, the best manipulator played so

vigorously with foods that he was among the slowest of chimpanzees in learning to eat solids. Object-manipulation, or, better, the underlying mechanism of adaptation which causes *S* to change from autistic to externally-directed patterns of responsiveness, is absolutely necessary, but is not sufficient for the development of specialized or biologically "appropriate" activities with objects. Specialized activities as such usually require the channeling of responses along certain lines, *and* the inhibition of those reactions which are common to all objects. In the light of the results with *Kaspar Hausers* we can better understand why older laboratory-reared animals avoid or play with nesting materials (I. BERNSTEIN, 1962), tools (SCHILLER, 1952, 1957) and a member of the opposite sex (NISSEN, 1954a, 1954b) instead of performing what *we think* are the correct responses of nest building, instrumentation, and copulation, respectively. The descriptions of behavior in the latter studies of the development of specialized activities fit in perfectly with the sequence of adaptation to "biologically neutral" objects in *Kaspar Hausers*; in a sense they simply take up the problem of responsiveness where infant data would leave off.

Taking into account the role of specific responses such as object-manipulation and stereotypy in general patternings of behavior (which involve many postural, spatial, and temporal adjustments), it would have been possible to predict from the first tests to what the chimpanzees would do when placed into a strange bare room (MENZEL, DAVENPORT, and ROGERS, 1963b). Object-contact scores with small objects correlated significantly with, e.g., how much time *S* would spend in a quadrupedal position, how frequently he would locomote, and whether or not he would circumvent a barrier. A single minute of testing in the bare room was all that was required to distinguish restricted from wild-born animals (an additional group of 11 wild-born *S*s was tested to demonstrate this), and reliable individual differences in behavior organization persisted for 6 weeks and over 35 hours of exposure to the room. Initially all animals appeared highly disturbed, but whereas the wild-born *S*s ran quadrupedally, screamed, and beat on the walls or tried to open the test room door, the restricted *S*s lay prostrate and quiet, and either performed stereotyped movements or went to sleep. With repeated tests, the former tended to become less active, and the latter became more active. Most of the restricted *S*s eventually explored the room, while the wild-born *S*s settled down to sleep. Those restricted animals that were previously high manipulators were the first to explore the room.

2. Effects of cumulative experience on restricted chimpanzees. Follow-up studies of individual isolation-reared *S*s after 27 months of age were performed using small objects as stimuli (MENZEL, DAVENPORT, and ROGERS, 1961; MENZEL, 1963). These experiments showed that

autistic response patterns decrease in frequency and object-contact activities emerge in a seemingly spontaneous fashion when the animals are given exposure to a sufficient number of innocuous objects. After adapting *S*s to a dozen or so different small objects, a "completely novel" object could be introduced and, instead of lying still or stereotyping, the chimpanzee would grasp it within a few seconds and commence vigorous play. This finding was particularly striking since some *S*s had earlier shown no clear evidence of play reactions with objects, and one or two had never been observed to grasp an object in normal fashion. The process of adaptation was much the same across many objects as it was with a single object (see the earlier description of adaptation).

From such studies we may conclude at least tentatively that the "innate" response to an object is a sequence or set of behaviors, rather than any specific reaction. The complete unfolding of the sequence depends upon the complicated interaction between response characteristics of the species, object factors, and experience. In restricted *S*s most initial stages of the sequence are seen with all objects. Included in this sequence are many behaviors which in the adult animal would seem to involve "entirely different" motivational mechanisms. A cumulative process of adaptation determines where the individual chimpanzee will customarily start in this sequence. "Timid" *S*s start from the beginning and each step might take considerable time, but "bold" *S*s either start from a later point or skip across scattered points of the sequence in less than a minute (MENZEL, 1962a). It is impossible, however, to specify the precise amount of experience required. Five hours of object-exposure has no predictable effect unless the generalized adaptation level and the motor organization of the individual *S* is also taken into account.

Less formal observations of the restricted chimpanzees — the oldest of which are currently over 6 years old and out of isolation for several years — indicate a drastic reduction in the amount of time spent in autistic patterns under normal living conditions and also a much increased general tendency to immediately engage in direct interaction with novel features of the environment. Now, a pistol shot would frighten them less than did the sight of a small wood block when they were 2 yr. old[1]. Although we have serious doubts as to their potential "complete normality" either in postural behaviors or in effectively performing biologically appropriate specialized activities either with

[1] See also HEBB and RIESEN, 1943; RIESEN and KINDER, 1952; WELKER, 1956. It is important to state that these investigators studied nursery-reared chimpanzees. As we have indicated, the difference between such *S*s and our restricted *S*s is not great: *all* nursery-reared infants are clearly different from captured ones in posture and stereotypies, and on the average are more timid.

inanimate objects or with social beings, they have advanced remarkably in the simpler aspects of behavior toward objects, and are very much chimpanzees. At the present time the similarities between them and wild-born animals far outweigh the differences.

III. Effects of stimulus factors

In our work and elsewhere there is slim evidence that any object can evoke a common differential response from all chimpanzees independently of experience. By this criterion, then, there are no stimuli which innately elicit a specialized drive behavior. On the other hand, it is probable that a number of stimulus characteristics produce systematic variations in behavior whether or not these characteristics are associated with other stimuli such as food or shock. Novelty (lack of experience with a given object) is certainly one such characteristic for all chimpanzees. As we have seen, a novel stimulus is not a simple variable that elicits a fixed reaction; instead, orderly transitions from total avoidance of contact to vigorous play might follow as a function of exposure to the object. How a chimpanzee responds to an object of course also depends upon the mechanisms of novelty-discrimination and generalization. It is not sufficient to say simply that a *S* has never before seen a specific object; in order to understand how he will respond to object A, we must know what other "similar" objects he has seen, whether or not he is capable of distinguishing A from B, C, or D, and what cues are in fact utilized in the perception of similarity. ("Effective novelty" is defined as much in terms of *S* as in terms of the physical stimuli.) In one experiment (MENZEL, DAVENPORT, and ROGERS, 1961) we studied the discrimination of novelty by thoroughly adapting *S* to a single object, a small white cube, and subsequently testing responses to objects that varied systematically from this standard in size, brightness, and shape. As judged by varying amounts of contact, the chimpanzees were capable of discriminating between most objects. The new objects were at first avoided but soon came to evoke much more contact than the familiar object. New cues evoked more contact than cues embodied in the standard object; and objects new in two or three cues evoked more contact than objects new in only one dimension. White objects or cubes in general produced a different reaction from black objects or triangles.

Incidental observations had convinced us that the visual modality was of overwhelming importance in producing avoidance toward novel objects in restricted *S*s. For example, most *S*s initially screamed and became rigid, or collapsed into a prostrate position, if a stranger tried to touch him; but by simply placing one's hand or a cloth over *S*'s eyes and keeping it there, *S* could be quickly quieted down and even picked up

and carried. In other respects, however, little was known about what stimuli or stimulus characteristics are of the greatest importance to behavior. To a certain extent, this problem calls for a trial and error approach. As other investigators have observed, the chimpanzee's preferences and aversions among objects can be highly idiosyncratic, and the range of stimuli that can produce affective response is almost unlimited (HEBB and THOMPSON, 1954; WELKER, 1961). Thus in one experiment we found almost by accident that metallic objects produced much greater caution in two *S*s than did objects made of wood; and we have observed that flexible objects such as paper, rope, or chain are eventually attractive to all young chimpanzees, in some cases being a more effective lure than food; and again we have observed idiosyncratic fears, such as one wild-born *S*'s phobia over any bone or toy bone that was painted red. On the other hand, dead snakes, skulls, and the traditional array of "fear stimuli" rarely produced their presumed differential effects on our *S*s.

Obviously, one might easily get lost in this area if one simply selects for study objects that are presumed to evoke innately specialized reactions, or analyzes only "popular" stimulus characteristics such as form and size and color. Intensive stimulus characteristics (especially size, movement, and distance), however, appear to be uniquely important and demanding of close attention. As shall become clear, we use the term "intensity" in two distinct but commonplace ways: first to specify the strictly objective fact that one stimulus has "relatively more" of a given physical property than another stimulus; and second, to take account of obvious psychophysical principles such as thresholds, adaptation effects, summation of two variables, and contextual effects. If the distinction needs to be emphasized, the reader may use "physical intensity" whenever we are talking of variations in a single independent variable, and "effective intensity" or "perceived intensity" whenever we take anything more into account.

We suspect that: (a) stimulus intensity factors innately effect changes in *S*'s general level of excitability or state of adaptation, just as does novelty; (b) specific behaviors such as withdrawal or grasping have different threshold levels, i.e., they simply occur at different levels of effective intensity, and it is confusing to speak as if they reflect completely different drives, (c) the sequence of "fear-caution-aggression-play-satiation" described earlier is not haphazard, but should be observable under any set of conditions which serve to progressively lower the effective intensity of a stimulus. Further, we feel that almost any dimension related to intensity should affect *S* in similar fashion; consequently, for example, a large moderately familiar object = a small complex novel one = a distant but rapidly moving one.

Results from experiments on the effects of object size (MENZEL, 1962a) strongly supported such notions. Size and novelty produced almost equivalent effects. The more timid of several *S*s initially avoided all objects (pieces of plywood), but eventually commenced to approach and manipulate them. After a period of extremely vigorous play *S*s came to simply hold the objects in hand or mouth, look around the room, and rock back and forth; an observer might say they looked bored. But whereas this entire sequence might be observed to occur within a few days for the smallest object of 1 sq. in., for some *S*s the sequence took weeks or was never completed in 6 wk. of testing where the largest object (251 sq. in.) was concerned. The smaller the object or the "bolder" the animal the more rapid and complete the sequence of adaptation. On some days we could, on successive 1-min test trials, have a chimpanzee alternately acting bored, playful, or terrified simply by changing the size of the piece of plywood object placed in his cage. Medium-sized pieces of wood evoked the most intense play, but the more experience *S* had with the object the larger the size required to produce either play or withdrawal.

Even more interesting, the same size of object could within seconds be used to alternately terrify the chimpanzee or get him to play; all that was necessary was to place the object inside the cage vs. just outside the cage. Another experiment (MENZEL, 1962b) obtained similar results with a different species — wild-born rhesus monkeys. Presumably the cage wire serves to increase the effective distance between *S* and stimulus (HEDIGER, 1955), and this, so far as *S*'s behavior is concerned, is equivalent to a change in size.

Some unpublished experiments on object-movement using ordinary nursery-reared animals, are also available, and the story is much the same. The faster a small object (wood block or stuffed toy) moves, the more likely the chimpanzee is to avoid the situation completely. Lower rates of movement, however, produce object manipulation and play. The rate of movement required to produce equal frequencies of approach and avoidance can be measured fairly precisely; and this "threshold" moves steadily upward as the chimpanzee gains experience with the object. The introduction of a new object lowers the threshold for movement, and again we see caution displayed toward almost any movement. Analogously, with objects of equal familiarity, a large object does not have to move nearly as rapidly as a small object in order to produce avoidance.

Not only rate of movement, but also certain *types* of movement might be innate determiners of chimpanzee's reactions to small objects (cf. SCHIFF, CAVINESS, and GIBSON, 1962). Thus, for example, an object which moves only when it is approached was found to be much

more fear-inducing than an object that moves steadily, or another that stops moving when the chimpanzee approaches. It is possible that *S*'s distance from the object, or the increase in retinal size of an approaching stimulus, is the critical factor affecting response to these types of movement.

Results on the effects of movement of simple objects suggested an explanation for why an adult chimpanzee will avoid a strange animal even though it has never before seen, let along been injured by, a similar creature. Certain classes of complex objects — living beings — have in the past moved in specific ways, and these movements as such, being effectively intense, are a sufficient reinforcer to condition avoidance of similar forms even when these forms are stationary. (The degree of object-complexity itself probably facilitates conditioning: see S. BERNSTEIN and MASON, 1962.) To test such a notion, we attempted to "condition" a nursery infant to approach one block of wood and to avoid another. The objects were presented one at a time, and were at first stationary. If *S* came close to the "negative" object the experimenter caused it to begin moving rapidly, whereas if *S* came close to the "positive" object it moved only very slowly. The objects were presented in balanced, irregular order. Learning took place within a few 150-sec trials. Soon *S* avoided the first object completely (it never had to move at all in over 10 consecutive trials) and manipulated the second as soon as it entered the cage.

Rather than call this conditioning, one could of course describe the chimpanzee's behavior in terms of sensitization and habituation. The choice of terms is arbitrary for this experiment. The main point is that a stimulus does not have to be physically intense at the time of testing to be effectively intense. The chimpanzee can respond to an object's *potential* for reacting in an intense fashion. Moreover, the same variable — rate of movement — serves as either a "positive" or "negative" reinforcer, depending upon the specific level chosen.

The importance of intensive factors in the general behavior of the chimpanzee can scarcely be underestimated. Size, distance, and movement certainly affect even such complex social patterns as dominance, aggression, and communication in feral adults. Our data strongly suggest that the perception of, and arousal value of, these factors are not learned in the ordinary sense, and neither are they acquired for each class of objects separately. Object size, for example, is a potent determiner of response, whether we are dealing with foods, toys, or social beings, and with the behavior of *Kaspar Hausers* or of sophisticated adults. The exact form of stimulus-response relation is all that must be learned or what is determined by nonintensive elements unique to a specific class of objects. Attention to factors other than novelty and

intensity becomes necessary principally *after S* has habituated (or developed physically and perceptually) up to a certain stage (see SCHNEIRLA, 1959). For example, two of our *S*s came to show some indication of "attachment" to a "claspable" stuffed toy, after they had gone through the stages of avoidance and vigorous play. A block of wood, presented on alternate 5-min trials, produced no comparable effect (MENZEL, 1963; but see particularly HARLOW and ZIMMERMANN, 1959; MCCULLOCH, 1939 on the importance of texture as an evoker of "social" types of responses to inanimate objects).

IV. Conclusions: Responsiveness as a general factor

The evidence available at the start of this project was insufficient for precise predictions regarding the origins, mechanisms, or even the basic dimensions of responsiveness in naive chimpanzees. Indeed, there was no assurance that chimpanzees could *survive* in the conditions of severe restriction that were imposed, let alone become alert, discriminative, and free enough from gross sensori-motor damage to permit the detailed examination of specifically "motivational" problems. Partly for these reasons, we seldom attempted to test one extant theory of behavioral development against another. Our concern was more practical and descriptive: What do *Kaspar Hausers* do? Of what are they capable? How can we classify their behavior; and what is the simplest possible way in which to organize such a classification? How many additional factors must we take into account to describe the behavior of other chimpanzees who have had a greater variety of experience during infancy (0 to 21 mo.)? What do these results imply about the common nature of responsiveness in all chimpanzees?

Partial answers to these questions have been given or implied previously, so here we will be brief and dogmatic. At 2 yr. of age chimpanzees that have been reared in "maximally restricted" *Kaspar Hauser* conditions do everything that is done by animals that have been given a companion chimpanzee, simple manipulanda, or varied visual stimulation, but otherwise maintained individually in the restriction of a small cubicle. Later, they probably do everything that any similarly aged chimpanzee reared under "normal" nursery conditions (involving maternal separation) will do. Nurseryreared and feral animals are easily distinguished, but they are all unmistakably chimpanzees: their similarities outweigh their differences. Individual differences reside principally in: (a) the presence of certain motor habits, (rocking, swaying, thumbsucking, etc.) in essentially all nursery-reared chimpanzees, and their absence in mother-reared chimpanzees not subject to prolonged confinement, (b) some differences in the manner and idiosyncrasy with which specific responses are organized into larger stable *patterns* of

behavior, and (c) the adequate stimuli for the release of a pattern, this last point including the greater susceptibility of some chimpanzees to become overly aroused by novel or mildly intense stimuli of any form. Similarities between individuals are most clearly seen in the fact that even *Kaspar Hausers* eventually did perform (by the age of 4 or 5 years) virtually every discrete response that can be observed in the normal pre-adolescent. What was required for the evocation of these reactions was not specific sorts of situations in which each response could be "learned", but principally any class of variable — including a tranquilizing drug for one S — which reduced an excessive arousal state. While our data highlight rather than contraindicate the importance of "experience", they suggest that habituation learning was a more important mechanism than tuition or associative learning for the appearance of "new" responses. Not only most responses but also entire sequences and patterns of behavior appear to be latent in *Kaspar Hausers*. An impressive fact is the sheer nonspecificity, interchangeability, and plasticity of "releasing stimuli" for chimpanzees.

The behavior of all restricted groups can be classified and defined as if "responsiveness" were a single experimental problem, which encompasses all more specific problems. While this predisposes us toward the view that responsiveness is also a unitary *psychological process*, there is nothing to force such a conclusion. One *can* also accurately describe the behavior of chimpanzees without recourse to any drive terms or instinct terms whatsoever, although it is usually more convenient to use such terms informally when necessary; one *can* also accurately describe chimpanzee behavior as if it involves an unlimited variety of drives and instincts, although this leads to unnecessary confusion if one's categories are taken seriously: e.g., if one tries to establish at which points in the sequence of adaptation fear, play, aggression, or sex conflict, and at which points each drive is prepotent. The advantage of viewing all forms of drive behaviors as facets of "responsiveness" is that the observed orderliness of behavior changes across time and the observed orderly continuities of behavior across stimulus conditions are highlighted. Specific responses can be related to a general system of behavioral organization and a single set of working principles can be applied to virtually any drive behavior. The probability of a given response occurring can be predicted from a knowledge that other elements of a given ("same") *pattern* were observed, and their failure to occur can be predicted from the presence of incompatible patterns of behavior. The Table is an attempt to summarize our observations and speculations in the most compact form possible, and to provide a tentative picture of behavioral organization in the chimpanzee. We have tried to fit some more complex forms of activity, studied by other

Table. *Types of chimp responses to objects*

General determinants of response		Behavior		
Effective intensity of object	Other factors	Direction with respect to object	Overt activities	Accompanying vacalizations
Low	General situation (territory) and general state of *S* critical. Test obj. of less importance than other factors. Quiescence if situation has no other possibilities for action	Variable	"*Quiescence, or distraction to other objects*" Sleep Sit, look around, manip. other objects, manip. self General displacement acts; stereotypy, often simultaneous with object-contact Cursory manipulations — mouthe, grasp, "accidental" contacts	Non-specific
Moderate	Specific obj. properties (cue functions) critical; obj. intensity less important. Behavior variations are more in form than in vigor. Responsiveness appears diversified rather than unitary	Toward, but obj. is means to, or part of, goal	"*Specialized activities with objects*" Instrumental activity with several objects manipulated and attended to simultaneously Use of obj. as tool — extrinsic goal (e.g. food) more important than object as such (KÖHLER) Activity performed on object: grooming, eating Pseudo-instrumentation: obj.-activity is goal (SCHILLER) Varied prehension and inspection (without play) Sex patterns (NISSEN) Clutching. (Problem here: is the "object" of clutching partner or test object?)	Food-bark, "bronx cheer", grooming noises — according to specific objects
Moderate-high	Test obj. is prepotent determiner of response. Obj.-intensity more important than specific cues, at least in naive *S*s	Toward Ambivalent	"*Play*" Supine manipulation, genital stimulation, lie on, drape, climb in, wrestle, "smile" Prehension in mouth, hand, foot, thigh, etc. Gross activity centered about object; some grasping included "*Overt Aggression*" Bite, hit in conjunction with other contact	"Pleasure pant" Scream? Roar

High		Ambivalent	*"Cautious exploration" (discrete contacts)* Discrete hit, grab-throw-run Touch with wrist, fingers, lips, toes *"Caution" (approach without contact) and "Mild threat"* Reach toward, swing at "Smell" "Distant activity"-threat pattern, whirl, pace, jump, straddle, socalled diffuse activity Lean and orient from distance	Hoot bark yelp ?
High — Very high	Whether avoidance will be passive or active depends on e.g., duration of stimulation, previous effects of similar objects, and possibilities for escape. Otherwise object intensity is major affecting variable	Away, but hard to tell; i.e., *potential* retreat, along with non-approach	*"Fear I."* (Passive avoidance) Displacement acts and stereotypy come in again; activity level, use of all available space, and orientation toward object are, however, less than chance. No "accidental" contacts. Unless temporal factors and previous history are taken into account or unless other acts occur, this is behaviorally indistinguishable from lowest levels (quiescence) . . . *S* is "jumpy" rather than distractible . . . He remains close to partner even if not clutching. Huddling	Non-specific (Lab *S*s)
		Away	*"Overt fear"* (active avoidance) Fawning or begging toward observer Initiate clutch with partner Retreat Freeze and submit Sleep or passive avoidance (incl. huddle and sway) might follow if stimulation is prolonged and no escape is possible	Whimper Scream Scream and gag

Probable patterns of behavior with an object of a given effective intensity consist of: (a) frequent occurrence of acts designated for that level, and (b) decreasing frequency of acts in more and more remote levels. Intuitive judgments of chimpanzee behavior do not merely rely upon single indicator responses; they take into account patterns of behavior, equivalence relationships between response A and response B in a pattern, and the reciprocally inhibiting effects of pattern X upon pattern Y.

The term "effective intensity of an object" is used in approximately the same sense as a student of perception would use it. As such it is neither a true independent variable nor a formalized central drive or trace. However, its relationship to physical intensity and adaptation factors is presumed to be simple so long as threshold factors are taken into account and other physical variables are held constant. Many factors which affect "excitement level" or "generalized adaptation level" (e.g., territory, drugs, hunger, association of the object with shock) may change the physical intensity required to evoke a response.

investigators, but not by us, into the table, which is, of course, based principally on work with young laboratory-reared chimpanzees. We hope that the table will prove descriptively accurate for most chimpanzees that display the specific responses in question. Whether any basic motivational principles are to be found in feral chimpanzees and not in laboratory animals, is a matter that further research will have to settle.

Summary

1. The behavior of infant chimpanzees reared from birth to 21 months under conditions of extreme environmental and social restriction was described and catalogued.

2. The effects of experience upon responses were outlined: (a) *Kaspar Hausers* are similar to most chimpanzee infants raised in a laboratory nursery. (b) The major differences at 2 years of age are between nursery-reared and mother-reared or wild-born chimpanzees; and these differences tend to decrease as a function of cumulative experience. (c) Individual differences reside principally in the patterning of motor behavior and in the adequate stimuli for the release of a pattern. Descriptions of individual differences in terms of "social" or "emotional" factors are possible but gratuitous.

3. A wide range of behaviors were described as *stages* in a general sequence of adaptation to objects.

4. Effects of stimulus factors upon the responsiveness of restricted chimpanzees were outlined: (a) At 2 years of age stimulus novelty is prepotent, and novelty produces avoidance. (b) Intensity factors such as size, distance, and movement are next in importance. Intensity and novelty function in similar fashions; large amounts produce avoidance and smaller amounts produce approach. (c) Nonintensive stimulus factors become important principally after considerable adaptation has occurred.

5. It was argued that all specific drive behaviors in physically intact infant chimpanzees can be analyzed as facets of "responsiveness". Using the *Kaspar Hauser* data as a starting point, a wide range of chimpanzee responses was classified in terms of a single frame of reference.

Zusammenfassung

1. Es wurde das Verhalten junger Schimpansen beschrieben, die von ihrer Geburt an bis zum Alter von 21 Monaten in gegenständlich und sozial verarmter Umgebung aufgewachsen waren.

2. Die Wirkungen der Erfahrung auf das Verhalten wurden aufgeführt: a) Die „Kaspar Hauser", Tiere mit äußerster Verarmung der

Umwelt, verhalten sich ähnlich wie die meisten im Laboratorium aufgezogenen Schimpansen. b) Die größten Unterschiede, die im Alter von 2 Jahren zu finden sind, bestehen zwischen den im Laboratorium aufgezogenen Schimpansen auf der einen Seite und den von der Mutter aufgezogenen oder in der Wildnis geborenen auf der anderen. Diese Unterschiede tendieren dazu, mit zunehmender Erfahrung abzunehmen. c) Individuelle Unterschiede liegen hauptsächlich in der Art der motorischen Verhaltensmuster und den spezifischen Reizen, die nötig sind, um sie in Gang zu bringen. Beschreibungen dieser Unterschiede als Auswirkungen von „sozialen" und „emotionalen" Faktoren sind möglich, erscheinen jedoch willkürlich.

3. Ein weiter Bereich von Verhaltensweisen ließ sich als eine *Stufenfolge* innerhalb einer allgemeinen Anpassung an die Gegenstände beschreiben.

4. Die spezifischen Wirkungen der Reize auf das Verhalten der unter eingeschränkten Bedingungen aufgezogenen Schimpansen wurden kurz dargestellt: a) Im Alter von 2 Jahren ist die Neuheit der Reize am wirksamsten, und Neuheit bewirkt Vermeidungsreaktionen. b) Faktoren der Intensität wie Größe, Nähe und Bewegung sind die nächstwichtigen. Intensität und Neuheit wirken ähnlich; große Beträge bewirken Vermeidung, geringe Annäherung. c) Mit der Intensität nicht zusammenhängende Faktoren werden grundsätzlich erst dann wirksam, wenn eine beträchtliche Gewöhnung stattgefunden hat.

5. Es wurde aufgeführt, daß man alles spezifisch triebgesteuerte Verhalten körperlich ungeschädigter Schimpansenjungen als „Facetten" einer allgemeinen Reaktionsbereitschaft analysieren kann. Mit den *Kaspar-Hauser*-Daten als Ausgangspunkt konnte ein großer Teil des Verhaltens der Schimpansen in einem geschlossenen Bezugssystem klassifiziert werden.

Literature

Berkson, G., W. A. Mason, and S. V. Saxon: Situation and stimulus effects on stereotyped behaviors of chimpanzees. J. comp. physiol. Psychol. (In press.)

Bernstein, I.: Response to nesting materials of wild-born and captive-born chimpanzees. Anim. Behav. **10**, 1—6 (1962).

Bernstein, S., and W. A. Mason: The effects of age and stimulus conditions on the emotional responses of monkeys: responses to complex stimuli. J. genet. Psychol. **101**, 279—298 (1962).

Brown, J. S.: The motivation of behavior. New York: McGraw-Hill 1961.

Chow, K. L., and H. W. Nissen: Interocular transfer of learning in visually naive and experienced infant chimpanzees. J. comp. physiol. Psychol. **48**, 229—237 (1955).

DAVENPORT jr., R. K., and G. BERKSON: Stereotyped movements of mental defectives: II. Effects of novel objects. Amer. J. ment. Defic. **67**, 879—882 (1963).

—, and E. W. MENZEL jr.: Stereotyped behavior of the infant chimpanzee. Arch. gen. Psychiat. 8, 99—104 (1963).

— — and C. M. ROGERS: Maternal care during infancy: Its effect on weight gain and mortality in the chimpanzee. Amer. J. Orthopsychiat. **31**, 803—809 (1961).

GAVAN, J. A.: Growth and development of the chimpanzee: A longitudinal and comparative study. Hum. Biol. **25**, 93—143 (1953).

HARLOW, H. F., and R. R. ZIMMERMANN: Affectional responses in the infant monkey. Science **130**, 421—431 (1959).

HASELRUD, G. M.: The effect of movement of stimulus objects upon avoidance reactions in chimpanzees. J. comp. Psychol. **25**, 507—528 (1938).

HAYES, C.: The ape in our house. New York: Harper 1951.

HEBB, D. O.: Emotion in man and animal: An analysis of the intuitive processes of recognition. Psychol. Rev. **53**, 88—106 (1946).

—, and A. H. RIESEN: The genesis of irrational fears. Bull. Canad. Psychol. Ass. **3**, 49—50 (1943).

—, and W. R. THOMPSON: The social significance of animal studies. In: Handbook of social psychology, p. 1532—1561, ed. by G. LINDZEY. Cambridge (Massachusetts). 1954.

HEDIGER, H.: Studies of the psychology and behavior of captive animals in zoos and circuses. New York: Criterion 1955.

HEWES, G.: The anthropology of posture. Sci. Amer. **196**, 122—132 (1957).

KÖHLER, W.: The mentality of apes. New York: Harcourt-Brace 1925.

KORTLANDT, A.: Chimpanzees in the wild. Sci. Amer. **206**, 128—138 (1962).

MASON, W. A., and P. C. GREEN: The effects of social restriction on the behavior of rhesus monkeys: IV. Responses to a novel environment and to an alien species. J. comp. physiol. Psychol. **55**, 363—368 (1962).

—, and H. F. HARLOW: Initial responses of infant monkeys to solid foods. Psychol. Rep. **5**, 193—199 (1959).

MCCULLOCH, T. L.: The role of clasping activity in adaptive behavior of the infant chimpanzee: III. The mechanism of reinforcement. J. Psychol. **7**, 305—316 (1939).

MENZEL jr., E. W.: Individual differences in the responsiveness of young chimpanzees to stimulus size and novelty. Percept. mot. Skills **15**, 127—134 (1962a).

— The effects of stimulus size and proximity upon avoidance of complex objects in rhesus monkeys. J. comp. physiol. Psychol. **55**, 1044—1046 (1962b).

— The effects of cumulative experience on responses to novel objects in young isolationreared chimpanzees. Behaviour, **21**, 1—12 (1963).

— R. K. DAVENPORT jr., and C. M. ROGERS: Some aspects of behavior toward novelty in young chimpanzees. J. comp. physiol. Psychol. **54**, 16—19 (1961).

— — — The effects of environmental restriction upon the chimpanzee's responsiveness to objects. J. comp. physiol. Psychol. **56**, 78—85 (1963a).

— — — Effects of environmental restriction upon the chimpanzee's responsiveness in novel situations. J. compl. physiol. Psychol. **56**, 329—334 (1963b).

NISSEN, H. W.: A field study of the chimpanzee. Comp. Psychol. Monogr. 8, Nr. 36, 1—122 (1931).

— Primate psychology. In: Encyclopedia of psychology, p. 546—570, ed. by P. L. HARRIMAN. New York: Philosophical Library 1946.

NISSEN, H. W.: The nature of the drive as innate determinant of behavioral organization. In: Nebraska symposium on motivation, p. 281—320, ed. by M. R. JONES. Lincoln (Nebraska) 1954a.
– Development of sexual behavior in chimpanzees. In: Symposium on genetic, psychological and hormonal factors in the establishment and maintenance of patterns of sexual behavior in mammals, p. 204—230. Amherst (Massachusetts) (mimeo.; 1954b).
— Axes of behavioral comparison. In: Behavior and evolution, p. 183—205, ed. by A. ROE and G. G. SIMPSON. New Haven: Yale Univ. 1958.
— K. L. CHOW, and J. SEMMES: Effects of restricted opportunity for tactual, kinesthetic, and manipulative experience on the behavior of a chimpanzee. Amer. J. Psychol. **64**, 485—507 (1951).
—, and A. H. RIESEN: Onset of ossification in the epiphyses and short bones of the extremities in chimpanzee. Growth **13**, 45—70 (1949).
RIESEN, A. H.: Plasticity of behavior: Psychological aspects. In: Biological and biochemical bases of behavior, p. 425—450, ed. by H. F. HARLOW and C. N. WOOLSEY. Madison (Wisconsin): Univ. of Wisconsin 1958.
—, and E. F. KINDER: Postural devlopment of infant chimpanzees. New Haven: Yale Univ. 1952.
SCHIFF, W., J. A. CAVINESS, and J. J. GIBSON: Persistent fear responses in rhesus monkeys to the optical stimulus of "looming". Science **136**, 982—983 (1962).
SCHILLER, P.: Innate constituents of complex responses in primates. Psychol. Rev. **59**, 177—191 (1952).
— Innate motor action as a basis of learning. In: Instinctive behavior, p. 264—287, ed. by C. SCHILLER. New York: International Univ. 1957.
SCHNEIRLA, T. C.: An evolutionary and developmental theory of biphasic processes underlying approach and withdrawal. In: Nebraska symposium on motivation, p. 1—42, ed. by M. R. JONES. Lincoln (Nebraska): Nebraska Univ. 1959.
WELKER, W. I.: Effects of age and experience on play and exploration of young chimpanzees. J. comp. physiol. Psychol. **49**, 84—89 (1956).
— An analysis of play and exploratory behavior in animals. In: functions of varied experience, p. 175—226, ed by D. W. FISKE and S. R. MADDI. Homewood (Ill.): Dorsey 1961.
YERKES, R., and A. YERKES: The great apes. New Haven: Yale Univ. 1929.
— — Nature and conditions of avoidance (fear) response in chimpanzee. J. comp. Psychol. **21**, 53—66 (1936).

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