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*This chapter integrates Vygotsky's concept of the zone of proximal development into a field-theoretical conceptual framework based on the axioms of the theory of open systems.*

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## *Construction of the Zone of Proximal Development in Adult-Child Joint Action: The Socialization of Meals*

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Following the methodological ideals of the hard science of classical mechanics, psychology at large, including developmental psychology, has developed its conceptualizations of psychological phenomena on the basis of the axioms of closed, rather than open, systems (Bertalanffy, 1981). Thus, the developing child is usually construed by psychologists as an individual person in himself or herself, the importance of whose relationships with the environment is at best mentioned but very rarely studied. This rarity of attempts to study children's development within environments follows logically from the definition of psychology as a science dealing with psychological phenomena abstracted from their contextual embeddedness (Super and Harkness, 1981).

In contrast, the complex structured phenomena of biological and social realities are more adequately handled on the basis of the theory of open systems. The subject matter of research on child development is the interdepen-

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dence relationship between the developing child and the environment. The explication of the implicit forms of that interdependence is the task toward which developmental psychology needs to strive. The open-systems approach challenges the traditional quest for prediction of developmental outcomes and the search for the invariant trajectory of development. First, in the case of open systems, the developmental outcome of a system is in principle impossible to predict on the basis of the initial conditions present in the system. Second, the principle of equifinality applies in open systems: The final state (outcome) of a system can be reached from different initial conditions and via different pathways (Bertalanffy, 1950). Thus, if the development of children is conceptualized from an open-systems perspective, it is both unpredictable and variable in the forms of developmental trajectories. The basis of the unpredictability and variability of developmental trajectories lies in the interdependence of children and environments.

Accordingly, an open-systems approach to child development is by definition context-inclusive, rather than context-free. In this chapter, I outline a possible theoretical framework for the study of child development in a context-bound manner integrating Vygotsky's (1978) concept of the zone of proximal development (ZPD) with an ecological frame of reference for child development. That framework will be illustrated by an analysis of child environment transactions in the second year of life in meal settings.

### The Structured Nature of Environment

Each and every setting or object in the human environment is both physical and cultural. This is due to the historical development of the means (and the benefit) of attributing meanings to objects, events, and settings in our surroundings. In parallel to the attribution of meaning, many objects and settings in the human environment are outright products of culture, constructed by human beings for some meaningful purpose.

The developing child acts within the structured context of the human environment. The child's actions change the particular state of that context; that is, they transform the structure of the context. The changed context provides the child with new opportunities for action that may have been unavailable to him previously. At the same time, the structure of the child's environment defines the set of possible actions that are available to the child at the given state of the environment. This idea is closely related to the concept of affordance in contemporary ecological psychology (Gibson, 1979, Shaw and others, 1982). Gibson (1979, p. 127) defines affordance as follows: "The *affordance* of the environment are what it *offers* the animal, what it *provides* or *furnishes*, either for good or ill. . . I mean by it something that refers to both the environment and the animal in a way no existing term does. It implies the complementarity of the animal and the environment." I argue here that affordances in settings and of objects in settings define the limits of what actions of

the child are in principle possible. For example, for a three-month-old infant, a staircase does not afford climbing. That affordance comes into existence when the infant develops to the point when it attempts climbing. In this sense, the set of affordances defines the niche for the child's structure of actions within the environment (compare Soraci, 1982).

It is clear that the joint determination of the field of possible actions by the structure of the environment and the available action patterns of the child creates the possibility of high variability in the particular forms of the possible actions of individual children, both within cultures and cross-culturally. This makes it important to study that variability—both in the form of interindividual or intercultural variability and as expressed in change in children's actions over time (intraindividual variability)—not in terms of error but as the subject of the investigation. The legacy of the Laplacean tradition of attributing the causation of observed phenomena to constant causes does great disservice in psychology to the study of development. A more adequate study of human actions requires theoretical concepts that are suitable for describing child-environment interdependence in terms of variability. The contemporary state of our science offers remarkably few such concepts. The concept of affordance is one of these few.

However, the changes in the field of possible actions need not automatically induce changes in the child's actual behavior. In fact, the constraints placed on our actions by affordances are quite wide (sometimes extremely wide; see the discussion of this issue in Cutting, 1982), so the change in the outermost limits of the field of possible actions need not trigger the actualization of these new opportunities.

Effectivities are a subset of affordances that are actualized in the activity of the person in an environment. In the case of the developing child's relationships to the environment, the question of how effectivities emerge in the child's actions on the widely affording environment is of special interest from the perspective of developmental psychology. In order to answer that question, the process of the child's transaction with the environment has to be conceptualized. The developing child's relationships with the environment are channeled by other people—parents, grandparents, older siblings, and so forth. The major function of adult-child interaction from the perspective of child development lies in the regulation of child-environment relationships (Valsiner, 1983).

Within the field of objects and affordances related to them in the environment of the child, the zone of free movement (ZFM) is defined for the child's activities. The ZFM structures the child's access to different areas in the environment, to different objects within these areas, and to different ways of acting on these objects. The boundaries of the ZFM are the sites where the ZFM is constantly either reinstated or redefined. The concept of the ZFM has its roots in the field theory of Lewin (1933, 1939). The ZFM is a changing structure of adult-child environment relationships that canalizes (determines

the limits but does not rigidly determine) the development of the child's actions in directions that are expected in the given culture. The ZFM is a socially constructed cognitive structure of child-environment relationships. It is socially constructed, because it is based on the system of meanings of the adult members of the culture and because it is the result of adult-child interaction. It is a cognitive structure, because it organizes child-environment relationships on the basis of beliefs and meanings used by members of the culture in their activities. Finally, contrary to the widespread tendency to project cognitive phenomena into the "mind" of a small child, the cognitive structure here is a structure of relationships between the child's actions and the affordance of the objects. The central thesis of the present theoretical framework is that effectivities in a child's actions emerge as a result of the social construction process mediated by the ZFM.

The ZFM is an inhibitory mechanism. Its function is to limit the child's actions in the particular structured environment. Within the ZFM, it is possible to specify subzones that organize the child-environment relationships further. These zones—zones of promoted actions (ZPA)—are subareas of the ZFM where the child's caregiver attempts to promote certain actions with particular objects. The child may, but need not, comply with this effort by the adult. If the child does not comply, no restriction or limiting action by the adult needs to follow. This contrasts with the adult's behavior when the child crosses the boundaries of the ZFM and the adult acts to reinstate or redefine the boundary.

### The Zone of Proximal Development

The ZFM and the ZPA are mechanisms through which the degrees of freedom for the child's actions within environmental settings are selectively regulated. Their particular organization canalizes the child's actions in particular directions. However, the relationships between the ZFM and the ZPA are insufficient to account for the social nature of the temporal dimension of child development. Both the ZFM and the ZPA characterize the status quo of the organization of the child-environment relations at a given time and context, but they contain no information about the potential futures of these relationships. Integration of Vygotsky's (1978) concept of the zone of proximal development (ZPD) into the present theoretical framework would extend it to include the future of the child's development. The ZPD involves the subset of possible actions on objects that the given child at the given state of development cannot yet perform independently but that the child can perform cooperatively with an adult. In the course of experience, actions that previously were possible for the child only in cooperation with an adult (that is, actions within the ZPD) become available for him in individual activities.

The three zones under discussion—ZFM, ZPA, and ZPD—can relate to one another differently in particular cases. The ZPA is usually included in

the ZFM. That is, the activity of the child that is promoted by the adult has to be within the range of possibilities that are available to the child. However, under some circumstances, the ZPA can be introduced to bring certain activities from outside the ZFM into it—for example, when an adult introduces an activity, such as cutting food with a knife, that previously had not been accessible to the child individually. Here, it is easy to see that the ZPA can serve to restructure the ZFM.

The ZPD is closely related to the ZPA. Indeed, it can, but it need not, overlap partially or totally with it. Parents can attempt to promote certain action patterns of the child at a time when the child's developmental history has not made him or her ready. In this case, the ZPA and the ZPD do not overlap. Parents can also promote action patterns at a time when the child is just becoming able to perform them in cooperation with an adult (ZPA overlaps with ZPD); later, the child will be capable of performing these actions individually. Or, the parents may decide not to promote and not to allow a certain activity that the child would otherwise be able to accomplish with the help of others. In this case, the ZPD lies outside the ZFM. If the boundary of the ZFM is not reset so as to include the set of actions in the ZPD, then the parental socialization strategy eliminates the possibility that the child will develop skills in these possible but unactualized actions.

### Canalization of Children's Actions During Meals

The relationships between the ZFM, the ZPA, and the ZPD will be illustrated with examples from the meal setting. Children's meals provide an especially useful structured situation for developmental psychological research, since all aspects of the situation are set by the psychological reality itself. The meals take place regularly, since the children need to be fed. They are organized by a cultural system of rules, like the meals of adults (Douglas, 1975; Douglas and Gross, 1981). The scripts for meals are generally well elaborated in each culture, and children acquire knowledge of these scripts relatively early (Nelson, 1981). The food objects used during meals afford a great variety of actions (for example, putting food into the mouth, offering it to a dog, throwing it on the floor, playing with it, and so forth). Finally, during meals the actors are pursuing definite goals. The child is trying to get satiated, and the adults are attempting to feed the child and to socialize the child into the "proper" ways of eating for the given culture. Different cultures have vastly different social rules of eating that are purposefully socialized. For example, the use of the left hand while eating is strictly forbidden in the Hindu culture (the left hand is used for "dirty," unclean activities, such as cleaning the body), and the children are canalized into using their right hand while eating. Cultural tools that require different manual skills—such as forks and spoons versus chopsticks—have been devised for eating in different cultures. A detailed description of the development of the feeding behavior of North American children is available in Gesell and Ilg (1937).

The findings reported in this chapter come from a study of twenty-eight children from American middle-class families (range of years of education for both mothers and fathers: fourteen to seventeen or more). The children—seventeen boys and eleven girls—ranged in age between ten and fifteen months at the beginning of the study. The children's behavior during mealtime (usually lunch, but occasionally dinner or breakfast) was videotaped in home conditions in all families at least twice at a one-month interval. The course of the whole meal—from beginning to end—together with some time both before and after the meal was videotaped. An ordinary videotaping session lasted for about one-and-one-half hours.

All but one ( $N = 27$ ) of the children in the present sample were fed in a high chair during the videotaped meals. The high chair is a cultural tool that creates a microsetting for both the child and the adult to organize the meal. First, the design of the high chair limits the freedom of the child's action. The child, who is usually strapped to the high chair seat, cannot climb up or slide down in the seat. The child is also limited in the extent to which he or she can turn around and lean forward to grasp objects beyond the tray set up before him or her. As a matter of convenience for adults, the high chair brings the child to the sitting level of other persons at the table. This affords the child a view of what is going on at the table and it exposes other peoples' activities to him or her. At the same time, the child in the high chair can also easily be moved away from the vicinity of prohibited objects that she or he might be able to grasp.

Although the high chair limits the range of the child's freedom of action, it does not eliminate it. A child in a high chair can perform a number of actions: He or she can manipulate anything on the tray, throw anything overboard, turn to the right or left, or try to look down at the floor. Last but not least, a child confined to a high chair can display active protest that goes beyond the tolerance of the adults and leads to termination of the attempts to keep the child in the chair.

The cooperative activity in the meal situation takes place within the confines of the affordance structure of the high chair. The ZFM is defined by the physical limitations of the child's actions, together with the social regulations of actions of the child in the high chair superimposed by the adult. For example, the adult determines whether the child is allowed to smear food all over the tray. If making a mess is not allowed, the adult would intervene in any action by the child that would result in a mess. From the adult's point of view, the meal constitutes a multiple-criteria problem-solving situation: The adult can simultaneously pursue the goals of feeding the child, maintaining the ZFM with regard to messes, and promoting self-feeding skills, which are in the ZPA.

### Transfer of Control over the Spoon from the Adult to the Child Through Joint Action Within the ZPD

Spoons are ingenious tools that have been developed in human cultures to accommodate the needs of food transport and preparation. In ontogeny, the

mastery of spoon use is achieved over relatively long periods of joint adult-child action. The adult begins with full control over the spoon and uses it to get food to the child's mouth. The end goal for the adult is for the child to use the spoon efficiently without any dependence on the adult. Gradually, control over the actions involving the spoon is transferred from the adult to the child.

Let us observe the longitudinal course of the development of spoon use in one child who was followed from twelve to eighteen months. Sarah was always fed in the high chair in the kitchen.

In setting 1, Sarah was twelve months and twenty-two days old. The meal started when the mother (M) gave Sarah (S) a plastic spoon to manipulate. M used another spoon to transport food from a jar to S's mouth. Subsequently, M put pieces of banana on a tray, and S used her fingers to feed herself, abandoning the plastic spoon. M put the spoon back into S's hand. S threw it away. M took her spoon, set a piece of banana on the spoon, and gave the spoon + food to S, promoting the reception of it by S's right hand. S took the spoon and moved it towards her mouth, while M continued to keep S's hand + spoon + food on track with her own hand. When the spoon arrived in S's mouth, M released her hold. S took the spoon out of her mouth, and M resumed her hold of the spoon + S's hand. S again moved the spoon to her mouth under the guidance of M's holding. This episode characterizes the ZFM-ZPA-ZPD relationship: The meal starts with the reduction of S's ZFM. Sarah is placed in the high chair, and her mother spoon-feeds her. The episode with the spoon illustrates an action pattern that is both within the ZPA—the mother tries to promote Sarah's use of the spoon—and within the ZPD—Sarah can use the spoon if her mother guides her hand to her mouth.

In setting 2, Sarah was thirteen months and eighteen days old. During this meal, spoon transfer from M to S was not observed. S attempted to get hold of the spoon herself and to get it into the jar from which M was feeding her. M kept the jar on the tray but in her own hand, so that S could not get hold of it. M tried to redirect S's attention to the picture of a flower on the jar's label. S's independent manipulation of the jar is off-limits—that is, outside the ZFM—but touching the exterior of the jar is within the ZFM, and in respect to the label, it is within the ZPA. No joint action within the ZPD was observed during this session.

In setting 3, Sarah was fifteen months and twenty-three days old. M was spoonfeeding S from a container that she held on the tray with her left hand. M put the spoon into S's hand and helped S to get food from the container onto the spoon. S took the food on the spoon to her mouth, but M's hand kept holding S's hand + spoon + food until it reached S's mouth. This episode was followed by one in which M allowed S recurrently to dip the spoon into the jar and bring it to her mouth without M's support. Later, parallel feeding occurred: S continued dipping the spoon and bringing it to her mouth, while M took another spoon and transported food to S's mouth intermittently with S's self-feeding acts. Sarah's "dipping" the spoon to feed herself are within the ZFM, and, since mother sets up the situation for them, they are in the

ZPA. Using the spoon appropriately—both for getting food on in and for transporting it to the mouth—is still in the ZPD. In the case of parallel feeding, the ZFM continues to include S's "dipping" acts.

In setting 4, Sarah is eighteen months and twenty-nine days old. S was given a spoon and a jar containing baby food. These were put onto the tray, and S used the spoon appropriately, scooping food onto it and transporting it to her mouth herself. No parental guidance or cooperation was observed there. However, S could not adjust the wrist position in the upward arm movement to bring the spoon to her mouth in a horizontal position. Thus, the spoon entered S's mouth upside down. Toward the end of the meal, the father spoon-fed S the last bites of the food that she could not get out of the jar. Occasionally, S leaned forward in the high chair trying to get to a food container on the neighboring table. Father immediately removed that container away, so that it was clearly outside S's reach. In this episode, the transfer of control over the spoon from adults to the child has been completed. Thus, the spoon-related actions are no longer in the ZPD, even if Sarah's actions with the spoon are still juvenile, as the upside-down orientation of the spoon in Sarah's mouth shows. The other container that Sarah tried to reach is outside the ZFM, and that fact was reinstated by the father's moving it further away from her.

#### Variations in the Transfer of Control over the Spoon: Context Dependence of the ZPD

Learning to use culture-provided self-feeding utensils—spoons, forks, knives, chopsticks—displays equifinality: All children end up mastering these skills. The individual paths to that equifinal state, however, are vastly variable, as they are constructed in the course of everyday acting by the child and adults in the meal situation. This variability is the result of redundancy. The task—feeding the child—can be accomplished in a variety of ways—allowing the child to use fingers to feed himself or herself, giving a spoon to the child and guiding the child's hand, controlling the spoon and transporting the food to the child's mouth. During the meal, both the child and the adult can alter their methods. Even when the child is able to use the spoon adequately, he or she can revert to finger-feeding. Even when the child can handle the spoon well with adult help, the adult may prefer to retain control over spoon and feed the child more quickly and with less mess than would otherwise be possible. There need not be any consistency in the way in which a mother organizes two consecutive meals for her child. In one case, she may shovel food into the child's mouth herself because she is in a hurry. In another, she may give the spoon to the child and (if necessary) guide the child's action. This potential absence of consistency, together with the redundancy of child-feeding methods, cannot be treated as lack of organization in the phenomenon. Rather, it specifies the existence of a flexibly organized structural mechanism of human action. Table 1 presents the range of organizational forms of meals that were observed in the sample at least once.

**Table 1. Forms of Adult-Child Joint Action  
Occurring During Meals**

<i>Form</i>	<i>Description</i>	<i>Actions Afforded to the Child</i>
1.	A takes F by H and puts into C's mouth	a) refusal (C keeps mouth closed; turns head away, spits F out) b) acceptance
2.	A takes F by H and puts into C's mouth hand	a) refusal (C drops F from H; gives F back to A; throws F overboard the tray) b) manipulation (C manipulates F) c) acceptance (C transports F to mouth H or by Sp/Fo if available)
3.	A takes F by H and puts on Tr	a) abandonment (C does not touch F) b) manipulation (C manipulates F by H) c) acceptance (C transports F to mouth by H or by Sp/Fo if available)
4.	A takes F by Sp/Fo and puts into C's mouth	same as for Form 1, + C tries to grab the Sp/Fo
5.	A takes F by Sp/Fo and puts the Sp/Fo into C's H	same as in Form 2
6.	A takes F by Sp/Fo and puts onto Tr	a) abandonment (C does not touch F or Sp/Fo) b) manipulation (C takes Sp/Fo into H and manipulates) c) acceptance (C uses Sp/Fo to take F to mouth or disconnects F and Sp/Fo and uses H to transport F to mouth)
7.	A puts Sp/Fo and F separately on Tr (F can be in Cont)	a) abandonment b) manipulation (either F, or Sp/Fo, or both) c) acceptance (C transports F to mouth using either Sp/Fo or no utensil by H)
8.	A puts Sp/Fo into C's H and F (in Cont or not) on tray, then guides the C's hand with Sp/Fo to F and Sp/Fo to mouth	a) refusal (C thrusts the H free) b) acceptance and cooperation

*Note:* A = adult, C = child, Sp = spoon, Fo = fork, F = food object, H = hand, Tr = tray, Cont = container

Scrutiny of Table 1 reveals that different organizational forms of the adult-child joint action in the task of feeding can put a different emphasis on the necessity for individual action by the child alone. For example, in forms 1 and 4, the child's degrees of freedom of action are limited to the maximum extent under the circumstances of the present task. The child has a number of strategies of refusal available (turning the head away, keeping the mouth closed,

spitting the food out, intercepting and diverting the approaching spoon or fork). On the side of cooperation, the only strategy available to (and expected from) the child is acceptance (by opening the mouth on time and swallowing the food). These forms of joint action tend generally to occur earlier in ontogeny, although it is always possible for an adult-child dyad to revert back to them later. The development of adult-child cooperation in feeding tasks is characterized by the emergence of new, more complex forms of joint feeding actions: for example, form 8 (a case demonstrating the functioning of the ZPD), form 7, and form 6 (control over the utensil and the food is transferred to the child). From the child's point of view, these complex joint action forms provide him or her with the necessity for sequentially organized actions. For example, in case of form 7, the child has, first, to take a spoon or fork and extract food from a container (if one is used); second, to move the spoon or fork to the mouth without losing the food on the way; and, third, to insert the spoon or fork bearing the food into the mouth, retrieve the utensil leaving food in the mouth, and swallow the food. This sequence of actions is a complex integrative motor activity that is mastered in the joint action of adult and child during feeding through action that moves through the ZPD into the individual repertoire of the child's actions.

Whatever forms of joint adult-child action a particular dyad uses in feeding situations at a particular time, the flexible nature of switching from one form to another needs to be emphasized. The adult can switch the form (for example, the mother, seeing that the child will not use the spoon without making a mess, can revert to spoon-feeding), or the child can demand that the form be changed (for example, after being fed for a while, the semisatiated child can refuse to open his mouth to accept a spoonful of food offered by mother, but he transports the food to his mouth himself if the food is put on the tray). Such flexibility in adult-child dyadic problem solving is the basis for any dynamic adaptation to changing conditions of the organism-environment relationships (Thom, 1972). In contrast, an organism whose action patterns were rigidly organized (but whose behavior was predictable for that very reason) would be an adaptational misfit and incapable of development.

### Conclusions: The Zone of Proximal Development and the Emergence of Skills in Ontogeny

The concept of the zone of proximal development is basically a metaphorical device to capture the nature of interactive processes whose systemic organization results in the emergence of new skills in the developing child. In the theoretical framework advanced here, the ZPD is the concept through which the development of the field structure, which consists of the ZFM and the ZPA, is introduced. Through application of the concept of ZPD, we can think about the basic reality of child development: Certain activities that at time  $t(o)$  cannot be accomplished by the child may become possible at time

$t(o + x)$ , having been catalyzed by the cooperation of adults. The field structure of ZFMs and ZPAs is constantly changing, particularly in the directions provided by the ZPDs. ZPDs are collective processes that lead to the development of new skills.

The epistemological status of the ZPD should be made explicit. Vygotsky's emphasis on the zone of proximal development coincides historically with the introduction of topological concepts into psychology by Lewin (1936). The concepts of zone, field, and boundary make it possible to conceptualize the variability of psychological phenomena. These terms allow us to transcend a popular dogma in psychology — that which treats the variability of or in a phenomenon as error that conceals the static, fixed truth from the observer. Zone concepts (in contrast to point concepts, such as averages) make it possible to treat the variability of phenomena as the subject matter of investigation. This variability is necessarily limited by boundary conditions that provide structure for the developmental process. For a developing child, the relationship of the ZFM with the ZPD and the ZPA defines the general direction and particular limits of the canalization of development.

A note of caution of the use of field-theoretical concepts is in order. The zone concepts cannot be treated as causal entities in explaining psychological phenomena in terms of linear causality (if cause X, then outcome Y). In the thinking of psychologists, many concepts often wind up becoming causal entities. The majority of explanatory principles in psychology are static entities to which causality for some phenomena is attributed. Field-theory concepts and the ZPD are endangered by a similar possibility (Waddington, 1966). Such statements as "X happened, because of the field of X" remain empty tautologies until the processes in the field that lead to X are specified. Specification of the processes that lead to an outcome is the explanation of that outcome. In this sense, a field-theoretical framework of children's development needs to specify the process relationships of the zone of proximal development with other zones in the field. From our analysis, it follows that the overlap of the ZPD and the ZPA would be an optimal relationship between these zones (parents promote actions that the child can accomplish cooperatively with them but not alone at that state of development). Both the ZPD and the ZPA are preferably within the ZFM. Under these circumstances, we can observe how interindividual processes (joint action) precede intraindividual processes in ontogeny, canalizing the child toward accomplishment of historically (culturally) given objectives of socialization.

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