THE DEVELOPMENTAL NICHE: A THEORETICAL FRAMEWORK FOR ANALYZING THE HOUSEHOLD PRODUCTION OF HEALTH

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Abstract—Recent efforts to promote child survival and development internationally have focused new attention on the importance of the household as a mediator of both environmental risks and programmatic interventions to promote better health. In this paper, we introduce a theoretical framework, the 'developmental niche,' derived from studies of children's behavior and development in different cultural contexts, as a tool for analyzing the household production of health. The developmental niche is conceptualized in terms of three basic components: (1) the physical and social settings of the child's everyday life; (2) culturally regulated customs of child care and child rearing; and (3) the psychology of the caretakers. The relevance of each of these components to the household production of health is illustrated through examples from research in several cultures, including Malaysia, Kenya, Bangladesh, India, and the U.S. Further discussion centers on three corollaries of the developmental niche framework that point to the interactive relationships among the three components, between the niche and the larger environment, and between the niche and the child (or any individual seen from a developmental perspective). It is suggested that this approach is useful for identifying and collecting relevant information on household-level factors that affect health outcomes, and thus for organizing more effective interventions. At a theoretical level, the developmental niche framework also facilitates understanding processes of mutual adaptation between the individual and the environment as they are filtered through the constraints of household settings, customs and caretaker psychologies.

Key words—culture, health, children, household

International efforts to promote child survival and maternal reproductive health have recently focused new attention on the sociocultural interface between the delivery of health care on the one hand and health outcomes for individuals on the other. As captured in the phrase 'the household production of health,' there is growing recognition that the preservation of health and the healing of illness are active and complex endeavours. In this context, the image of the health service users as passive 'consumers' is misleading both for the understanding of health producing behavior and for the organization of health care interventions.

Recognition of the need for a new approach has grown from experiences in programmatic interventions over the last few decades in developing countries and among disadvantaged groups in industrialized societies. There is now increasing awareness that eliminating specific disease threats, for example through vertically organized immunization programs, may not greatly reduce mortality in environments where children's survival is at risk from multiple sources [1, 2]. Likewise, the beneficial effects of early intervention programs on children's school performance often are not maintained once the intervention is over [3]. A critical ingredient for success in programs to promote survival and health development appears to be the incorporation of new attitudes, beliefs and behaviors in individuals and families [4, 5].

As a new construct, the 'household production of health' is still being elaborated both theoretically and methodologically. There is a need at present for approaches that facilitate systematic consideration of environmental influences operating at the household level, together with their outcomes for health and development. In this paper, we introduce a theoretical framework, the 'developmental niche,' derived from studies of children's behavior and development in different cultural contexts, that we believe is equally applicable to study of the household production of health. After reviewing the historical roots of this approach, we illustrate its application to studying health issues in the household context through examples from research in several cultures. Finally, we discuss the problems as well as the usefulness of this approach to studying the household production of health.

THE DEVELOPMENTAL NICHE

The concept of the developmental niche was elaborated in the context of field studies of child development and family life in a rural community of Kenya and comparison studies in the U.S. during the
1970s [6]. At the time of this work theoretical shifts in anthropology and psychology were beginning to address in a new way the organized diversity of human development. Anthropological approaches, most notably by the Whiting's and their colleagues [7, 8], refocused older issues of 'culture and personality' on how the structure of the environment, mediated at the household level through factors such as mothers' workload and the settings to which children are assigned, operates to create different contexts of development for children [6, 9]. In developmental psychology, there was a major movement during the late 1970s to see children's natural environments in a newly appreciative light. The laboratory paradigm which had dominated developmental research for several decades was criticized as inadequate for understanding central aspects of human development [10], and there was a call instead for study of the child-in-context [11]. Bronfenbrenner [12], arguing along similar lines, proposed an 'ecological' approach to children's environments, dividing them into a series of four concentric social systems. The life-course and life-span approaches, also emerging in this period, were especially influential in focusing attention on the continuous and inductive aspects of human psychological environments [13, 14].

Several perspectives from biology contributed directly to our elaboration of the developmental niche, as well as being reflected, in part, in the shifts in anthropology and psychology outlined above. Early work in genetics and embryology produced such relevant concepts as environmental induction and the epigenetic landscape [14, 16], borrowed elsewhere with enthusiasm by psychologists [17, 18]. From biological ecology came new perspectives on development as adaptation, elaborated with good effect by anthropological studies of the relationships between biology and behavior [19-21]. The common importance of these approaches was their understanding of behavior and development as co-produced by the individual and the environment as interactive systems, rather than, as in the previous environment-vs-heredity arguments, being the product of two independent competing forces. Important aspects of this view are also now incorporated into developmental systems theory [22].

The developmental niche thus builds on recent theoretical advances in anthropology, psychology, and biological ecology. As a synthesis of ideas from each of these disciplines, the developmental niche is distinctive in its focus on the developing child in the household context. Thus, we combine a cultural concern with understanding the systematic organization of the environment with a developmental orientation to the biologically based needs and capacities of children and their experiences over time. Although the child and the environment are viewed as interactive systems, the household, as the center of early human life, is seen to be the focal mediator of this relationship, working largely through culturally constructed mechanisms. Because these can have different kinds of effects on children of different developmental status, we view the micro-environment from the point of view of the child in order to understand outcomes for child health and development.

The developmental niche is conceptualized in terms of three major subsystems which function together as a larger system, and each of which operates conditionally with other features of the culture. The three components are: (1) the physical and social setting in which the child lives; (2) culturally regulated customs of child care and child rearing; and (3) the psychology of the caretakers.

These three subsystems share the common function of mediating the individual's experience within the larger culture. Regularities in the subsystems, as well as thematic continuities from one culturally defined developmental stage to the next, provide material from which the child abstracts the social, affective, and cognitive rules of the culture, much as the rules of grammar are abstracted from the regularities of the speech environment. Similarly, these subsystems work together to regulate the pattern of health and disease during the childhood years. We turn now to some examples of how each of the components of the niche influences child health and development.

Physical and social settings

The physical and social settings of everyday life—how, where, and with whom children spend their days—provide the most directly observable sources of information about how household and individual environments are organized. In relation to the household production of health, the study of settings provides systematic information relevant to disease transmission and health maintenance. An example comes from observations on variation in rates of dengue fever incidence among children in Malaysia [23]. Dengue fever (DF) and its more serious form, dengue haemorrhagic fever (DHF), are transmitted in Malaysia by the mosquito vectors Aedes aegypti and Aedes albopictus. The A. albopictus is forest-dwelling, but the A. aegypti, a rapid, multiple blood feeding mosquito, breeds inside houses in man-made receptacles containing clean, cool water. It is a persistent, efficient vector of DF and DHF in its ability to disseminate viruses to many people at essentially the same time. With an incubation period of 10 days for the virus, the disease can rapidly reach epidemic proportions. To date no immunological methods are available to control the disease, so public health measures in Malaysia have focused on the prevention of disease transmission. After a series of large-scale epidemics in the 1970s, government efforts have been successful in minimizing the occurrence of cases in many communities, but pockets of high incidence remain.

Variation in rates of DF are related to several large-scale environmental and demographic factors.
Seasonal rains, urban areas, and poor sanitation facilities are all related to endemicity. Nevertheless, within these large parameters significant variation remains. A detailed household-level observational survey in a small satellite town outside the national capital revealed some of the causes for high rates of DF and DHF. Among the Chinese population in this community, certain features of daily life promote mosquito breeding in households. Water was often stored in large, open jars, drums, and cement tanks. Smaller breeding sites were created by use of water-filled ant barriers placed under the feet of food storage cabinets. In addition, many Chinese families put water and fruits on an altar in the house as an offering to the Goddess of Mercy, leaving them for up to 2 weeks. Finally, some households discarded old tires, tins, and coconut shells in the yard, where they would collect rainwater and provide more breeding sites for the mosquitoes.

Among Malay households in the same community, other customs provided breeding sites for the Aedes mosquitoes within the household. For example, Malays often kept a jar of water in front of the house, where all who entered would wash their feet in order to prevent contamination of the house by evil spirits which, it was believed, could attach themselves to the soles of the feet outside. Many Malays also kept potted plants in their houses, one of which, the 'money tree', had its roots constantly immersed in water, thus creating a permanent breeding site for mosquitoes. Another significant feature of the social and physical environment in relation to dengue transmission in the Malay community was the observance of congregational prayer at a community mosque at dawn and dusk, times that corresponded to the feeding times of the Aedes mosquito. The mosques had receptacles in front for washing hands and feet before entering, where millions of mosquitoes could breed; from these receptacles, the mosquitoes had ready access to multiple blood sources at the same time, thus maximizing opportunities for disease transmission.

In the above example, the ecological model is of two interacting species—the human host and the disease-bearing insect vector—who share a common environment. Within this framework, the question becomes how diurnal variation and life cycles of the two species interact to promote or inhibit disease transmission; the epidemiological reference points of time, place and person are central here. The concept of the developmental niche can help to integrate the ecological and epidemiological perspectives and further operationalize them through more careful attention to how the physical and social environments of daily life differentially affect particular members of households. In the Malaysian example, the high rate of DF among women in the community might be related to their higher rates of exposure to domestic mosquitoes, since they were probably at home more than the men. Likewise, the higher rate of DHF and consequently the higher death rate from this disease among children might also be due to multiple exposures to bites from infected mosquitoes within their own homes. In order to test these hypotheses, it would be necessary to collect systematic information on the physical and social settings for particular individuals within household and community settings, in relation to seasons and times of day.

As the DF example illustrates, a central aspect of the developmental niche framework is its focus on the micro-environments of particular individuals within households. Different daily routines of mothers, fathers and children provided for different characteristic patterns of exposure to the mosquito vectors. It is also likely that developmental differences among household members (the 'person' variable in epidemiological terms) contributed to variation in rates of illness. For example, children had lower immunity levels and were probably also less aware of being bitten by mosquitoes than were adults. The developmental niche's focus on the 'point of view of the child' (or indeed any individual seen in life-span developmental perspective) can thus support analysis of illness and health for any particular developmentally defined group within the parameters of physical and social settings of households.

Awareness of variations in the environments of particular individuals within households can also lead to the study of variation across households in the physical and social settings of daily life. This approach is illustrated by Sper et al.'s [30] study of infectious respiratory infection among young children in Kenya and the U.S. In the Kenyan community, all children were at home with siblings and parents during the first 2 years of life, but the settings of daily life for these children varied in how many other young children were in the immediate environment. Children who were observed more frequently in the company of other young children were also observed to have colds more frequently, as demonstrated by 'spot observations' of the children throughout the year. This pattern is consistent with the finding from U.S. studies that children who are in the company of other young children in group care are sick more often.

**Customs of child care**

The study of physical and social settings is fundamental in that it is through these contexts that patterns of disease and health are formulated. Systematic study of these micro-environments can also be useful, however, in leading to awareness of the customs of child care that help shape them. By 'customs' we refer to culturally prescribed sequences of behavior so commonly used by members of the community, and so thoroughly integrated into the larger culture, that they do not require individual rationalization and are not necessarily given conscious thought. Although the outside observer may be able to see such customs as techniques of coping...
with particular issues in child care (such as keeping an infant in sight), or as adaptations to particular environmental features (such as cold weather or the use of cooking fires), members of the culture are more likely to think of customary behaviors as the 'natural' way of doing things, or as the only reasonable solution to some problem. Customs of child care and child rearing in this sense include not only daily routines such as bathing or feeding practices, but also larger, institutionalized complexes such as formal schooling, religious confirmation, or the use of amulets.

Our research on child development and family life in a rural Kipsigs community of Kenya illustrates how customs of child care affect child health and development [24-31]. The infant's niche in Kokwet, as we refer to the community that we studied in the early 1970s, was shaped by several customs that together guaranteed that the infant would be in close proximity to a caretaker at all times. During the day, the infant would be held or carried on the caretaker's back, using cloths tied around her body to support the baby's back and neck but allowing the baby to interact with the surrounding environment. The mother would often carry the baby in this way as she would fetch water or do errands. While the mother was at home or working in the nearby fields, a sibling caretaker would take care of the baby, either carrying it or sitting with the baby on a cloth or cow skin spread on the ground. At night, the baby would sleep in skin-to-skin contact with the mother, as well as in close proximity to other young children in the family. Nursing was customarily on demand, and the breast was used to soothe as well as to satisfy the baby's hunger. This model of infant care was appropriately expressed in the term used for taking care of a baby, nam lakwet, meaning literally to 'hold the baby'.

Several lines of experimental evidence suggest that one consequence of the increased physical contact and stimulation resulting from these customs is the promotion of normal growth and development, including body size, attentional processes, and the emergence of neuromuscular competences. Both Porter [32] (using a passive but vigorous exercise program) and Clark et al. [33] (holding infants briefly in a spinning office chair) significantly affected advancement in reflexive and gross motor behavior infants through physical stimulation. Similarly, it has been known for a number of years that kinesthetic and tactile stimulation improve the development and viability of premature infants [34, 35]. Super [36] has suggested that culturally directed methods of handling and stimulating infants, as well as customs of deliberate teaching, are critical factors behind the so-called precocity of early development in many African infants.

The transition from infancy to early childhood in Kokwet was marked by several changes in customs of child care that removed the child from the immediate proximity of the mother and other caretakers, weaning from the breast and back, and the end of the child's special relationship with an older sibling caretaker [25, 26]. Instead, the child was now expected to join the group of young siblings (mostly under 7 years) who would play together, help with watching the cows and with household tasks, and form a small audience for the goings-on of the household. A child in this status was no longer afforded the special attentions bestowed on infants, and this was reflected in their more subdued, less verbal behavior [24].

The most decisive marker for the transition from infancy to early childhood in Kokwet was the birth of the next sibling, an event experienced at some point by most children since families averaged more than 8 children born over the mother's reproductive years. The actual length of intervals between births, however, varied considerably, with some babies born just over a year after the previous birth, while others came after intervals of several years. In the context of these culturally regulated customs of child care, the length of the interval following the birth of a child was a significant factor in the health-sustaining aspects of the child's environment [28]. For example, earlier weaning would mean a transition to a higher proportion of family foods, which were more likely to be contaminated with disease-causing organisms; and the lesser degree of attention given to second- to youngest children might result in less frequent feeding or care during illness. Emotionally, these children had to take a peripheral position in the family at a time when they might not yet be developmentally ready to fill the early childhood niche of apprentice household helper.

Research on caretaking practices and infant diarrheal disease in Bangladesh also illustrates how customs of child care affect child survival and development [37]. Diarrhea is a frequent and dangerous health problem for infants in these villages, where the prevalence rates range up to 57% and the majority of infants (78%) suffer second- or third-degree malnutrition, as indexed by weight-for-age. A detailed analysis of the patterns of infection showed two ages of heightened risk for diarrhea. The first period spanned about 9 to 16 months, with a peak incidence around 1 year. The second period began a few months later and peaked at 20 months of age.

Ethnographic and observational data revealed that the first period of diarrhea corresponded to the age (median 11 months) at which the Bangladeshi infants began to crawl on the often contaminated dirt floor of the household courtyard. Because hand-to-mouth activity is a primary method of exploring the world at this age, as well as a technique for self-feeding, the frequency of touching and ingesting animal feces and other contaminated detritus was remarkably high (44% of the mothers estimated that their infants touched or mouthed feces in the previous 2 weeks). The speed and distance of travel by these infants who were at the crawling stage, as well as the amount of time spent out of sight of the caretaker (for example,
having crawled around the corner of a building), were found to be significantly correlated with the incidence of diarrhea. Thus, during the age from 9 to 16 months of age, factors in the physical surroundings, in interaction with the developmental status of the child, created a period of heightened risk. In this context, the local custom of carrying or holding infants of this age was an important moderator of the risk of diarrhea. Even though the clothing of the caretaker might be contaminated as well, infant carrying reduced the infant’s exposure to the denser sources of contamination on the floor.

The second peak of risk for diarrheal illness, at 20 months, corresponded to the age at which mothers first introduced significant quantities of supplementary foods, which were a major source of infection as well as an increased demand on the digestive capacities of the child. Often prepared with unclean utensils and served in unsanitary containers, left exposed to flying insects, and sometimes returned to the child after being dropped on the ground, solid foods at this age presented a risk to health even though they were desperately needed to support growth. Many customs surrounding preparation of foods and their introduction to children’s diets converged to create this second period of heightened risk of diarrhea.

Psychology of the caretakers

Both customs of child care and the settings of children’s everyday lives are closely related to the third component of the developmental niche: the psychology of the caretakers. The relevance of this component to the household production of health is vividly illustrated by studies of excess female mortality among infants and young children in north India and Bangladesh. Although in developed societies males have a higher rate of mortality and morbidity than do females from conception throughout the life-span [38, 39], the patterns of early mortality in north India and Bangladesh confound this pattern. After the opening weeks of life, when male mortality is higher (presumably due to greater vulnerability to environmental challenges), female mortality rises relative to male mortality by increasing amounts during the early childhood years [40, 41].

Researchers at the International Centre for Diarrheal Disease Research, Bangladesh (ICDDRB) have carried out studies to trace the immediate causes of excess female mortality in the study population, a group of rural communities in Matlab Thana. They found that females were less well nourished and received less food than males at all ages, and that although rates of illness were the same for children of both sexes, male children were more likely to be taken to the hospital for medical treatment than were females [42]. Thus, female children were being put at higher risk of death both through consistent relative deprivation of food, and by less responsive care in the event of illness. The differential medical care (with male child hospitalization rates exceeding female rates by two-thirds) is particularly striking in that hospital care and transportation were provided free of charge by the ICDDRB.

The Matlab finding is compatible with Das Gupta’s [40] study showing that excess female mortality in the Punjab of north India is accentuated in the more economically advantaged families, although the overall mortality in this group is lower. In both cases, the investigators have related the differential mortality rates to the cultural pattern of ‘son preference’ which predominates in that part of the world. Son preference is thought to be related to the relative economic and social roles of men and women in adulthood [43]. For example, women must be provided with expensive d-wires when they marry, and they must move away from their families permanently. Men, on the other hand, bring in wealth to their families through marriage, and they also have essential roles as supporters of their parents’ old age and in performing the necessary funeral rites. Son preference is reflected in customs related to the birth of a child, with great rejoicing at the birth of a boy but few congratulations for the mother of a girl [44].

The expression of the cultural value of ‘son preference’ at the household level in parental psychologies takes on central importance as the generator of the physical and social environments and customs of child care that have an immediate impact on survival and health. The mother of a newborn girl, especially after the birth of several girls in succession, may feel that she has failed as a wife, as a daughter-in-law, and as a mother. Under these conditions, the death of a female child may seem like a solution to a problem in the mother’s own life-course development as well as lifting a burden from the entire family.

The role of parental psychologies in the household production of health is pervasive, not only in extreme examples such as excess female mortality but also in its effects on care of the healthy child. Cross-cultural differences in parental concern with basic functions such as sleeping and eating provide an example. Today’s American middle class culture emphasizes the importance of training babies to sleep through the night at an early age: books are written on the subject [45], and a great deal of informal communication among parents centers on this topic [46]. In this context, babies who are temperamentally disposed to establish regular schedules for sleeping are perceived by parents as ‘easy’, whereas those who sleep at irregular intervals are ‘difficult’, especially if this disposition is combined with other temperamental qualities such as intensity and negative mood [47].

In contrast, New’s [48] research on mothers and infants in Italy has shown a different focus of parental concern: eating, rather than sleeping, was what mothers worried about, and infants or toddlers who were irregular or fussy in their eating patterns were the ones who were considered difficult. These differences in parental psychologies are expressed
in different focuses of care: whereas American middle class parents devote a good deal of attention to establishing a regular pattern of sleep for infants, Italian mothers show their concern with eating by feeding the toddler themselves well into the second year of life, and may even resort to the use of nutritional injections for the child who seems to be eating inadequately.

THREE COROLLARIES

The three components of the developmental niche, as shown in the examples discussed here, are different aspects of the same reality. The utility of defining them as distinctive components lies in the complementary research strategies which each perspective engenders. As the examples discussed above suggest, however, awareness of any given component leads to questions about the others as well as how each component interacts in turn with the larger environment on the one hand and with the individual on the other. Three corollaries of the developmental niche framework suggest some of the ways in which these interactive systems operate.

The developmental niche as a system

The three components of the niche operate as a system, that is, with homeostatic mechanisms that promote consonance among them. In the household production of health, outcomes are often the result of mutual reinforcement among the different components of the niche, and in this sense are overdetermined. The observable physical and social settings of everyday life are to a large extent shaped by customary practices, and these in turn are systematically related to culturally shared beliefs, goals and emotional orientations of the caretakers. Thus, in the case of differential female mortality in Bangladesh, the physical and social environments of young boys and girls have been found to vary in relation to health care; customary patterns of food availability contribute to parallel variation in nutritional status. Likewise, the contrast between the American middle class pattern of parental concern with children's sleep and the Italian concern with eating are reflected in different customs of care related to each domain, with greater elaboration in the focal domain. Thus, while the Italian mothers studied by New spent a great deal of time in feeding their young children (as well as in cooking for the entire family), the American parents we have studied have elaborate bed-time routines for their children and well-thought-out strategies for dealing with the child who doesn't want to go to bed on time or who wakes up in the middle of the night. Settings of everyday life also co-vary with parental psychologies and customs of care: for example, American infants and young children are apt to sleep in separate rooms from their parents, whereas in the Italian sample the opposite is true.

The interplay of customs and setting in the creation of risk can be seen in a more detailed analysis of the Manikganj data in which the age-dependent risks of diarrhea can be seen to vary with season [37].

The 12-month peak is most pronounced (relative to surrounding ages) during the warmest months, ideal for promoting bacterial growth, and when new sources of contamination are plentiful as flooding from the seasonal rains brings in detritus from surrounding fields, rivers, and latrines. This is the most dangerous season to crawl around on the compound floor. In contrast, the peak of risk at 20 months, presumably the result of contaminated supplementary foods, is most prominent (absolutely and relatively) during the hottest months when water for washing hands and utensils is scarce and polluted. What might appear to be a modestly shifting level of diarrheal prevalence in the infant population, therefore, is in fact a substantial but coordinated fluctuation in several distinct patterns of infection. Parental ignorance of germs as a cause of disease plays a crucial role in maintaining both syndromes of disease exposure. The patterns are created and moderated by the systematic interaction of seasonally varied setting, customs of feeding and handling, and parental psychology, as well as developmental status of the child.

With the application of the developmental niche framework to the household production of health, it becomes clear that consistent patterns of health outcomes for particular groups of people are actually dependent on the stability of the niche as a system; and conversely, that a change in any one component may lead to alteration in the outcome. In the example of dengue fever in Malaysia, it was noted that rates of disease incidence vary during the year, reflecting changes in the physical environments that promote or inhibit the breeding of the vector. Differential exposure patterns for men, women and children were also related to different patterns of behavior (e.g. time in the house, attendance at evening worship) that were set by culturally defined outcomes. The lack of recognition that 'wriggling worms' in household water containers are sources of serious disease was part of this system. For the Chinese population two other beliefs contributed to heightened morbidity and mortality. One was a widely shared suspicion that a larvicide promoted by the Government of Malaysia was actually intended to reduce the Chinese population through slow poisoning (with consequent rejection of its use by many Chinese households). A second was a traditional Chinese belief that during the 7th month of the lunar calendar (July-August), one should not seek medical attention for fear of attracting evil spirits which could invade the body and cause illness or death. During this time, hospital admissions for dengue fever among Chinese tended to decline, but mortality increased. Thus, in the Malaysian context the household production of health as related to dengue fever was affected by
variations in each of the three components of the niche over time, or in relation to different groups of people. From the perspective of health interventions, it is clear that any one of these components could provide a point of entry for change in the system, but maximum and lasting effectiveness must ultimately include all three.

In considering the developmental niche as a dynamic, constantly evolving system, no one of the components can be seen as ultimately causative of the others, even though caretakers attempt to organize physical and social settings for children that are consistent with their own customs and ethnopsychologies, and they rationalize their own behavior in the light of culturally shared perspectives. This point can most effectively be discussed in the context of the second corollary of the developmental niche framework.

**Components of the developmental niche and external systems**

Each component of the developmental niche interacts differentially with other features of the larger culture and ecology. The niche is an 'open system' in the formal sense [49]; elements from outside enter into the system to create perturbations, leading to new attempts to re-establish equilibrium by participants in the system. At any given time, however, it is likely that the system is not in a complete state of equilibrium, since influences from outside the system can be at work in relation to one or more of the components or subsystems of the niche.

Relationships between customs of care and culture change in Kokwet, and their effects on child health outcomes, illustrate this point. Because the birth of the next child was an important element in the Kipsigis cultural definition of infancy and because the infant's niche there did not accommodate more than one infant at a time, the length of the birth interval following each child was a central determinant of the child's caretaking environment. Traditional practices in Kipsigis, as well as among other sub-Saharan African groups, were oriented explicitly to prolonging the birth interval through breast feeding and sexual abstinence. Among the older women in Kokwet, the average birth interval was 31 months [28]. A child born at the beginning of this interval, thus, would be weaned at about 2 years (when the child's mother realized she was pregnant again), and would 'graduate' to childhood status at about age 2. In contrast, corresponding birth intervals for the younger mothers averaged 26 months, moving the whole process of weaning and other changes in the child's physical and social settings to a younger age for the child.

The trend toward shorter birth intervals observed in Kokwet (see also 49 for national trends) was related to a decrease in breast feeding and the shortening of the postpartum period of sexual abstinence, coupled with a lack of use of modern contraceptives. Each of these proximate determinants of fertility was independently related to different aspects of the larger environment. For example, the decrease in breast feeding was associated with increased use of bottles, related in turn to the sale of infant formula and a public image of bottles as 'modern'. The shortening of the period of sexual abstinence may be related to changing norms of marital relationships, and certainly appears related to decreasing rates of polygyny. Lack of acceptance of modern contraceptives in Kenya has been attributed to a wide range of factors, including the continuing cultural value placed on large families, low status of women, and poor availability of contraceptive services [51].

The shortening of infancy as a culturally recognized developmental stage with its corresponding niche was not well adapted in Kokwet to the biologically based developmental needs of children [28]. Although a particular child might undergo this transition at an earlier than optimal age due to being followed by a younger sibling born after a short interval, parental ethnopsychologies regarding infancy and early childhood were not altered. Indeed, we suspect that, despite the traditional practices which had been oriented to prolonging birth intervals, parents were generally not aware of the undesirability of short birth intervals. We can imagine at least three reasons for this. The first is that the cultural value of having many children might well outweigh the potential health risk of short birth intervals. The second, related factor was that parental concern traditionally centered on the survival and health of the infant, and thus the developmental and health needs of the second to youngest child in the family tended to be underplayed. Finally, general improvements in child survival in recent years may have lessened recognition of this new threat.

In order to understand local adaptations to changes introduced from the outside such as those which have led to shorter birth intervals, it is useful to refer back to the first corollary of homeostatic mechanisms promoting cultural consistency. As we have discussed previously [6], when change is introduced through one of the components of the developmental niche, the initial cultural response is likely to be 'conservative' in that attempts are made to preserve as many elements as possible of the subsystem altered, and the other two components may not change at all. Thus, in the birth interval example, changes in some customs of care (especially breast and bottle feeding) resulted in general changes in the developmental niches for children who were followed by short birth intervals; but the overall organization of the developmental niches of infants and children in this community were not altered. Eventually, however, if consequences of change grow and ripple through the system, the same forces of homeostasis that minimize the initial response will now bring the three components of the developmental niche into a new consonance. In the Kipsigis
case, further and more frequent reduction of birth intervals might eventually arouse parental awareness of 'poorness-of-fit' within the constraints of the culture. This might lead either to the adoption of new methods of birth control to prolong birth intervals, or to the reconceptualization of infancy based more on age than on sibling status. The issue of mutual adaptation between the developing child and the culturally mediated environment is addressed by the third corollary of the developmental niche framework.

**Mutual adaptation of child and niche**

The growing child and the developmental niche are co-evolving, mutually adapting units within a larger system. There has been, traditionally, a bias in the field of child development to see children as passive recipients of environmental influences rather than as active agents in their own development. Theoretical shifts in developmental psychology have profoundly altered the traditional view, with greater recognition of environmental adjustments to children's temperament and the study of child effects on parental behavior [47, 52, 53]. A related shift is underway in pediatrics, especially as the role of behavior in child health becomes more salient [54, 55].

At the cultural level, the effects of developmental change on the structure of the caretaking environment can be observed through the many cross-cultural regularities that correspond to biologically based growth and development. Widely varying cultures, for example, recognize rather similar amounts of time as a distinct post-partum period, characterized as a time of vulnerability for mother and infant that requires special caretaking responses [56]. Likewise, the period of time that infants in Africa are seen as vulnerable to the 'evil eye' of jealous others corresponds developmentally to the opening year of life when the infant is at greater risk of illness and death. Many culturally constructed environmental adaptations to the growing child are positive or protective ones, such as keeping the infant in close proximity to the mother through carrying and co-sleeping practices.

At the individual level, differences in child health outcomes can be mediated not only by characteristics of the caretaking environment but also by child characteristics. DeVries' [57] study of infant temperament and survival among the Masai, a pastoralist people of Kenya, suggested that it was the fussy, difficult infants who were more successful at surviving a time of drought than were their quieter, easier peers. Likewise, Super's [31] research on infant temperament and caretaking patterns among Kipsigis and American groups shows that characteristics of the infant strongly predict how much time the infant spends with the mother, although the direction of the relationship is reversed in the two samples.

As these examples suggest, the idea of mutual adaptation does not imply that the outcome is always optimal health for the child. Because the child and the niche are interacting, open systems, a 'steady state' is never achieved. The issue is not only historical time lags in cultural adaptation, but also the fact that developmental niches, like individuals, have constraints on their adaptability. In the Kenyan example discussed above, we noted a wide variety of factors which might impede parental response to the negative sequelae of shortened birth intervals. In India and Bangladesh, the constraint on maximizing survival chances for all children is the differential value placed on boys and girls, with the resulting bias toward care for boys. Other constraints originate in cultural beliefs about health that may be erroneous from a biomedical perspective: for example ignorance about the germ theory of disease in Malaysia and Bangladesh. Even when parents recognize health threats, they may be constrained in their ability to deal with them effectively by other elements of their own lives. For example, many American parents realize that infants and young children are likely to become ill more often if placed in group care, but they send the child anyway because they need supplementary care for the child in order to accommodate their own work schedule. In this case, parents' assessment of the degree of risk becomes an important factor as it relates to other constraints in the environment.

In summary then, the statement that the organism and the developmental niche are mutually adapting is true here with the same qualifications as is true in ecological theory [see 58]; feedback loops are not always positive in effect, and maximization of the child's chances of survival and healthy development is moderated by the constraints of the physically and culturally constructed environment. The currents of change at any given time may alter the balance in ways that affect the child's health outcomes in both positive and negative directions.

**SUMMARY AND CONCLUSIONS**

As the phrase 'the household production of health' implies, the framework that has been elaborated here is an ecocultural one that contrasts with biomedical models. The mediation of disease potential and the creation of environments favorable or unfavorable to children's survival and healthy development take place within the context of the household. The challenge to analyzing how these processes unfold is, as a beginning, to develop theoretical frameworks that can engender systematic study of their effects on health outcomes. The developmental niche is a theoretical framework that provides a basis for organizing information about the micro-environment of the individual, including settings of daily life, customs of child care, and the psychology of the caretakers. Together, these components of the niche shape the child's daily routines, direct interactions between
Household production of health

caretakers and the child, and organize the larger strategy of care.

We have reviewed several examples of evidence for direct causal links between particular components of the developmental niche and health outcomes. In doing so, we have also drawn attention to the fact that each component of the niche is related systematically to other subsystems. The result of this linkage can be health outcomes which are culturally "intended", whether they be positive or negative for the individual. In this case, the three components are ecologically redundant: physical and social settings are regularized by customs of child care, and the psychology of the caretakers is oriented to the achievement of cultural goals such as an infant who sleeps through the night or a larger number of sons than daughters. Alternatively, the three components of the niche may relate to each other in a culturally accidental manner which nevertheless is necessary from an ecological perspective in order to create certain health outcomes, such as differential rates of mosquito-borne disease or of respiratory infection. In these cases, the central point is that health outcomes are the joint product of the three components of the niche, and thus efforts to change these outcomes need to take all components into account.

The developmental niche, like the household, is embedded in larger cultural and physical systems. Our discussion of interactions with these systems, and their implications for health, has illustrated the point that change can originate from many sources, with consequent adaptations at both individual and societal levels. At the same time, the examples discussed here have also illustrated the fact that adaptation at any given time is not necessarily optimal for the health outcomes of individuals. The mutual adaptation of organism and niche is filtered through the many constraints of the physical and cultural ecology, including conflicting needs for household organization, lack of culturally accepted knowledge, and assessments of relative risk.

The application of the developmental niche framework to analysis of the household production of health should lead to several useful results. The three components of the niche provide a starting point for the collection of systematic information about how health outcomes are affected by the household-based organization of the individual's micro-environment. Understanding of how the three components interact with each other as well as with aspects of the larger environment, the biology of disease processes, and the developmentally based health needs and potentials of the individual should lead to more effective formulation of intervention strategies. Finally, at a theoretical level, consideration of the developmental niche framework as it applies to health outcomes in the household context points to conflicts and complexities in processes of mutual adaptation, and to the need to refine further our conceptualization of how these are resolved by individual family members in their own historical moments.

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REFERENCES

18. Searl-Salapatek S. An evolutionary perspective on infant intelligence: Species patterns and individual