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Analyzing Diversity in Developmental Pathways: Methods and Concepts

Kurt W. Fischer, Catharine C. Knight, Martha Van Parys

Diversity is pervasive in cognitive development, with different children developing along distinct pathways [Fischer and Knight, 1990; McCall et al., 1977]. Although there is strong empirical support for this proposition, the research methods commonly used to study cognitive development, especially within the Piagetian tradition, are biased against detection of diversity. These methods have been designed to detect one and only one hypothesized pathway. They have been insensitive to other pathways, reducing pathway differences to variations in stage or in rate of movement along the one hypothesized pathway.

This blindness to diversity is not necessary. There are straightforward methods available that provide powerful ways of detecting developmental diversity across individuals and cultural groups, although these methods have not been commonly employed. To detect the natural diversity of development, a method must have one key characteristic. It must use multiple measures specifically designed to assess developmental diversity, such as multiple partially ordered tasks, multiple assessment conditions, or multiple contexts of application [Fischer, 1987; Fischer and Bidell, 1991; Fischer et al., 1984].

Use of each of these types of multiple measures has produced evidence for related varieties of developmental diversity. Methods employing multiple partially ordered tasks within a specific domain show diversity in pathways both within and between individuals. Each person develops not along a single developmental sequence, but along multiple strands forming a developmental web. And different individuals produce different developmental pathways - different patterns of multiple strands within a domain. A domain that illustrates these two types of diversity in pathways

is the development of early reading of words, where children work to integrate strands for sight, sound, and meaning in order to read.

Methods employing multiple conditions for assessing development in a single domain have shown that, on each developmental strand, individuals occupy a range, not a single point. Methods employing multiple contexts for application of a skill reveal the influence of affective meaning on development. The personal meaning of a skill affects the way people use it, producing complex relations between use and developmental level. A domain that illustrates this diversity in range and affective meaning is the development of age and sex categories. In this domain, both assessment condition and meaning produce important variations in developmental pathways.

Methods for Detecting Developmental Sequences and Webs

Cognitive development classically has been conceived as movement through a single sequence of stages, with the adaptation of behavior increasing as individual children move up the developmental ladder from stage to stage. Individual variations in development have been conceived primarily in terms of the rate of progression up the ladder and the stage at which a person's development stops. When people do not evidence a higher rung of the ladder, they must be standing on a lower rung. There is no other pathway, according to this classical view [Kohlberg, 1969; Piaget, 1983].

An alternative conception is that development involves a web rather than a ladder [Bidell and Fischer, 1992], as shown in figure 1. Individuals construct interweaving strands as they develop progressively more complex skills, with the result that there are many developmental pathways, not just one. When people do not show a higher step along one strand, they may be progressing along a different strand.

Developmental researchers have been unable to detect these different strands because their assessment instruments have been designed to measure development in terms of one ladder, or set of stages, such as Piaget's [1983] stages of epistemological development or Kohlberg's [1969] stages of moral judgment. The many different strands in the web of development have been forced by these instruments into one scale, as if there were only one strand. The result has been marked underestimation of the natural diversity in developmental pathways [Bronfenbrenner, in press; Gilligan, 1982; Newman et al., 1989].

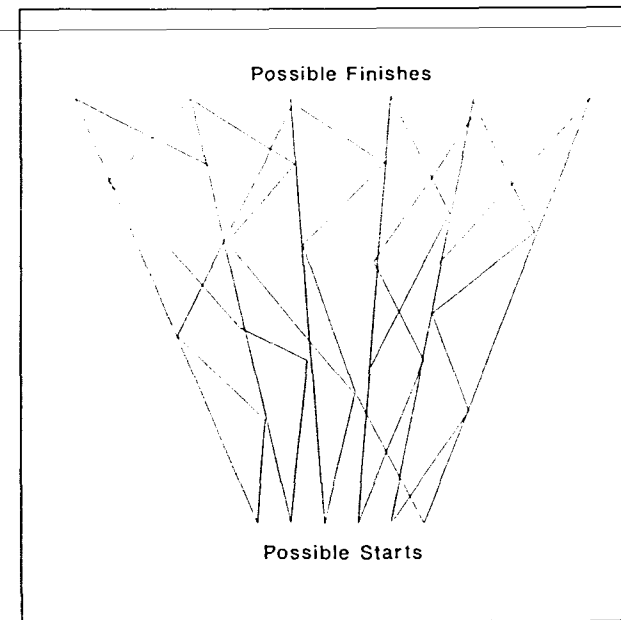


Fig. 1. The web metaphor for developmental pathways (web of constructive generalizations).

Guttman-Type Assessments of Sequences

Sequence is at the core of all development, which is movement from one behavior to another over time. To capture development, researchers need methods for detecting sequences [Flavell, 1972]. The most common methods entail administration of one task to children at different ages, in a cross-sectional or longitudinal design. In cross-sectional research, different children constitute each age group, and a developmental sequence is inferred from changes in average behavior across children from one age group to the next. For most of the history of cognitive-developmental research, methodologists have been dissatisfied with making developmental inferences based on cross-sectional data [Appelbaum and McCall, 1983; Wohlwill, 1973]. A longitudinal method has been regarded as superior because it provides independent assessments of different steps in development for an individual child. Even a single task administered longitudinally provides data on performance at different points in development.

Another way of providing independent assessments of different developmental steps can be used in either cross-sectional or longitudinal designs. In the Guttman [1944] scaling method, separate tasks are used to simultaneously assess different points along a scale. For a five-step linear developmental sequence, at least five tasks are required, a minimum of one for each step. If the tasks form a single scale, a child will pass all tasks up to some step in the scale and fail all tasks beyond that step.

The Guttman scaling method follows the logic of the longitudinal design. Variations in the tasks along some developmental dimension(s) replace variations in the age of the child tested longitudinally. That is, repeated assessments of each child with task variations replace repeated assessments with age variations. For each child, the method produces a profile of task performances in place of a profile of age performances. In this way, a Guttman scale provides a quasi-longitudinal test of a developmental sequence within a single assessment session.

A test of sequence through Guttman scaling has advantages over a traditional longitudinal design. It provides a direct assessment of every step in the sequence through an independent task, whereas most longitudinal studies assess all steps with one or a few tasks, it being assumed that the task is equally valid for assessing each step [Roberts, 1981]. The scaling method also reduces many of the measurement and sampling problems of longitudinal studies, such as practice effects and sampling biases [Fischer and Farrar, 1987; Horn and Donaldson, 1976]. Incorporation of Guttman-type scales into longitudinal designs amplifies the power of those designs. Variations in both task and age within each child provide powerful assessments of systematic change in individual performance. That is, for longitudinal designs, Guttman scales substantially increase measurement sensitivity and provide a double test of sequence – both within the Guttman scales and across time.

Despite the strengths of Guttman-type assessments, they have not been widely used. The reason may be that the statistics initially devised to test Guttman scaling, called scalograms, tested only for linear sequences – developmental ladders. In the 1960s, early in the 'cognitive revolution', several investigators [Kofsky, 1966; Wohlwill & Lowe, 1962] used Guttman scaling to test linear sequences postulated by Inhelder and Piaget [1959/1964]. When these studies failed to support the postulated sequences, researchers seemed to lose interest in Guttman scaling. The conclusion appeared to be that something must be wrong with the method since it did not detect the postulated linear sequences.

In fact, both the original scalogram techniques and the postulated sequences were at fault. Both were based on the assumption of a single developmental ladder. Piaget's theory postulated that all development involves step-by-step univocal progression through a single sequence of stages. Likewise, scalogram techniques required that all tasks in the assessment battery form a single, linear developmental scale. Any kinds of deviations from that scale were considered evidence against the postulated sequence, even if there was order in the deviations. The studies thus failed because both the theory and the method shared the same incorrect assumption of a single, linear developmental scale, with no allowance for diverse strands within a pathway.

Assessing Developmental Webs

The logic of Guttman scaling does not require a single, linear sequence. The ordering of performance profiles across tasks can be used to infer not only a single sequence but also a more complex pathway – a developmental web. When scalograms were originally devised, testing for complex pathways was difficult because computations were time-consuming, prior to the existence of modern computers. As a result, statisticians devised simple methods requiring only hand calculation. Now that computers have eliminated the calculation problem, it has become possible to use the logic of Guttman scaling to test for developmental patterns that involve parallel and intersecting strands.

Oddly, there has been little research using these kinds of methods, despite the wide availability of computers for 30 years. The obvious advantages of examining developmental profiles have led to recurrent interest in devising Guttman-like methods [Coombs and Smith, 1973; Flavell, 1972; Longeot, 1978; Rudinger, 1981; Thorngate and Carroll, 1986], but the techniques available have been complex and have not included direct tests for developmental webs. Also, they have been inaccessible or difficult to use.

Building primarily on the work of Krus [Krus, 1977; Krus and Blackman, 1988], we have devised a simple technique for analysis of developmental webs [Knight and Fischer, in press; Kuleck et al., 1990, see also Edelstein et al., 1984]. Called 'Partially Ordered Scaling of Items' (POSI), this statistical technique is based on analysis of performance profiles across tasks. (Copies of the program for personal computers are available

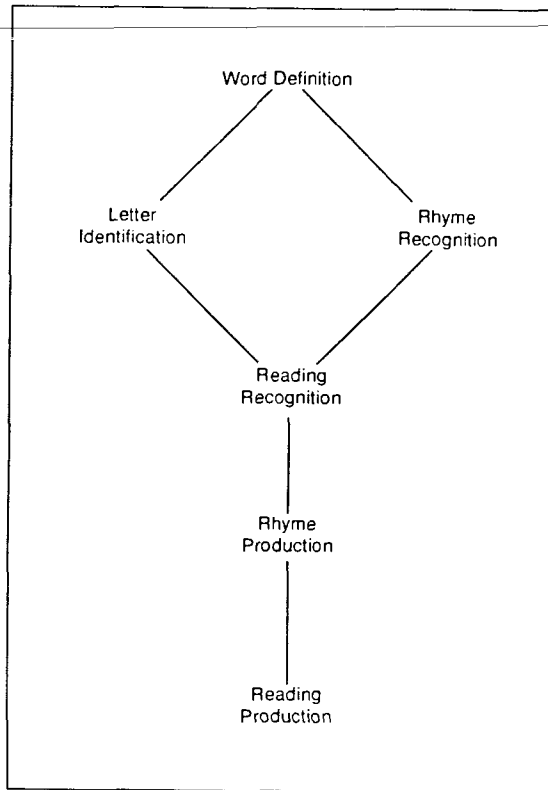


Fig. 2. A developmental pathway with branching and integration (from top to bottom).

from the first author). Figure 2 shows one of the most elementary types of developmental webs, with one short branching. Table 1 lists the profiles that define that web for the simplest type of scale – zero/one (absent/present). The profiles for steps 2a and 2b show that these two tasks do not order with respect to each other; that is, one does not develop consistently before the other. But each of the two tasks does order with respect to all the other tasks in the table, as shown in figure 2. Thus, the profiles in table 1 define a developmental sequence with a simple, short branch in which steps 2a and 2b are parallel to each other.

POSI involves analysis of a set of empirically obtained profiles to describe any developmental sequence or web that the profiles show. A

Table 1. Response profiles for the predicted developmental sequence

Step	Word definition	Letter identification	Rhyme recognition	Reading recognition	Rhyme production	Reading production
0	-	-	-	-	-	-
1	+	-	-	-	-	-
2a	+	+	-	-	-	-
2b	+	-	+	-	-	-
3	+	+	+	-	-	-
4	+	+	+	+	-	-
5	+	+	+	+	+	-
6	+	+	+	+	+	+

Note: + = pass; - = fail.

computer compares the profiles for all pairs of tasks to identify the orderings that obtain in the data. The result is a diagram called a 'dendrogram' that specifies the orderings, as in figure 2. Besides the orderings themselves, POSI also provides estimates of the distance between ordered items, which Krus and Ceurvorst [1979] call 'dominance', but we will not deal with this aspect of the technique in this chapter.

The developmental web in figure 2 was predicted for the six tasks listed there and in table 1. They all assess skills related to reading single words in English [Knight and Fischer, in press]. The tasks assess both visual-graphic analysis of words, as in letter identification and reading recognition, and analysis of the sounds of words, as in rhyming. According to many models of reading, children need to learn to integrate visual-graphic and sound-analysis skills in order to read skillfully [LaBerge and Samuels, 1974]. Figure 2 predicts a developmental sequence for integrating these skills.

Diversity in Pathways in a Single Domain: Reading

In an empirical study of the skills in figure 2, children performed all six tasks for 16 words. In word definition, children simply had to say or show what the word meant. In letter identification, they were asked to specify what the letters were as they viewed the written form of the word.

In rhyme recognition, 4 words were spoken to them, and they had to choose which one rhymed with the word they had read. In rhyme production, they had to produce a rhyming word. Reading recognition involved choosing one of four line drawings as showing the object or action that the written word referred to. Reading production involved directly reading (saying) the word from the written form.

The hypothesized sequence began with word definition because in beginning reading, children need to know a word before they can work with it. The letter identification and rhyme recognition tasks were predicted to be independent because early in the development of reading, children have not yet integrated visual-graphic (identifying letters) and sound-analysis (rhyming) skills. The coming together of the two branches to form a single sequence for the remaining tasks reflects the integration of sight and sound in skilled reading of single words.

A total of 120 children in first, second, and third grades (ages 6–8) were tested with 16 common words from their school reading series, such as *frog*, *cake*, and *dress*. Analysis using POSI was done with the performance profiles for the six tasks across the 16 words. The dendrogram obtained was almost exactly like the one predicted in figure 1. The only exception was that the word definition task did not order with the letter identification task. That is, the line connecting word definition and letter identification in figure 2 was missing, but all other predicted connections were present. This exception is an apparent result of ceiling effects, in that most children passed both word definition and letter identification for most words.

The study was cross-sectional, with different children assessed at each grade level. POSI allows cross-sectional testing of a predicted developmental pathway (linear sequence or web) because the use of multiple tasks provides independent assessments of different steps in the pathway. A longitudinal study of the pathway is being carried out to test the sequence across the same age period. Preliminary analyses indicate that children show the predicted pathway longitudinally as well.

The developmental web in figure 2 is extremely simple, with only one branch. Most developmental pathways are probably more complex, like the web shown in figure 3 for the same six reading tasks. This complex dendrogram is defined by a set of profiles for task performance like that in table 1, but the set is much larger in number. In this alternative pathway, word definition begins development; the tasks then form three independent branches – one for rhyming, one for letter identification, and one for

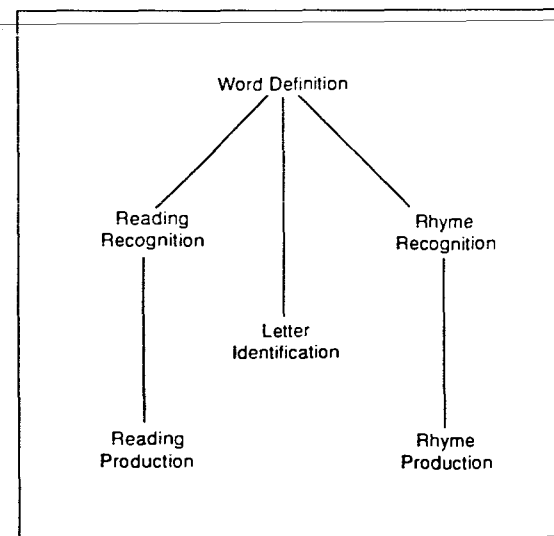


Fig. 3. An alternative pathway showing multiple branching without integration (from top to bottom).

reading. There is no integration of these branches into reading skills like those described in most theories of reading.

Analyses of performance profiles of individual children on the six reading tasks showed that both of these pathways in fact occurred [Knight and Fischer, in press]. Children did not show just one, nor even two pathways. They evidenced three distinct developmental pathways for the six tasks. The single-branch, integrated pathway in figure 2 – the one detected by the POSI analysis of the entire sample of children – was the most common pathway, especially for children who were skilled readers. The multi-branch, unintegrated pathway in figure 3 occurred in a number of children who were poor readers. A third pathway occurred in students having reading difficulties, as well as some normal readers.

To uncover the two pathways besides the most common one, we first tested the generality of the hypothesized single-branch pathway by doing separate POSI analyses for high- and low-skill readers. The dendrogram for high-skill readers was similar to that for the entire sample of children, showing the pattern predicted in figure 2. But the dendrogram for low-skill readers was very different, showing a complex web of connections and

dissociations between tasks, with much less systematic ordering than for high-skill readers.

To better understand these findings, especially for low-skill readers, we undertook analysis of the individual profiles shown by each child for all words. In this method, called 'pattern analysis', we determined the profiles that co-occurred for each individual child with different words. Because there is not yet a statistical program for carrying out this kind of analysis, it required time-consuming tabulation of profiles and co-occurrences. However, the logic is still that of Guttman scaling. The patterns of task profiles specify a particular developmental web. When it is possible to clearly define distinct groups of children who are expected to show different pathways, POSI can be used to describe the pathways. But if there is diversity within a group, as there was among the low-skill readers in our study, individualized pattern analysis is required.

The pattern analysis showed that low-skill readers produced two different sets of co-occurring profiles, defining two developmental pathways other than the one predicted for normal readers. One pathway was the three-branch, unintegrated one shown in figure 3. The other was similar to the one in figure 3, showing poor integration of sound-analysis and visual-graphic skills, but there was no separate branch for letter identification. Word definition and letter identification ordered in sequence, and then there were only two branches, one for the reading tasks and one for the rhyme tasks. The three pathways are being tested in the previously mentioned longitudinal study, and preliminary analysis indicates replication of all three.

The detection of three different developmental sequences for six simple, everyday reading tasks calls into question the common assumption, built into many research designs and standardized tests, that virtually all children learn to read in the same way. It suggests that research on the development of early reading skills will facilitate understanding the processes of reading and contribute to better methods of teaching reading and remediating reading problems. It also implies that children with reading problems will show distinct developmental sequences depending on the bases of their problems.

One of the three observed sequences consistently led to good reading. It involved a simple, direct pathway of reading development, in which skills from the visual-graphic and sound-analysis domains were eventually integrated in the reading production task. The other two sequences, which were associated with long-term reading problems, provided a different picture. Instead of direct, integrated pathways, they showed separation of

skills in different domains, suggesting that the primary difficulty of poor early readers may be integration of the domains of reading [Adams, 1990; Bradley and Bryant, 1985; Chall, 1967; Olson, 1985]. Yet, this integration difficulty was not limited to poor readers. Some normal readers showed the two-branch sequence for some words, demonstrating a lack of integration of visual-graphic and sound-analysis domains. The three-branch sequence, however, was limited to poor readers.

These findings are consistent with the argument that different children require different strategies for teaching and learning reading. Interventions that facilitate integration will produce major improvements in reading for many children, but some children may face lifelong difficulty in achieving such integration. For them, alternative strategies for teaching and learning reading may be needed [Pennington et al., 1984].

This simple study involving only six tasks shows that diverse developmental pathways can be detected straightforwardly with multi-task methods. Investigators need only use multiple, partially ordered tasks and then search for consistent patterns in task ordering. We predict that the use of such methods will uncover diverse pathways in most domains of cognitive development.

Variation in Developmental Level within a Domain: Sex Roles and Age Roles

Diversity in the ordering of developmental steps is only one of the ways in which people show different developmental pathways. Another type of diversity involves variation in a person's developmental level within a domain, or what has been called the individual's 'developmental range' [Lamborn and Fischer, 1988]. Although classical analyses of cognitive development assume that a person is at a single step on a developmental ladder, it is now well documented that on each developmental strand, a person occupies a zone, or multi-step region. Even within a narrowly defined cognitive domain, a person routinely uses a range of steps, not a single step. This range can be viewed as a more precise definition of what Vygotsky [1978] called the 'zone of proximal development' [Fischer et al., in press; Granott, in press]. Developmental range has been investigated for a wide array of domains and ages, and it has been found in virtually all children after the age of 3-4 years [Fischer et al., 1984; Kitchener and Fischer, 1990].

A domain in which we have studied developmental range is that of sex roles and age roles in young children [Van Parys, 1983]. From an early age, children are interested in the primary social categories used to classify people in their culture. Age and sex are defining dimensions for important social categories in all known cultures [Whiting and Edwards, 1988]. Primary categories in English include 'girl', 'boy', 'woman', and 'man', which are defined by the intersection of age and sex. Other categories are defined by only one of these dimensions – child and adult for age, female and male for sex. In English, people most commonly use the words that simultaneously define age and sex. In some other languages, words defined by only one of the dimensions are emphasized. For example, everyday usage in Korean focuses on age – child and adult – with the sex distinction serving as an optional addition – for example, male child, female child [Woo, 1990].

A powerful way of assessing young children's understanding of social categories is based on their enjoyment and propensity for stories and pretending. Preschool children can be difficult to test, but their enjoyment of pretend stories makes it possible to assess their social understanding relatively easily by engaging them in acting out and telling stories.

Table 2 presents simple developmental sequences predicted for stories about age and sex roles among American children: The table describes the gist of the story that children had to act out or tell to pass each step. The sample consisted of 72 white middle-class American children evenly distributed between the ages of 2 years 6 months and 6 years 2 months. Toy human figures were used to act out each story. For the sex-role stories, there were boy, girl, man, and woman figures; for the age-role stories, there were simple, genderless figures that could 'grow up', becoming taller when they were pushed from the bottom.

Since one of the purposes of the study was to compare development of age and sex roles, the developmental strands for age and sex were analyzed separately. The performance profiles across the tasks showed that the predicted sequences held strongly, with 68 of 72 children fitting the profiles for the simple sequence predicted for each role. For the two sequences, the ages of children passing parallel steps were similar, although the age role developed slightly ahead of the sex role. Boys and girls showed no differences for either sequence.

To assess developmental range, children were tested individually in several conditions varying along one of the most potent factors affecting developmental level – degree of contextual support for high-level function-

Table 2. Development of understanding of sex and age roles

Skill	Sex roles	Age roles
Active agent	Child makes doll perform at least one behavior, not necessarily fitting sex or age categories	
Behavioral role	<i>Role for child's own sex:</i> Child makes boy/girl doll play with toys fitting own sex	<i>Child role:</i> Child makes child doll play with a child's toys rather than an adult's tools
Shifting behavioral roles	<i>Shift from one sex to other sex:</i> Child first makes boy doll play with boys' toys and then makes girl doll play with girls' toys	<i>Shift from adult role to child role:</i> Child first makes adult doll cook and fix the stove and then makes child doll play with toys
Effect of one-dimensional change on role	<i>Sex constancy during long time in bed:</i> Child makes doll of own sex spend a long time in bed and still remain the same sex	<i>Change in size from child to adult role:</i> Child makes child doll play with toys and then has it grow up into an adult, who works with tools
Shifting between effects of one-dimensional changes on role	<i>Shift from sex constancy despite one change, to sex constancy despite other changes:</i> Child makes doll of own sex remain the same sex, despite one of the changes in step 6 at a time, shifting between them	<i>Shift from child/adult difference in one trait, to child/adult difference in another trait:</i> Child makes child and adult dolls show one child-adult difference (from step 6) at a time, shifting between them
Effects of multi-dimensional changes on role	<i>Sex constancy despite long time in bed and changes to different-sex clothes and name:</i> Child makes doll of own sex remain the same sex even when he or she spends a long period in bed, changes clothes to those of the other sex, and changes name to one fitting the other sex	<i>Unidirectionality of age growth for size, strength, and activity:</i> Child puts together several age-role characteristics that change with growth; child doll puts on a necklace that will not fit adult, adult doll builds a tent that child doll cannot build, and child doll plays in tent, where adult will not fit
Integration of effects of multi-dimensional changes on both roles	<i>Integration of sex and age roles in children and adults:</i> Child makes girl and boy dolls play with sex-appropriate toys and refer to their future rolls as woman and man; child then makes them grow up into woman and man dolls who show sex differences and refer to having been girl and boy	

ing. In the high-support condition, an adult modeled a story for each step in table 2, and the child was asked to act out or tell a story like the one modeled. This condition provided the test of Guttman scaling for the age- and sex-role sequences.

Following the high-support condition were two low-support conditions in which the children made up stories without any immediate modeling or prompting from the adult. First was the free-play condition, in which the adult asked children to make up stories of their own like the ones they had just done; she stepped out of the room for 5 min and videotaped the children's stories. Second was the best-story condition, in which the adult returned to the room and asked children to make up the best story they could.

For both high- and low-support conditions, children's performances were characterized by upper and lower limits, called optimal and functional levels, respectively. In the high-support condition, children performed every story successfully up to their limit – their optimal level – and failed every story beyond that. In the low-support conditions, they produced several spontaneous stories that varied across a lower portion of the sequence. The steps of these stories also showed a limit – the child's functional level – which children did not exceed even when they were asked to produce the best story they could. The gap between optimal and functional levels defines a child's developmental range.

For most children 4 years of age and older, the developmental level of their stories fell 1–3 steps as they moved from high- to low-support conditions. That is, there was a gap of 1–3 steps between their optimal and functional levels. A typical pattern for a 6-year-old, for example, was to perform up to step 5 with high support but only to step 3 with low support. Most children showed the same functional level in both low-support conditions, but some performed 1 step lower in the best-story condition. We attribute this difference to greater opportunity to show a high step in the free-play condition, in which children typically produced several stories, while in the best-story condition they did only one story.

Across a number of studies in different domains, children have shown large, stable individual differences in their developmental range for a particular domain [Fischer et al., in press; Fischer et al., 1984]. When tested as many as 5 times within the same domain, children typically have shown the same range for each assessment, with correlations of approximately 0.9 between assessments. When more than one type of condition was used to provide high or low support, results were similar across conditions. Also,

the size of the developmental range has been found to increase systematically with age, at least to the late 20s [Kitchener and Fischer, 1990]. Only in the first 3 years of life does there appear to be little or no gap between optimal and functional levels.

Although the developmental range has not been studied systematically until recently, it is captured by a phenomenon that most people experience as students and teachers. A teacher provides an exposition of a concept that is difficult for a student, such as relativity, natural selection, or developmental range. At the moment of the teacher's exposition the student understands the concept at a high level, discussing it with some sophistication. Later, when the student tries to resurrect the concept to explain it to a friend or write about it on a test, his or her level of understanding is much lower. Without the prompting of the teacher's exposition, the student can produce only a lower, functional level of understanding. The higher-level, optimal understanding can be brought back by the repeat of the prompt by the teacher (or someone else); but within a few minutes after the prompt, the student's understanding again returns to the lower, functional level.

Relation between Understanding and Affective Meaning: Gender Differences

The developmental pathways for understanding stories about age and sex roles in table 2 seem simple – two parallel linear sequences that show no gender differences. For boys and girls, the orderings of tasks were the same, and the means and distributions of developmental steps at each age were very similar [Van Parys, 1983]. Although this lack of difference between boys and girls is important, it represents only one small aspect of the developmental pathways for age and sex roles. There is much more to the roles than what is captured in these sequences. Sex and age roles have individual affective meaning – that is, the value a child places on the role as it is applied to the self and to others. Even when the development of understanding is similar across individuals, the affective meaning of the concepts or skills will often produce great developmental diversity in pathways [Brown, 1991; Connell, 1991; Harter, 1983].

A particularly likely place to find such diversity is in gender – the psychological, affective meaning of being male or female. Recent research has shown dramatic differences in social behaviors and interpretations between boys and girls, and the differences increase during childhood

[Benenson, 1990; Gilligan, 1982; Maccoby, 1990; Whiting and Edwards, 1988]. Cognitive differences between boys and girls appear to be small for most domains, but social differences seem powerful, especially when the social behavior is tied to children's own categorizations and attributions of gender.

In our study, assessments of the individual affective meaning of the role categories produced a portrait rich in gender differences. Boys and girls showed different developmental pathways for connecting understanding and affective meaning of age and sex roles. With better understanding (and greater age), boys used gender more often and more consistently to provide personal meaning, while girls used it less often and less consistently, focusing instead on age or other factors.

To assess the affective meaning of age and sex roles, we used four tasks in which each child made choices based on age or sex categories. (Several other tasks are not described here.) Two tasks involved self-identification, and two involved preference for people or toys. In the two self-identification tasks, children classified or identified themselves with drawings of individuals or groups of people in which both age and sex varied. For each task, children received a score based on the number of times that they identified themselves in terms of age (child or adult) or sex (female or male). In the people preference task, children chose categories of people (man, woman, boy, girl) they would like to be with. In the toy preference task, they chose between toys that were stereotyped in terms of gender.

Children's choices demonstrated powerful developmental changes in the affective meanings of the roles for boys and girls. As children grew older and understood the roles better, girls and boys came to show more and more differences in their choices, moving toward the pattern shown in figure 4. These differences supported the argument that sex roles had disparate meanings for boys and girls, even though the levels of understanding were similar. As children came to understand age and sex roles better, girls often avoided using gender as a basis for identification and choice, while boys often preferred it. These developmental effects dominated the results. There were no effects independent of age, no strong preferences for one category across all tasks or ages, for either boys or girls.

The specific pattern of choices varied with the particular task. For the self-identification tasks, girls became more likely with development to identify themselves as children, while boys became more likely to identify themselves as males. These relations held for both measures – age and role understanding.

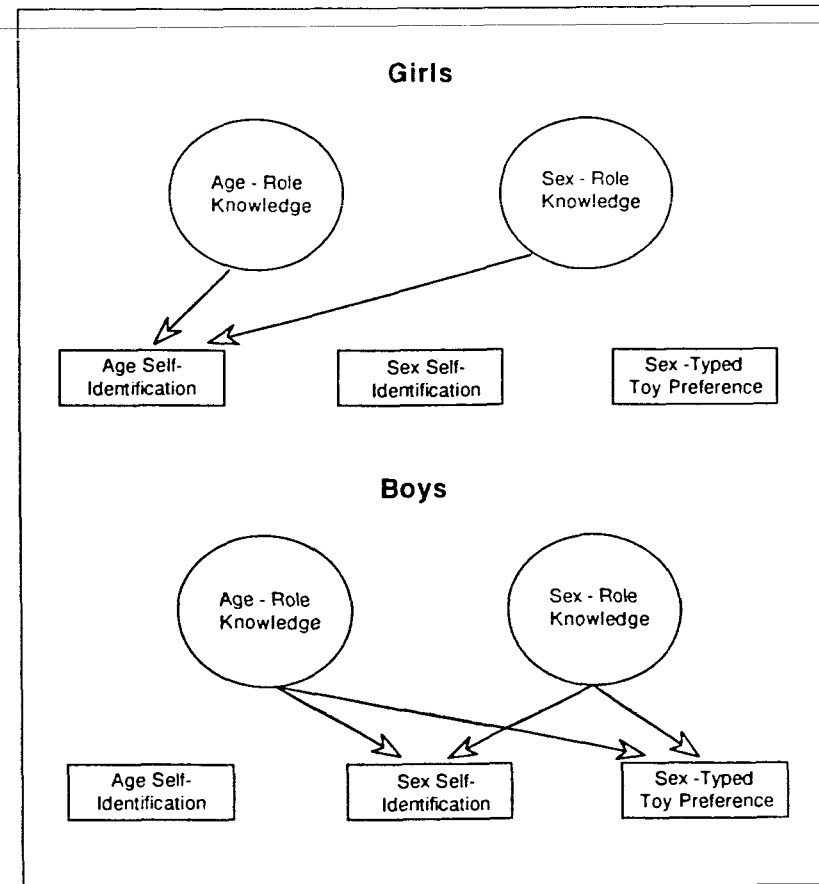


Fig. 4. Relations between knowledge and use of age and sex categories in girls and boys.

Toy preferences also showed a strong gender difference, with boys preferring male-stereotyped toys more as they grew older and understood the roles better. Girls, in contrast, showed no systematic trend with age or understanding and only a slight overall preference for female-stereotyped toys.

Gender differences also occurred in the sex and age of people that children preferred to be with. Consistent with previous findings [Maccoby, 1990; Whiting and Edwards, 1988], children preferred being with other

children of the same sex: for both boys and girls this preference increased with greater understanding of sex roles. Thus, for this one type of preference only, both girls and boys made choices based on sex, although boys made these choices more consistently than girls.

In the case of age preference, children showed more complex gender differences. Girls preferred being with children rather than adults, and this effect increased with age and age-role understanding. In contrast, boys' preferences changed as they grew older and understood age roles better. They first preferred being with children and later preferred being with adults. Apparently, boys liked to associate themselves with the more powerful role of adult even though they themselves were still children.

In general, then, boys and girls used sex and age information differently, apparently based on the different affective meanings of gender for them. The richness of the gender differences suggests a need for revision of the classical view that with age, children identify more and more with their own gender [Kohlberg, 1966].

We hypothesize that these effects partly reflect the values placed on male and female roles in white American culture. Male roles often have more status and power than female roles [Emmerich, 1959; Gilligan, 1982; Leahy, 1983]. In other cultures, the values of sex roles can be different, with resulting differences in affective meanings for boys and girls. There is evidence, for example, that the female role is more valued than the male role in some aspects of black American culture [Fine and Zane, 1989; Ogbu, 1978; Weston and Mednick, 1970].

In a study of race, age, and sex roles involving similar measures of self-identification, black and white middle-class American girls and boys showed patterns that appeared to reflect this cultural difference [Van Parys, 1981]. For white preschool children, the results were similar to those in our study, with boys gradually identifying more with gender while girls came to identify less with it. But for black preschool children, the effect was reversed. Girls tended to identify themselves in terms of gender more than age, and boys tended to avoid gender. This study also examined identification in terms of race. An additional gender difference occurred for black children. A number of young black boys devalued being black, identifying themselves as white, but few black girls showed self-identification as white. White children showed no gender differences involving race and no self-identification as black.

These gender and race differences in the use of sex, age, and race information illustrate the importance of adding affective meaning to the

analysis of developmental pathways. With the addition of affective meaning, even concepts that seem to display identical cognitive-developmental sequences turn out to show major developmental differences.

Conclusions: Diversity and Processes of Development

Diversity in development is pervasive, but much research in the field of cognitive development is based on methods that are insensitive to diversity. When methods are sensitive to diversity, research uncovers it at every turn. Development moves through multiple distinct strands, forming a web-like pathway for each person in each domain. Different people move through distinct developmental webs. Individuals show a developmental range for each strand in a web, producing multiple levels of behavior. Even when level of understanding is the same across people, different individuals use concepts and skills distinctively, based on affective meaning.

Traditional conceptions of development have reduced these many differences to variations in movement along a monolithic developmental ladder or staircase. Although we have emphasized methods for going beyond this overly simple framework, another way of moving toward the same goal is to emphasize the specific *processes* of development in concrete behaviors in real children and adults. Indeed, an emphasis on methods and a focus on processes naturally go together in the attempt to understand developmental diversity. Analysis of processes requires detection of the particulars of variability and diversity because it is those particulars that allow inferences about process [Bidell and Fischer, 1992; Siegler and Crowley, 1991].

Each of the types of diversity described in this chapter has specific implications regarding the nature of developmental processes. The specificity and web-like nature of developmental pathways lead away from global concepts of developmental change, such as Piagetian [1975] equilibration. Instead, they encourage a focus on the explicit links between behaviors, as in the concepts of co-occurrence and constructive generalization. Several researchers have noted that co-occurrence of specific behaviors can reflect the emerging coordination of these behaviors [Bidell, 1990; Perry et al., in press; Wilkening et al., 1980]. Through this co-occurrence and coordination, independent developmental strands become integrated and differentiated. Co-occurrence and coordination in turn typically lead to constructive generalization, for example when children progressing along a pathway of reading come to be able to read a word in different types of print and different

contexts. Gradually, through these specific processes and diverse pathways, children can build up highly general conceptual structures for understanding their world and giving it meaning [Case and Griffin, 1990; Case et al., this volume; Fischer and Farrar, 1987].

The phenomenon of developmental range relates processes of short-term variability in level of behavior to processes of long-term development. With the natural variability that individuals routinely show within the developmental range, major developments occur within short time periods and can be studied in individuals without waiting months or years for long-term development to occur. Research on variability within the range thus provides a link between short- and long-term change. Vygotsky [1978] described some of the social factors that affect this variation and posited ways that they contribute to long-term development, but work based on his concepts has thus far barely scratched the surface of the developmental range [Granott, in press].

One of the most neglected areas in the study of cognitive development is analysis of the effects of affective meaning, which seem to be central to developmental diversity [Brown, 1991]. Previous hypotheses about the processes relating cognitive development to affective meaning have been overly simple. For example, understanding sex roles does indeed influence children's gender-related identifications and preferences, but the relation is not the simple linear one that has been hypothesized. Greater understanding does not lead uniformly to greater choice based on gender; instead, it produces diverse effects based on the affective meaning of the sex role for the individual in his or her culture.

One of the goals of cognitive research in the coming years should be thorough analysis of these kinds of diversity in development. It is time to move beyond the narrow approaches of the past that made it difficult to detect diversity and variation. With better methods and more emphasis on process, future researchers can establish a strong empirical basis for bringing the study of diversity into explanations of cognitive development.

Acknowledgments

The research described in this chapter was supported by grants from the Spencer Foundation, NICHD, The MacArthur Foundation Network on Early Childhood, and Harvard University. We thank Mark Appelbaum, Thomas Bidell, Daniel Bullock, Bruce Kennedy, David Krus, Walter Kuleck, Malcolm Watson, and John Willett for their contributions.

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Case R. Edelstein W (eds): The New Structuralism in Cognitive Development. Theory and Research on Individual Pathways. Contrib Hum Dev. Basel, Karger, 1993, vol 23, pp 57-70

Individual Differences in the Emergence of Pretend Play¹

Siegfried Hoppe-Graff

As I understand Piaget's theory, individual differences in development are irrelevant. His topic of interest was the growth of knowledge in the epistemic and not in the psychological subject [Cellerier, 1987]. In other words, his aim was to characterize the growth of knowledge in human beings as a species-specific process. Thus, his theory rests on the premises that (a) cognitive development has universal characteristics, and (b) it is constructed by the very same processes and leads to the very same results in each and every individual. Of course, Piaget was confronted with individual differences in his empirical studies, but he neglected them because they were irrelevant in theoretical terms.

One of the most important tasks for cognitive-developmental research, therefore, is to add the dimension of individuality to the structuralist framework of the Geneva school. It is the goal of this chapter to present one proposal as to how this could be accomplished. I begin with a taxonomy of individual differences in development, which I think is necessary because there is a lack of clarity and precision in discussion of individual differences. Next, I use these distinctions in describing results regarding individual differences from a study of early pretend play. I then demonstrate that there is no sufficient explanation for these results within the classical Piagetian framework. Finally, I present some of my own ideas on individual differences and explore the implications of these ideas for structural theory.

¹ This chapter is based on research carried out with the aid of a grant from the German Research Council (Deutsche Forschungsgemeinschaft).