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WHAT, WHEN, AND HOW ABOUT WHY: A LONGITUDINAL STUDY OF EARLY EXPRESSIONS OF CAUSALITY

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ABSTRACT

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Children's expressions of causality in natural discourse with adults were examined in terms of linguistic, contextual, and pragmatic influences. Specifically, the causal statements, questions, and responses to causal questions of eight 2-3-year-old children were examined in terms of developments in language content, form, and use. With respect to content, the referential and functional uses of causal expressions for both children and adults were to ongoing or imminent situations, with the speaker commenting on his or her intention to act, or requesting the listener to act. The major categories of reference in all three utterance types were *negation*, *direction*, and *intention*. In terms of form, there were (a) increasing use of connectives to link clauses for all the children, and (b) three main patterns of clause order differentiating among the children: cause/effect, effect/cause, and equal use of both orders. The use of expressions of causality developed in the order: child statements < adult questions < child responses < child questions. The relationship of the linguistic context to these developments was found to be one of mutual influence between child and adult. The results are discussed in terms of previous hypotheses concerning (a) causal reasoning (especially those put forth by Piaget, and by Werner & Kaplan in 1963), (b) the relationship between language and conceptual development, (c) the constraints involved in different discourse situations, and (d) variation in child language.

I. BACKGROUND

The purpose of this study was to examine the development of causal expressions in children's discourse in the period from 2 to 3 years of age, considering the influence of conceptual, linguistic, and pragmatic factors of language development.

With respect to conceptual development, infants begin to acquire primitive notions of cause and effect in the period of sensorimotor intelligence as they learn to act with schemas of "practical" causality to modify reality to suit their own needs (Bell 1973; Piaget 1954, p. 220). It is generally held that the child's causal reasoning continues to be qualitatively different from the adult's until age 7 or 8 (Piaget 1925/1955, 1928/1969, 1930/1972; Werner & Kaplan 1963). According to Werner (1948), the young child's causal reasoning is subjective and concrete, with an inability to differentiate cause and effect. Werner and Kaplan (1963) suggested that the child transforms causal and conditional dependency relations into the simpler relations of sequence and simultaneity which mirror perceptions. According to Piaget, development of the ability to understand and express both cause/effect relations (e.g., "the man fell off his bicycle because someone got in his way") and logical relations (e.g., "that animal is not dead because it is still moving") depends upon the decline of egocentrism (Piaget 1925/1955, 1928/1969) and the process of reversibility (Piaget 1930/1972), among other things. Thus, although there are differing views of the precise nature of the child's conception of causality, there is a consensus that truly causal understanding develops slowly and is not apparent until age 7 or 8.

With respect to linguistic development, substantial evidence has been offered to suggest that the understanding and expression of causal and other dependency relationships in language undergo great change from ages 4 to 10 (Johnson 1972; Katz & Brent 1968; Laurendeau & Pinard 1962; Piaget 1928/1969, 1930/1972; Vygotsky 1962). Very little is known, however, about the emergence of the expression of causality before the age of 4, that is, how children begin to acquire the linguistic means to express and respond to expression of causal events in discourse. The use of causative verbs (e.g.,

“have,” “make,” “get,” “kill,” “open”) has been described in young children’s speech (Baron 1972; Bowerman 1974), and the results from these studies suggest that children have begun to express cause/effect relationships by the age of 3. However, this ability to encode a single causative notion in a sentence, such as “*make* the man sit down” or “I *get* it dirty,” is conceptually and linguistically different from the ability to encode the causal relation *between two events* in a sentence, such as “I can’t reach to Ria because she’s too far away” or “I’m gonna move this [ashtray] away so the fire can’t get into your eyes.”

At least the following two linguistic variables interact in determining the surface structure of complex sentences that express a causal relation between two events: the order of the clauses, and the conjunction used to connect the clauses. In terms of clause order, one can use a cause/effect order, for example, “the boy was tired so he took a nap”; or one can use an effect/cause order, for example, “the boy took a nap because he was tired.” The clause orders appear to be relatively free in English; there is no apparent difference either in meaning or in frequency. However, the clause order and conjunction used to connect the clauses are interdependent. *Because* can only be used with effect/cause order; you can say “the boy took a nap because he was tired,” but you cannot say “the boy was tired because he took a nap” (at least and mean the same thing). Similarly *so* can only be used with cause/effect order; you can say “the boy was tired so he took a nap,” but you cannot say “the boy took a nap so he was tired” (again, and mean the same thing).

With respect to the pragmatic aspects of expressions of causality, there are differences among utterances that are causal statements, causal questions, and responses to causal questions according to events in the context that influence language use. In the present study, the development of expressions of causality will be described in terms of the acquisition of these aspects of language use in intersection with aspects of the content and form of causal expressions.

II. METHOD

SUBJECTS AND PROCEDURES

Longitudinal, spontaneous speech data from eight children were analyzed in the period from approximately 24 to 41 months. The subjects are firstborn children of middle-income, college-educated parents living in New York City. They were chosen with these social and birth-order limitations in an effort to reduce variability in their linguistic behavior that could result either from sibling interference or cultural differences. Each child was visited individually in the home, and audiorecordings of the child interacting naturally with an adult (investigator and parents) were made. The audio data were subsequently transcribed and included all speech by the child and adults as well as relevant nonlinguistic context and behavior, using the procedure described in Bloom (1970, pp. 234–239) and Bloom and Lahey (1978).

Four of the children—Eric, Gia, Kathryn, and Peter—are part of the longitudinal investigation of child language that has been reported elsewhere (e.g., Bloom, Lahey, Hood, Lifter, & Fiess, in press; and Hood, Lahey, Lifter, & Bloom 1978). These data consist primarily of investigator-child interactions. The data from the four other children—David, Mariana, Paul, and Steven—included equal proportions of mother-child and investigator-child interaction. Information regarding age, mean length of utterance (in morphemes), and sample size for each child is presented in table 1. The first samples of the children's language behavior that were analyzed for the purposes of this study were those in which the children first began to produce causal utterances. This occurred between 24 months 1 week of age (Kathryn, Time III) and 29 months 2 weeks of age (David, Time I). Earlier data were available from Eric, Gia, Kathryn, and Peter (from approximately 19 months of age), as already indicated. Earlier data were also available from Mariana and David, who were subjects in an observational study of early play and language (from approximately 16 months of age).

TABLE 1
SUMMARY DESCRIPTION OF SPEECH SAMPLES

CHILD	N OBSERV.	AVERAGE DURATION EACH OBSERV. (Hr)	AGE RANGE ^a	MEAN LENGTH OF UTTERANCE		
				Range	Mean Incre- ment	SD
David.....	12	5	29, 2-41, 1	2.98-5.59	.20	.42
Eric.....	8	8	25, 1-36, 0	2.63-4.21	.11	.56
Gia.....	7	8.4	25, 2-34, 2	2.30-3.71	.28	.45
Kathryn.....	8	8.9	24, 2-35, 1	2.83-5.82	.20	1.03
Mariana.....	11	5	26, 0-36, 2	3.10-5.54	.19	.51
Paul.....	7	5	25, 3-32, 3	2.13-4.75	.42	.64
Peter.....	13	4.3	25, 3-38, 0	2.00-3.58	.13	.45
Steven ^b	6	5	25, 3-31, 1	2.01-3.06	.21	.30

^a Age is given in months and weeks.

^b Steven's family moved away before the study was completed.

CRITERIA FOR DATA COLLECTION

Utterances were included in the analysis if they met formal or semantic criteria. Formal criteria for considering an utterance included (1) a "causal" word (e.g., "because," "so,"¹ and "why") in child utterances, whether or not the word unambiguously expressed a causal notion; (2) occurrence of the child utterance following an adult "why" or "how" (meaning "how come" or "how do you know") question, regardless of the semantic or syntactic relationship to the question. Events in which adults asked causal questions that were not followed by a child utterance were also analyzed. Semantic criterion for analysis was an implicit reference to two events and/or states with a causal relation between them. This procedure involved investigator inferences about the causal meaning of child sentences, and was essential in order to explore the developmental relationship between the order of causally related clauses and the use of causal connectives. Thus, child utterances such as "that a piano/don't draw on that," said while Kathryn was pointing to a piece of sheet music, were included in the study.

CODING

Child utterances that met the formal and/or semantic criteria for analysis were coded as statements, responses to adult questions, or questions. Child statements were analyzed in terms of the semantic and syntactic relations between clauses; child responses were analyzed in terms of their semantic and syntactic relations to the adult questions; child questions were analyzed in terms of their semantic and syntactic relationship to prior utterances by adult and/or child.

¹ Excluded were occurrences of "so" as an intensifier, as in "so big," or as an introducer, as in "so then I ate lunch."

Child Statements

All spontaneous causal statements were coded (1) for the presence or absence of causal connectives; (2) according to whether the meaning relation between the clauses was causally interpretable or not; and (3) if causally interpretable, utterances were coded for clause order. Causally interpretable utterances expressed a causal or conditional relation between one event or state and another event or state.² The relation was either interpreted as causal by the adult(s) present or was judged so by the investigator upon retrospective consideration. The relation did not have to be true or necessarily make sense from an adult point of view to be counted as causally interpretable, for example:

Peter (25,3)³

(putting pen away and looking
for another pen)

get another one/it dirty

Eric (31,2)

(pretending)

I'm putting medicine on the lamb's
leg cause he had a booboo

Those utterances that were causally interpretable were then coded according to the order in which the clause expressing "cause" and the clause expressing "effect" were expressed. Examples of cause/effect order were:

Eric (28,1)

(holding bear on ladder)

hold de ladder [cause] and e won't
fall down [effect]

Mariana (32,1)

(running away from picture
of large knife)

it's gonna cut you [cause]/let's
get away from it [effect]

Examples of effect/cause order were:

Kathryn (24,2)

I not go in the bathroom [effect]/
I did tinkle [cause]

² The definitions of "causal" and "conditional" were those given in Webster's *Third New International Dictionary*: causality—The relation of cause and effect or between certain regularly correlated events or phenomena as a necessary connection or intrinsic bond embedded in the very nature of things; conditional—Expressing a condition or supposition. While it was recognized that there are alternative logical and semantic analyses of causality that could have been utilized, the decision was made not to impose any preconceived, adult categorization of kinds of causality on the data.

³ N's in parentheses after the child's name refer to age in months and weeks. Utterances on the right were spoken by the child; utterances on the left were spoken by the adult. Description of the nonlinguistic context is presented on the left in parentheses.

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Paul (30,3)

(regarding TV, which is on)

I left it open [effect] because

I wanna watch it [cause]

Other clause orders were equivocal, that is, both cause/effect and effect/cause interpretations were tenable, for example:

Gia (29,3)

I don't have any more tape/it's

all used up now

David (38,0)

(trying to put animals on train)

the animals don't fit

L: They don't fit?

no they don't/cause they fall down

Utterances that could not be interpreted in some causal sense included (1) the use of repetition, such as “I’m hungry because I’m hungry”; (2) anomalous utterances where the relationship between the clauses could not be determined; and (3) incomplete and partially unintelligible utterances.

Interjudge reliability for the coding of child statements was obtained for (1) judgment of causal versus noncausal statements; (2) for causal statements only, judgments of causally interpretable versus not causally interpretable statements; and (3) for causally interpretable statements only, judgment of the order of cause-and-effect clauses. Proportions of agreement of two independent observers with the investigator's original coding ranged from .91 to 1.0 (see Hood 1977).

Response to Adult Questions

All child responses to adult "how" and "why" questions were coded for the presence or absence of causal connectives and the meaning relationship of the child utterance to the question.

Causally interpretable utterances were those child responses that consisted of a causal explanation in relation to the content of the question. For example:

Eric (28,1)

L: Why?

there's no more juice for you

cause I drink it all

Mariana (31,1)

L: Why're you taking off your socks?

take off my socks

because it's not cold outside/
they're not cold

Instances where the child's response expressed only some motivation or intention were included here. For example:

Eric (28,1)	open it
L: Why?	because I want you to open it

Utterances that could not be interpreted in some causal sense were either instances of (1) no response; (2) the use of "because" alone, for example, "Why is she crying?" "because"; (3) the use of repetition, where the child's response repeated either the previous child's utterance or part of the adult's question; (4) utterances that were anomalous or irrelevant, where the child's response either had no relationship to the adult question or the relationship could not be determined; or (5) incomplete or unintelligible utterances.

In addition to the coding of the child responses to adult questions, all adult questions were coded as (1) contingent on what the child said previously, (2) representing a change in topic, or (3) introducing a new topic.

Child Questions

All "why" questions asked by the children were coded according to their form and the initiator of the topic of the question.⁴ With respect to form, child questions were either single-word utterances, such as "why?" "cause why?" or, more rarely, "why not?" or multiword utterances, for example:

Peter (38,0)	
(Py is wrapping string around doll house)	Why you wrapping it around?

With respect to the topic, child questions were either semantically contingent upon a prior adult utterance and thus continued reference to the discourse topic, for example:

David (39,0)	
(D wants two pieces of banana bread)	
M: I'll cut it so you'll have two	no don't cut them/why you go an cut them?

or were not contingent on a prior adult utterance and were child initiated, for example:

Paul (29,2)	
(watching L write)	why you gonna do that?

⁴ Other causal questions besides "why," e.g., "how come you're leaving," were not intentionally excluded from the study; they just did not occur.

III. RESULTS

The major findings of this study revealed systematic development in the content, use, and form of the causal utterances of the eight children, and these results are presented in the order: (a) language content—reference and functions expressed in statements, questions, and responses; (b) language use—developmental relationship among the discourse categories statements, questions, and responses; (c) language form—clause order/connective relationship; and (d) language input—effects of linguistic context on the content, form, and use of the children's causal expressions.

FREQUENCY OF TYPES OF CAUSAL UTTERANCES

The frequencies of causally relevant child statements, child questions, and adult questions are presented in table 2 for each child at each time.⁵ As can be seen, except for Steven, there was a substantial increase in each type of utterance for all the children, and, in general, there were more child statements than adult questions at each sample. For each child overall, child statements were more frequent than adult questions which were more frequent than child questions (except for Steven, who had fewer child statements than adult questions). Child causal statements and adult causal questions appeared at approximately the same time, between 24 and 26 months; child causal questions were a later development and did not become productive (i.e., five or more different occurrences) until 30 months of age (except for Paul).

LANGUAGE CONTENT: REFERENCE AND FUNCTIONS

Content analyses of causal utterances revealed similarity among causal statements, child causal questions, and adult causal questions in that all three utterance types made reference most often to actions or states that were either directions or intentions, often with some negative aspect of the situa-

⁵ Adult questions, rather than child responses, were counted since a substantial number of adult questions received no linguistic response.

TABLE 2
N CHILD STATEMENTS, CHILD QUESTIONS, AND ADULT QUESTIONS

Child	Time	<i>N</i> Causal Statements	<i>N</i> Adult Why Questions	<i>N</i> Child Why Questions
David.....	I	24	12	...
	II	22	32	...
	III	11	18	...
	IV	11	6	...
	V	29	11	...
	VI	41	11	...
	VII	88	22	...
	VIII	66	15	1
	IX	60	20	4
	X	81	24	6
	XI	113	12	5
	XII	88	28	6
Total.....	...	634	211	22
Eric.....	(IV) ^a	...	4	...
	V	7	8	4
	VI	27	18	1
	VII	26	12	...
	VIII	31	16	2
	IX	44	19	...
	X	40	12	3
	XI	31	46	26
	XII	40	65	84
Total.....	...	246	200	120
Gia.....	(IV) ^a	...	8	...
	V	7	5	...
	VI	9	24	1
	VII	36	54	...
	VIII	64	36	7
	IX	37	37	10
	X	44	30	16
	XI	56	47	20
Total.....	...	253	241	54
Kathryn.....	(II) ^a	...	2	...
	III	18	2	...
	IV	24	11	...
	V	18	16	1
	VI	29	12	1
	VII	57	25	3
	VIII	60	30	57
	IX	156	26	43
	X	215	39	49
Total.....	...	577	163	154

^a The samples in parentheses represent supplementary data. They were not part of the present study, since no child causal statements occurred in them.

TABLE 2 (*Continued*)

Child	Time	<i>N</i> Causal Statements	<i>N</i> Adult Why Questions	<i>N</i> Child Why Questions
Mariana	I	5	7	...
	II	7	6	...
	III	8	17	...
	IV	22	12	...
	V	16	18	...
	VI	16	26	...
	VII	25	15	...
	VIII	23	12	...
	IX	36	16	1
	X	49	24	3
	XI	36	17	13
Total	...	243	170	17
Peter	(VII) ^a	...	1	...
	VIII	9	3	...
	IX	22	3	...
	X	15	2	...
	XI	8	4	...
	XII	18	4	...
	XIII	10	1	...
	XIV	12	4	...
	XV	29	4	...
	XVI	19	9	...
	XVII	33	16	...
	XVIII	24	7	4
	XIX	37	26	20
	XX	56	12	45
Total	...	292	96	69
Paul	I	15	15	...
	II	17	12	...
	III	15	22	13
	IV	10	9	21
	V	37	19	32
	VI	29	13	12
	VII	77	10	16
Total	...	200	100	94
Steven	I	1	7	...
	II	9	14	...
	III	10	10	...
	IV	5	14	...
	V	6	18	...
	VI	9	10	1
Total	...	40	73	1

tion. In addition, time reference was most often to ongoing or imminent events or states. Conspicuously absent from the data were utterances that made reference to two sequential actions, independent of intention or direction, such as "the man fell off his bicycle because he hit a tree."

Utterances were considered *negative* if they referred to the nonoccurrence of an event or to a nonexistent state of affairs. Negation was most often expressed by a negative function word, such as "no," "not," "can't," "don't," "didn't," "doesn't," "isn't," etc. However, utterances which referred to a negative situation by the use of other words with negative connotation (mostly verbs and attributives) were also categorized as negative.⁶

Directions and *intentions* both made reference to imminent actions or states without the expression of negation. Requests for action by the listener were considered *directive*; they expressed the desire on the part of the speaker for some action on the part of the listener. This could be expressed explicitly ("you read this book"; "help me tie my shoe") or implicitly ("I want juice" said in a whining voice). *Intentions* made reference to actions and events which either (a) occurred immediately following the utterance, or, if they did not occur, which (b) the speaker appeared to intend or desire. Such utterances made explicit reference to intention with a matrix verb, such as variants of "want," "going to," "have to," and "let's." Utterances that could not be categorized as negation, direction, or intention were classified as *other*.

The utterances expressing negation, direction, and/or intention made reference to nine main types of situation. Each situation is identified below, with child statements used as illustrations.

1. Nonoccurrence of an event or state.

Peter (35;0)

it can't go cause it's too little
[negation]

⁶ The distinction between negative function words and verbs and attributives with negative connotation is similar to the distinction between nexal and special negation, made by Jespersen (1961). Nexal negations are those in which the entire predication is negativized; in special negations, some particular word is negativized. Some examples of special negation mentioned by Jespersen are words with the prefixes no- (e.g., nobody, nowhere), un- (e.g., unhappy), in- (e.g., inhuman), etc.; scarcely, hardly, (a) little, and (a) few (Jespersen 1961, pp. 426-467). Many of the verbs given below could be considered instances of special negation. In addition, the attributives with "too" as intensifier, as in "too big," would appear to be cases of special negation, although Jespersen did not discuss "too" in this way. The instances of special negation found in the children's causal statements were used in the following types of situation: (a) reference to toys that did not work, paper that was torn, etc.—break, broke, broken, wrecked, tore; (b) reference to objects that are not present—missing, lost, empty; (c) reference to objects that abruptly change state, most often a tower of blocks, cups, etc., that is knocked down—fall off, fall out, knocked down, knock over; (d) reference to a completed event or state, where there is not more to be done—finished, stopped, turn off; (e) reference to an object being unattainable—stuck, locked; (f) reference to the removal of an object in the sense of getting rid of it—throw away, throw garbage, take off (clothes), put away; (g) reference to silence—be quiet, hush, shut up; (h) reference to an object (or sometimes a person) being in a state which impedes an action—too heavy, too tight, too hard, too hot, too small.

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Kathryn (32,1)

L: Where do you
think she'd like to
sit? (doll)

(K holding chair for
doll, but table already
has chairs on four sides
of it)

well, there's no room because there's
so many chairs around there
[negation]

Such utterances were often used in the sense of being stymied or stifled.

Paul (26,2)

(after trying to move
highchair close to table)

too stuck/I can't do it
[negation]

Eric (31,2)

I can't lift this up/oh it's too heavy
[negation]

2. Request for assistance. Such utterances also referred to a nonoccurrence of an event or state, but they differed from 1 in that they explicitly asked for help.

Gia (25,2)

(has trouble putting
lamb in block; giving
it to L)

can't do it/you do it
[negation-direction]

Mariana (35,2)

(bringing book to L)

could you read this to me cause
I don't know how
[negation-direction]

3. Abrupt change in state. Such utterances made reference to a sudden often unanticipated change in an object, such as a tower toppling over.

Paul (25,3)

(playing with bendable
rubber figure that has
no wire in one arm;
arm will not stay at
figure's side)

this boy pop/it's broken
[negation]

Eric (34,2)

(regarding wheel)

this one didn't go far/it hit truck
[negation]

4. Rejection. Such utterances expressed the negative intent of the speaker as agent. Often they contradicted or refuted the previous speaker's suggestion.

Eric (34,2)

L: Can we read this
book?

no

L: No?

because I want to play records
[negation-intention]

Kathryn (32,1)

L: You didn't tell me
about the play.

well/I don't want to

L: Oh.

I'm too tired [negation]

5. Prohibition. Such utterances were negative requests to stop the occurrence of an action by someone else. They differed from rejection in that the action or state negated referred to the listener as agent, not the speaker.

Gia (33,0)

(regarding tower of
blocks)

don't knock this down/I gonna
[negation-intention]

Peter (35,0)

don't ring the bell either/Jenny
will wake up [negation]

6. Caution. Such utterances made reference to a cautionary action on the part of the child or adult to block the occurrence of an unwanted event.

David (38,0)

L: OK.

you can bring me my puzzle

very careful so pieces don't fall
down [direction-negation]

Eric (36,0)

move over/cause the train hurt you
[direction]

7. Requests for action—self. Such utterances expressed the need for action on the part of others to change the speaker's state or allow the speaker to perform some action.

David (34,0)

(holding L's pocketbook,
which he can't open)

you can open it OK ↑ /I'm gonna
look in it [direction-intention]

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8. Requests for action—other. Such utterances asked for action on the part of others to change the state of someone or something other than the speaker (usually a toy).

Gia (33,0)
(regarding bendable
figure)

bend her like that and then she
sits down [direction]

Kathryn (30,3)
(regarding beads)
L: OK.

you put them back on again
because they dumped out [direction]

9. Permission. Such utterances expressed the speaker's desire for some object or intended action. In addition to acquiescence, some action by the listener is also intended. For example, if both child and adult are playing in the living room and the child says, "I want a cookie/I'm hungry," the child likely intends the adult to get the cookie for him or her.

Mariana (35,2)

I want some milk cause I have a
cold [intention]

Gia (25,2)
(L and G playing in
living room)

I want go door see my Mommy
[intention]

There was little development over time in the frequency of these nine types of situations and little variation among the children in their use. The most frequent were: nonoccurrence of an event or state, request for action—self, and request for assistance. In addition, there was a slight tendency for prohibition and rejection to become more frequent in the later samples.

Expression of Negation, Direction, and/or Intention

The three categories of meaning expressed in causal utterances, negation/direction/intention, were each examined as they occurred across utterance types for the individual children. Some child statements and some adult question-child response sequences could be double coded, that is, categorized as negation-direction, negation-intention, or direction-intention. The proportion of utterances with negative words, directives, and/or reference to intended actions was consistently over .60, for each of the children, for all three utterance types (see table 3). For all samples combined, negation, direction, and/or intention was expressed in .90 of statements, .81 of adult questions, and .67 of child questions.

The relative frequency of the individual content categories (negation, direction, intention, and other) was determined in its relation to utterance

TABLE 3
COMPARISON OF CHILD STATEMENTS, ADULT QUESTIONS, AND
CHILD QUESTIONS IN TERMS OF PROPORTION OF EACH
WITH NEGATION-DIRECTION-INTENTION CONTENT

CHILD	TIME	UTTERANCE TYPE		
		Statements	Adult Questions	Child Questions
David.....	I	.88	.92	...
	II	.95	.97	...
	III	.91	.78	...
	IV	.82	.83	...
	V	.96	.91	...
	VI	1.0	.82	...
	VII	.91	.91	...
	VIII	1.0	.80	1.0 ^a
	IX	.78	.80	.75 ^a
	X	.82	.96	.83
	XI	.94	.80	1.0
	XII	.74	.79	.83
Total.....	...	.88	.86	.86
Eric.....	V	1.0	.62	.25 ^a
	VI	.87	.78	1.0 ^a
	VII	.79	.73	...
	VIII	.87	.88	1.0 ^a
	IX	.85	.79	...
	X	.75	.83	.67 ^a
	XI	.89	.76	.44
	XII	.97	.72	.61
Total.....	...	.86	.76	.58
Gia.....	V	1.0	.50 ^a	...
	VI	1.0	.91	1.0 ^a
	VII	.97	.89	...
	VIII	.94	.81	1.0
	IX	1.0	.73	.70
	X	.98	.93	.75
	XI	.80	.85	.95
Total.....	...	.93	.85	.85
Kathryn....	III	.94	.67 ^a	...
	IV	.96	.45	...
	V	.83	.56	.50 ^a
	VI	.83	.58	1.0 ^a
	VII	.98	.92	1.0 ^a
	VIII	.95	.83	.65
	IX	.92	.80	.29
	X	.87	.82	.68
Total.....	...	.90	.76	.56

^a Utterance type not productive.

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TABLE 3 (Continued)

CHILD	TIME	UTTERANCE TYPE		
		Statements	Adult Questions	Child Questions
Mariana.....	I	1.0	.86	...
	II	1.0	.67	...
	III	1.0	1.0	...
	IV	.95	.92	...
	V	.88	.83	...
	VI	.81	.88	...
	VII	.96	.87	...
	VIII	.91	1.0	...
	IX	.86	.88	1.0 ^a
	X	.93	.91	.67 ^a
	XI	.78	.65	.69
Total.....	...	.89	.87	.71
Paul.....	I	.93	.80	...
	II	1.0	.67	...
	III	1.0	.65	.54
	IV	1.0	.90	.90
	V	.94	.79	.75
	VI	.93	.92	.92
	VII	.94	.80	.75
Total.....	...	.95	.77	.78
Peter.....	VIII	1.0	.33 ^a	...
	IX	1.0	1.0 ^a	...
	X	1.0	1.0 ^a	...
	XI	1.0	1.0 ^a	...
	XII	.94	.50 ^a	...
	XIII	.88	1.0 ^a	...
	XIV	.92	.50 ^a	...
	XV	.93	.50 ^a	...
	XVI	.89	1.0	...
	XVII	.85	.88	...
	XVIII	.95	.86	1.0 ^a
	XIX	.89	.72	1.0
	XX	.88	.54	.55
Total.....	...	.92	.75	.72
Steven.....	I	1.0 ^a	.62	...
	II	1.0	.79	...
	III	1.0	.80	...
	IV	1.0	.86	...
	V	1.0	.83	...
	VI	1.0	1.0	1.0 ^a
Total.....	...	1.0	.82	1.0
All chil- dren com- bined.	...	.90	.81	.67

type (child statement, adult question, child question) in three ways. For each utterance type individually, the children were compared to one another in terms of the proportion of utterances in each category. The distribution of utterances in content categories was most similar from one child to another in child statements. The largest proportion of utterances (from .37 for Gia to .50 for Steven) expressed negation, while the smallest proportion of utterances (from 0 for Steven to .11 for Eric) were classified as other. The proportions of direction and intention were similar; except for Paul and Steven, there was less than .05 difference between them. In addition, similarities occurred among the children in the distribution of content categories in child questions. Only for adult questions were the relative proportions of utterances in the categories different from child to child. In other words, the children were similar to each other in the content of their causal utterances, both statements and questions, while there was more variability from adult to adult in their causal questions.

The remaining two comparisons concerned the interaction of utterance types and content categories. The magnitude of difference in comparisons of the frequency of categories and utterance types varied, depending on the particular category and utterance type being compared. Chi-square tests of differences in the frequency of each content category—negation, direction, intention, and other—across utterance types were performed, and the summary results are presented in table 4. In the category comparisons, negation was the most similar in its distribution across the three utterance types. In the utterance type comparisons, adult and child questions were most similar across content categories.

Time Reference

All causally interpretable child statements were examined to determine the direction of difference between the time of the event (event time) and

TABLE 4

N STATISTICALLY SIGNIFICANT DIFFERENCES IN FREQUENCY OF CONTENT CATEGORIES
ACROSS UTTERANCE TYPE COMPARISONS AS DETERMINED
BY χ^2 TESTS OF DIFFERENCES*

Utterance Type Comparison	Negation	Direction	Intention	Other	Total
Child statements: adult questions.....	1/8	3/8	4/8	6/8	14/32 (.44)
Child statements: child questions.....	2/7	5/7	3/7	6/7	16/28 (.57)
Adult questions: child questions.....	2/7	5/7	1/7	2/7	10/28 (.36)
Total.....	5/22 (.23)	13/22 (.59)	8/22 (.36)	14/22 (.64)	...

* $p < .05$.

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the time of the utterance about the event (speech time). Utterances that referred to ongoing events and to events that were imminent or just about to happen (i.e., direction and intention) were categorized as *present*; utterances making reference to events that were not about to happen were categorized as *future*. Utterances that made reference to any past event or state, including the immediate past (e.g., "the tower fell down"), were categorized as *past*.

For all of the children, reference to past and future events occurred relatively late, was always infrequent, and showed surprisingly little development. In general, utterances which referred to past events were rarer (from 0 for Steven to .16 for Eric) than utterances which referred to future events (from .08 for Eric to .19 for Kathryn). Thus, overwhelmingly, the children's causal statements made reference to ongoing or immediately future events or states.

LANGUAGE USE: STATEMENTS, QUESTIONS, AND RESPONSES

The developmental relationship among the three utterance types was examined in terms of relative frequency, onset and maintenance of productivity (five or more different utterances), and meaningfulness.

Frequency

Each child showed a large increase over time in the frequency of either child statements, child questions, or both. In contrast, the frequency of adult questions was much more stable, with fewer than 40 causal questions in each of 68 out of 72 samples. Thus, for the children's speech, there were large increases in frequency over time for the same child, with differences among children. For adult speech, however, there was little variation in frequency, either over time or across children.

Productivity

The occurrence of five or more different utterances in a sample was used as an index of productivity (see Bloom, Lightbown, & Hood [1975] for discussion of productivity in child language). As seen in table 2, child statements and adult questions were productive at the same time; child questions were a later development. Where earlier data were available, the sample before the emergence of child statements was examined to see if adult questions had occurred at an earlier time (sample *N*'s in parentheses in table 2). For Eric, Kathryn, and Peter, adult questions were not productive in earlier samples, while for Gia they were. The general tendency, then, was for adult questions to become productive only when child statements also became productive. Child questions became productive much later than statements and adult questions, and, except for Paul and Peter, remained nonproductive for at least two samples after they first appeared.

Meaningfulness

While there was relatively little difference among the children in the frequency of adult questions, there was development in the way the children responded to adult questions. The earliest responses to adult questions were not causally interpretable: they were either no response, repetition, anomalous, or the single word "because." Causally interpretable responses were compared with child statements classified as either causally interpretable or not, in terms of both absolute and proportional frequencies for each child at each time (see fig. 1). The absolute frequencies of causally interpretable statements and responses were nearly equal in the first few samples; however, proportionately, more of the child statements were causally interpretable than were responses to adult questions, even at the beginning. While absolute frequencies and proportions of both increased over time, causally interpretable statements increased more and were always more frequent.

Causally interpretable responses occurred productively between $1\frac{1}{2}$ and $5\frac{1}{2}$ months later than causally interpretable statements. Child questions occurred productively only after both causally interpretable statements and responses were productive for all of the children (except Paul). Thus, the same developmental sequence—statements < responses < questions—was observed for absolute number of utterances in each utterance type as well as for the frequency and proportion of utterances that were causally interpretable.

Variation in the Use of *Why* Questions

There were three forms of *why* questions: (1) the single-word "why?"; (2) multi-word *why* questions; and (3) single-word/multi-word *why* sequences in which the child asked "why?" and was queried by an adult "why what?" and then produced a multi-word *why* question. For example:

Eric XII

L: Let's leave your blanket
here/you can't keep
your blanket

why?

L: Why what?

why can't I take my blanket?

Children's questions were most often contingent, that is, related both contextually and linguistically to a prior adult utterance, as in the above example. Noncontingent questions also occurred and were always multi-word questions; the proportion of noncontingent questions tended to decrease over time for all the children except Paul.

Single-word *why* questions tended to increase, and except for Paul who asked single-word *why* questions overwhelmingly, when causal child ques-

FIGURE 1.—Frequency and proportion of statements and responses that were causally interpretable for each child.

tions became productive both single-word and multi-word questions occurred. The developmental trend was for *why* questions to emerge gradually in the early samples, for single-word and multi-word questions to appear together, for single-word *why* questions to increase, and for noncontingent questions to decrease.

LANGUAGE FORM: CAUSAL CONNECTIVES AND CLAUSE ORDER

There was a developmental interaction between connective forms and clause order (effect/cause and cause/effect) in causally interpretable child statements, with both similarities and variation among the children.

Connectives

The number and proportion of causally interpretable statements with different connectives are presented in table 5. The children began making causal statements without connectives; six of the children combined clauses without any connectives to begin with. The proportion of statements without connectives declined steadily, and by the last sample less than .50 of the children's statements (except for Steven) occurred without connectives. In most cases "and" was either the first connective used or the most frequently used connective in the first sample with connectives, and its use declined. More specific connectives were distributed differently among the children, both in terms of acquisition and subsequent development. Both David and Peter acquired "because" before "so"; Gia, Kathryn, and Paul acquired "so" before "because"; Mariana and Eric acquired "because" and "so" together. By the last sample, "because" was much more frequent than "so" for Gia, Kathryn, David, Mariana, and Paul, but essentially equal to "so" for Eric and Peter.

Clause Order

The absolute frequency and proportion of statements in cause/effect and effect/cause order for each child at each time are presented in figure 2. The children varied in their overall use of the two clause orders, with three predominant patterns and a continuum in the relative frequency of cause/effect and effect/cause orders. Three of the children represented the clearest examples of the three patterns that were observed along the continuum: Kathryn presented equal distribution of the two orders, Eric presented unequal distribution with cause/effect order predominating, and Steven presented unequal distribution with cause/effect order predominating. The data from the remaining five children also placed them along the continuum: Paul, Peter, and David were similar to Steven in that they used effect/cause order predominantly. Gia was similar to Kathryn, with little difference in the use of the two orders until the last sample where effect/cause order predominated. The data for Mariana showed a pattern that was somewhat

TABLE 5

PRESENCE OF DIFFERENT CONNECTIVES IN CAUSALLY INTERPRETABLE STATEMENTS^a

Child	Time	No Conj.	"and"	"so"	"be- cause"	Other ^b	Total
David.....	I	.88(21)	.04(1)	...	...	.08(2)	24
	II	.67(14)	.14(3)	...	.14(3)	.05(1)	21
	III	.73(8)	.18(2)	...	.09(1)	...	11
	IV	1.0(11)	...	...	...	...	11
	V	.56(14)	.12(3)	...	.28(7)	.04(1)	25
	VI	.31(10)	.06(2)	...	.62(20)	...	32
	VII	.09(6)	.06(4)	.04(3)	.76(51)	.04(3)	67
	VIII	.20(10)	.08(4)	.14(7)	.51(26)	.08(4)	51
	IX	.11(5)	.02(1)	.28(13)	.48(22)	.11(5)	46
	X	.21(14)	.03(2)	.26(18)	.49(33)	.01(1)	68
	XI	.12(11)	.01(1)	.14(13)	.71(64)	.01(1)	90
	XII	.08(6)	.04(3)	.08(6)	.74(53)	.05(4)	72
Eric.....	V	1.0(7)	...	...	...	...	7
	VI	.48(11)	.35(8)	.09(2)	.09(2)	...	23
	VII	.35(8)	.48(11)	...	...	.17(4)	23
	VIII	.42(13)	.19(6)	.22(7)	.06(2)	.10(3)	31
	IX	.49(17)	.03(1)	.11(4)	.23(8)	.14(5)	35
	X	.27(10)	.22(8)	.30(11)	.11(4)	.11(4)	37
	XI	.56(15)	...	.26(7)	.18(5)	...	27
	XII	.20(7)	.06(2)	.34(12)	.31(11)	.09(3)	35
Gia.....	V	1.0(7)	...	...	...	...	7
	VI	1.0(9)	...	...	...	...	9
	VII	.75(27)	.19(7)	.05(2)	...	...	36
	VIII	.47(29)	.11(7)	.13(8)	...	.29(18)	62
	IX	.78(29)	.03(1)	.14(5)	...	.06(2)	37
	X	.50(20)	.08(3)	.18(7)	.20(8)	.04(2)	40
	XI	.47(24)	.08(4)	.04(2)	.33(17)	.08(4)	51
Kathryn.....	III	.94(17)	.06(1)	...	...	...	18
	IV	1.0(24)	...	...	...	...	24
	V	.78(14)	.22(4)	...	...	...	18
	VI	.55(16)	.03(1)	.24(7)	.10(3)	.07(2)	29
	VII	.15(7)	.02(1)	.40(19)	.38(18)	.06(3)	48
	VIII	.27(12)	.02(1)	.36(16)	.32(14)	.02(1)	44
	IX	.16(21)	.01(2)	.41(55)	.38(51)	.04(5)	134
	X	.23(47)	.10(20)	.11(23)	.38(77)	.17(34)	201
Mariana.....	I	1.0(5)	...	...	...	...	5
	II	1.0(7)	...	...	...	...	7
	III	.62(5)	...	...	...	.38(3)	8
	IV	.70(14)	...	.20(4)	.05(1)	.05(1)	20
	V	.81(13)	.06(1)	.06(1)	.06(1)	...	16
	VI	.56(9)	.19(3)	.12(2)	...	.12(2)	16
	VII	.52(13)	.16(4)	...	.12(3)	.20(5)	25
	VIII	.26(6)	.13(3)	.13(3)	.04(1)	.43(10)	23
	IX	.26(9)	.11(4)	.06(2)	.20(7)	.37(13)	35
	X	.40(18)	...	.11(5)	.33(15)	.15(7)	45
	XI	.31(11)	.03(1)	.11(4)	.31(11)	.23(8)	35

^a N's on the left in each col. are proportions; frequencies appear in parentheses.^b Includes "when," "then," "to," "if," "unless," etc.

TABLE 5 (*Continued*)

Child	Time	No Conj.	"and"	"so"	"be- cause"	Other ^b	Total
Paul.....	I	1.0(15)	...	...	...	...	15
	II	1.0(17)	...	...	...	...	17
	III	.87(13)	...	...	.13(2)	...	15
	IV	.70(7)	...	.10(1)	.20(2)	...	10
	V	.67(24)	.06(2)	.14(5)	.08(3)	.06(2)	36
	VI	.55(16)	.03(1)	.21(6)	.10(3)	.10(3)	29
	VII	.11(7)	.03(2)	.23(15)	.61(39)	.02(1)	64
Peter.....	VIII	1.0(9)	...	...	...	...	9
	IX	1.0(22)	...	...	...	...	22
	X	1.0(15)	...	...	...	...	15
	XI	1.0(8)	...	...	...	...	8
	XII	1.0(18)	...	...	...	...	18
	XIII	1.0(10)	...	...	...	...	10
	XIV	1.0(12)	...	...	...	...	12
	XV	.90(26)	.10(3)	...	...	...	29
	XVI	1.0(19)	...	...	...	...	19
	XVII	.94(31)	.03(1)	...	...	.03(1)	33
	XVIII	.58(11)	.16(3)	...	.26(5)	...	19
	XIX	.32(9)	.07(2)	...	.46(13)	.15(4)	28
	XX	.30(13)	.07(3)	.30(13)	.26(11)	.07(3)	43
Steven.....	I	1.0(1)	...	...	...	...	1
	II	1.0(9)	...	...	...	...	9
	III	1.0(10)	...	...	...	...	10
	IV	1.0(5)	...	...	...	...	5
	V	.83(5)	...	...	...	.17(1)	6
	VI	.56(5)	...	.22(2)	.11(1)	.11(1)	9

similar to Eric; for seven of 11 of Mariana's samples, cause/effect order predominated, and the difference between the proportions of the two orders in these samples was generally greater than .30. However, at the beginning and to some extent at the end, effect/cause predominated. Of all the children, Mariana showed the greatest variability.

Connective and Clause Order Interactions

The particular clause order differences were established before the children ever used connectives. The arrows on each graph in figure 2 indicate when the causal connectives (e.g., "so" and "because") began to be used productively in the children's causal statements. When the children began to use causal connectives, the connectives used by each child were generally consistent with the already established tendency to use particular clause orders. Kathryn and Gia, with no preferred clause order, began to use both "because" ("when" in the case of Gia) and "so" at about the same time. On the other hand, Eric, with cause/effect order predominating, used "so" first and only later "because," while Peter and David, with effect/cause order predominating, used "because" first and later "so." Only Mariana and Paul showed connective use at odds with their clause order tendencies

FIGURE 2.—Frequency and proportion of child statements in cause/effect and effect/cause order for each child.

(data from Steven was uninformative, since he never used connectives productively). Moreover, the children used the right connectives with the right orders; except for David, they rarely made mistakes. That is, utterances such as "I hurt my toe because there's a Bandaid on it" were extremely rare.

The connective "and" seemed to be a precursor to "so," since its use decreased as "so" became predominant (for those children who used "so"). Moreover, "and" was used only with cause/effect order. This was true even for David, Paul, and Peter, the children who used effect/cause order predominantly.

Although it appeared that patterns of preferred clause order determined the connectives the children used, particularly for the emergence of causal statements with connectives, the effect was not absolute. With subsequent development, the dominant clause order pattern sometimes showed a temporary fluctuation along with the productive use of a connective which up until that point had occurred only rarely. Some instances of this are shown by the arrows in figure 2. For example, at 38 months Peter's increase in cause/effect order coincided with the productive use of "so," which was only used with cause/effect order. Similarly, Paul's increase in cause/effect order at 29,2 coincided with the productive use of "so," while the later great increase in effect/cause order at 32,2 coincided with the later productive use of "because."

Thus, there were three main patterns in the emergence of clause order: predominant cause/effect order, predominant effect/cause order, and similar distribution of the two orders. These clause order patterns existed before the children began to use connectives, and the eventual use of a particular connective was consistent with the particular clause order patterns. There was fluctuation in clause order patterns in subsequent development with the introduction of newly productive connectives.

Error Analysis of Connective/Clause Order Use

Errors in causal statements—for example, the use of "because" with cause/effect order, or "and" or "so" with effect/cause order—accounted for only .06 of all the children's causal statements. Such errors were restricted in two ways. First, almost all of the errors consisted of the use of "because" with cause/effect order. (There were four instances of errors with "and"; six with "so"; and 57 with "because.") Second, most of the "because" errors occurred with one child, David; 45 of the 57 errors were David's.

There are actually two meanings that "so" can have as a causal connective. It can mean *therefore*, as in "the second book is old so I hafta buy a new one"; alternatively, it can mean *so that* or *in order that*, as in the directive "you put this gate up so the baby can't get in." When all child statements with

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“so” were examined in terms of these two meanings of “so,” a developmental progression was found—from “so” meaning *so that* to “so” meaning *therefore*. For example, with respect to Eric’s “so” statements, those that had a *therefore* interpretation increased from none at Eric VIII to .42 at Eric XII. The other children, except David, showed a similar pattern. However, David’s overall proportion of “so” statements meaning *therefore* was lower than any of the other children, especially those who used “so” frequently (.14 for David, in comparison with .69 for Peter, .38 for Kathryn, and .21 for Eric).

Errors in the use of “because” with cause/effect order overwhelmingly had a *therefore* interpretation: for example, “he sick cause I gonna fix him.” In only two out of 57 occurrences of “because” with cause/effect order did “because” mean *so that*. More important, .89 of David’s “because” errors were occurrences of “because” meaning *therefore*. The difference between David and the other children can be schematized as shown below.

Thus, David’s errors in clause order and connectives were indeed systematic. Unlike the other children who gradually began to express a *therefore* relationship with “so,” David expressed the *therefore* relationship with “because,” his predominant connective.

LANGUAGE INPUT: EFFECTS OF LINGUISTIC CONTEXT

The effect of the linguistic context was examined by comparing similarities and differences in content and form between child causal utterances and adult causal utterances.

Comparisons of Content in Adult and Child Speech

Comparisons of the distribution of content categories across utterance types suggested, first, that the children tended to have similar patterns in their own speech, while the adults talking to them did not. That is, the distribution of the content categories was similar across children for child statements and child questions but different across children for adult questions. Second, adult and child questions were more similar to each other than either was to child statements. That is, when the content categories across utterance type were compared for each child individually, there was more similarity between adult and child questions than between the two types of child utterances (statements and questions).

Comparison of Form in Mother and Child Clause Orders

One possible explanation for the variation among the children in their use of clause order might have been differences in the speech that the children heard: the children's mothers might have used clause orders differentially. In order to test this hypothesis, mothers' causal statements from David, Mariana, Paul, and Simon (the four children from whom enough mother-child interaction was available for comparison) were analyzed for clause order patterns.

The results of this analysis are presented in figure 3. The proportions of mothers' statements in cause/effect order and effect/cause order are pre-

FIGURE 3.—Proportion of statements in cause/effect and effect/cause order for four mother-child pairs. Data points to the left of the dotted line on the graphs for David's and Mariana's mothers represent supplementary data from earlier videotaped sessions.

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sented on the left-hand side of the figure, for each mother at each time. Next to the data from each mother, on the right-hand side of the figure, are the corresponding proportions in her child's speech.

Just as the children were different from each other in their use of the two clause orders, the mothers also were different from each other. However, when each mother was compared with her child, the differences among the mothers matched the differences among the children. The child with the most variable use of clause orders, Mariana, had the mother with the most variable use of clause orders. Notice also that Mariana and her mother presented essentially the same variable pattern: in terms of proportion of cause/effect order, a sharp increase followed by a slower decline, with a slight increase by the last sample. Two of the children with effect/cause patterns, Paul and Steven, had mothers with effect/cause patterns. Only David and his mother showed different patterns; however, they were not as different as they could be. That is, David showed an effect/cause pattern, while his mother showed a pattern of equal use of cause/effect and effect/cause orders (rather than a contrary cause/effect pattern).

As a measure of the general consistency of each child's and each mother's clause order pattern, the children were compared with their respective mothers according to the number of samples in which the proportion of statements in cause/effect order was greater than in effect/cause order. These comparative data from the mothers and their children are presented in table 6. As can be seen, except for David, the mothers were similar to their children in terms of the number of samples in which use of cause/effect order was greater than use of effect/cause order.

TABLE 6

N SAMPLES IN WHICH THE PROPORTION OF CAUSAL STATEMENTS IN CAUSE/EFFECT ORDER WAS GREATER THAN THE PROPORTION IN EFFECT/CAUSE ORDER, FOR FOUR MOTHER-CHILD PAIRS^a

Child	Mother	Child
David.....	6/11 ^b	3/12
Mariana.....	5/11	7/11
Paul.....	1/6	0/6
Steven.....	0/5	1/5

^a The supplementary data from earlier samples that are presented in fig. 3 for David and Mariana have not been included in this comparison.

^b Samples in which the proportions in the two orders were equal were discounted.

IV. DISCUSSION

THE CONTENT OF CAUSAL EXPRESSIONS

The findings of this study strongly suggest that 2–3-year-old children have some understanding of causal relations between events and/or states and that they have the ability to express such relations. This result is in conflict with the views of Piaget (1925/1955, 1928/1969, 1930/1972) and Werner and Kaplan (1963), neither of whom have credited the child with a conception of causality until the age of 7 or 8. According to Piaget, young children see two events as merely juxtaposed in time and space; they are not aware of any sequential relation between the two. According to Werner and Kaplan, children see causal relations as temporal relations; they are aware that one event precedes another but are unaware of the dependency relation between the two events.

There was no evidence that the children in this study either merely juxtaposed causal events or interpreted them as only temporal. The form of the children's causal statements provided evidence that they were aware of the dependency relationship between two clauses and did not simply juxtapose the two. Moreover, the children's use of causal words was consistent with the dependency relations in the causally interpretable events in the context.

An explanation for the different conclusions suggested by the results of the present study can be found in an examination of what the children were talking about. Piaget (1928/1969, 1930/1972) and Werner and Kaplan (1963) based their conclusions on data concerning how children talk about observable sequential actions that involve physical objects. However, the children in this study simply did not talk about causal events that occurred between physical objects in the world, and rarely made reference to sequential actions in their causal statements. They were no doubt aware of events of physical causality as, for example, a cup falling off a table because someone's elbow hit it; and, likewise, they probably talked about such events in other ways, for example, with a single-word utterance such as "uh oh," or with an utterance expressing a single relation, such as "cup fall down" or

"I knock it down," but they did not talk about such events with causal utterances. However, the children did talk about intentions and motivations in their causal utterances which could be support for Piaget's characterization of the child's first causal relations as expressing "motivational" or "psychological" causality. Although the children made reference to intentions and motives in their causal utterances, their linguistic expression of causal relations was no less systematic because it dealt with psychological rather than physical phenomena.

Although the children in this study did not talk about physical causality in their causal statements, physical causality is precisely the type of situation that has been presented to children in experimental studies of the development of causality (e.g., Corrigan 1975; Hood 1972; Hood & Mansfield 1971; Johnson 1972; Katz & Brent 1968; Kuhn & Phelps 1976; Sullivan 1972). (See Hood [1977] for a review of this literature.) Subjects in these studies have generally been older than the subjects of the present study. While information about the situations that these older subjects made reference to in their spontaneous causal statements has not been available, it is nevertheless possible that the content of the experimental tasks presented to such subjects differed from the content of their own speech. The traditionally poor performance of older children in such studies may be due in part to the contrast between the content of the causal tasks presented to them and the content of their own spontaneous causal utterances.

In the present study there was little change over time in the content of the children's causal statements. First, the same categories of meaning—negation/direction/intention—accounted for approximately the same proportion of the children's speech at the beginning of the study when they were 2 years old, and at the end when they were 3 years old. Second, while there was a slight tendency for reference to past and future events to be a somewhat later development, even at the last samples, such reference accounted for an average of less than .10 of the child statements.

The one development in the content of the children's causal statements was that, for seven of the eight children, the relations expressed in utterances with the connective "so" progressed semantically from a *so that* to a *therefore* relation. While there was also progression from *so that* to *therefore* relations in David's causal statements, he used different connectives to express these different meanings—"so" for *so that* and "because" for *therefore*.

The relatively late emergence of a *therefore* relationship expressed by "so" or "because" in the children's causal statements supports Piaget's idea that *therefore* ("puisque") represents a more complex type of reasoning than *because* ("parce que"). Piaget based this assumption on his observations that utterances with "puisque" are extremely rare in children younger than 9 or 10, although he did acknowledge that "puisque" is generally an infrequent word in French. A parallel situation exists in English; "therefore" is rare in

adult speech and does not occur in child speech. However, in English a *therefore* relationship can be expressed by "so," a word that is exceedingly common in adult speech and, as was found in this study, also in child speech.

THE FORM OF CAUSAL EXPRESSIONS

While there was little development in the content of causal expressions, there were major developments in the form of all three types of the children's causal utterances: causal statements, causal questions, and responses to adult questions.

Causal Statements

Since six of the eight children had preferred clause order before they ever used causal connectives and since the children rarely made errors in combining connectives with clause order, it seems likely that clause order preference determined connective use. Thus, it is not the case that children become aware of the interdependence of clause order and causal connective at the same time, nor that the causal connective used determines the clause order.

The results of different clause order patterns and the consistency between clause order pattern and connective acquisition provide little evidence to support either of the alternative hypotheses suggested by Piaget (1928/1969) and Werner and Kaplan (1963) to explain the development of the child's causal reasoning. In Piaget's view, causal events are seen as merely juxtaposed and "because" means *and* to the child. However, six of the eight children had clear preferences for expressing clauses in a particular order, and the children who did not use a preferred clause order (as well as the other children who did) used the appropriate connectives with whatever orders they used. They did not make mistakes that would suggest that "because" meant *and* to them. One child, David, did use "because" with cause/effect order. However, there was no evidence that he used "because" to mean *and*. Rather, David appeared to use "because" to mean *therefore*, in contrast with his use of "so" to mean *so that*. A second finding that was inconsistent with Piaget's juxtaposition hypothesis was the use of "and" with cause/effect order exclusively (vs. no connective with effect/cause order) in the earliest utterances. This consistent differentiation of the two clause orders would appear to argue against the idea that children lack directionality in their causal thinking.

There was also little support for Werner and Kaplan's (1963) hypothesis that causal relations are first expressed in an order that matches the perceived order of events. While it is true that two children, Eric and Mariana, did appear to be using what could be termed a temporal order strategy (i.e., they used a cause/effect order predominantly), the other six children clearly did not: four of them used the opposite of a temporal order strategy in

mentioning the effect before the cause, while the other two children used both orders. (See Hood [1977] for further discussion of these results in relation to the literature on causal reasoning.)

Responses to Adult Questions

In general, the adults in this study began to ask *why* questions when the children began to make causal statements. For all the children except Kathryn, however, there was at least a 2-month lag between the appearance of adult *why* questions and causally interpretable responses to such questions. The children progressed from giving responses that were largely semantically anomalous and structurally incomplete (or not responding at all) to the point where the majority of their responses were semantically meaningful and structurally complete. This result is in basic agreement with the developmental sequence observed by Blank (1975) and Blank and Allen (1975), in an observational study of one child from 18 to 31 months of age. However, the children in the present study progressed further than their subject by the end of the study; they gave causally interpretable responses more often than not, and they were also older.

Child Questions

The appearance of *why* questions at approximately 30 months of age for the children in this study is consistent with previous reports in the literature (e.g., Brown 1968; Davis 1932; Lewis 1938; Smith 1933). The result that between .42 and .64 of the children's questions expressed negation or were contingent on prior adult utterances which expressed negation is consistent with other studies that also found negation to be a factor in children's early *why* questions (Blank 1975; Blank & Allen 1975; Issacs 1930; Lewis 1938).

The development in the children's *why* questions was one of increasing frequency rather than changes in content or form. With the exception of Paul, most of the children had at least one multi-word *why* question either before or at the same time as single-word "why," and in the samples when *why* questions were first productive approximately half the questions were multi-word. Seven of the children seemed to be following a different course of development in the asking of *why* questions than the child studied by Blank (1975) and Blank and Allen (1975), who used the single-word "why" for a relatively long period of time, from 18 to 25 months, before multi-word *why* questions appeared. In addition, Blank also reported that her subject's *why* questions progressed from being contingent on previous adult speech to initiating dialogue, but for seven of the children in this study there was a decrease in noncontingent questions. Blank reported a further constraint on *why* questions: not only were they contingent on a prior adult utterance from 18 to 25 months but that utterance was a *negative* statement by the adult. Only later, from 28 to 31 months, were *why* questions asked equally often after adult affirmative statements and negative statements. In the

present study, in contrast, *why* questions occurred after adult affirmative statements from the beginning.

THE USE OF CAUSAL EXPRESSIONS

The children in this study produced spontaneous causal statements before they gave causally interpretable responses to *why* questions and, with one exception, both statements and responses occurred before the children asked *why* questions themselves. Like these children, two of the children described by Brown (1968) also learned to ask *why* questions only after they could give well-formed responses to adult *why* questions. One possible explanation of the sequence—statements < responses—would be if the adult questions were unrelated to the ongoing topic of conversation and situation, so that the message in the question was new to the child. However, the overwhelming majority of the adult questions were contingent on a preceding child utterance, for example:

Eric (25,1)	baby Nancy crying
M: Why is baby Nancy crying?	

Another possible explanation of the sequence—statements < responses < questions—is the explanation often offered in the literature for the late appearance of *why* questions relative to other Wh-questions in children's speech: that *why* and *when* questions emerge after *what* and *where* questions because they refer to unobservable or intangible events or ideas, in contrast to *what* and *where* questions which have more figurative referents (Blank 1975; Blank & Allen 1975; Brown 1968). However, the same sequence—statements < responses < questions—was also observed for locative *where* questions in the language development of Eric, Gia, Kathryn, and Peter (Bloom & Hood, unpublished data). A similar result was reported by Söderbergh (1974) for the development of *what* questions by a Swedish-speaking child, who did not ask *what* questions until she responded appropriately to *what* questions from adults (and similarly for *why* questions). If the relative tangibility hypothesis to explain the late appearance of *why* questions were to explain the sequence of development, one would not expect the same sequence in language use for *where* and *what* questions as well, which do have identifiable (tangible) referents and are among the earliest questions children ask.

A more general explanation of the sequence—statements < responses < questions—observed in this and other studies is the fact that expressing a spontaneous statement, responding to a question, and asking a question are fundamentally different tasks (see Bloom 1974; Bloom, Rocissano, & Hood 1976). It appears that it was easier for the children to say something based on their own semantic intention (a statement) than to say something based

on a semantic intention that was either influenced by the message of another speaker (a response) or was intended by the child to influence the semantic intention of another speaker (a question). In the response context, it is necessary to process both the form and content of the speaker's message in relation to the situation. If the child processed the form of the utterance (i.e., the word "why") but not necessarily the content, the simplest responses were the single word "because" and/or an imitation of part or all of the adult's utterance. Only when responses to questions became interpretable more often than not was there evidence that the children had indeed taken into account both the form and the content of the previous message. The fact that interpretable responses occurred only *after* the children could express interpretable causal relations in their spontaneous statements suggests that responding to the form and content of a question required at least three things: first, that the child be able to encode causal relations; and, second, that the child be able to encode causal relations with a semantic intention that is influenced by the message of the other speaker. Third, responding required the ability to maintain discourse over two or more turns, given that adult causal questions were most often contingent on prior child utterances.

The question context presented additional form and content requirements to the child. Asking causal questions obviously required a new form for encoding causal relations. In terms of content, the child's semantic intent was both influenced by and influenced the other speaker, in that the child was intending to evoke a semantic intent on the part of the other speaker. The source of the children's semantic intention varied, then, in these ways in the statement, response, and question contexts: in making a statement the semantic intention originated with the child; in responding to another's question the semantic intention was influenced by the other speaker; in asking a question the semantic intention originated with the child but also entailed an inference about the other speaker to evoke a semantic intention. The fact that the children in the present study began to ask "why" only after they were able both to encode a causal relation in a statement and respond appropriately to an adult *why* question refutes the claim of Blank (1975) and Blank and Allen (1975), who looked at questions and responses and concluded that the use of "why" begins with no conceptual understanding at all.

THE RELATIONSHIP BETWEEN LINGUISTIC CONTEXT AND LANGUAGE DEVELOPMENT

The relationship between the adult and child speech in this study was one of mutual influence. The distribution of the content categories (negation/direction/intention) was more similar between adult and child ques-

tions than between child statements and adult questions, which were, in turn, more similar in content than child statements and child questions. Since child questions were a later development, similarities between adult and child questions may have reflected the influence of adult speech. However, there was evidence of the influence of child speech on adult speech in the similarity between child statements and adult questions and the finding that, in general, adult questions occurred after child statements. The mutual influence between linguistic context and the children's language was also apparent when mothers' and children's causal statements were compared in terms of clause order: there was generally greater similarity between mother-child pairs than among mothers or among children. These results are consistent with the results of several studies that have dealt more directly with adult-child interaction and reported a mutual interaction (e.g. Bloom et al. 1976; Seitz & Stewart 1975; Söderbergh 1974).

V. CONCLUSIONS AND DIRECTIONS FOR FUTURE RESEARCH

To conclude, the development of the expression of causal relations was systematic and generally consistent for the eight children, but there was also variation among them in form (patterns of clause order) and use (one child asked "why?" at the same time as he answered *why* questions appropriately). This variation in language form and use, with consistency in language content, is consistent with other reports of variation in the child-language literature (see, e.g., Bloom 1970; Bloom, Hood, & Lightbown 1974; Bloom, Lightbown, & Hood 1975; Clark & Garnica 1974; Ferguson & Farwell 1975; Nelson 1975; Ramer 1976). Whereas the variation reported in other studies has been in the development of simple sentences by younger children, the variation observed in the present study had to do with the development of complex sentences by children up to 3 years of age. Thus, it appears that variation is not limited to the very earliest stages of development. Rather, it is possible that similarity in content and variation in form and use will prove to be a continuing pattern, observable whenever new linguistic structures are being learned.

Two further studies are suggested by the results of this study. Both have to do with the gradual shifting in the child's orientation: (1) from referring to one's own intentions to taking account of another speaker's intentions, and (2) from anticipating imminent events to reflecting on immediate past events.

ORIENTATION TO INTENTION OF SELF AND OTHER

The children in this study were learning to take into account the activities of people other than themselves in their causal statements. However, reference to the listener's actions or states generally took the form of directives in which the child requested the listener to do something. Thus, the children still focused on their own intentions. The developmental sequence in language use that was observed in this study, however, is

suggestive that the children were gradually learning to take the listener's intentions into account and to differentiate their own intentions from those of others. Although the content analysis of child and adult questions did not include a differentiation between intention of child and intention of adult, there is a strong suggestion in the data of developmental differentiations between adult and child intentions and between speaker and listener actions. In developmental sequence—causal statements < responses to adult *why* questions < child *why* questions—there was also a sequence of three different intentional orientations as schematized below.

As can be seen, this development in orientation is one of both successive differentiation and expansion. In expressing a causal relation through a statement, the orientation was the child's own intention; reference was to what the child was about to do or wanted the listener to do. When adults asked *why* questions of the child, they made reference to intentions of both the child (the listener) and themselves (as speakers). This situation differs from that of child statements in three ways: (1) the reference to the child's own intentions is now expressed by another speaker in the form of a question, (2) reference is now also made to the adult's intentions, and (3) reference is also made to different intentions according to whether the speaker or listener was the actor. There was further differentiation with *why* questions: when asking *why* questions the children made reference to both speaker and listener as actor, whether the intention was on the part of the child or the adult.

Thus, the development from statements to responses to questions may be coextensive with development from referring to actions by self and others as aspects of one's own intentions, to referring to both actions and intentions of both self and others. Such a decentering from oneself has been considered

a major aspect of language development as well as cognitive development more generally (e.g., Piaget 1925/1955, 1928/1969).

ORIENTATION TO EVENT TIME

Certain findings on the kinds of situations encoded in causal utterances suggested that, for the child, the relationship of utterance time to event time is one of simultaneity or a relationship in which utterance time immediately precedes event time. Further, it is suggested that the relationship is different in adults' speech to children; for adults the relationship is either one of simultaneity or one in which utterance time immediately follows event time.

Although most child and adult utterances were similar in referential and functional content and expressed *negation*, *direction*, and *intention*, most often there was a small proportion of *other* kinds of reference (which by definition did not make reference to imminent actions or states). These other references were most frequent for child questions, next most frequent for adult questions, and least frequent for child statements. Since many child questions were contingent on a prior adult utterance, the situations referred to in such questions were often adult initiated. Thus, while the children and adults rarely made reference to situations that were neither ongoing nor imminent, the adults did so more often than the children. While what *other* actually consisted of was not explored directly in this study, the impression was that, for the adults, utterances in the category most often made reference to the immediate past, to what the child or adult had just done. It might be said that the children were anticipatory, while the adults were more reflective. Both had the present as their starting point, but the children looked forward and anticipated events, primarily events that involved their own activities, while the adults looked backward to reflect upon what had just occurred, both in terms of their own and the child's activities. While the children still talked primarily about their own actions, they had begun to talk about the activities of people other than themselves, but such talk was in the form of directives and, in that sense, was still very much tied to the child's own intentions and motivations. However, the possibility that an important development in later language development is the gradual change from an anticipatory to a reflective orientation deserves further study.

REFERENCES

- Baron, N. The evolution of English periphrastic causatives: contributions to a general theory of linguistic variation and change. Unpublished Ph.D. dissertation, Stanford University, 1972.
- Bell, W. The perception of causality in the infant. Paper presented at the biennial meeting of the Society for Research in Child Development, Philadelphia, March 1973.
- Blank, M. Mastering the intangible through language. In D. Aaronson & R. Rieber (Eds.), *Developmental psycholinguistics and communication disorders*. New York: New York Academy of Sciences, 1975.
- Blank, M., & Allen, D. Understanding "why": its significance in early intelligence. In M. Lewis (Ed.), *Infant intelligence*. New York: Plenum, 1975.
- Bloom, L. *Language development: form and function in emerging grammars*. Cambridge, Mass.: M.I.T. Press, 1970.
- Bloom, L. Talking, understanding and thinking. In R. L. Schiefelbusch & L. L. Lloyd (Eds.), *Language perspectives—acquisition, retardation, and intervention*. Baltimore: University Park Press, 1974.
- Bloom, L.; Hood, L.; & Lightbown, P. Imitation in language development: if, when, and why. *Cognitive Psychology*, 1974, **6**, 380–420.
- Bloom, L., & Lahey, M. *Language development and language disorders*. New York: Wiley, 1978.
- Bloom, L.; Lahey, M.; Hood, L.; Lifter, K.; & Fiess, K. Later language development: acquisition of syntactic connectives and semantic relations in complex sentences. *Journal of Child Language*, in press.
- Bloom, L.; Lightbown, P.; & Hood, L. Structure and variation in child language. *Monographs of the Society for Research in Child Development*, 1975, **40**(2, Serial No. 160).
- Bloom, L.; Rocissano, L.; & Hood, L. Child-adult discourse: developmental interaction between information processing and linguistic knowledge. *Cognitive Psychology*, 1976, **8**, 521–552.
- Bowerman, M. Learning the structure of causative verbs: a study in the relationship of cognitive, semantic, and syntactic development. *Papers and Reports on Child Language*, June 1974.
- Brown, R. The development of Wh- questions in child speech. *Journal of Verbal Learning and Verbal Behavior*, 1968, **7**, 279–290.
- Clark, E., & Garnica, O. Is he coming or going? On the acquisition of deictic verbs. *Journal of Verbal Learning and Verbal Behavior*, 1974, **13**, 559–572.
- Corrigan, R. A scalogram analysis of the development of the use and comprehension of "because" in children. *Child Development*, 1975, **46**, 195–201.
- Davis, E. The form and function of children's questions. *Child Development*, 1932, **3**, 57–74.
- Ferguson, C. A., & Farwell, C. B. Words and sounds in early language acquisition. *Language*, 1975, **51**, 419–439.

MONOGRAPHS

- Hood, L. Comprehension and production of causal and temporal conjunctions. Unpublished manuscript, 1972. (Available from Columbia University.)
- Hood, L. A longitudinal study of the development of the expression of causal relations in complex sentences. Unpublished Ph.D. dissertation, Columbia University, 1977.
- Hood, L.; Lahey, M.; Lifter, K.; & Bloom, L. Observational descriptive methodology in studying child language: preliminary results on the development of complex sentences. In G. P. Sackett (Ed.), *Observing behavior*. Vol. 1. *Theory and applications in mental retardation*. Baltimore: University Park Press, 1978.
- Hood, L., & Mansfield, A. The linguistic expression of causality in the child. Unpublished manuscript, 1971. (Available from Columbia University.)
- Issacs, N. Appendix on children's "why" questions. In S. Issacs (Ed.), *Intellectual growth in young children*. New York: Harcourt & Co., 1930.
- Jespersen, O. *A modern English grammar on historical principles. Part V: Syntax*. London: George Allen & Unwin, 1961.
- Johnson, H. The child's understanding of causal connectives. Unpublished Ph.D. dissertation, University of Wisconsin, 1972.
- Katz, E., & Brent, S. Understanding connectives. *Journal of Verbal Learning and Verbal Behavior*, 1968, 7, 501-509.
- Kuhn, D., & Phelps, H. The development of children's comprehension of causal direction. *Child Development*, 1976, 47, 248-251.
- Laurendeau, M., & Pinard, A. *Causal thinking in children*. New York: International Universities Press, 1962.
- Lewis, M. M. The beginning and early functions of questions in a child's speech. *British Journal of Educational Psychology*, 1938, 8, 150-171.
- Nelson, K. Individual differences in early semantic and syntactic development. In D. Aronson & R. Rieber (Eds.), *Developmental psycholinguistics and communication disorders*. New York: New York Academy of Sciences, 1975. 263.
- Piaget, J. *The construction of reality in the child*. New York: Basic, 1954.
- Piaget, J. *The language and thought of the child*. New York: Meridian, 1955. (Originally published 1925.)
- Piaget, J. *Judgment and reasoning in the child*. Totowa, N.J.: Littlefield, Adams, 1969. (Originally published 1928.)
- Piaget, J. *The child's conception of physical causality*. Totowa, N.J.: Littlefield, Adams, 1972. (Originally published 1930.)
- Ramer, A. Syntactic styles in emerging language. *Journal of Child Language*, 1976, 3, 49-62.
- Seitz, S., & Stewart, C. Imitations and expansions: some developmental aspects of mother-child communications. *Developmental Psychology*, 1975, 11, 763-768.
- Smith, M. The influence of age, sex, and situation on the frequency, form and function of questions asked by preschool children. *Child Development*, 1933, 4, 201-213.
- Söderbergh, R. The fruitful dialogue, the child's acquisition of his first language: implications for education at all stages (Project Child Language Syntax, Reprint No. 2). Stockholm: Stockholm University, Institutionen for Nordiska Sprak, 1974.
- Sullivan, L. The development of causal connectives by children. *Perceptual and Motor Skills*, 1972, 35, 1003-1010.
- Vygotsky, L. S. *Thought and language*. Cambridge, Mass.: M.I.T. Press, 1962.
- Werner, H. *Comparative psychology of mental development*. New York: Science Editions, 1948.
- Werner, H., & Kaplan, B. *Symbol formation*. New York: Wiley, 1963.

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COMMENTARY

COMMENTARY BY CHARLES J. BRAINERD

Hood and Bloom's analysis of causal language during the third year of life has produced some specific findings that, no doubt, will stimulate follow-up research by other language-development investigators: the statements → reasons → questions sequence is potentially a very interesting result whose universality needs to be established; the fact that children's preferred clause orders (cause/effect, effect/cause, or mixed) seems to be correlated with their mothers' preferred clause orders emphasizes the importance of the linguistic environment in the development of causal language; the fact that some features of causal language that might be expected to undergo age change did not (e.g., the types of situations in which causal language occurred) suggests considerable underlying stability in young children's causal language. However, the most important result emerging from Hood and Bloom's analysis, at least from my perspective, is the remarkable precocity and sophistication of their subjects' utterances when judged by the claims of cognitive-developmental theories such as Piaget's (1930). In this commentary, I shall attempt, first, to place this finding in context by considering it in relation to both the recent literature on causal concepts in somewhat older children and in relation to the cumulative data base on precocious acquisition of concrete- and formal-operational concepts.

The classic data on when children first grasp causal concepts comes, of course, from Piaget's (1928, 1930) landmark studies. Piaget found little evidence of concepts that an adult would recognize as causal until age 7 or 8. The problem with Piaget's data is that they were generated by his clinical method, which is known to be an exceptionally conservative diagnostic procedure (e.g., see Brainerd 1978b). It is conservative in both a general sense and in a specific sense. The general way in which the method is conservative is that it makes heavy linguistic demands on both the input side (comprehension) and the output side (production) of concept assessment. The age norms that Piaget has reported for concepts from his concrete-operational and formal-operational stages tend to drop dramatically when

one reduces either linguistic input demands (e.g., Miller 1976; Siegel 1971, 1978) or linguistic output demands (e.g., Brainerd 1973b; Brainerd & Brainerd 1972; Brainerd & Hooper 1975). The specific way in which the clinical method is conservative, as Braine (1959) first pointed out, is that tests for individual concepts usually require particular skills that seem quite irrelevant to the concept being diagnosed. For example, counter-vailing perceptual illusions are often incorporated into tests of conservation and transitivity. This requires that subjects must grasp the relevant concepts *and* be able to resist illusions to pass the tests. When these seemingly irrelevant requirements are reduced or eliminated, age norms drop (e.g., Brainerd 1973a; Roodin & Gruen 1970).

Insofar as causal concepts are concerned, a fairly substantial amount of evidence has accumulated showing that these concepts are present a good deal earlier than Piaget's work suggests. Although relevant studies have been reported by other investigators, the main lines of evidence have been developed by Siegler (1975, 1976) and by Shultz and his associates (Shultz, Bindra, & Clarke, *in press*; Shultz & Butkowski 1977; Shultz, Butkowski, Pearce, & Shanfield 1975). Siegler (1976), for example, found that 5-year-olds make correct causal inferences about the behavior of a computer-like apparatus using information about both necessity and sufficiency. The main developmental trend seemed to be in the types of information on which causal inferences were based (necessity-only or sufficiency-only vs. necessity-plus-sufficiency), not in the presence of causal inference *per se*. In other words, age changes seemed to be performance-like rather than competence-like. A similar pattern is apparent in a recent study by Shultz et al. (*in press*). Shultz et al. administered a series of physical causality problems and a parallel series of logical necessity problems to children between the ages of 3 and 13. The subjects were required to make inferences from antecedents to consequents and from consequents to antecedents on all problems. Performance was excellent at all age levels whenever problems (either causal or logical) involved a determinate antecedent-consequent relationship, with performance being essentially perfect for causality problems that involved a generative relationship between cause and effect. Developmental trends were largely confined to the extension of causal and logical inference to indeterminate antecedent-consequent relationships. Again, age changes seemed more performance-like rather than competence-like.

Hood and Bloom's data help fill in this picture in two important ways. First, their subjects are much younger than those in other studies. The youngest age level studied in most previous experiments on causal development is kindergarten, with Shultz et al.'s (*in press*) inclusion of older preschoolers being a notable exception. Consequently, elementary causal understanding seems to be an even earlier achievement than one would infer on the basis of these experiments. Second, Hood and Bloom's data are

linguistic. To avoid the pitfalls of Piaget's clinical method, the designs of recent experiments have reduced input demands by posing causal problems in the context of a concrete system of some sort (e.g., Siegler's pseudo-computer) and have reduced output demands by requiring only judgment (choice) responses from subjects. Positive evidence of causal concepts from such paradigms leaves open the question of whether young children are capable of more symbolic forms of causal understanding. It now seems likely that they are.

The literature on causal concepts is only the tip of an iceberg. It is but a small component of a much larger data base showing precocious emergence of several physical, logical, and mathematical concepts from Piaget's concrete-operational and formal-operational stages. The evidence in this literature is of two general sorts, namely, normative data from studies using concept tasks with simplified input and/or output characteristics and data from concept-learning experiments. Concerning normative studies with simplified tasks, there is now ample evidence that preschool children possess basic conceptual competence in areas such as the following: classification (e.g., Hooper, Sipple, Goldman, & Swinton 1974; Siegel, McCabe, Brand, & Matthews 1978); transitive inference (e.g., Brainerd 1974; Bryant & Trabasso 1971); cardinal number (e.g., Gelman 1972; Lawson, Baron, & Siegel 1974); ordinal number (e.g., Brainerd 1979a); and perspective taking (e.g., Borke 1978). All of these concepts nominally belong to the concrete-operational stage and, therefore, should not appear until the middle elementary school years. Although normative evidence of precocity is especially extensive for concrete-operational concepts, some similar evidence has been obtained for formal-operational concepts such as propositional logic (e.g., Brainerd 1976; Ennis 1975) and probability (e.g., Yost, Siegel, & Andrews 1962).

In learning experiments, a wide assortment of training procedures seems to be capable of inducing specific concepts in young children that they are not supposed to be capable of understanding. Experiments of this sort have been reported for moral concepts (e.g., Rosenthal & Zimmerman 1978), relational and classificatory concepts (e.g., Brainerd, 1974), number concepts (e.g., Bucher & Schneider 1973), and perspective-taking concepts (e.g., Burns & Brainerd 1979). Far and away the most extensive data have been reported for conservation concepts (for some recent reviews, see Beilin 1978; Brainerd 1978a). It turns out that cognitive-developmental theories such as Piaget's or, say, Kohlberg's (1968) can tolerate some learning effects if it can be shown that children's ability to learn a concept in a training experiment is rigidly constrained by what they already know about that concept. In fact, concept learning and pretraining knowledge seem to be remarkably independent when the subjects are young children (see Brainerd 1977, 1979b, 1979c).

What does all this evidence of conceptual precocity portend for cognitive-developmental theory? One of the most interesting ramifications, I think, is that the cognitive-developmental theoretical tradition may be trying to explain an alleged fact that, it now seems, may not be a fact at all. I assume we can all agree that the job of any theory is to explain the facts, to tell us why things are as they are. Although the theories of science may serve a variety of functions, not the least of which are aesthetic ones, the main thing that distinguishes scientific theories from articulate common sense is that theories have explanatory significance. If this point can be accepted, then one of the most fundamental measures of a theory's adequacy is whether the facts it professes to explain are as alleged. As everyone knows, cognitive-developmental models in the Piagetian tradition are characterized by a long list of theoretical constructs (stage, structure, operation, assimilation, equilibration, and so on). It seems, judging from Piaget's data, that these complicated and occasionally unfathomable notions are intended to explain why the acquisition of even simple conceptual competencies is an *exceedingly slow* process: infants are supposed to take 2 years just to discover that objects have independent existences; it is supposed to take 5 or 6 more years to acquire the simplest concepts about relations, classes, and quantities; it is supposed to take at least 9 more years to lay in the rudiments of symbolic logic.

But we now have reason to believe that the emergence of basic conceptual competencies is not the slow process envisioned in cognitive-developmental theory. On the contrary, a rather good case can be made to the effect that concept development is a fast-in-competence process in which age change is primarily a matter of changes in the level and extent of concept usage. So perhaps the time has come to ask: Apart from historical or aesthetic reasons, is there any clear motivation for retaining ideas such as structure, equilibration, etc., as theoretical assumptions?

References

- Beilin, H. Inducing conversation through training. In G. Steiner (Ed.), *Psychology of the twentieth century*. Vol. 7. Munich: Kindler, 1978.
- Borke, H. Piaget's view of social interaction and the theoretical construct of empathy. In L. S. Siegel & C. J. Brainerd (Eds.), *Alternatives to Piaget: critical essays on theory*. New York: Academic Press, 1978.
- Braine, M. D. S. The ontogeny of certain logical operations: Piaget's formulation examined by nonverbal methods. *Psychological Monographs*, 1959, 73(5, Whole No. 475).
- Brainerd, C. J. Order of acquisition of transitivity, conservation, and class inclusion of length and weight. *Developmental Psychology*, 1973, 8, 105-116. (a)
- Brainerd, C. J. Judgments and explanations as criteria for the presence of cognitive structures. *Psychological Bulletin*, 1973, 79, 172-179. (b)
- Brainerd, C. J. Training and transfer of transitivity, conservation, and class inclusion of length. *Child Development*, 1974, 45, 324-334.
- Brainerd, C. J. On the validity of propositional logic as a model for adolescent intelligence. *Interchange*, 1976, 7, 40-45.

MONOGRAPHS

- Brainerd, C. J. Cognitive development and concept learning: an interpretative review. *Psychological Bulletin*, 1977, **84**, 919-939.
- Brainerd, C. J. Learning research and Piagetian theory. In L. S. Siegel & C. J. Brainerd (Eds.), *Alternatives to Piaget: critical essays on the theory*. New York: Academic Press, 1978. (a)
- Brainerd, C. J. *Piaget's theory of intelligence*. Englewood Cliffs, N.J.: Prentice-Hall, 1978. (b)
- Brainerd, C. J. *The origins of the number concept*. New York: Praeger, 1979. (a)
- Brainerd, C. J. Markovian interpretations of conservation learning. *Psychological Review*, 1979, **88**, 181-213. (b)
- Brainerd, C. J. Concept learning and developmental stage. In H. J. Klausmeier & associates, *Cognitive development from an information processing and a Piagetian view*. Cambridge, Mass.: Ballinger, 1979. (c)
- Brainerd, C. J., & Brainerd, S. H. Order of acquisition of number and quantity conservation. *Child Development*, 1972, **43**, 1401-1405.
- Brainerd, C. J., & Hooper, F. H. A methodological analysis of developmental studies of identity conservation and equivalence conservation. *Psychological Bulletin*, 1975, **82**, 725-737.
- Bryant, P. E., & Trabasso, T. Transitive inference and memory in young children. *Nature*, 1971, **232**, 456-458.
- Bucher, B., & Schneider, R. E. Acquisition and generalization of conservation by preschoolers, using operant training. *Journal of Experimental Child Psychology*, 1973, **16**, 187-204.
- Burns, S. M., & Brainerd, C. J. Effects of constructive and dramatic play on perspective taking in very young children. *Developmental Psychology*, 1979, **15**, in press.
- Ennis, R. H. Children's ability to handle Piaget's propositional logic: a conceptual critique. *Review of Educational Research*, 1975, **45**, 1-41.
- Gelman, R. The nature and development of early number concepts. In H. W. Reese (Ed.), *Advances in child development and behavior*. Vol. 7. New York: Academic Press, 1972.
- Hooper, F. H.; Sipple, T. S.; Goldman, J. A.; & Swinton, S. S. A cross-sectional investigation of children's classificatory abilities. Technical Report No. 295, Research and Development Center for Cognitive Learning, University of Wisconsin, 1974.
- Kohlberg, L. Stage and sequence: the cognitive-developmental approach to socialization. In D. A. Goslin (Ed.), *Handbook of socialization theory and research*. Chicago: Rand McNally, 1968.
- Lawson, G.; Baron, J.; & Siegel, L. S. The role of number and length cues in children's quantitative judgments. *Child Development*, 1974, **45**, 731-736.
- Miller, S. A. Nonverbal assessment of Piagetian concepts. *Psychological Bulletin*, 1976, **83**, 405-430.
- Piaget, J. *Judgment and reasoning in the child*. New York: Harcourt & Brace, 1928.
- Piaget, J. *The child's conception of physical causality*. London: Kegan Paul, 1930.
- Roodin, P. L., & Gruen, G. E. The role of memory in making transitive inferences. *Journal of Experimental Child Psychology*, 1970, **10**, 264-275.
- Rosenthal, T. L., & Zimmerman, B. J. *Social learning and cognition*. New York: Academic Press, 1978.
- Shultz, T. R.; Bindra, D.; & Clarke, K. Understanding relations of necessity and sufficiency in logically equivalent causal and noncausal problems. *Journal of Experimental Psychology*, in press.
- Shultz, T. R., & Butkowsky, I. Young children's use of the scheme for multiple sufficient causes in the attribution of real and hypothetical behavior. *Child Development*, 1977, **48**, 464-469.
- Shultz, T. R.; Butkowsky, I.; Pearce, J. W.; & Shanfield, J. Development of schemes for

- the attribution of multiple psychological causes. *Developmental Psychology*, 1975, **11**, 502-510.
- Siegel, L. S. The sequence of development of certain number concepts in preschool children. *Developmental Psychology*, 1971, **5**, 357-361.
- Siegel, L. S. The relationship of language and thought in the preoperational child: a reconsideration of nonverbal alternatives to Piagetian tasks. In L. S. Siegel & C. J. Brainerd (Eds.), *Alternatives to Piaget: critical essays on the theory*. New York: Academic Press, 1978.
- Siegel, L. S.; McCabe, A. E.; Brand, J.; & Matthews, J. Evidence for the understanding of class inclusion in preschool children: linguistic factors and training effects. *Child Development*, 1978, **49**, 688-693.
- Siegler, R. S. Defining the locus of developmental differences in children's causal reasoning. *Journal of Experimental Child Psychology*, 1975, **20**, 512-579.
- Siegler, R. S. The effects of simple necessity and sufficiency on children's causal inferences. *Child Development*, 1976, **47**, 1058-1063.
- Yost, P.; Siegel, A.; & Andrews, J. Nonverbal probability judgments by young children. *Child Development*, 1962, **33**, 769-780.

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