Piaget on the child's understanding of the necessity of logical laws

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Jean Piaget is well known in psychological circles as an individual who has been researching the cognitive growth of children and adolescents for over half a century. Piaget, however, does not consider himself a psychologist but rather a genetic epistemologist – one who studies the way knowledge is acquired in individuals. It is Piaget's belief that many traditional epistemological problems, especially those relating to the source and nature of intellectual knowledge, can be solved by empirical means.

Johnson (1976) has recently examined Piaget's work and agrees with Piaget that his empirical work has relevance to epistemological theory and the study of the individual's understanding of logic. One particular aspect of Piaget's work, language learning and the child's view of the necessity of logical laws, has been elaborated by Johnson and will be discussed in this paper. Before Johnson's ideas are considered, Piaget's theory will be briefly outlined.

Much of Piaget's work has centered around the development of logic in children. His own method of investigating children's thought is an interview approach, where the experimenter has a clear idea of the questions he/she wants to ask, but where the direction and form of subsequent questions is determined by the child's answers.

Piaget contends that complex logical modes of thinking are developed from the child's overt activities on macroscopic objects. In infancy the actions are overt sensorimotor behaviors. As the child grows older, the actions become progressively internalized, first at a simple, concrete level and then at more and more complex levels as abstract, systematized thought (Piaget, 1974, pp. 65–91).

Piaget is a stage theorist and believes that intellectual development can be divided into chronological levels. The order of these stages is invariant, although the specific age ranges vary with the individual. Piaget (1972, pp. 19–51) delineates four main stages of cognitive development:

(1) Sensorimotor (birth to 2 years). During this period the child integrates sensations and motor activities.

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(2) Pre-operational (2 years to 6–7 years). In this period, the child symbolizes his world through images, words, and drawings. The child is incapable of true logical thought.
(3) Concrete-operational (7 years to 12–13 years). The child can reason according to logical systems about concrete objects and events.
(4) Formal operational (12–13 years onwards). The child is able to reason logically about systems of propositions and possible combinations of factors that may enter into a problem. It is at this stage that the logical abilities that underlie abstract thinking are available to the child.

These four stages are the structure within which Piaget establishes his theory of cognitive development.

The view that language is the source of logic has been termed the thesis of the linguistic validation of logical laws. Johnson (1976) describes the linguistic thesis as the view that the laws of logic are self-justifying in that, once their meaning is understood, their truth is undeniable. The validation is independent of both physical and mental experience and derives rather from language. Piaget (1969, pp. 87–90; 1971, pp. 9–10; 1972, pp. 63–76) and Johnson (1976) attribute this view to the logical positivists and claim that the thesis is false.

Johnson says that language as the *source* of logic has two hidden developmental consequences: (1) The *necessity* of laws of logic is tied only to the condition of learning a language; (2) These logical laws are not binding formal structures prior to language learning, but are binding only as soon as a language is mastered (Johnson, 1976). He contends that the linguistic thesis is an empirical hypothesis that can be experimentally tested by answering the following two questions: (a) Do persons operate in accordance with these logical laws as soon as they master a language and not before? (b) Is the necessity of logical laws tied only to the learning of language? (Johnson, 1976). It is Johnson's belief that the empirical evidence gathered by Piaget contradicts these points and thereby invalidates the linguistic thesis. Johnson has chosen Piaget's work on the law of non-contradiction to support his position. The evidence appealed to is the purported fact uncovered by Piaget that children below the age of about 12 see no necessity for the law of non-contradiction and often contradict themselves. This is related to Piaget's contention that the recognition of the necessity of the laws of formal logic does not occur in the child until certain mental structures are "constructed," usually in early adolescence.

Johnson refers to the following passage from Piaget:

> Tu (7½) thinks that boats float "because they are wood." – *Why does wood stay on the water?* – *Because it is light* and the little boats have sails. – And those that have no sails, why do they not sink? – Because it is light. – ... And how about big boats? – Because they are heavy. – Then,

heavy things stay on top of water? – No. – Does a big stone? – No, it sinks. – *And big boats?* – *They stay because they are heavy.* – Is that the only reason? – No. – What else? – Because they have sails. – And when these are taken away? – Then they are less heavy. – And if the sails are put on again? – The same thing happens. *They stay on the water because they are heavy.* (Johnson, 1976, from Piaget, 1924/1966, p. 196, italics mine)

Johnson (1976) believes that the fact that children feel no compulsion to be consistent in what they say is just what we would expect of those who do not recognize any necessity for the law of non-contradiction. Johnson anticipates a possible objection here:

The objection that the child really does not understand what he is being asked and is thus led to contradict himself would save the thesis regarding the derivation of logic from language, but the objection can be entertained only at the expense of making the ability to maintain consistency the criterion of understanding a term. And such a stipulation certainly flies in the face of the fact that this child can point out light/heavy objects, floating/sinking objects, and small/large boats without error. Piaget himself considers the possibility that the children do not understand the questions they are being asked as a line of objection against his method, and points out that on the level of conscious formulation, *the responses the children make show clearly that they do understand.* I would argue even more strongly that to use the law of non-contradiction as a criterion of understanding meaning is not only arbitrary, but viciously circular if one is asking whether language is the source of logical necessity. (Johnson, 1976, p. 8, italics mine)

Johnson concludes that:

both of the developmental hypotheses which issue from the linguistic validation of logical laws are incorrect. *The laws of identity and non-contradiction are not automatically binding as soon as one has mastered a language*, and therefore, logical necessity is not tied only to the condition of learning a language. The necessity of certain formal operations such as non-contradiction must either derive from something entirely different from language, or from language plus other ingredients. (Johnson, 1976, p. 3, italics mine).

As does Piaget, Johnson (1976) contends that language is a *necessary* but not a *sufficient* condition of formal propositional thought. There are several points to be made regarding the arguments advanced by Johnson and Piaget.

Johnson's characterization of the "linguistic thesis of logical truths" is conceptually muddled on two points. *First*, as I understand Johnson, he takes the linguistic theorist to be saying that the *necessity* of any logical truth is a function of the idealized meanings of certain truth-functional sentential connectives, together with the standard truth-definitions for complex sentences formed from other sentences by way of these connectives. Whether or not the linguistic thesis is correct (or whether Johnson's description is historically correct) is not the issue. What is dubious is Johnson's assumption that the meaning conditions of an expression are the conditions under which the expression is learned (cf. points (1) and (2)). This assumption explains why he says that, on the linguistic thesis, logical

necessity is dependent upon "the condition of learning a language." But why would anyone hold that the meaning of a term is a function of the conditions under which it is learned? Second, Johnson conflates the truth-conditions of a sentence with the conditions under which a person is *justified* in believing its truth. These are two quite different things. Notice, by the way, that if my first point is correct, then Johnson's so-called "empirical disconfirmation" of the linguistic thesis involving language-learning is misguided from the start.

Neither is it clear from the passage cited from Piaget that the child sees no necessity to the law of non-contradiction. The child is certainly not saying "p" and "not p" at the same time. Piaget's discussion with Tu starts with what Tu has to say about *little wooden boats* (e.g., toy wooden models, etc.). When Piaget shifts to talk about "big boats," we are led to believe that Tu is being asked a question about *extremely large boats* (perhaps, boats not made of wood), e.g., battleships, aircraft carriers, tugboats, the Queen Mary, etc. But it may be that Tu isn't interpreting Piaget's question in this way at all. For example, Tu may be taking "big boats" to refer to much larger wooden toy boats. These are heavy compared to smaller-scale toy models and are less heavy when the sails are taken off (if they have any). It appears to this writer that Tu believes that some heavy things float on water while other heavy things (a big stone) do not. So, we need to get clear what Tu takes the reference of "big boats" to be as well as the reference of "boats made out of wood."

What Tu does say, given Piaget's report, is the following: (1) *Boats made out of wood* float because they are *light*; (2) *Big boats* float because they are *heavy*. Now (1) and (2) are not logically contradictory with each other. One reason is that, on Tu's understanding of Piaget's questions, "boats made out of wood" and "big boats" need not be co-extensional. Another problem is that it is unclear whether "light" and "heavy" are contrasting terms whose meanings are defined in comparison to water, i.e. "x is light if and only if x's density is less than that of an equal volume of water" and "x is heavy if and only if x's density is more than that of an equal volume of water"; or whether "light" and "heavy" are to be understood in terms of the *kind of material* of which an object is composed. It is conceivable that both interpretations (or some other) are operative in this case. Furthermore, water is a difficult medium to think about and there is much about it that ought to be confusing for an inquisitive mind. Although many light objects like wood float, many heavy objects like boats float also. The difficulty is further compounded by the fact that the same object may behave differently with only a slight variation in conditions. For example, the human body can both sink and float in water. The dialogue is not probing enough to determine what the child understands by the terms he

uses. A relevant issue here is just what does Johnson mean by "criteria of understanding?" What are the criteria of understanding Johnson and Piaget employ if consistency is not one of them? (One can agree that consistency cannot be a *necessary* condition of understanding, for we would all have to confess ignorance).

Piaget and Johnson also underestimate the importance of adhering to the law of non-contradiction in everyday discourse. What would it be like for there to be a language in which this law did not hold? In such a language, it would be possible for it to be the case that a proposition expresses the thought which is both A and *not* A. But this is impossible, since such a thought would be no thought. In other words, the law of non-contradiction simply states that if a thought is expressed in words, what is expressed is *not* not itself. This is simply a necessary condition for expressing thought at all. That is, we could not distinguish what was expressed from what was not expressed, since what was expressed cannot be distinguished from its negation. When one speaks a language, or expresses a thought, in order to say something significant and informative what one is saying must be distinguished from what one is not saying. This is a simple logical fact that underlies the possibility of thought expression itself.

In conclusion, the view espoused by Piaget and Johnson that children below the age of 12 see no necessity for the logical law of non-contradiction is problematic. First of all, Piaget's dialogues with children which are considered supportive of this position are not clearly so. Secondly, Piaget and Johnson underestimate the necessary nature of following the logical law of non-contradiction in everyday discourse. The mere possibility of saying something significant and informative at all presupposes that the law of non-contradiction is enforced.

RÉSUMÉ

Piaget et Johnson contestent tous deux la thèse voulant que le langage soit la source de la logique, un point de vue qu'ils attribuent au positivisme logique. Johnson prétend que la nécessité des lois logiques n'est pas liée seulement à l'acquisition du langage et, pour appuyer sa position, il invoque les travaux de Piaget sur la loi de non-contradiction. Or la présentation faite par Johnson de la "thèse linguistique" confondrait certaines notions. De plus, l'exemple emprunté à Piaget n'appuierait pas clairement la position voulant que les enfants ne suivent pas la loi de non-contradiction. Enfin Piaget comme Johnson sous-estimeraient la nécessité, pour le discours, de se conformer à la loi de non-contradiction.

REFERENCES

Johnson, G Piaget's studies on child logic and the validation of logical laws. *Philosophy of the Social Sciences*, 1976, 6, 1–13.

Piaget, J. *The psychology of the child*. New York: Basic Books, 1969.
Piaget, J. *Genetic epistemology*. New York: Norton, 1971.
Piaget, J. *The principles of genetic epistemology*. London: Routledge & Kegan Paul, 1972.
Piaget, J. *Judgment and reasoning in the child*. New Jersey: Littlefield, Adams & Co., 1966. (Originally published, 1924)
Piaget, J. *The child and reality*. New York: Viking Press, 1974.

First received 11 November 1978