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ScienceDirect
Cognitive Development 22 (2007) 124–129
COGNITIVE DEVELOPMENT

Short communication

Negative priming effect after inhibition of weight/number interference in a Piaget-like task

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Abstract

Piagetian tasks have more to do with the child's ability to inhibit interference than they do with the ability to grasp their underlying logic. Here we used a chronometric paradigm with 11-year-olds, who succeed in Piaget's conservation-of-weight task, to test the role of cognitive inhibition in a priming version of this classical task. The experimental design was such that the misleading strategy "number-equals-weight" to inhibit on the prime (a Piaget-like item with weight/number interference) became a congruent strategy to activate on the probe (a subsequent item where weight and number covaried). A negative priming effect of 142 ms was observed for the prime-probe sequence. This result is consistent with the prediction that success on Piaget-like tasks (the prime) requires an inhibition process.

Keywords: Inhibition; Negative priming; Conservation task; Weight

To mesh better with new facts, Piaget's (1984) theory needs to incorporate inhibition into each stage of cognitive development, from infancy to adulthood (Bjorklund & Harnishfeger, 1990; Dempster & Brainerd, 1995; Diamond & Gilbert, 1989; Diamond & Lee, 2000; Houdé, 2000; Pascual-Leone, 1988). According to Dempster (1995), "Conservation and class inclusion [i.e., the famous Piagetian tasks] have more to do with the ability to resist interference than they do with the child's ability to grasp their underlying logic." (p. 15). In Piaget's conservation-of-number task, for example, when shown two rows of objects containing the same number of objects but of different lengths (after the objects in one of the rows have been spread apart), the child has to say whether the two rows have the same number of objects (Piaget & Inhelder, 1969). Until the age of 7, children usually erroneously say there are more objects in the longer row. For Piaget, this means that children at this age have not yet reached the "number stage" (the concrete

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0885-2014/$ – see front matter © 2006 Published by Elsevier Inc.
doi:10.1016/j.cogdev.2006.06.003

operations stage). Contrary to this view, it follows from Dempster's interpretation that to succeed in Piaget's task, the important thing is not being able to activate number capacities per se, but to inhibit a misleading strategy, namely the visuospatial "length-equals-number" strategy (an often-relevant quantification heuristic used by children and still used by adults) (Houdé, 2000). To test this new interpretation, we previously used (Houdé & Guichart, 2001) a chronometric paradigm with 9-year-olds (at the concrete operations stage) who succeed in the Piaget's conservation-of-number task. The experimental design was a two-part, prime-probe numerical task, such that the misleading strategy "length-equals-number" that had to be inhibited on the prime (a Piaget-like item with number/length interference) became a congruent strategy to activate on the probe (a subsequent item where number and length covaried). According to Tipper's (1985) interpretation (knowing that conflicting views exist: see Tipper, 2001, for a review), if the misleading strategy is inhibited when the prime appears, then activating the same strategy on the probe should set off a negative priming effect (i.e., a longer response time).[1] Indeed, a negative priming effect was observed for the prime-probe sequence, compared to a control condition. This result is consistent with the prediction that success on Piaget-like tasks requires an inhibition process.

In order to generalize this first result, here we reused the same experimental design with a Piaget's conservation-of-weight task, which is – following Piaget's terminology – from the "infra-logic" domain (i.e., continuous contents: weight, liquids, mass, and length), contrasted with the "logic" domain (i.e., discontinuous contents: number). Remember that according to Piaget, children are not able to reason correctly about weight conservation until the age of 10 (thus with a discrepancy regard to number conservation during the concrete operations stage) (Piaget & Inhelder, 1969). When shown two displays of objects containing the same quantity of substance, and consequently the same weight, but of different number (for example, one big ball and three small balls), the child has to say whether the two displays have the same weight. Until the age of 10, children usually erroneously say that the three-balls display is heavier than the one-ball display. Here again, we hypothesize that to succeed in this Piaget's task, the child has to inhibit the misleading "number-equals-weight" strategy.

To test this new interpretation, we reused our chronometric paradigm (Houdé & Guichart, 2001) with 11-year-olds who succeed in the Piaget's conservation-of-weight task. The experimental design was a two-part, prime-probe task, such that the misleading strategy "number-equals-weight" that had to be inhibited on the prime (a Piaget-like item with weight/number interference) became a congruent strategy to activate on the probe (a subsequent item where weight and number covaried). According to Tipper's (1985) interpretation, if the misleading strategy is inhibited when the prime appears, then activating the same strategy on the probe should set off a negative priming effect, i.e., a longer response time.

Note that, by definition, the negative priming paradigm can only test for inhibition if the child succeeds on the preceding interference item (here, the Piaget-like item). The idea is to find out whether or not the child used inhibition to succeed on the prime, by measuring the priming effect on the probe. Contrary to the customary procedure in child psychology, it is not failure on the task that is analyzed here (in which case we would have studied younger children using another method) but success.

Note also that the task we used was not a conservation task in the strict Piaget sense (where there is *transformation* of one of two displays), but a weight/number interference task where children

[1] Initially, Tipper's negative priming paradigm was defined in terms of stimuli, with a target stimulus to be processed and a distractor stimulus to be ignored (or inhibited). The present setup is a variation applied to cognitive strategies activation/inhibition (like in Houdé & Guichart's (2001) paper prereviewed by Steve Tipper).