Informal Algorithms in Children

Monica Bucciarelli [1-2]

[1] Università di Torino, Torino, ITALIA
[2] Centro di Logica, Linguaggio, e Cognizione, Torino, ITALIA
monica.bucciarelli@unito.it

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Abstract

Where does the ability to devise algorithms come from? Most abilities appear to depend on interactions between innate factors and experience.

My studies on children, in collaboration with Mackiewicz, Khemlani and Johnson-Laird, show that fifth-grade children who have had no experience with programming are nevertheless able to understand informal algorithms and even to devise their own. The domain concerned re-arranging the order of toy cars in a railway train, using a single track and a siding. Such a track allows for powerful algorithms, since both the siding and one side of the track act as places to "store" cars during re-arrangements.

These studies lead us to three main conclusions.

First, children can devise algorithms, even those that are recursive (i.e., they depend on repeated loops of operations), although they are harder than those that are not recursive (i.e., they depend on a list of operations without loops). The former place a greater load on working memory than the latter.

Second, children differ in ability, though there is no reliable difference between boys and girls. Ability is likely to reflect a difference in the processing capacity of working memory (at least partially determined by innate factors). So, for example, when children cannot even touch the cars, their "iconic" gestures of moves help them. When they are prevented from gesturing, their performance is poorer.

Third, children (and adults) use kinematic mental simulations to envisage the effects of moves on the railway track.

References

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