Odd-Even effect in multiplication revisited: The role of equation presentation format

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Introduction

Several studies suggested that people usually make use of many different strategies to solve simple arithmetic problems (digit-addition and digit-multiplication). (Lemaire & Fayol, 1995; LeFevre, Bisanz, Daley, Buffone, Greenham, & Sadesky, 1996; Krueger, 1986; Krueger & Hallford, 1984; Zbrodoff & Logan, 1990). For example, to verify simple multiplication questions, 2 x 3 = 7; 4 x 6 = 25, people will retrieve the answer of the question from their memory base and compared it with the mentioned answer (memory-retrieval hypothesis) *or* people will first check out if the mentioned answer of the question violates the parity rules of multiplication (parity-checking hypothesis). Recently, a similar study was conducted by Lochy, Seron, Delazer, & Butterworth, (2000), they proposed an alternative account to the odd-even effect: number evenness hypothesis. They reasoned the effects were mainly due to the familiarity of even numbers of the products rather than the parity-checking rule. However, the rationale of this hypothesis is basically in line with the memory-retrieve hypothesis because both of them emphasized the distributional information of the products or the mathematical equation from the memory. To further verify the odd-even effect in multiplication and to assess the validity of those hypotheses, I replicated the study by altering the presentation format of the mathematical equation in this paper. revising from the traditional standard format [a x b = c] to a reverse format [c = a x b]. The reverse presentation format will obviously affect the memory capacity of the equation because people would not normally remember the multiplication table in that specific format. Therefore, if the memory-retrieval hypothesis or the number evenness hypothesis are really the underlying mechanism of the multiplication processes, the similar pattern of results will be showed and should be consistent with the previous studies (Lochy et al., 2000). Otherwise, other explanations should be further sought. The present study attempts to evaluate the strengthen of those hypotheses and their roles played in the temporal course of simple multiplication process by using the presentation format as a crucial examination tool.

Experiment

The basic design of the present experiment is similar to the study of Lochy et al. (2000). Three main variables in the present experiment: (1) presentation format of the equation: (a x b = c) vs. (c = a x b); (2) types of problem: (even x even) vs. (odd x odd) vs. mixed; (3) size of split: +1 +2 +3 +4 –1 –2 –3 –4.

Procedure

A series of simple multiplication problems were randomly presented to each participant in one of the two forms (a x b = c) or (c = a x b). Participants were asked to verify whether the equation is true or false by pressing a key. Response latencies were recorded from the onset time of the equation that displayed on the computer screen to the manual response.

Results and Discussion

Three main findings in the present study were concluded.

First, the format of equation presentation is in fact influence the verification time of the participants (reverse mode takes longer time to verify than the traditional mode). It is sensible because the internal representation of the simple multiplication knowledge is initially encoded in the traditional form (2 x 3 = 6) instead of the reverse form (6 = 2 x 3).

Second, collapsed over the levels of presentation format, in the traditional format, results obtained from the present study were replicated the general pattern of results to the odd-even effects which were reported in Lochy et al., (2000). Third, the most interesting point here is that on the contrary, in the reverse presentation mode, the odd-even pattern of results was typically consistent with the parity-checking rule rather than the other hypotheses. Clearly, in the processing of simple multiplication, people will rely heavily on the mathematical knowledge stored in their memory base. However, once the relevant information cannot be easily triggered from the memory store, other alternatives will be used immediately (parity-checking rule) to solve the original arithmetic problem. These findings seem to support the multiple-strategy hypothesis in solving simple mathematical problems (Lemaire & Fayol, 1995).

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