Access Facilitation in Tie Problems

Michele Burigo (mburigo@plymouth.ac.uk)
School of Psychology, Faculty of Science, Drake Circus,
University of Plymouth, PL4 8AA, UK

Luisa Girelli (luisa.girelli@unimib.it)
Department of Psychology, University of Milan,
20100, Milan, Italy

Introduction

Arithmetic problems formed by repeated operands (e.g., 2x2) are solved faster and more accurately than comparable non-ties operations (e.g., 2x3). This advantage is known as the "tie effect" (Miller, Perlmutter & Keating, 1984). Two accounts competed in explaining this effect: an encoding based account (Blankenberger, 2001) and a access based account (Campbell & Gunter, 2002; LeFevre, Shanahan & DeStefano, 2004). The present study provides additional evidence against the encoding-based interpretation (Exp1) and supports the hypothesis of an access facilitation for tie problems (Exp 2)

Experimental sessions

Experiment 1 required participants to produce verbally the result of a multiplication. In the "Product" condition both operands were shown on the screen. In the "Memory" condition one operand had to be kept in memory and multiplied by a number presented on the screen. In this way, encoding of the two operands took place at different times, thus minimizing, according to the encoding hypothesis (Blankenberg, 2001) the facilitation for ties. In both "Product" and "Memory" conditions, a strong advantage for tie problems was found (see figure 1).

Experiment 2 required participants to classify, in a true/false task, a number as belonging or not to a "target table"; for example, given the table of 5 as the target one, participants had to decide whether the number 36 was included in the table or not. This procedure allow us to verify whether the tie effect could emerge even when encoding process were excluded. The results showed that tie results were processed faster and were less error prone than non tie results, indicating that the tie advantage applies also to indirect access to problem knowledge (e.g., "Does 9 belong to the 3 table or not?").

Discussion

The present study aimed to analyze different accounts of the tie effect, i.e., the encoding hypothesis and the access hypothesis. Experiment 1 demonstrated that tie problems are faster and more accurate than non tie problems even when encoding is limited to a single factor. Experiment 2 investigated the access hypothesis, according to which the tie advantage is mainly based on difference in accessibility and memory distinctiveness of tie problems. Campbell and Gunter (2002) firstly suggested that the tie effect reflects better memory for the repeated operand problems compared to other problems.

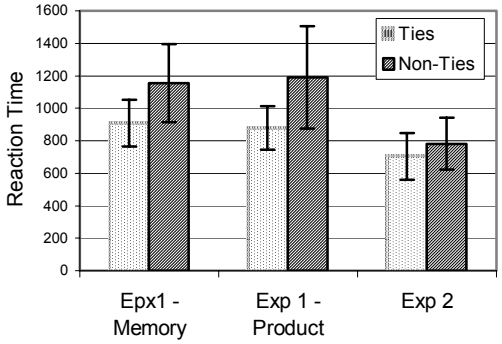

Figure 1: RTs distribution across large and small problems

The memory advantage has been explained in terms of higher frequency of ties during learning, more practice associated to the use of ties as "anchors" in procedural strategies (e.g., 6x7 = (6x6) +7 = 36+7 = 42), and greater distinctiveness determined by their reduced source of associative interference. The results of Experiment 2 further support the memory-hypothesis, demonstrating that tie answers were faster to be recognized and rarely incorrectly rejected as multiple of a target factor than comparable non tie answers. Clearly, encoding processes may hardly be responsible for these results. Overall, we argue that this evidence add to the existing literature favoring a memory based account of tie effect in simple arithmetic (Campbell & Gunter, 2002).

References

Blankenberger, S. (2001). The arithmetic tie effect is mainly encoding-based. *Cognition*, 82, B15 - B24.

Campbell, J. I. D., & Gunter, R. (2002). Calculation, culture, and the repeated operand effect. *Cognition*, 86, 71 – 96.

LeFevre, J.A., Shanahan, T. & SeStedano, D. (2004). The tie effect in simple arithmetic: An access-based account. *Memory & Cognition*, 32 (6), 1019 – 1031.

Miller, K.F., Perlmutter, M., & Keating, D. (1984). Cognitive arithmetic: Comparison of operations. *Journal of Experimental Psychology: Learning, Memory, and Cognition*. l0, 46 - 60.