Are Relations Directly Detected at Initial Encoding?

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This study examines how representations for relations are formed during initial stimulus encoding. One possibility is parallel encoding of elements and relations, such that detection of relations does not require binding, but rather involves matching a new stimulus to a relational template or schema that is retrieved from LTM. A second possibility is a serial account: that there is no direct detection of relations, but rather binding occurs only after elements have detected, at which point their configuration is encoded.

These two possibilities make differing predictions regarding the encoding of elements and relations. First, the first possibility predicts that elements and relations should be represented comparably, whereas the second possibility predicts that relations should be represented less often than elements. Second, the two possibilities differ in their expectation of illusory binding (i.e., binding of target elements to a distracter relation, or distracter elements to a target relation). The first possibility predicts that illusory binding should be symmetrical: given that both elements and relations are identified, there should be both binding of distracter elements to a target relation and binding of a distracter relation to target elements. On the other hand, the second possibility predicts that illusory binding should be asymmetrical: given that elements, but not relations, are identified prior to binding, there should be binding of distracter elements to a target relation, but not binding of a distracter relation to target elements, since this latter case requires an identified relational schema.

To distinguish between the two possibilities, we incorporated an immediate recognition procedure. The general procedure involved subjects receiving on each trial two study items in succession (presented on a computer screen), one a target and one a distracter, with order of presentation randomly counterbalanced across trials. Subjects then received two recognition items simultaneously on the screen, with one of these items being an old item (i.e., identical to the target study item), and the other a foil. Subjects' task was to choose which of these items had been presented during the study phase (i.e., the target). Subjects' choices and latencies were recorded.

The stimuli used were three horizontally-aligned shapes, with elements being shapes of objects and relations being the patterns among 3 shapes within each arrangement. Three relations were used (ABA, AAB, and ABB), with A and B representing different shapes (e.g., an ABA relation might be circle-square-circle). A second within-participants factor was the type of foil paired with an Old target (in the forced-choice recognition task). There were 5 types of foils: E_{New}/R_{Target} foils (same relation as target, but new elements), E_{Target}/R_{New} foils (same elements as target, but a new relation), $E_{Target}/R_{Distractor}$ foils (same elements as target, but relation from the distracter item), $E_{Distractor}/R_{Target}$ foils (same relation as target, but elements from the distracter item), and E_{New}/R_{New} foils (new elements and relations).

The two possibilities predict different patterns of accuracy across foil types. If relations are detected directly, then there should be no difference in accuracy between E_{New}/R_{Target} foils and E_{Target}/R_{New} foils, since participants should be equivalently sensitive to violations of both elements and relations. However, a different pattern was found: participants made fewer choices of E_{New}/R_{Target} foils than E_{Target}/R_{New} foils, indicating that they were more likely to have encoded elements than relations.

Comparisons among foils also afford examination of illusory binding for elements and relations. If participants directly detect elements during encoding, they should be more likely to choose a foil containing elements from the distracter study item ($E_{Distractor}/R_{Target}$ foils) than elements not presented in the study phase (E_{New}/R_{Target} foils) of that trial. At the same time, if participants directly detect relations during encoding, they should be more likely to choose a foil containing relations from the distracter study item ($E_{Target}/R_{Distractor}$ foils) than relations not presented in the study phase (E_{Target}/R_{New} foils). Consistent with both possibilities, there was evidence of illusory binding for distracter elements onto target relations; however, consistent only with the second possibility, there was not symmetrical illusory binding for relations. In other words, participants were not more likely to choose the foil containing distracter relations than the one containing new relations, indicating that distracter relations were not represented above and beyond relations never presented during the trial.

Thus, data clearly support the second possibility, that unlike elements, relations are not detected directly during encoding, but more likely representations for relations emerge from configural binding of elements. Of course, it could very well be the case that this is only true for unlearned relations such as those used here. Future studies will involve training of relations to examine whether well-learned relations are detected directly at encoding.

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