

## Feature and Conjunction Errors in Recognition Memory: Evidence for Dual-Process Theory

Todd C. Jones

*New York University and Victoria University of Wellington, Wellington, New Zealand*

and

Larry L. Jacoby

*Washington University in St. Louis*

Feature and conjunction errors in recognition memory were investigated using a dual-process framework. In Experiment 1, dividing attention at study or test decreased old word recognition but did not influence feature and conjunction recognition errors after correcting for false alarms to new words (baseline). In Experiment 2, a response deadline manipulation influenced old word recognition but not feature and conjunction effects (i.e., feature or conjunction error rate minus baseline). Across Experiments 3 and 4, study repetitions increased the probabilities of feature and conjunction errors for participants under strong pressure to respond quickly. However, no such increases were observed for participants who were given more time to respond, providing evidence that the familiarity underlying feature and conjunction errors can be countered with recollection. Thus study repetition increased both familiarity and recollection. Feature and conjunction errors are based on familiarity in the absence of recollection. An approach that combines an item–associative distinction with a dual-process framework (e.g., Yonelinas, 1997) also can account for these errors. However, an approach that uses a feature-configuration distinction must be modified to account for these results. © 2001 Academic Press

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False memory phenomena have enjoyed a great surge of interest in the past decade (Roediger, 1996), and one line of this research has focused on false recognition of recombined study stimuli on a later test. For example, participants might study *buckwheat*, *blackmail*, and *jailbird*,

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Address correspondence and reprint requests to Todd C. Jones, School of Psychology, Victoria University of Wellington, P.O. Box 600, Wellington, New Zealand. E-mail: [todd.jones@vuw.ac.nz](mailto:todd.jones@vuw.ac.nz).

and then on a later recognition test, judge whether *buckshot* (partly old) or *blackbird* (both parts old but recombined) occurred on the study list. False recognitions of these types of items have been referred to as feature errors (e.g., *buckshot*) and conjunction errors (e.g., *blackbird*; Reinitz, Lammers, & Cochran, 1992). The results from this type of false recognition experiment typically show that old responses are given to truly old stimuli at a higher rate than that for conjunction stimuli, followed by that for feature stimuli, followed by that for wholly new stimuli (old > conjunction > feature > new). Throughout this paper, we refer to a difference in false alarm rates for feature lures and new words as a feature effect and the difference in false alarm rates for conjunction lures and new words as a conjunction effect. (These effects reflect higher false alarm rates for feature and conjunction lures compared to a new word, which is

considered to be a baseline.) Finally, feature and conjunction errors have been found to occur with a variety of materials (single words, where syllables are conjoined, Underwood & Zimmerman, 1973; word phrases, Underwood, Kapelak, & Malmi, 1976; compound words, Ghatala, Levin, Bell, Truman, & Lodico, 1978, Underwood et al., 1976, Reinitz et al., 1992; face drawings, Reinitz et al., 1992, Reinitz, Morrissey, & Demb, 1994; photographs, Searcy, Bartlett, & Meman, 1999; abstract figures, Kroll, Knight, Metcalfe, Wolf, & Tulving, 1996).

Recently, a dual-process theory of memory was used to account for feature and conjunction errors (Jones, Jacoby, & Gellis, in press). In dual-process theory, an automatic process, familiarity, and a controlled process, recollection, provide alternative bases for responding (e.g., Atkinson & Juola, 1974; Hay & Jacoby, 1996; Hintzman, Caulton, & Levitin, 1998; Hintzman & Curran, 1994; Jacoby, 1991, 1999; Jacoby, Yonelinas, & Jennings, 1997; Mandler, 1980, 1991; Yonelinas, 1994, 1997). Familiarity is characterized as relatively fast, whereas recollection is characterized as relatively slow (e.g., Atkinson & Juola, 1973, Hintzman & Curran, 1994; McElree, Dolan, & Jacoby, 1999).

Both familiarity and recollection contribute to performance on a recognition test. For old words, familiarity and recollection work in concert—either process can lead to a hit. New words are assessed on the basis of familiarity (e.g., on a strength continuum; Yonelinas, 1994, 1997; Yonelinas, Kroll, Dobbins, Lazzara, & Knight, 1998). Recognition of feature and conjunction lures is based on both familiarity and recollection, but familiarity and recollection oppose each other. Familiarity pushes one to commit feature and conjunction errors, but recollection can be used to avoid the errors. Conjunction lures possess a higher familiarity strength than feature lures because the familiarity for both elements (instead of one element, as is the case for feature lures) is boosted by the study phase presentations.

For example, if one was to see the study primes *checklist* and *needlepoint* in a first phase but *checkpoint* on a recognition test, familiarity engendered by the components from the study

primes (e.g., *check* from *checklist* and *point* from *needlepoint*) would push one to respond “old.” If one depended solely on familiarity in making a recognition decision, then one would likely commit a conjunction error. However, one could avoid such an error by recollecting that *checklist* or *needlepoint* was presented in the study phase, not *checkpoint*. Thus feature and conjunction errors are based on familiarity in the absence of recollection.

Feature and conjunction lures are thought to be poor retrieval cues for the corresponding study primes, resulting in very low recollection (Jones et al., 2001). One reason feature and conjunction lures are poor retrieval cues is that there is a lack of transfer of conceptual information from study to test (e.g., Roediger, Weldon, & Challis, 1989). That is, *checkpoint* is conceptually different from *checklist* and *needlepoint*. Without a strong overlap in conceptual processes between study primes and test lures, retrieval of the study prime is a challenge. With familiarity relatively unopposed by recollection, feature and conjunction errors are difficult to avoid (see Kroll et al., 1996, and Reinitz et al., 1992, on the difficulty of avoiding the errors).

Another theory of feature and conjunction errors is that memory judgments are based on a familiarity assessment, and feature and conjunction lures possess greater familiarity than new words (e.g., Rubin, Van Petten, Glisky, & Newberg, 1999). Thus, feature and conjunction lures are identified “old” at higher probabilities than baseline. In cases where recollection of the study primes is nonexistent (i.e., recollection = 0), feature and conjunction error rates provide a good measure for familiarity. However, this approach does not allow the possibility that one could avoid an error by remembering that a different word was presented in the study phase. To avoid an error, a second process is required. Experiments 3 and 4 demonstrate this point.

Dissociations between old item recognition and feature and conjunction errors support the familiarity–recollection explanation. Old word recognition is based on familiarity and recollection working in concert, but feature and conjunction errors are based on familiarity in the absence of recollection. Therefore, a change

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