INTERFERENCE

Extensive research within the verbal learning tradition identified interference as the primary cause of forgetting (Melton & Irwin, 1940). Research from this perspective dominated work on the aging of memory for some time (see Welford, 1958); however, the rise of cognitive psychology in the 1970s triggered a paradigm shift away from the issue of forgetting and from interference mechanisms in particular. Cognitive gerontologists conducted few interference studies, and the field turned toward information-processing themes such as encoding, storage, and short-term versus long-term memory. Today, however, interference is of renewed interest, both in mainstream cognition and within cognitive gerontology, as at least one prominent view of cognitive aging predicts age differences in interference as a result of age differences in inhibitory capabilities (Hasher & Zacks, 1988; Zacks & Hasher, 1994): Converging evidence suggests that attentional inhibitory mechanisms

that regulate the contents of working memory are impaired with aging. In this view, older adults are assumed to suffer from increased interference between relevant and irrelevant information that is simultaneously activated within working memory.

Before discussing whether interference susceptibility does, in fact, differ across the adult life span, it will be useful to clarify several theoretical and empirical points. Interference is most commonly conceived as acting in either a retroactive or a proactive manner. Retroactive interference (RI) occurs when new learning has a detrimental effect on the recollection of previously learned information, for example, in the forgetting of one's old phone number after moving to a new home. Proactive interference (PI) occurs when previously learned information has a detrimental effect on the recollection of newly learned information, for example, in the forgetting of Spanish vocabulary words learned as a third language.

In the laboratory, RI and PI are traditionally induced with paired-associate memory tasks. Here subjects typically learn a critical list of word pairs for which their memory is later tested. RI and PI are manipulated by requiring subjects to learn another "interference" list of word pairs either sometime after the critical list (RI) or sometime before the critical list (PI).

Most studies of aging and interference have examined RI effects, and the data from a variety of tasks and stimuli are straightforward: Even when younger and older adults are matched on their original learning of the critical list, older adults show more RI than do younger adults (Arenberg, 1967, 1968; Davis & Obrist, 1966; Hulicka & Rust, 1964; Kay, 1951; Query & Megran, 1983; Ross, 1968; Suci, Davidoff, & Braun, 1962; Traxler, 1973; Wimer, 1960; Worden & Meggison, 1984; Zaretsky & Halberstam, 1968). There are a few exceptions to this trend, but most of these exceptions can be explained either by floor effects (Wimer & Wigdor, 1958) or by the use of middle-aged "young" groups instead of college-aged "young" groups (Desroches, Kaiman, & Ballard, 1966; Hulicka & Weiss, 1965). A study by Hulicka (1967) demonstrates another problem limiting several interference studies: testing for recall of very short stimulus lists (e.g., from 4- to 10-word pairs) may be a rather insensitive measure of age differences (see Gerard, Zacks, Hasher, & Radvansky, 1991). Further, different measures even within the same task may be differentially sensitive to interference effects. Hulicka (1967) reports age-equivalent recall of list 1 after the interference list, but there are large age differences in the number of trials to relearn list 1 after the interference list. Similar findings of age-related RI differences in relearning, but not in recall, are reported by Wimer & Wigdor (1958).

Fewer studies have examined age differences in PI with paired-associate tasks, but these unanimously report increased PI effects with aging (Dale, 1975; Kliegl & Lindenberger, 1993; Traxler, 1973; Winocur & Moscovitch, 1983). Older adults recall fewer critical list items than do younger adults, and they are also more likely to have prior list items intrude into their recall of the critical list. Although it is beyond the scope of this article to address other types of PI tasks in detail (e.g., the Brown-Peterson and release from PI paradigms), evidence for age-related PI differences in these tasks is more mixed, with some studies reporting increased PI with age (e.g., Elias & Hirasuna, 1976; Fozard & Waugh, 1969; Hartley & Walsh, 1980; Inman & Parkinson, 1983; Kausler, Wiley, & Lieberwitz, 1992; Mistler-Lachman, 1977; Talland, 1967) and some reporting no age differences (e.g., Dobbs & Rule, 1989; Keevil-Rogers & Schnore, 1969; Lorsbach, 1990; Moscovitch & Winocur, 1983; Parkinson, Inman, & Dannenbaum, 1985; Puckett & Lawson, 1989; Puckett & Stockburger, 1988). Drawing conclusions from these studies is thus difficult, especially because many of them may suffer from the sensitivity limitation of using extremely short stimulus lists. Upon closer inspection of methods, however, it is clear that the number of lists over which PI is measured is a critical variable. Studies indicating age differences in PI had a mean of 7.0 lists (excepting one outlying study), whereas studies indicating age equivalence in PI had a mean of 25.1 lists. Because PI has been demonstrated to build rapidly over lists (Wickens, 1970), studies with large numbers of lists may be measuring too late to detect age differences in PI that appear very quickly.

Because an extensive literature eventually identified competition among potentially appropriate response candidates as the dynamic source of interference (rather than unlearning; see Postman & Underwood, 1973), it is particularly important to explore competition effects in older adults. Recent work does this directly, using response time tasks such as the "fan ef-

fect" procedure (Anderson, 1983) that may also have the benefit of being more sensitive to age differences than paired-associate tasks. Here subjects typically learn a list of facts about characters who perform different actions. Some characters within this list are associated with only one action, and other characters are associated with several actions. Subjects are later tested with a speeded recognition test of studied versus nonstudied facts. Fan effects are said to occur when memory for a specific target fact is increasingly poor (as indicated by increasing recognition latencies and error rates) as additional facts are associated with the target's elements (i.e., when more actions are associated with a given character). Increasing the number of items associated with a given element increases the amount of competition between these response candidates at retrieval. And as in RI and PI tasks, older adults demonstrate greater interference effects than do younger adults (Cohen, 1990; Gerard et al., 1991; Rogers, Cantor, & Nestor, 1993).

In summary, older adults consistently exhibit exaggerated interference effects across a spectrum of RI, PI, and fan effect tasks, suggesting that older adults differentially suffer from response competition at retrieval. As the ability to discriminate the sources of potential competing responses has been identified as at least one major source of competition effects (Underwood, 1977; Underwood & Freund, 1968), it becomes useful to examine the relationship between interference and source memory in aging. A burgeoning literature on source memory, or source "monitoring" (for a review, see Johnson, Hashtroudi, & Lindsay, 1993), suggests that older adults are less able than younger adults to recall context information and to discriminate the sources of previously encountered information (e.g., Burke & Light, 1981; Hashtroudi, Johnson, & Chrosniak, 1989; Kliegl & Lindenberger, 1993; Mantyla & Backman, 1992; McIntyre & Craik, 1987). Thus, in addition to deficits in inhibitory capabilities (Hasher & Zacks, 1988), deficits in source monitoring may contribute to older adults' increased susceptibility to the competition among response candidates that underlies interference.

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THE ENCYCLOPEDIA OF AGING

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