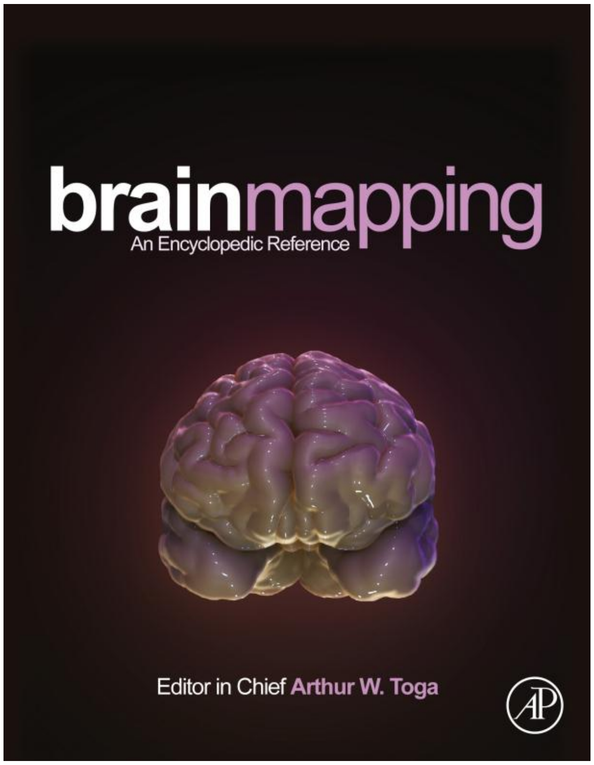

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Familiarity

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Phenomenological Accounts

According to Tulving (1985), familiarity is closely tied to the phenomenological experience of 'noetic consciousness' – when one remembers something without reliving a past episode (or without 'mentally time-traveling'). This is distinguished from autonoetic consciousness, when one is aware that one is reliving a past event (akin to recollection). Tulving devised an experimental procedure to measure these two types of experience, called the 'remember/know' procedure, in which participants indicate which of these two types of conscious experience accompanies each item in a recognition memory test. However, the mapping between the experimental labels 'remember' and 'know' and the theoretical concepts of recollection and familiarity may not be one to one (Mayes, Montaldi, & Migo, 2007). According to some (e.g., Gardiner, Ramponi, & Richardson-Klavehn, 1998), noetic consciousness and autonoetic consciousness are mutually exclusive, in that one cannot experience both states simultaneously, in which case the mapping is bijective. Alternatively, a recollected item might also always be familiar, in which case remember judgments will be a subset of know judgments (a 'redundant' relationship; e.g., Knowlton & Squire, 1995); or recollection and familiarity could be processes that occur independently, so that a remember judgment can sometimes be accompanied by familiarity and sometimes not.

Controlled Versus Automatic Retrieval

Another conception of familiarity relates to the work of Jacoby (1991), who distinguished familiarity in terms of automatic retrieval, in contrast with the controlled (effortful) process of recollection. He designed a 'process dissociation' procedure in which participants either endorse studied items regardless of their study context (the 'inclusion' condition, where automatic and controlled processes work together) or only endorse studied items from one context while rejecting unstudied items and studied items from another context (the 'exclusion' condition, where controlled and automatic processes are 'in opposition'). By assuming that the controlled and automatic processes are independent, the contribution of each can be estimated by simple linear combinations of performance in the inclusion and exclusion conditions. A number of other variables (e.g., semantic elaboration at study or a switch in modality at test) were found to have dissociable effects on these estimates of familiarity and recollection.

Attribution Theory

Jacoby also related familiarity to the automatic process of fluency. Fluency refers to more efficient processing of a stimulus owing to its prior exposure and may occur at multiple levels of processing (e.g., perceptual and/or conceptual fluency). Fluency is often assumed to be the cause of behavioral priming. Jacoby pointed out that familiarity may have the same underlying cause as priming, differing only in whether that fluency is consciously attributed to the past (familiarity) or not (priming). This has become known as 'attribution' theory and is important in relating notions of explicit and implicit memory.

Much research has since investigated conditions under which attribution occurs. One situation concerns whether people are aware of an alternative cause of fluency. For example, Jacoby and Whitehouse (1989) presented masked repetition primes before each item in a recognition test and found that they increased the likelihood that participants would endorse an item as studied (even if it was not). However, when the primes were rendered supraliminal by removing the masks, the opposite result was found, whereby participants were less likely to endorse the subsequent item as studied (even if it was). This was interpreted as fluency being erroneously attributed to the past (i.e., experienced as familiarity) when the cause of the fluency was unknown (i.e., when the prime was subliminal), but being erroneously attributed to the prime (rather than the study phase) when that prime was a perceptible, potential cause. Others have argued that fluency is only attributed to the past when it is unexpected (the 'discrepancy–attribution' hypothesis; Whittlesea & Williams, 2001). For example, fluent processing of the face of an occasional work colleague in a foreign airport (where one does not expect to recognize people) is more likely to be experienced as familiarity than is seeing the same face in the workplace (where fluent processing of faces is expected).

Other researchers have investigated whether familiarity depends on certain types of fluency. For example, some have argued that familiarity arises from conceptual but not perceptual fluency (e.g., Wagner & Gabrieli, 1998). Further research is needed to determine whether or when attribution occurs.

Statistical and Computational Models

Building on the assumed independence of familiarity and recollection, Yonelinas (2002) developed a statistical model of recognition memory in which familiarity is assumed to reflect a continuous dimension (as in signal-detection theory), whereas recollection is assumed to be a discrete occurrence (i.e., recollection either does or does not occur, though when it does occur, the amount of contextual information retrieved can vary). By plotting hits versus false alarms in a recognition test as a function of another variable like confidence (a receiver–operator curve (ROC)), one can estimate the two parameters of this 'dual-process' model – namely, (i) the difference in the means of the familiarity distributions for studied and unstudied items and (ii) the probability of recollection. Several experimental manipulations have again been found to

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dissociate these estimates of recollection and familiarity. There are other two-parameter models, such as the unequal variance signal-detection model (in which the recollection parameter is replaced by a parameter controlling the ratio of the variances of the studied vs. unstudied distributions), that can also fit ROCs well. However, even though these models only appeal to a single dimension of evidence on which participants base their recognition decision, they allow for the possibility that qualitatively different (though still continuous) processes like familiarity and recollection are combined onto this single dimension (Wixted & Mickes, 2010).

Computational models have been proposed that mimic these statistical models, but additionally specify representations and mechanisms. In some distributed memory models, for example, familiarity is assumed to correspond to the 'global match' between a vector (pattern) that represents the recognition cue and a matrix that captures a composite memory of all patterns previously presented (Clark & Gronlund, 1996). Recollection, on the other hand, corresponds to the pattern that is output when the same cue pattern is projected through this memory matrix. In other words, familiarity and recollection are computationally distinct outputs from the same memory system, in that the former is a single scalar value, whereas the latter is a new pattern (which may include additional contextual information from the original study pattern that is not present in the cue pattern). More recently, neural network models have been proposed that not only add explicit learning rules but also actually propose more than one memory system (i.e., more than one layer of weights; e.g., Norman & O'Reilly, 2003). One argument for these separate systems is that one is needed for pattern separation (to keep memories distinct enough for recollection), whereas another is needed for pattern completion (to generalize over different memories and provide a composite measure of familiarity). These systems have been mapped onto different brain regions, for example, the hippocampus versus perirhinal cortex, respectively, based on recent neuroscientific data.

Neural Substrates

Neuropsychological evidence has suggested that lesions to the hippocampus in patients with amnesia often impair recollection, whereas familiarity can remain intact if the surrounding medial temporal cortex is unaffected (e.g., Mayes, Holdstock, Isaac, Hunkin, & Roberts, 2002). More recently, Bowles et al. (2007) reported a single case with perirhinal damage but intact hippocampus who showed evidence of impaired familiarity but intact recollection, providing a double dissociation (though there is still debate whether this is the appropriate functional distinction for these anatomically distinct regions (e.g., Wixted & Squire, 2011)). Functional magnetic resonance imaging (fMRI) has provided support for this dissociation, in particular with repeated findings of reduced fMRI responses in the perirhinal cortex for studied relative to unstudied items, regardless of whether recollection is likely to have occurred (and hence associated with familiarity; e.g., Henson, Cansino, Herron, Robb, & Rugg, 2003). This reduction in fMRI response is analogous to decreased firing rates in perirhinal neurons to repeated stimuli that have been reported in animal studies of recognition memory. Event-related potentials from electroencephalography have also identified a component called the FN400 (a frontal negativity peaking around 400 ms) that appears to correlate with familiarity (and is topographically distinct from a later component associated with recollection), though debate continues over whether the FN400 component reflects (explicit) familiarity as opposed to (implicit) priming, specifically conceptual fluency (cf. Paller, Voss, & Boehm, 2007; Rugg & Curran, 2007). According to attribution theory, fluency may indeed be the common cause of these neural responses, with an additional attribution process (possibly occurring later in prefrontal cortex, or as part of a sustained retrieval state) determining whether or not this fluency is experienced as familiarity.

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See also: **INTRODUCTION TO COGNITIVE NEUROSCIENCE**: The Medial Temporal Lobe and Episodic Memory; **INTRODUCTION TO SYSTEMS**: Memory.

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