Hadyn Ellis and Andrew Ellis

Why we study … *repetition priming*

THIS series of articles is designed to convey to a wider audience not only some of the reasons for choosing to work in a particular way or area, but also why it is so exciting. We have independently chosen to employ priming techniques for a number of reasons which are outlined below. What is less easily conveyed, however, is the pleasure and satisfaction we take in being able to use such a reliably robust and informative method for establishing some of the fundamental mechanisms of mind/brain function.

It is so much easier for other scientists to discover the basic laws governing whatever they are studying. Psychologists, by contrast, have relatively few such building blocks upon which securely to construct their hypotheses and theories. We are impressed by the progress made using repetition priming as a basis for determining, in particular, models of word and object recognition. We very much hope that, having read our short piece, others will share our enthusiasm.

Attempting to understand the mental and brain processes underlying complex cognitive activities — such as recognising words and objects, remembering and attending — is inherently rather difficult. Approaches vary in detail, but cognitive psychologists usually adopt a traditional black box methodology: they systematically vary input parameters (independent variables) and measure output in terms of accuracy or speed (dependent variables); they then try to infer what is going on inside the box from the effects they observe.

Repetition priming is a variation upon this general technique. Essentially, if a familiar stimulus such as a word, face or object is presented twice within some finite time (and we shall return to the question of just how long that interval may be), then it is processed more efficiently at the second occurrence. This means that the initial processing of the item must leave a residual trace of some form that facilitates subsequent recognition of the same thing. Such facilitation is called repetition priming, and it is usually measured by the reduced time required to process primed stimuli compared with similar stimuli that have not been primed.

These days, if you pick up any journal devoted to experimental psychology, you will find a number of articles with the word 'priming' in their titles. Not all are to do with repetition priming; some, for example, may be concerned with the related phenomenon of 'semantic' or 'associative' priming, whereby recognition of a familiar stimulus can be facilitated if the item immediately preceding it is related in some way (e.g. the word BUTTER preceded by the word BREAD, or a picture of Tony Blair preceded by a picture of Gordon Brown). Associative priming for faces was first reported by Bruce and Valentine (1985).

The popularity of priming paradigms owes much to the difficulties faced by researchers trying to discern the complicated workings of the mind's machinery. If we return to repetition priming, researchers have studied its properties simply to learn something about the effects that encounters with familiar things have on the central nervous system.

Researchers have also used it as a tool to probe the way that knowledge is represented in the mind and brain. For example, recognising Margaret Thatcher's face as familiar is primed if you have seen the same photograph of her some time earlier or, indeed, if you have recognised a different photograph (Ellis *et al*., 1987), but the act of recognising her face as familiar is not primed if you have recently recognised her written name or her voice (Bruce & Valentine, 1985; Ellis *et al*., 1987; Ellis *et al*., 1997). This pattern of data has been taken to indicate that the recognition systems for faces, names and voices are separate in the initial stages of processing. The fact that young children show essentially the same priming effects as adults implies this to be an innate or early acquired property of the way we process information (Ellis *et al*., 1993).

Hadyn Ellis (left) and Andrew Ellis

When we talk here of 'recognising a face as familiar', we typically have in mind a task in which you see a random sequence of familiar and unfamiliar faces then have to press one button if the face is known to you and another if it is not (the so-called 'familiarity decision task'). Earlier recognition of names or voices does not affect your speed of responding to faces under these conditions. It is a different matter, however, if your task is to name familiar faces. Here, if you have recently read the famous people's names aloud, you will name their faces more rapidly (Ellis *et al*., 1996). We believe that this is because recognition systems for faces, names and voices that are 'domain-specific' in the early stages of processing converge later on central systems which store semantic knowledge about people (e.g. their occupations or nationalities) and also store their spoken names. Access to these later stages can be primed by one sort of input and then generalised to another, and so can cross between modalities. Models of person recognition, such as that proposed by Burton *et al*. (1990) are well able to account for such findings (see Young, 1997).

A further application of repetition priming concerns its use to understand anterograde amnesia in brain-damaged individuals. These people quickly forget any new information given to them, but priming techniques can show that some (implicit) trace of their experiences may be retained. For example, an amnesic patient who has read a list of words including the word REASON will show an increased probability of completing the word fragment REA _ _ _ as REASON rather than, say, READER or REALITY some time later. This occurs even though respondents may have absolutely no conscious recollection of having read REASON and, indeed, no recollection of the episode in

which they were given words to read (Moscovitch *et al*., 1994). What this seems to show is that amnesic patients retain internal representations of words, objects and faces which can be adjusted by experience, even when the processes which mediate conscious recall of priming episodes are severely damaged.

So, by what interval of time can two encounters with a familiar stimulus be separated with repetition priming continuing to be observed? The answer would seem to be that — at least under some circumstances — the encounters can be separated by weeks or months with the first encounter still priming the second (Cave, 1997). For example, Flude (1993) showed that the recognition of celebrity faces could be primed by an encounter four or five months earlier. The effect was smaller than if the priming encounter was just a few minutes earlier, but it was there nonetheless. Over such intervals of time, normal healthy people are unable to recall consciously which faces they saw all that time ago. That is, the dissociation between priming and episodic recall, which is so striking in the amnesic patients, can also be observed in normal participants if you subject them to the right conditions.

In sum, repetition priming is just one of many techniques used by experimental psychologists in an attempt to understand the workings of our minds and brains. As experimental effects go, it seems to have produced an above-average number of insights which, when combined with insights from other experimental techniques, plus neuropsychology and computational modelling, have advanced our understanding of how we recognise familiar objects, faces and words.

What we have avoided saying anything about, of course, is just how priming works and what neural processes may support it. That will have to wait for another opportunity.

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