Bumper cars are a perennial favorite at county fairs and amusement parks. On the floor of each car, there is a single button that the driver pushes to go. To stop, the driver releases the button, and friction gradually stops the car. For quick stops, it is best to bump into another car. (This, of course, is the whole point of the ride.) Rush hour traffic in any major city often resembles bumper cars. The cars start and stop, and they dart in and out, but they do not generally bump into each other. This is because automobiles have brakes in addition to accelerators, giving their drivers much finer control and maneuverability.

Cognition can be compared with bumper cars and traffic jams. Various cognitive processes are ongoing simultaneously, some becoming more active, others becoming dormant. How are unwanted cognitive processes stopped? Do other, more active processes block them, bumper car style, or are there inhibitory mechanisms, cognitive brakes, as it were, that actively stop unwanted processes? This is the question addressed in the book *Inhibition in Cognition*, edited by David S. Gorfein and Colin M. MacLeod.

The chapters in this book cut a wide swath across cognitive psychology. Three chapters each are devoted to the areas of attention and performance, memory and language, development and aging, and pathology and psychopathology. In each area, the reader can find authors who favor the concept of inhibition in cognition and those who argue for alternative explanations. Reading across the chapters, one can discern four important themes. The first theme is the definition of inhibition, a term that means different things to different researchers, and the second theme has to do with the relationship between inhibition at the neural and cognitive levels. The third theme concerns issues involving the measurement of inhibition, and the fourth theme revolves around parsimony in model building. Within each theme, a wide variety of opinions is expressed.

**Definition**

The concept of inhibition in cognition goes back at least as far as William James (1890/1983), who, in his classic text *Principles of Psychology*, discussed the process of attention largely in terms of inhibiting irrelevant information coming in from the senses. Pillsbury (1908) developed this idea further by suggesting that attention proceeds through a combination of facilitation and inhibition. A quarter century later, Stroop (1935) commented in the introduction to his classic article that the concept was frequently invoked in the literature; however, he also lamented that the term *inhibition* was not clearly defined and was used interchangeably with
interference. More than 70 years later, the definition of inhibition is still unresolved, as MacLeod points out in Chapter 1 of the present volume.

The various authors of this book propose several definitions for inhibition as it is used in cognitive psychology. In Chapter 1, MacLeod offers what is probably the clearest distinction between inhibition and interference. He suggests that the term interference be used in the more general sense to describe an observed drop from baseline when multiple streams of information are processed simultaneously. The term inhibition, then, would be reserved for a mechanism that directly reduces the activity of some cognitive process. In Chapter 4, Neill argues for the distinction “between inhibition as a cause and inhibition as an effect” (p. 74); a close reading of this chapter, however, suggests that Neill’s “inhibition as an effect” means roughly the same as MacLeod’s interference, with Neill’s “inhibition as an cause” being more or less equivalent to MacLeod’s concept of inhibition. Reyna and Mills (Chapter 10) use both terms, viewing interference as a passive process and inhibition as an active process, perhaps even requiring “active self-control” (p. 205). In addition, several authors introduce the term suppression in much the same sense that Gernsbacher (1990) used it in her structure-building theory of lexical ambiguity processing. It appears, then, that suppression represents the same concept as MacLeod’s inhibition. Thus, although it cannot be said that the authors in this volume have reached a consensus on terminology, their ideas do seem to converge toward a common view of what inhibition is.

Levels of Analysis

Part of the confusion with the definition of inhibition derives from the fact that the term is used at multiple levels of analysis. Inhibition at the neuronal level is a long-established fact; however, as MacLeod (Chapter 1) points out, there is no reason to assume that neuronal inhibitory processes carry up to the cognitive level. For example, Neill (Chapter 4) observes that it is “tempting” to interpret positive and negative priming as “analogous to the opposing effects of excitation and inhibition on the activation level of the neuron” (p. 63); however, he goes on to add that other interpretations are better supported by the data. Likewise, Levine and Brown (Chapter 14) remark that it is “natural to suppose” that neural inhibition underlies apparent cases of cognitive inhibition (p. 281), but they devote the bulk of their chapter to demonstrating why this assumption is unwarranted.

There is also evidence for inhibitory processes at the cortical level. Several authors in the current volume point to the dorsolateral prefrontal cortex in particular as an executive inhibitory mechanism. Mayr (Chapter 2) argues that this region is implicated in the switch costs that accrue when shifting attention from one task to another while multitasking. Lustig, Hasher, and Zacks (Chapter 8) point to this same area, among others, in explaining cognitive deficits in the aged. For example, they interpret reduced working memory capacity as a decrease in the ability to inhibit irrelevant information from attention, in much the same way that James (1890/1983) did. On the other hand, Levine and Brown (Chapter 14) are more reserved about the idea of a prefrontal executive, arguing that both excitatory and inhibitory processes are active at the neuronal level in this region of cortex.

It is not clear just how inhibition at the cognitive level relates to inhibition at the neural level. One tack is to interpret cognitive inhibition as analogous to the volitional suppression of a motor response. This is the position Neill (Chapter 4) takes in his discussion of negative priming, and Anderson and Levy (Chapter 5) take a similar stance in their examination of memory suppression. Another tack is to argue for various levels of inhibition, each building on the level below, with neuronal inhibition at the base. This is the position that Faust and Balota (Chapter 11) take in their discussion of dementia of the Alzheimer’s type. Furthermore, Neill maintains that even within the realm of cognition it is necessary to distinguish “different levels of representation” in which inhibition might occur (p. 75). Indeed, Carr (Chapter 15) maintains that an important way to understand inhibition in cognition is by examining the underlying neural processes. This position seems to contradict
MacLeod's assertion in Chapter 1 that “there is no necessary relation between cognitive inhibition and neural inhibition” (p. 14). In sum, the authors of this volume express a wide range of opinions on this issue.

**Measurement and Baseline**

A persistent problem in research on cognitive inhibition is the question of how exactly to measure it. MacLeod (Chapter 1) points out that a drop below baseline is not necessarily indicative of inhibition for two reasons, first because the drop could be due instead to interference and second because the baseline itself “is always subject to debate” (p. 15). As Dagenbach et al. (Chapter 3) point out, switch costs are a “basic fact” of multitasking (p. 46); the challenge then to the researcher is to explore the roots of these costs in particular situations, with inhibition being only one possibility. Just measuring the cost of switching between tasks is problematic, and determining that the cost is due to inhibition is even more challenging. Anderson and Levy (Chapter 5) argue that methods for testing inhibition need to be modified to ensure that the perseverative effect of inhibition, which may actually facilitate later trials, does not skew the measured deviation from baseline. They suggest that the putatively inhibited items be tested independently. In addition, lower-level factors of performance need to be properly controlled. For example, Burke and Osborne (Chapter 9) argue that some apparent cognitive decrements in older populations, which are often interpreted in terms of loss of inhibitory control, are in fact due to sensory impairments.

**Parsimony**

Parsimony is a concern to many of the authors of this volume. In Chapter 1, MacLeod expresses his doubt that inhibition could ever be the most elegant explanation. Instead, he suspects that other mechanisms that have already been established will suffice in explaining the experimental data, and he exhorts his colleagues to always consider alternatives before invoking inhibition. Gorfein and Brown (Chapter 6) share the same concern, and, moreover, they admonish their colleagues “to make sure they haven't implicitly snuck inhibition into their model” (p. 103). Likewise, Carr (Chapter 15) insists that the null hypothesis should always be that the observed effect is produced without inhibition. Several authors (Gorfein and Brown, Chapter 6; Burke and Osborne, Chapter 9) even suggest that examples of supposed cognitive inhibition might be more parsimoniously explained at a lower level, such as a sensory deficit or neural inhibition.

On the other hand, other authors in the volume disagree, arguing that inhibition could be a parsimonious explanation for the data. Though reluctant to accept inhibition, Dagenbach et al. (Chapter 3), maintain nevertheless that it is “a useful solution of a particular range of cognitive processing dilemmas” (p. 60). Furthermore, Levine and Brown (Chapter 14) view activation and inhibition as “complementary operations” that are “partners as much as opponents” (p. 298). Faust and Balota (Chapter 11) concur with this view, adding that “inhibitory control” is needed “to regulate the signal-to-noise ratio” (p. 216). In a similar vein, Lustig, Hasher, and Zacks (Chapter 8) argue that inhibitory mechanisms are needed to account for the speed and accuracy observed in cognitive processing, and Mayr argues that inhibition is the best explanation for what he calls the “stability–flexibility dilemma” (p. 28), by which he means the need to maintain accuracy in spite of distractions and the ability to shift task focus quickly when needed. Finally, Nigg, Carr, Martel, and Henderson (Chapter 13), in an investigation of inhibitory processes in psychopathology, are unconcerned whether inhibition is a parsimonious explanation at the cognitive level because they find putative examples of cognitive inhibition to be useful concepts at the clinical level.

**Conclusion**

This volume addresses an important issue in cognitive psychology that is often overlooked. As Stroop (1935)
pointed out, the concept is in common use, often inconsistently from one context to another. Many researchers assume the existence of inhibition at the cognitive level, mainly because of its ubiquity at the neural level, without considering whether it is the most parsimonious explanation or even how to measure it. The authors in this collection do not achieve consensus on any of these issues. Rather, the strength of this book is the breadth in which the question of inhibition in cognition is examined. All the principle arguments are laid out, leaving it up to the readers to decide on their own, but giving them ample evidence to consider regardless of their initial position on this issue. This book is an important contribution to the field of cognitive psychology.

References