

The duality of mind: An historical perspective *

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In recent years an exciting body of work has emerged from various quarters devoted to exploring the idea that there is a fundamental duality in the human mind. Since the 1970s *dual-process* theories have been developed by researchers on various aspects of human psychology, including deductive reasoning, decision-making, and social judgement. These theories come in different forms, but all agree in positing two distinct processing mechanisms for a given task, which employ different procedures and may yield different, and sometimes conflicting, results. Typically, one of the processes is characterized as fast, effortless, automatic, nonconscious, inflexible, heavily contextualized, and undemanding of working memory, and the other as slow, effortful, controlled, conscious, flexible, decontextualized, and demanding of working memory. Dual-process theories of learning and memory have also been developed, typically positing a nonconscious *implicit* system, which is slow-learning but fast-access, and a conscious *explicit* one, which is fast-learning but slow-access.

More recently, some theorists have sought to unify these localized dual-process theories into ambitious theories of mental architecture, according to which humans have, in effect, two minds. Such theories claim that human central cognition is composed of two multi-purpose reasoning systems, usually called *System 1* and *System 2*, the operations of the former having fast-process characteristics (fast, effortless, automatic, nonconscious, etc.), and those of the latter slow-process ones (slow, effortful, controlled, conscious, etc.) (e.g., Evans and Over 1996; Sloman 1996; Stanovich 1999, 2004). It is often claimed that System 2 is unique to humans, and that it is the source of our capacity for decontextualized abstract thinking, in accordance with logical norms. These all-encompassing theories are sometimes referred to as *dual-system* theories, in contrast to more localized *dual-process* ones, but ‘dual process theory’ is also used as an umbrella term for both, and for convenience we shall often adopt this usage.

In the form just outlined, dual-process theories are the product of the last thirty years or so, but it would be a mistake to think that hypotheses about mental division are unique to contemporary psychology. In fact, modern dual-process theories can be seen simply as the latest and most sophisticated development of ideas that have been around for centuries. In this chapter we shall survey this history of thinking about mental duality, looking at precursors and related theories in philosophy and psychology, and giving a detailed account of the origins of modern dual-process and dual-system theories themselves. We shall not aim to identify patterns of influence, except for some fairly modest ones in recent work. In many cases, the ideas discussed

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appear to have been developed quite independently, and in any case claims of influence are hard to establish — sometimes even for the theorists involved (see Evans 2004). Rather, we shall aim to show how theories of mental duality have emerged independently in different contexts. It strikes us as greatly significant that dual-process ideas have been continually discovered and rediscovered by many authors throughout the history of philosophy and psychology. We suspect this reflects on the nature of the object of study that all these authors have in common: the human mind.

The chapter is organized by themes rather than strict chronology. The first section looks at theories of mental division from Plato to Freud, focusing in particular on claims in the philosophical literature. The second section surveys relevant work in experimental psychology from the nineteenth century through to the mid-twentieth. Section 3 charts the history of modern dual-process theories in specific fields, and Section 4 describes the subsequent development of dual-system approaches. The fifth section considers the contribution of contemporary philosophy, where several researchers have developed dual-process theories of their own, and the final section offers some speculations about the future development of dual-process ideas.

1. Division in the mind: Plato to Freud

The idea that the mind is partitioned is an ancient one. Perhaps the most famous account before Freud's is to be found in Plato, who claimed that the soul is divided into three parts: *reason*, *spirit*, and *appetite*, understood as mini-agents, each with its own goals and reasoning powers (Plato 1993, pp.144-152, pp.354-361; for discussion see Annas 1981, ch.5). Reason seeks truth and pursues what is best for the person as a whole; spirit loves honour and winning; and appetite judges by appearances and seeks superficially gratifying things. Harmony within the soul comes when reason controls the other two parts, training spirit to serve its goals and regulating appetite in line with its judgements of what is genuinely desirable. This is fanciful psychology, of course, and heavily influenced by Plato's political theory (the three elements in the soul correspond to the three classes in his conception of the ideal society), but there are nonetheless some analogies with dual-process approaches. Like dual-process theory, Plato's account is designed to explain psychological conflict — to show how we can harbour conflicting attitudes towards the same object. And Plato's conception of reason is similar to some modern conceptions of System 2, being that of an analytic system, which seeks the good of the individual as a whole and is able to override more superficial judgments and desires originating in the other parts of the mind.

Anticipations of dual-process theory can also be found in philosophical debates about animal mentality. Many philosophers have held that humans exhibit a qualitatively different kind of mentality from other animals. Indeed, some have denied that animals have minds at all, at least in the sense of a capacity for rational thought. Aristotle, Aquinas, and Descartes all took this view. Such views partially anticipate those of many dual-process theorists, who see System 2 as uniquely human and as conferring reasoning capacities different in kind from those of animals. Descartes's

views on this topic are particularly interesting. Descartes famously denied that animals have minds, which he equated with incorporeal souls. Language use, he argued, is the only sure sign of thought, and animal behaviour can be mechanistically explained without reference to genuinely mental processes. Yet Descartes did not ignore the complexity of animal psychology (as we would call it). He held that animals have perceptions, memories, appetites, and passions, albeit of a nonconscious kind, which are complex physiological states and which guide action mechanically, without the involvement of a soul (Descartes 1664/1985, p.108). Moreover, he held that much *human* behaviour is the product of similar mechanical processes, including such everyday activities as walking and singing, when they take place without the mind attending to them (Descartes 1642/1984, p.161; Cottingham 1992). Though Descartes may not have thought of it as such, this is a rudimentary dual-process view.

Other writers have argued for the uniqueness of human reasoning without denying that animals can think. Leibniz maintained that animal behaviour is guided solely by inductive reasoning, as is the larger portion of our own (he says ‘three-fourths’; 1714/1989, p.208). However, he held that humans also have a capacity for ‘true reasoning’ — that is, a priori reasoning based on necessary truths, such as those of logic and mathematics. This capacity, he held, derives from our possession of reflective consciousness, which enables us to form metaphysical concepts, such as those of substance, cause, and effect (Leibniz 1702/1989, pp.188-91, 1714/1989, pp.208-9). Locke, too, held that there is a ‘perfect distinction’ between human and animal reasoning powers. Animals can think about particular things, as presented to their senses, but they lack the power of *abstraction*. That is, they cannot form general ideas of features common to many instances — the idea of whiteness, for example, as opposed to ideas of particular white things. This is evident, Locke argues, from the fact that animals lack language, and with it, signs for general ideas (Locke 1706/1961, Vol 1, pp.126-7). Other writers have argued for the uniqueness of human mentality on the grounds that thought (at least of the distinctively human kind) constitutively involves language — that we can, in some sense, ‘think in’ language. This view was proposed by both Herder and Hamman in the late eighteenth century (see Cloeren 1988), and, as we shall see later, it is advocated by several contemporary philosophers of mind. Again, all of these accounts contain the seeds of a dual-process approach, and they partially anticipate modern theorists who characterize System 1 reasoning as associative, context-bound, and non-linguistic, and System 2 reasoning as rule-based, abstract, and language-involving.

We turn now to the theme of unconscious mentality, where the clearest anticipations of dual-process theory can be found. It is sometimes assumed that the concept of the unconscious originated with Freud, but this in fact is far from the case. It is true that many philosophers resisted the idea of unconscious mentality, following Descartes in identifying mind with consciousness. But there is, nonetheless, a long history of theorizing about the unconscious, though in many cases no distinction is made between mental states that are not present to consciousness and ones that are not available to it — *preconscious* versus *unconscious*, in Freud’s terms (for surveys,

see Ellenberger 1970; Reeves 1965; Whyte 1978). References to unconscious memories and perceptions crop up in various ancient and early modern philosophers; examples can be found in, among others, Plato, Plotinus, Augustine, Aquinas, Pascal, Spinoza, and Leibniz. Leibniz, in particular, made important observations about unconscious perception and memory. He distinguished between bare *perception* and conscious *appreciation*, and held that we continually experience a multitude of unattended *petites perceptions*, which are below the threshold of consciousness but which collectively shape our conscious experience (Leibniz 1714/1989, p.208, 1765/1996, pp. 53-55). He also noted that we often retain information which we cannot consciously recall but which nonetheless influences our thoughts and behaviour (Leibniz 1765/1996, pp.106-7).

With the rise of German idealism and Romantic aesthetics in the late eighteenth and early nineteenth centuries, claims about the unconscious became common. There are frequent references to unconscious mental states in Herder, Schelling, Hegel, and Schopenhauer, among others, as well as in creative writers such as Goethe, Richter, and Wordsworth. These writers' conceptions of the unconscious had strong metaphysical and mystical overtones. The German idealists thought of the unconscious as part of the underlying structure of reality, rather than as a postulate of empirical psychology (Gardner 1999, 2003), and the Romantic writers saw it as a source of inspiration and creative energy. Nonetheless some interesting psychological observations can be found in their work.

Schopenhauer's writings are particularly relevant from our perspective. Schopenhauer held that there is a blind 'will to life' at work throughout nature, which shapes our conscious intellects to its own ends, in line with powerful primitive impulses, especially sexual ones. (In a striking metaphor, he likens the relationship between the will and the intellect to that of a strong blind man carrying a sighted lame man on his shoulders; Schopenhauer 1819/1966, Vol 2, p.209.) Anticipating (and probably influencing) Freud, Schopenhauer claimed that the will represses ideas it finds painful and promotes ones it finds comforting. Moreover, like many modern dual-process theorists, he stressed the limitations of our self-knowledge and the relative impotence of the conscious intellect. He held that we possess unconscious desires, emotions, and resolutions — sometimes shameful ones — which we discover only indirectly, through observing our reactions. And he suggested that we are often ignorant of the true motives for our actions and that our conscious resolutions require backing from unconscious processes if they are to be effective (ibid. Vol 2; pp.209-11).

Philosophers continued to develop broadly metaphysical theories of the unconscious throughout the nineteenth century (Gardner 2003). Eduard von Hartmann's widely-read 1868 book *Philosophy of the Unconscious* synthesized Hegel and Schopenhauer, and Nietzsche and Bergson each produced influential accounts of their own. This work is, however, of marginal interest from our perspective, though it offered ammunition for philosophers and psychologists working to combat Cartesian conceptions of the mind and provided the intellectual context for the work we discuss next.

We turn now to another strand of thinking about the unconscious. Several nineteenth-century philosophers and physicians developed a view of the unconscious as a set of automatic processing systems for everyday tasks — a view which directly prefigures the modern conception of the cognitive, or ‘adaptive’, unconscious invoked in contemporary dual-process theories. Again there is a rich history here, and we can mention only a few milestones.

A largely forgotten pioneer in this area is the French philosopher known as Maine de Biran, who wrote on the influence of habit on thinking (Maine de Biran 1803/1929; for discussion see Schacter and Tulving 1994). Maine de Biran noted that habitual actions could become so ingrained as to be completely automatic and unconscious, and he drew a distinction between habit-based memory systems and conscious memory, positing two systems for habitual responses: *mechanical memory* and *sensitive memory* — the former for motor skills, the latter for affective responses. Conscious memory was assigned to a third system, *representative memory*. In making such distinctions, based on function and content, Maine de Biran anticipated modern distinctions between implicit and explicit memory systems.

Another important development was the gradual recognition of the existence of unconscious mental *processes* underlying conscious thought and action — a view now commonplace, but radical in the nineteenth century. Helmholtz was one of the first to posit unconscious inferences, in his work on perception (Helmholtz 1867/1962; Hatfield 2002). The case for the existence and importance of unconscious processes was also made by a group of British philosophers and physicians, notably Thomas Laycock, William Hamilton, and William Carpenter, whom Timothy Wilson has dubbed the parents of the modern theory of the adaptive unconscious (Wilson 2002, p.10). Laycock developed the doctrine of the *cerebral reflex* — the view that many higher brain functions are effected by sophisticated but unconscious reflex processes, similar in kind to the more primitive ones in the brain stem and spinal cord. Laycock suggested that instinctive and emotional responses could be explained in this way, as could some aspects of intelligence (Laycock 1845, 1860). Hamilton vigorously attacked his Cartesian contemporaries and defended a doctrine he called *mental latency* — the view that the mind contains far more ‘mental furniture’ than consciousness reveals — pointing to evidence for unconscious processing in perception, the association of ideas, and the performance of habitual and skilled actions (Hamilton 1860, Vol 1, pp.235-52). As Hamilton put it, ‘the sphere of our conscious modifications is only a small circle in the centre of a far wider sphere of action and passion of which we are only conscious through its effects’ (ibid, p.242). Carpenter gathered evidence for what he called ‘unconscious cerebration’ (he regarded the term ‘unconscious reasoning’ as contradictory). He cited cases where people recall knowledge they do not know they possess (as in the phenomenon of ‘automatic writing’), and highlighted the role of unconscious processes in generating insights, modifying emotions, and supporting unacknowledged prejudices (Carpenter 1874, pp.515-43).

William James's views deserve mention here, too. James is often thought of as having opposed the positing of unconscious mental states, and as thereby exerting a retrograde influence on psychology (Baars 1986, pp.34-9). There is material to support this view (James 1890, Vol 1, pp.162-76), but it can be argued that James's target was a metaphysically-laden conception of the unconscious (Weinberger 2000), and James talks freely about states and processes at the margins of consciousness, if not completely outside it (see in particular his 1902 book on religious experience). Moreover, James himself contributed to the development of the modern conception of the cognitive unconscious with his account of *habit* (James 1890, Vol 1, ch.4). He describes how sequences of actions can become automatized through repetition, thus freeing up conscious attention for other tasks. James cites everyday routines such as dressing and opening cupboards: 'Our lower centres know the order of these movements,' he writes, 'and show their knowledge by their "surprise" if the objects are altered so as to oblige the movement to be made in a different way. But our higher thought-centres know hardly anything about the matter' (ibid. p.115). James notes that we can access this knowledge only indirectly, by performing or mentally rehearsing the actions in question. This account harmonizes well with the views of modern dual-process theorists, who treat habit formation as involving a transfer of control from the conscious volitional system to the unconscious automatic one (e.g. Stanovich this volume).

We turn now to a further tradition of theorizing about the unconscious, which came to overshadow the one just discussed — some would say with detrimental consequences. This is the appeal to the unconscious in psychiatry, which established itself as a discipline during this period. Nineteenth century scientists made extensive studies of mental disorder, especially what was called *hysteria* — a catch-all term for anxiety disorders, psychosomatic illnesses, and dissociative conditions such as amnesia and multiple personality disorder. These conditions were often seen as manifestations of unconscious states, and in the later decades of the century several theorists developed sophisticated *dynamic* accounts of mental disorder in terms of unconscious motivations. The pre-eminent name here is of course that of Sigmund Freud, who drew on clinical work by Pierre Janet and Josef Breuer, among others, and on the philosophy of Schopenhauer and Nietzsche. Freud developed a precise, detailed, and far-reaching theory of what he called the 'dynamic unconscious', which was designed to explain, not only hysteria and other psychopathologies, but also many aspects of normal development and behaviour. This work had a huge impact on early and mid twentieth-century psychiatric theory and practice, as well as on the popular imagination, but in recent decades it has attracted severe criticism, and today many regard it as wholly discredited (e.g. Grünbaum 1984, Macmillan 1997). (Many contemporary cognitive scientists prefer to speak of 'nonconscious' processes rather than 'unconscious' ones, precisely in order to distance themselves from Freud.) This is not the place to enter into debates about the value of Freud's work and legacy, however, and we shall confine ourselves to noting how Freud's conception of the unconscious differed from that in play in modern dual-process theories. Freud's views

are complex and changed considerably over the years, so we shall paint with a very broad brush.

Freud can certainly be described as a dual-process theorist. He held that the human mind is composed of two systems, a conscious one and an unconscious one, commonly labelled *Ucs* and *Cs* respectively. (He also posited a third, *preconscious* system, *Pcs*, which for many purposes can be regarded as a part of *Cs*.) He held that these systems operated in different modes ('primary process' and 'secondary process'), the former associative, the latter logical. He also held that the contents of the unconscious system were inaccessible to the conscious one, and that the unconscious system was a source of motivation and mental conflict. So far, modern dual-process theorists can agree. However, there are huge differences between Freud's *Ucs* and System 1, as standardly conceived. We shall mention three.

First, *Ucs* consists largely of repressed impulses (or, in Freud's earlier work, memories) that have been prevented from becoming conscious because of their traumatic nature. (Freud thought that material naturally progressed from *Ucs* to *Cs* if not repressed.) By contrast, the notion of repression has no role in modern dual-process theory. System 1 is assumed to have its own propriety knowledge base and goal structure, formed by routine belief-forming and desire-forming mechanisms, in response to perceptual information, bodily needs, and so on. And although some of its goals are genetically determined ones, which may conflict with those of System 2, these are not thought of as having been repressed. Second, *Ucs* is not a reasoning system; it does not represent negation, probability, time, or external reality, and seeks only to maximize pleasure and minimize pain, in accordance with the 'pleasure principle' (Freud 1915/2005, pp.69-70). System 1, on the other hand, is a set of inferential mechanisms for the control of various aspects of everyday behaviour, and has a rich representational structure. Thirdly, the influence of *Ucs* is indirect and often harmful. It has no direct access to motor control (ibid. p.70) and can influence conscious thought and action only indirectly, through its 'derivatives' — dreams, neurotic symptoms, and activities that symbolically represent the fulfilment of repressed impulses (ibid. pp.73-4). System 1, by contrast, has a far more direct and beneficial role. Some theorists hold that it can control action directly, bypassing System 2 altogether, others that it generates default responses, which are then vetted by System 2. Either way, its outputs are direct outcomes of its goals, rather than the indirect, symbol-laden influences characteristic of *Ucs*.

In his later writing Freud proposed a tripartite division of the human mind into *id*, *ego*, and *superego*, which cut across the earlier distinction between *Ucs* and *Cs* (Freud 1927). The *id* is a primitive pleasure-seeking system, the *superego* a moral system embodying social norms, and the *ego* the rational self, which deals with the external world and tries to reconcile the competing demands of the other two systems. Again, there are superficial similarities with a dual-process approach. System 1, like the *id*, harbours primitive, genetically programmed goals, whereas System 2, like the *ego*, pursues the goals of the individual as a whole. But there are also huge differences. For example, System 1, unlike the *id*, is capable of representing and engaging with external

reality, and the functions of the superego are not unique to either System 1 or System 2. (It is plausible to think that social norms can be internalized by both; see Saunders this volume.) In the end, whatever their value as therapeutic tools, Freud's taxonomies have little more relevance to contemporary dual-process theories than does Plato's tripartite division of the soul.

2. Experimental psychology: The first 100 years (or so)

In section 1, we sketched the history of thinking about dual processes through ancient philosophy down to the writings of Sigmund Freud. This work was conceptual or theoretical in nature and mostly based on informal observations of human behaviour and/or personal introspection by the authors. A very different kind of influence emerged with the discipline of experimental psychology. In order to appreciate this, we need to turn the clock back a little from the end of section 1 to the mid-nineteenth century, when researchers began to conduct systematic psychological experiments, mostly in German universities. Such early psychological research was, in fact, based primarily on the study of *conscious* mental processes, and the use of introspective reporting was common. Of particular importance were the psychophysical schools of Gustav Fechner and Wilhelm Wundt. Psychophysics is essentially the study of the relationship between the properties of physical stimuli and the perceptual experiences that they give rise to. It remains an active field to the current day, and many of the methods established in this early period are still in use.

Despite the long history of writing about unconscious processes, described in the previous section, early evidence of unconscious processing in psychological experiments generated considerable controversy in the fledgling discipline of psychology (for reviews, see Humphrey 1951; Mandler and Mandler 1964). The problems began with the studies of the Wurzburg school, around the turn of the nineteenth and twentieth centuries, with their new methodology. These researchers asked people to perform simple cognitive tasks, such as word association, and then immediately after to give an introspective report on what was going on in their minds. The researchers expected, in accordance with a long tradition of associationist philosophy, to find mediating images linking stimulus and response. For example, if the experimenter said 'egg' and the participant 'bacon', it was expected that they would then report an image of a breakfast table with a plate of bacon and eggs on it. Sometimes, this is what happened, but participants also reported on many occasions that no conscious experience intervened between stimulus and response, or else that they had an experience of an indescribable nature — the so-called 'imageless thoughts'. Wundt objected to the retrospective nature of the reporting, foreshadowing the famous critique of introspective reporting in modern psychology by Nisbett and Wilson (1977). Other psychological greats of the time, including Titchener, objected to the very idea that such things as imageless thoughts could exist — foreshadowing modern debates about the nature of mental imagery.

Outside of German psychology, the great British Victorian scientist, Sir Francis Galton, independently concluded that most brain work was automatic and unconscious. He used word association tests (which he invented) to explore unconscious associative processes, analysing the ideas generated for their rate, character, age, tendency to recurrence, and so on. He conducted these introspective experiments on himself and (remarkably) noticed how little of the brain's mental work was reflected in the contents of consciousness. The experiments, Galton concluded, revealed 'the multifariousness of the work done by the mind in a state of half-unconsciousness' and indicated the existence of 'still deeper strata of mental operations, sunk wholly below the level of consciousness' (1879b, p.162). He went on to stress the extent and importance of unconscious mental operations, and suggested that consciousness was little more than a 'helpless spectator' of the bulk of automatic brain work — a claim which prefigures the views of some contemporary theorists (1879a, p.433.) (In a poetical metaphor, Galton likened unconscious mental operations to waves travelling by night over an expanse of ocean, with consciousness being the line of breakers on the shore.)

The real hammer blow for introspective psychology, however, came from the foundation of the school of behaviourism by J B Watson in the early twentieth century, following publication of his famous paper, *Psychology as the behaviourist views it* (1913). This began what some observers see as a 'long dark age' in psychology that lasted some fifty years or more, until the cognitive revolution eventually swept it away. Even when the second author (J.E.) was studying psychology in the 1960s, the behaviourist B F Skinner was easily the most famous psychologist in the world, and his writings were still taken very seriously by many readers. Watson built on Pavlov's work on classical conditioning to construct a stimulus-response psychology that was stripped bare of mentalistic thinking. In philosophical terms, Watson was an extreme empiricist (as opposed to nativist), a firm believer in the *tabula rasa* or blank slate theory of the mind, so strongly advocated by the British empiricist philosophers, such as Locke. Thus Watson believed that, with the right conditioning, anyone could be made to be any kind of person. However, behaviourism had many ramifications beyond empiricism. It banished not only introspectionism but any form of mentalism — that is, the description of internal mental processes that mediate behaviour — as 'unscientific', on the grounds that science must be confined to what can be objectively observed. It also set a fashion of studying psychology through animal experimentation, with endless studies of rats and pigeons being conducted throughout this period, with the apparent objective of understanding the fundamental principles of learning in humans. With hindsight, we can see this as an extreme example of a System 1 research programme, in which habit learning was the only show in town.

Although behaviourism was the dominant school of psychology in the first half of the twentieth century, there were other schools of a much more cognitive nature, such as Piaget's emerging theory of cognitive development. An important influence was Gestalt psychology, which flourished in Germany in the inter-war period. The German word 'Gestalt' means form or shape, and the movement was based on a

holistic approach to perception and cognition, founded on the principle that the whole was greater than the sum of the parts. Originally applied to perception, Gestalt theorists also turned their attention to the study of thinking and problem solving. They challenged behaviourism by studying ‘insight’ problems — those that are solved by a sudden, discontinuous process of thought — which defy explanation in terms of gradual habit learning. There are dual-process ideas to be found in the Gestalt work on problem solving. For example, they contrasted ‘blind’ with ‘productive’ thinking, the former based on habit learning so beloved of behaviourists. Wertheimer (1945/1961) caricatured the then current fashion in Germany for teaching children mathematics by drill and rote learning, showing how it could lead to silly mistakes when the problem was slightly unfamiliar in form. Gestalt psychologists showed how people could acquire unhelpful ‘sets’ in problem solving through habit learning, or fail to solve problems due to ‘functional fixedness’ (Duncker 1945; Luchins 1942) in which they would not think of using an object for an unfamiliar purpose. The approach was highly evaluative, with habitual thinking, of the type promoted by behaviourism, being regarded as ‘bad’, while productive, insightful thinking was ‘good’. However, we can see here an anticipation of contemporary applications of dual-process theory, in which System 2 thinking is seen as necessary to intervene upon default, habitual System 1 thinking, in order for people to solve problems of an abstract or novel nature (Stanovich 1999). Gestalt psychology also provides the earliest reference in experimental psychology to the idea that thinking can be influenced by hints that are not consciously noticed (Maier 1931).

Before concluding this review of pre-modern psychological thinking, we should mention some work on the relationship between language and thought. Contemporary authors have strongly associated the possession of the uniquely human faculty of language with System 2 thinking (Evans and Over 1996), with the idea that such thought is realized through ‘inner speech’ being particularly emphasized by some contemporary philosophers, as discussed later in section 5. The contemporary study of executive working memory, which we see as a System 2 research programme, is one in which inner speech is also thought to play a major role (Baddeley 2007). In fact, this idea was well developed in writings of the Russian psychologist Lev Vygotsky (1934/1962) in the 1930s. Piaget (1926) had observed that young children exhibit ‘egocentric speech’ in which they appear to give themselves instructions while playing. Piaget believed that infants are essentially autistic and take some years to learn to become social beings and to decentre their thinking. Correspondingly, he observed that egocentric speech was dominant in preschool children but decreased rapidly from about the age of 7 or 8 years. Vygotsky, however, reinterpreted Piaget’s work assisted by findings of his own studies. For example, he showed that when children were frustrated and faced with difficult problems to solve, the proportion of egocentric speech increased markedly. Vygotsky (1934/1962, p.18) viewed ego-centric speech not as disappearing, as Piaget suggested, but as being internalized, commenting that ‘the inner speech of the adult represents his “thinking for himself” rather than social adaptation: i.e. it has the same function that egocentric speech has in the child’, adding

that ‘when egocentric speech disappears from view it does not simply atrophy but “goes underground”, i.e. turns into inner speech.’ (See section 5 for contemporary applications of this idea.)

Inner speech is also what gave behaviourists such as Watson, and later Skinner, a way out when forced to confront the issue of apparently conscious thinking. To Watson, for example, thought was simply subvocalization, which together with vocalization was merely a system of motor habits. However, language was to be the final battleground for behaviourism. When Skinner published his account of language in terms of operant conditioning, in the book *Verbal Behavior* (Skinner 1957), it was hailed as a masterpiece. Triumph turned to disaster, however, when a young linguist called Noam Chomsky wrote one of the most devastating and influential book reviews in the history of academia (Chomsky 1959). Chomsky’s critique went much deeper than the particulars of the book, exposing the fundamental weaknesses and limitations of the behaviourist approach. This was one of several key publications around this time that laid the foundation for the cognitive revolution to follow.

3. The modern history of dual-process theories

The modern history of dual-process theories, so far as we are concerned, concerns those that developed after the start of the cognitive revolution in psychology, which occurred during the 1960s and 1970s. We shall discuss here the origin of contemporary dual-process theories, in the narrower sense, in the order in which they roughly developed, in the fields of learning, reasoning, social cognition, and decision making. The further development of dual-system theories is covered in section 4.

It would be easy in an historical review such as this to create the impression that things developed in an orderly fashion, with each set of authors reading the previous and related work before engaging in their own research. In the case of dual-process theories, this would be particularly fictitious; most of these modern developments were little influenced either by the history outlined in earlier sections, or by earlier and parallel developments in the other fields of psychology. For example, the origin of modern dual-process theories is sometimes cited as stemming from the distinction between controlled and automatic processes in attention made by Schneider and Shiffrin (1977; also, Shiffrin and Schneider 1977). It is true that this work provided a major stimulus for the development of dual-processing accounts in social cognition from the 1980s onwards, but it actually played no part at all in the development of dual-process accounts of learning and reasoning which predated this publication. Reber’s theory developed from his programme of experimental study of implicit learning, which began in the 1960s (see Reber 1993 for a review). Reber’s work in turn played no part in the early development of the dual-process theory of reasoning which started with a collaboration between Peter Wason and Jonathan Evans in the mid-1970s. Reber’s work only came to influence the account of Evans and Over (1996) some twenty years later (see Evans 2004). In the study of social cognition, where dual-process theories have formed the dominant paradigm for the past 20 years and more,

the great majority of publications show no awareness at all of either the learning or the reasoning tradition.

This disconnectedness of the various fields is a reflection of modern psychology. There is now so much research conducted and reported in various fields that authors struggle to keep up with the literature in their own traditions and favoured paradigms. For example, few cognitive psychologists take the time to read social psychology and vice versa. This state of affairs permits parallel discovery of phenomena and theoretical ideas, and this is precisely what seems to have happened in the case of dual-process theories in cognitive and social psychology. There are many striking similarities in the theories developed in these different traditions, as well as some important differences of emphasis (Evans 2008).

We shall start by reviewing the origins of various modern theories that distinguish between what we shall call type 1 processes (fast, automatic, unconscious) and type 2 processes (slow, conscious, controlled) . Later we shall discuss the development of dual-*system* theories, which attempt to integrate work from different traditions and make stronger assumptions about the cognitive architecture of the human mind, leading to the popular terms ‘System 1’ and ‘System 2’. Because it is the oldest work in the modern history, we start with Arthur Reber’s studies of implicit learning.

By the mid-1960s the cognitive revolution was well under way in psychology, with the field of *cognitive psychology* recognising its own identity with the publication of Neisser’s (1967) book of that name. One of the most curious aspects of the revolution was its effect on the study of learning and memory. For the preceding 50 years of the behaviourist age, learning had been the dominant paradigm. The processes studied were slow and incremental, as in the many studies of classical and operant conditioning in animals, and in attempts to produce comparable paradigms in humans that required associative learning. With the cognitive revolution, however, researchers apparently stopped studying learning and started studying memory! Instead of studying gradual acquisition processes, researchers effectively studied one-trial learning. Methods such as free-recall (which has older origins) became popular. In this paradigm, participants are read a list of words just once, and then try to recall them in any order. This was one of the methods that quickly led cognitive psychologists in this period to distinguish between short-term and long-term memory systems (Atkinson & Shiffrin, 1968).

As one who studied psychology in the 1960s, the second author (J.E.) recalls being puzzled by this development at the time. How could learning and memory be different things? With hindsight, we can see that what actually happened was that researchers mostly shifted from studying implicit to explicit forms of memory. We now know that there are multiple memory systems in the brain, some of which are implicit and others explicit, a fact established beyond doubt by numerous neuropsychological studies (Eichenbaum and Cohen 2001). There is an explicit learning system located in the hippocampus and quite separate implicit learning systems residing in regions of the brain associated with motor skills and emotional processing. These can be dissociated from each other by specific kinds of brain damage: for example, patients with

hippocampal damage, known as amnesics, suffer impairment of explicit learning and memory, while retaining the ability to learn new skills and habits.

Starting his work well in advance of the neuropsychological studies, Reber is notable as one who continued to study human learning, while adapting to the cognitive revolution that was occurring around him. He was one of the first psychologists to coin the term 'cognitive unconscious' to refer to the idea that many cognitive processes occur outside of consciousness. In the 1960s Reber devised new paradigms for the study of implicit learning, defined as the 'acquisition of knowledge that takes place largely independently of conscious attempts to learn and largely in the absence of explicit knowledge about what was acquired' (Reber 1993, p.5). One of the most famous of these is the artificial grammar learning (AGL) paradigm. Participants are presented with letter strings to memorize, which, unknown to them, have been generated according to rules embedded in a finite-state grammar. Such grammars allow one to move through them using various branches and loops, with each move generating a letter. In this way, a large number of different grammatical strings can be generated.

In a second stage of the method, participants are told that the strings were rule-governed and then asked to classify new sets of strings as being 'grammatical' or 'ungrammatical'. As has been shown many times, participants are able to do this at levels well above chance, but without the ability to describe what rules they are using. Interestingly, this applies also when the AGL paradigm is administered to amnesic patients who have lost the ability to form new explicit memories (Knowlton *et al.* 1992). Such patients can learn to classify new strings, despite the fact that they have no recall of the training experience. In spite of findings like this, Reber's claim that participants extract rule information without explicit effort or awareness remains somewhat controversial. Critics have doubted whether implicit learning is wholly unconscious (Shanks and St John 1994) or whether rules are really being abstracted (Redington and Chater 2002). From the viewpoint of dual-process theory, however, the critical issue is whether the study of implicit learning implicates a distinct system of learning and knowledge from that involved in explicit memory tasks. The neuropsychological evidence appears to us to be conclusive on this point, strongly supported by evolutionary arguments for multiple memory systems (Carruthers 2006; Sherry and Schacter 1987). We should note also that evidence of implicit rule learning has been demonstrated in a range of experimental paradigms other than AGL and by a number of different laboratories (for reviews, see Berry and Dienes 1993; Reber 1993; Sun 2001).

Reber did more than provide evidence for distinct implicit and explicit learning processes: he also developed a dual-system theory of learning that has had a considerable influence on the generic dual-system theory of thinking, and we discuss his ideas below. Another major influence on dual-system theory was the development of dual-process accounts of deductive reasoning, an enterprise in which J.E. was involved from the start (for a detailed history, see Evans 2004). There are actually two distinct origins of this theory, both in the 1970s, but not connected up until some

years later. The first was the observation of a dissociation between behaviour and introspective reports, similar to that so famously discussed by Nisbett and Wilson (1977). Wason and Evans (1975) investigated some apparently discrepant findings on the Wason selection task. On the one hand, it seemed that participants were choosing cards according to a primitive 'matching bias' (Evans and Lynch 1973), which determines attention to items specifically mentioned in a conditional statement. On the other hand, participants were prone to give rational-sounding explanations of their choices, in terms of the instruction to choose cards that verified or falsified the conditional statement (Goodwin and Wason 1972). Wason and Evans concluded that matching bias was an unconscious determinant of responding, and that introspective reports were mere *post hoc* rationalizations (see Lucas and Ball 2005 for a recent replication of key findings). They also were the first to use the terms 'type 1' and 'type 2' processing, to refer to the unconscious and conscious processes respectively. If there was an historic influence on this, it was that of Freud, for Peter Wason was a barely in-the-closet Freudian.

The main stimulus for dual-process theories of reasoning, however, was the observation of the fact that logical processes seemed to compete with non-logical biases in determining behaviour on various deductive reasoning tasks (Evans 1977). What became the paradigm case of this was the apparent conflict between logic and belief bias in content-rich versions of syllogistic reasoning tasks, first documented by Evans, Barston and Pollard (1983; see Evans this volume). Subsequent research using a variety of methods has suggested that belief bias reflects a type 1 process, whereas successful logical reasoning on this task requires type 2 processing. Work of this kind led to the development of the heuristic-analytic theory of reasoning (Evans 1989, 2006) and later to the dual-system theory discussed below. None of this early work was influenced by dual-process accounts of learning, memory, and social cognition; rather, it was driven by an attempt to understand the experimental findings.

Next in the story, chronologically speaking, comes the development of dual-process theories of social cognition (see Smith and Collins this volume for a detailed review). Apart from some historic influence of Freud (Epstein 1994), however, the origin of dual-process theories in social psychology seems to come from two main sources. First, analogous to (but in ignorance of) the work of Wason and Evans, social psychologists needed to explain the dissociation between explicitly stated attitudes and actual social behaviour that was firmly established in experimental research conducted in the 1960s and 1970s. As Smith and Collins (this volume) document, the earliest models, developed in the 1980s, were designed to deal with persuasion and attitude change. One major tradition of work has focussed on lack of self-insight in social behaviour and the tendency for people to confabulate accounts of unconsciously caused behaviour (Wilson 2002). A number of the (numerous) dual-processing accounts of social cognition that have been developed since have been strongly influenced by developments in mainstream cognitive psychology that paradoxically had little or no influence on the development of dual-process theories of reasoning. One was the distinction between automatic and controlled processing,

already mentioned, which has been developed into a highly influential theory of automaticity in social judgement by John Bargh (see Bargh 2006).

Work on automaticity includes studies that show that stereotypes are powerful implicit knowledge structures that influence social behaviour in spite of explicit attitudes that are egalitarian. The main methodology for such studies has been that of *priming*, borrowed from the study of implicit memory (Kihlstrom *et al.* 2007; Schacter 1987) in cognitive psychology. Unconscious knowledge structures, such as implicit stereotypes and attitudes, can be primed by using apparently unrelated prior tasks that include content that activates the relevant knowledge. This then affects performance on the main task of social judgement or perception that follows. Another method favoured by social psychologists is the correlation of social judgements with measures of individual differences in thinking style, such as Need for Cognition (Cacioppo and Petty 1982) or the Rational-Experiential inventory (Epstein *et al.* 1996). However, it is debatable whether differences in thinking style are related to dual-process theories founded in distinct cognitive systems (see Evans this volume; Buchtel and Norenzayan this volume).

The dual-process approach to decision-making has been popularized recently by Kahneman and Frederick (2002) drawing upon generic dual-system theory, discussed below. However, the distinction between intuitive and reflective decision making has been around for a long time. In fact, it is implicit in some of Tversky and Kahneman's earlier writing about the heuristics and biases research programme. For example, Kahneman and Tversky (1982), who distinguished errors of application from errors of understanding, discussed both intuition and rule-based reasoning: 'It has been demonstrated that many adults do not have generally valid intuitions corresponding to the law of large numbers ... But it is simply not the case that every problem to which these rules are relevant will be answered incorrectly or that the rules cannot appear compelling in particular contexts' (p.449). They did not quite join up the dots at this stage by specifying (as Kahneman and Frederick now have done) that type 1 heuristics compete with type 2 rule-based reasoning in determining responding on such tasks.

Research on judgement and decision making is not necessarily cognitively oriented, with much research focussed on the adequacy of normative or other descriptive models to account for behaviour. However, sundry examples of dual-process thinking are to be found in these literatures, of which we shall briefly mention a few. In the tradition of work called social judgement theory (Doherty 1996), which dates from the ecological psychology of Brunswick, there is an account called *cognitive continuum theory* (Hammond 1996), which posits a distinction between intuitive and analytic thinking. However, as the name suggests, this is seen as a continuum rather than reflecting discrete cognitive systems. Fuzzy trace theory (Reyna 2004) posits a distinction between verbatim and gist memory, which are argued to underlie reflective and intuitive decision making respectively. Reyna is one of an increasing number of authors to emphasize the idea that intuitive decision making can be highly effective and often superior to that based on reflection (Dijksterhuis *et al.* 2006; Gigerenzer

2007; Gladwell 2005; Myers 2002). Most of these also point out that intuition can be unreliable and lead to cognitive biases as well.

4. The development of dual-system theory

As already observed, dual-process theories distinguish fast automatic (type 1) processes from slow deliberative (type 2) processes. Dual-*system* theories attribute the origin of these processes to two distinct cognitive systems. (For a further distinction between type 1 and 2 systems, see Samuels this volume.) As a result, such theories tend also to attribute long lists of additional features to distinguish the two forms of processing (See Table 1.1). The terms ‘System 1’ and ‘System 2’ were coined by Stanovich (1999), but the dual-system theory was devised by a combination of authors, and has much earlier origins. Reber (see 1993, Chapter 3) argued for the ‘primacy of the implicit’, proposing that consciousness was a late arrival in evolutionary terms, preceded by unconscious perceptual and cognitive functions by a considerable margin. He suggested that consciousness provided a unique executive function in human beings but that this had led to an illusory belief in consciousness as the primary cognitive system. In other words, unconscious cognition is the default and dominant system, while conscious cognition is a uniquely human and recently acquired plug-in that does a great deal less than we generally assume.

System 1	System 2
Evolutionarily old	Evolutionarily recent
Unconscious, preconscious	Conscious
Shared with animals	Uniquely (distinctively) human
Implicit knowledge	Explicit knowledge
Automatic	Controlled
Fast	Slow
Parallel	Sequential
High capacity	Low capacity
Intuitive	Reflective
Contextualised	Abstract
Pragmatic	Logical
Associative	Rule-based
Independent of general intelligence	Linked to general intelligence

Table 1.1. Features attributed by various theorists to the two systems of cognition

Reber (1993) went on to make a number of claims about the nature of implicit learning and implicit systems that helped to build the feature list of the generic dual-system theory shown in Table 1.1. We have already seen that his theory included age of evolution, implicit and explicit knowledge, and the idea that implicit but not explicit cognition is shared with other animals. In addition he also argued that implicit

function had low variability across individuals and was independent of general intelligence. He seems to have been the first author to have developed these ideas, which are now incorporated in the generic dual-system theory. However, mention should also be made of Epstein, whose cognitive-experiential self-theory evolved from publications in the early 1970s.

In a landmark development, Epstein (1994) proposed an integration of Freudian and cognitive ideas about the unconscious. Among contemporary dual-process theorists he is unusual, if not unique, in crediting the Freudian dual-process distinction between primary and secondary process thinking, and also in firmly attaching emotional processing to what has now become known as System 1. In this paper, Epstein also reviewed various cognitive research (although not that in the psychology of reasoning) and concluded (p.714) that 'There is widespread agreement among the various theories on the existence of a conscious, deliberative, analytical system that could reasonably be labelled a rational system.' This he contrasted with an experiential system that was 'not limited to nonverbal processing of information, as emotion-arousing verbal stimuli also evoke experiential processing.' As with Reber, the evolutionary argument for two systems of cognition is also to be found in this paper. Epstein asserts (p.714) that 'Higher order organisms evolved in a manner that replaced instinct with a cognitive system that ... could direct behaviour on the basis of learning from past experience. This system operates in a very different manner from a system developed much later that solves problems by use of symbols and logical inference.'

Evans and Over (1996) developed their dual-system account of reasoning and judgement primarily under the influence of the early dual-process theories of Evans, but with a substantial input from Reber's ideas and other writing in the field of implicit learning (Berry and Dienes 1993). They were not, however, aware of Epstein's work at that time, nor of the many developments of dual-process theories in the field of social cognition. The initial focus of their 1996 book was on the idea of two kinds of rationality. Initially, Evans and Over argued that instrumental rationality (achieving one's goals) need not involve normative rationality, in the sense of *explicitly* following rules prescribed by a normative system such as logic or probability theory. They argued that participants in reasoning experiments are often described as irrational because they fail to comply with instructions and violate norms. A good example is the influence of belief bias in reasoning described earlier. Because the instructions require people to assume the truth of the premises and draw logically necessary conclusions, any influence of belief is deemed to be erroneous (normatively irrational). However, as Evans and Over (1996) argued, it is (instrumentally) rational in everyday life to reason from *all relevant belief*. Thus they suggested that it is adaptive for our reasoning to be automatically contextualized with prior knowledge.

Evans and Over (1996) developed the notion of implicit and explicit cognitive systems, drawing upon the evolutionary ideas of Reber. Like Epstein, they emphasized the experiential nature of the implicit system, which they proposed to be based mostly on personal learning. In discussing the explicit system, they focused on how slow,

limited in capacity, and high effort it is by comparison with the implicit system and hence raised the question of what functional advantage it could provide. They commented (p.154) that ‘The advantage of the dual process system is that conscious reflective thought provides the flexibility and foresight that the tacit system cannot, by its very nature, deliver. Most of the time our decision making is automatic and habitual, but it does not have to be that way ... consciousness gives us the possibility to deal with novelty and anticipate the future.’ The most distinctive aspect of Evans and Over’s contribution, perhaps, is their emphasis on the idea of *hypothetical thinking*, which requires imagination of possibilities and mental simulations and the ability to decouple suppositions from actual beliefs. This kind of thinking they argued to be distinctively human and to require the recently evolved, second cognitive system.

Evans and Over (1996) acknowledged a parallel but highly relevant development in the shape of Sloman’s (1996) proposal of two systems of reasoning, described as associative and rule-based respectively. Sloman’s paper proved highly influential and helped to popularize the dual-process approach. It also helped inspire an integrative account of dual-process theories of social cognition under the same labels (Smith and DeCoster 2000; Smith and Collins this volume). Sloman’s scope was intentionally more limited than most of the dual-system accounts we have described, however, in that he restricted his account to reasoning and judgement and refrained from broader evolutionary arguments. However, he proposed a very clearly parallel architecture (see Evans this volume) for the two systems and made a number of specific proposals about how two forms of reasoning could occur.

The final major contribution to the dual-system account of reasoning was that of Keith Stanovich (1999; 2004; this volume), who coined the terms ‘System 1’ and ‘System 2’. Along with his collaborator Rich West, Stanovich ran a series of major studies of individual differences in reasoning and decision making. In interpreting their findings, he drew upon the dual-process theory of Evans and Over, but added back in the element of Reber’s account which they had overlooked. This is the idea that System 2, but not System 1, is linked to individual differences in general intelligence. A good example of Stanovich and West’s approach is the work reported in their (1998), which involved administering both abstract and deontic versions of the Wason selection task to large numbers of students. The abstract version is known to be very difficult, but the deontic version (which uses realistic contents) is much easier. Stanovich and West showed that the minority who can solve the abstract problem are of unusually high general intelligence (estimated from SAT scores), but that IQ confers little advantage in solving the deontic versions, where people can draw upon experiential learning and background knowledge. They thus inferred that abstract reasoning draws heavily upon System 2. In a large number of studies reviewed by Stanovich (1999) it was shown that students with high SAT scores generally perform much better on a range of reasoning and judgement tasks as assessed by standard normative systems.

In addition to developing the individual differences approach to dual-process research, Stanovich (1999, 2004, Stanovich and West, 2003) has also contributed

significantly to the debate concerning rationality and evolution. In doing so, he takes strong issue with the arguments of evolutionary psychologists such as Cosmides and Tooby (for example, 1992). His essential argument is that evolution will not necessarily confer adaptive advantages in a modern technological society because the modern environment differs so radically from that in which we evolved. Thus System 1 procedures often result in cognitive biases when we try to engage in abstract and decontextualized forms of reasoning. Thus Stanovich does not support what he calls the Panglossian position of assuming that people are invariably rational. On the contrary, he suggests that much educational effort must be devoted to developing System 2 thinking skills. He also suggests that, uniquely among animals, we have a cognitive system (2) on a 'long-leash' from the genes, which allows us to rebel and pursue our goals as individuals, and not necessarily those programmed by evolution.

5. The contribution of contemporary philosophy

We turn now to work by contemporary philosophers, some of whom have also developed dual-process theories of the mind — showing again how such views have been rediscovered in different traditions. A central concern in this area is with the analysis of everyday commonsense, or 'folk', psychology. It is important to stress that by 'folk psychology', philosophers do *not* mean the explicit beliefs that laypeople happen to have about the mind — 'folksy psychology' as one philosopher dubs it (Botterill 1996). Rather, they mean the basic concepts and principles by which we explain and predict each other's actions — in particular, the concepts of *belief* and *desire* and the principles that guide our application of them. Many philosophers argue that folk psychology in this sense constitutes a theory of the internal structure and functioning of the mind, which is tacitly known by almost all adult humans (e.g. Botterill 1996; Botterill and Carruthers 1999; Churchland 1981). This theory is sometimes likened to the tacitly known generative grammar that, according to Chomskyan linguists, guides our language use. (Folksy psychology, by contrast, corresponds to people's explicit beliefs about grammar, of the kind once taught in schools.) This view — known as the 'theory-theory' — is controversial, however, and other philosophers take a different view of the status of folk psychology. Some argue that it is more craft than science — a heuristic device, which involves no assumptions about the structure of the mind (e.g. Dennett 1987, 1991c). Others argue that our skill at everyday psychological prediction derives from an ability to run mental *simulations* of each other, rather than from a knowledge of theoretical principles (e.g. Goldman 1989; Gordon 1986; Heal 1986).

The debate about folk psychology focuses in particular on the analysis of the concepts of belief and desire. A key issue is whether in attributing beliefs and desires to people we implicitly commit ourselves to claims about the internal structure of their minds. Views on the matter can be characterized as deflationary or inflationary (the terms are ours). On deflationary views the criteria for possession of beliefs and desires are mostly or wholly behavioural. The extreme deflationary position is analytic

or 'logical' behaviourism, according to which attributions of mental states are simply attributions of complex behavioural dispositions or patterns (e.g. Ryle 1949). This view was influential in the first half of the twentieth century, and versions of it still have powerful advocates, most notably Daniel Dennett (e.g. Dennett 1987, 1991b). On inflationary views, by contrast, there are strict internal criteria for the possession of mental states, instead of, or in addition to, the external ones. The most popular view of this kind — functionalism — treats beliefs and desires as discrete representational states, defined by the role they play in mediating between stimuli and overt action (e.g. Fodor 1987, Lewis 1972). In one form or another, functionalism has been the dominant position in philosophy of mind from the 1960s onwards.

Philosophers of mind have also taken a strong interest in scientific models of the mind and in the question of their compatibility with folk psychology. On deflationary readings, folk-psychological descriptions involve few or no assumptions about internal structure and are compatible with a wide range of scientific models of the mind. On inflationary readings, by contrast, folk psychology does make such assumptions and is incompatible with some models. For example, some inflationary views assume that beliefs and desires are internal representational states, which are functionally discrete and can be selectively activated. Such a view is compatible with many computationalist models, but appears incompatible with some connectionist ones, which (arguably) do not support discrete representations of this kind. Some writers argue that if such connectionist models should prove correct, then folk psychology will be refuted and the concepts of belief and desire will have to be eliminated from serious discourse about the mind (e.g. Ramsey *et al.* 1990). Others prefer to adopt a more deflationary view, on which the potential for conflict between science and folk psychology is reduced (e.g. Clark 1993, Horgan and Graham 1990).

For the most part, these debates have proceeded within a unitary framework; it is assumed that there is just one basic type of belief and desire, and one kind of mental processing. However, some writers have argued that there are important distinctions to be drawn among everyday mental concepts, which point to the existence of different types of belief, or belief-like state, associated with different reasoning systems. (The focus is typically on belief, though it is usually implied that a similar distinction can be made for desire.) We shall briefly review some suggestions along these lines.

Norman Malcolm distinguishes *thinking* and *having thoughts* (Malcolm 1973). To say that someone has the thought that *p*, Malcolm notes, is to say that they have formulated that proposition, or that it has occurred to them, or crossed their mind. To say that someone thinks that *p*, by contrast, does not imply any of these things. Seeing a dog barking up a tree, we might say 'He thinks the cat went up that tree' — without implying that the creature had formulated or thought of the proposition *The cat went up that tree*. Malcolm focuses on conceptual issues and does not offer a substantive account of either of these psychological phenomena, though he argues that the ability to have thoughts is dependent on the possession of language. He concludes that there is no single paradigm or prototype of thinking, and suggests that it was by rashly

taking *having thoughts* as the paradigm that Descartes was led to deny that animals can think.

Daniel Dennett draws a related distinction between *belief* and *opinion* (Dennett 1978, ch.16; 1991c). Belief in Dennett's sense is a basic mental state, common to humans, animals, and even mechanical systems, and the criteria for its possession are entirely behavioural. Opinions, on the other hand, are more sophisticated, 'linguistically infected' states, which are possessed only by humans. To have an opinion is to be committed to the truth of a sentence in a language one understands (to have 'bet' on its truth), often as result of consciously *making up* or *changing* one's mind. Dennett suggests that the psychology of belief and opinion is very different, and that a mental architecture that will support non-linguistic animal-type beliefs may be quite inadequate to support opinions. Confusion between the two states, Dennett claims, lies at the root of many philosophical misconceptions about belief, and lends spurious plausibility to inflationary views of belief (1991c).

Another duality can be found in the work of Jonathan Cohen, who makes a distinction between *belief* and *acceptance* (Cohen 1992). Belief in Cohen's sense is a disposition, though not a disposition to action; to believe something is to be disposed to *feel it true*. Acceptance, on the other hand, is a mental action or pattern of action; to accept something is to have a policy of taking it as a premise in conscious, rule-based reasoning. Belief is passive, graded, non-linguistic, and exhibited by animals as well as humans, whereas acceptance is active, binary, linguistically formulated, and not exhibited by animals. Cohen argues that this distinction is implicit in everyday thinking about the mind and that it is crucial to the explanation of many familiar psychological phenomena. This duality of mental states implies a duality of mental processes, and Cohen notes that it corresponds well with the division between connectionist and computational models in psychology. Belief, he argues, being parallel, graded, and not rule-governed, can be modelled by connectionist networks, whereas acceptance, which is sequential, ungraded, and rule-governed, is better modelled by digital computer programs (Cohen 1992, pp.56-8).

Frankish (2004) argues that the folk-psychological term 'belief' is used to refer to two different types of state: one nonconscious, implicit, passive, graded, and non-linguistic, the other conscious, explicit, active, binary, and language-involving. This hypothesis, he argues, explains various tensions in folk psychology and can reconcile the competing intuitions that support deflationary and inflationary positions. A deflationary perspective is appropriate for talk about nonconscious beliefs, which guide spontaneous, unreflective behaviour. We attribute such beliefs freely to a wide range of creatures without assuming that they are discretely represented, and we cite them in explanation of actions without implying that they were individually activated. However, a more inflationary, functionalist, perspective is required for conscious beliefs, which can be individually called to mind, and whose activation may cause radical deviations from our normal patterns of behaviour. Building on Cohen's account of acceptance, Frankish develops a model of conscious beliefs as premising policies, which are actively adopted and executed in response to beliefs and desires of

the nonconscious type. This model of conscious belief, he argues, is functionalist in spirit but also compatible with a wide range of views about the internal structure of the cognitive system. To highlight the dependency relation between the two types of belief, Frankish dubs the nonconscious type *basic belief* and the conscious one *superbelief*.

There is a common theme to these distinctions: there is one type of belief that is implicit, non-linguistic, and common to humans and animals, and another (thought, opinion, acceptance, superbelief) that is explicit, conscious, language-involving, and uniquely human. And there are suggestions that each type is associated with a different kind of processing — parallel and connectionist in the first case, serial and rule-governed in the second. There is a clear, though not perfect, correspondence here with dual-process theories in psychology — the implicit form of belief corresponding to System 1 and the explicit form to System 2. (Of course, if implicit beliefs are behavioural dispositions, then they cannot be thought of as *inputs* to System 1 reasoning, but they can be regarded as manifestations of System 1 activity.) We think this correspondence offers further support for a dual-process model. Folk psychology, we suggest, is tracking, albeit obscurely, the same fundamental duality that scientific psychology has identified. Of course, this is not the only possible explanation of the correspondence. It could be that the dual-process perspective implicit in folk psychology has influenced explicit theorizing about the mind by philosophers and psychologists — resulting in the pattern of rediscovery we have highlighted in this chapter. We cannot conclusively rule out this hypothesis, but it seems to us a much less plausible one, given the diverse theoretical concerns of the writers discussed and the variety of methodological approaches they have employed.

The work discussed above was driven primarily by concerns with the analysis and evaluation of everyday psychological discourse, but contemporary philosophers have also contributed more directly to the development of dual-process theories by engaging in empirically based theorizing about mental architecture. In particular, many philosophers have been attracted to the idea that possession of language makes possible a new type of reasoning, different in character from the non-linguistic sort. This view is often coupled with the idea that the language-based reasoning system is a softwired one — a ‘virtual machine’ as Dennett puts it — which emerges from the interaction of pre-existing components. We shall briefly review some of this work, which can be seen as complementing the folk-psychologically based dualities discussed above.

We begin with Dennett’s account of the conscious mind (1991a). The biological brain, Dennett claims, is a collection of specialized hardwired subsystems, operating in parallel and competing for control of action. The conscious mind, on the other hand, is a virtual machine, which we create for ourselves by engaging in various learned behaviours — principally habits of private speech, either overt or silent. Dennett claims that such speech serves as a form of self-stimulation, and he suggests that it performs important executive functions, focusing the resources of different neural subsystems and promoting sustained and coherent patterns of behaviour.

There are echoes here of Skinner's account of thinking as automatically reinforcing verbal behaviour, mentioned earlier. By engaging in private speech, Dennett argues, we effectively reprogram our biological brains, causing their parallel machinery to mimic the behaviour of a serial computer. Dennett dubs this softwired system the *Joycean machine* — alluding to James Joyce's depictions of the stream of consciousness.

A somewhat similar view is proposed by Paul Smolensky — a cognitive scientist whose work has been much discussed by philosophers. Smolensky (1988) argues that a connectionist system could simulate the behaviour of a rule-governed serial processor by encoding natural language sentences expressing production rules (rules of the form 'If condition A obtains then do action B'). When the condition of an encoded production rule holds, Smolensky argues, associative processes would trigger the activity pattern encoding the linguistic representation of the entire rule, and the representation of the action part of the rule would then tend to trigger the action itself, thus constraining the system to obey the rule. The effect would be to create a virtual rule-based serial processor — a 'Conscious Rule Interpreter' — implemented by parallel associative processes. (Smolensky suggests that the activities involved would be conscious in virtue of the fact that they would involve stable large-scale activity patterns.)

Frankish also characterizes the conscious mind as a language-dependent virtual machine (2004, this volume). Conscious reasoning, he argues, is an intentional activity, which involves producing and manipulating sentences of inner speech and other forms of mental imagery, in order to execute various problem-solving strategies. These actions, Frankish claims, are motivated and supported by nonconscious metacognitive attitudes (desires to solve problems, beliefs about the strategies that may work, and so on), and they influence action in virtue of a nonconscious desire to act on the results of one's conscious reasoning. The result is a two-level picture in which the conscious mind is a virtual structure — Frankish calls it the *supermind* — which is implemented in metacognitive processes at the nonconscious level.

Finally, another variant of the 'virtual system' approach is found in Carruthers' work (2002, 2006, this volume). Carruthers advocates a massively modular view of the mind, according to which central cognition is composed of numerous semi-independent domain-specific subsystems. A major challenge for such a view is to explain the existence of flexible, domain-general thinking, of the distinctively human kind. In response, Carruthers argues that such thinking is performed by a virtual system, which is the product of our capacity for the mental rehearsal of action schemata — in particular, ones for the production of utterances. In the case of utterances, Carruthers argues, such rehearsal generates auditory feedback (inner speech) that is processed by the speech comprehension subsystem and tends to produce effects at the modular level appropriate to the thoughts the utterances express. Since utterances may combine outputs from different modules, this implements a form of domain-general thinking, and cycles of mental rehearsal create

a flexible domain-general reasoning system, using only the basic resources of a modular mind equipped with a language faculty.

The virtual-system approach proposed by these writers can be seen as a form of dual-process theory, which treats the second system as emergent from the first, rather than distinct from it. As the writers stress, this approach has particular attractions from an evolutionary perspective, showing how a radically new form of cognitive activity could develop without massive changes to neural hardware. From the viewpoint of cognitive and neural architecture, however, such virtual dual-process theories clearly differ significantly from those which describe System 2 as instantiated in mechanisms distinct from those of System 1. This is a debate which may ultimately be settled by work mapping type 1 and 2 processes on to underlying neural systems (see Lieberman this volume, for examples of such research). If type 2 processing is an emergent property of type 1 systems, then we should not expect a switch to wholly distinct neural areas when this kind of thinking is activated. The issue is not a simple one, however, since virtual-system theorists need not claim that *all* type 1 systems are involved in supporting type 2 reasoning, and they typically allow that some other systems are involved as well, notably language and motor control (for some empirical predictions of one version of virtual-system theory, see Carruthers this volume).

6. Future directions

How will dual-process theory develop? We can see three main trends in current research, which we expect to continue and flourish. The first involves reflection on the foundations of dual-process theory itself. We are confident that some form of two-systems theory will survive, but we also expect to see important modifications and qualifications to it. Many dual-process theorists are currently rethinking their views and recognizing that the original framework needs to be substantially revised. There are two aspects to this. One involves backing off from definitions of the two systems in terms of the processing styles involved — heuristic and associative on the one hand, analytic and rule-governed on the other (see the chapters in this volume by Buchtel and Norenzayan, Evans, Frankish, and Stanovich). Theorists are increasingly recognizing the diversity of the processes in both systems, and seeking to redraw the distinction between the two systems in other terms, distinguishing System 2 by its association with working memory (Evans this volume), high-level control (Stanovich this volume), or personal control (Frankish this volume). The second aspect involves the recognition of the range of processes involved in supporting System 2 reasoning. In recent work, for example, Evans posits *type 3* processes, which are involved in triggering System 2 activity and mediating between the two systems (Evans this volume). In short, it is likely that future two-systems theories will need to posit multiple kinds of cognitive *processing*.

The second trend is one of increasing integration between dual-process theorists in different fields. In the past, work on dual processes in social psychology and cognitive psychology proceeded largely in parallel, with little communication between

researchers. This is changing now (see Smith and Collins this volume; Klaczynski this volume), and we believe there is scope for significant experimental collaboration and theoretical integration in the future. We also feel that it is important to integrate dual-process theories of reasoning more closely with theories of perception, emotion, memory, and motor control, in order to develop overarching conceptions of mental architecture. An example is the application of the notion of ‘metacognition’, primarily developed in the study of memory, to dual-process accounts of reasoning and judgement (see Thompson this volume). A narrow focus is necessary in experimental work, but it is important to keep pulling back to consider the wider theoretical picture, as some philosophers of psychology have urged. Peter Carruthers’s 2006 book on the architecture of the mind, mentioned in the previous section, provides a good example of the kind of integrative theorizing we favour.

The third trend involves the application of dual-process theory, both within and beyond the academic world. Contemporary academic developments include computational modelling of dual-system architectures (see Sun *et al.* this volume) and the search for evidence of dual processes and systems through the methods of neuropsychology and neuroscience (see Goel 2005, 2007; Lieberman this volume). Authors with a strong evolutionary orientation are now trying to reconcile dual-process theory with a massively modular view of the human mind (see Mercier and Sperber this volume; Carruthers this volume). The theory is influencing the approach of moral philosophers, too (see L Saunders this volume), and impacting strongly on the debate about human rationality (see Evans and Over 1996; Stanovich 1999; C Saunders and Over this volume).

The idea that we have ‘two minds’, only one of which corresponds to personal, volitional cognition, has also wide implications beyond cognitive science. The fact that much of our thought and behaviour is controlled by automatic, subpersonal, and inaccessible cognitive processes challenges our most fundamental and cherished notions about personal and legal responsibility. This has major ramifications for social sciences such as economics, sociology, and social policy. As implied by some contemporary researchers (e.g. Stanovich this volume; Klaczynski this volume) dual-process theory also has enormous implications for educational theory and practice. As the theory becomes better understood and more widely disseminated, its implications for many aspects of society and academia will need to be thoroughly explored. In terms of its wider significance, the story of dual-process theorizing is just beginning.

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