Like Walt Whitman, this book contains multitudes. It is a collection of roughly 30 chapters, most of which describe dual-process models of some interesting and important psychological phenomena. With roughly 30 chapters on dual processes before them, some readers may be tempted by arithmetic to conclude that the human mind is characterized by roughly 60 psychological processes that are conveniently paired and explicated in these pages. Others may be suspicious of a number that is so perfectly round and that so coincidentally approximates the number of authors. Those readers may suspect that the human mind is actually characterized by a somewhat smaller number of processes—as small a number as, say, two—and that the authors of these chapters must therefore be describing different functions, consequences, or features of this fundamental pair.

PLATO'S GAME

So which is it? Two, roughly 30, or something between? It depends, of course, on how one counts. The neuroscientist who says that a particular phenomenon is the result of two processes usually means to say something unambiguous—for example, that the inferior cortex does one thing, that the limbic system does another, and that together the electro-chemical activities of these two anatomical regions produce a feeling of ennui, the aroma of stale cabbage, or the sneaking suspicion that one’s spouse has been replaced by a replica. In such instances the phrase “dual processes” refers to the activities of two different brain regions that may be physically discriminable, and the neuroscientist says there are “two processes” because the neuroscientist is talking about things that can be counted. But few of the psychologists whose chapters appear in this volume would claim that the dual processes in their models necessarily correspond to the activity of two distinct brain structures (cf. Smith & DeCoster, 1997). What, then, could these dry psychologists mean when they say “two”? Are such claims to be taken literally and tested? Could anyone do an experiment whose results would convince us that an embarrassing calculation error had been made and that, as it turns out, there are actually 11 processes underlying persuasion, or stereotyping, or person perception, or attitude formation?
Probably not. And the reason why not is that while the word “dual” is a stolid descendant of the Latin duo or “two,” “process” is a friskier term derived from the Latin processus, meaning “a moving forward” or “an unfolding in time” or, roughly speaking, “an event.” Surely a herd of philosophers could spend the happier part of eternity debating and never deciding whether a wink and a nod constitute one or two events for a blind horse. Because there are generally no tangible referents for the “processes” specified by dry psychology’s talk of dual processes, there is generally no proper way to count them, and hence no way to know whether they have been counted properly. Not to fear, because dry psychologists who champion dual-process models are usually not stuck on two. Few would come undone if their models were recast in terms of three processes, or four, or even five. Indeed, the only number they would not happily accept is one, because claims about dual processes in dry psychology are not so much claims about how many processes there are, but claims about how many processes there aren’t. And the claim is this: There aren’t one.

And why not? Because people are capable of too many different things—capable of being foolish one moment and wise the next, capable of behaving intransigently and then credulously in turn, capable of believing the right thing with their whole hearts while saying precisely the wrong thing with their whole mouths, and so on. The sheer variety of an individual’s behavior is perhaps the first and most inescapable observation one can make about a person, and such variety seems to cry out for explanation. “How could you be so stupid?” we ask—never of those who are stupid, but rather of those whose momentary stupidity stands in stark relief against the background of their typical cleverness. What could possibly give rise to the diversity of thought, feeling, and action of which most people are naturally possessed? Plato suggested that complex behavior is best understood as the product of the interaction of less complex faculties (Hundert, 1995) and some form or another of this “homuncular functionalism” (Lycan, 1991) has been the favorite explanatory strategy of philosophers and psychologists for the roughly 2,000 years since. Indeed, it is almost a truism in modern psychology that “the explanation of mental phenomena must always reside in the interaction and organization of multiple parts” ( Bateson, 1979, p. 103; emphasis in original). An inventory of those multiple parts—cognition and emotion, reason and intuition, automaticity and control, consciousness and unconsciousness, ego and id—provides a natural history of psychology’s attempts to explain the complexity of the individual (see Moskowitz, Skurnik, & Galinsky, Chapter 2, this volume).

A NOISE IN THE BOX

Like this book, then, the mind is also a container of multitudes. But how can a list of simple parts explain the complex behavior of wholes? Parts execute processes, and through their interaction, these processes give rise to complex behavior. Consider, for example, how four elementary “interior designs” might be used to explain the complex behavior of the soft drink machine at the refreshment counter in the cinema lobby (see Figure 1.1).

Selective Designs

The first thing one notices about a system is its overt behavior. For example, while standing in the popcorn line we may notice that when the underemployed teenager in the paper hat thumps the button on the side of the soft drink machine, the machine delivers a cup of cola. When the teen exhibits a somewhat lighter touch, the machine delivers a cup of water. How might we explain the complex behavior of the machine? The behaviorist would map the historical relations between the teenager’s taps and the machine’s spurs and offer these regularities as explanations of the machine’s reactions. But this is rather like explaining an automobile’s performance by avoiding all mention of things under the hood, and it naturally leaves modern psychologists hungry. Although we cannot see the soda machine’s interior from where we are standing, we might pass the time by speculating that deep inside the machine are two nozzles, one of which draws water from a hidden reservoir and spurs it into the output tube and the other of which does the same with cola. We might speculate further that the in-
tensity of the button press causes one or the other of these inner nozzles to spurt its particular brand of liquid into the output tube. An imaginary interior of this sort seems to do a fine job of explaining how a machine with just one output tube can behave "water-ishly" and "cola-ishly" in turn. Similarly, psychologists often explain the fact that people behave differently at different times by positing two inner processes that are activated by different stimuli. Chaiken's (1987) heuristic–systematic model, Petty and Cacioppo's (1986) elaboration likelihood model, Schwarz's (1990) mood-as-information model, and Tesser's (1986) self-evaluation maintenance model are just a few of the well-known social-psychological models that use selective designs to explain the behavioral variety of individuals. In each case, people do one thing on one occasion and another thing on another occasion because they are on all occasions inhabited by two qualitatively distinct processes, one of which is active and one of which is dormant in any given instance.

**Competitive Designs**

If the popcorn line is especially long, we might find ourselves dreaming up even fancier architectures. For example, we might imagine an interior design in which a button press causes both of the invisible inner nozzles to send their liquids surging toward the output tube. Upon arriving at the output tube, the faster or more forceful stream pushes up against a gate that allows the flow into the output tube, while simultaneously closing another gate that reroutes the slower or less forceful stream back to its original reservoir. We could even weave into our story something about how the force of the button press gives a hydraulic advantage to one or the other stream, thus determining which stream will hit the gate first and thus be funneled down the output tube. Or perhaps we would rather imagine that the humidity in the room, the magnetic fields generated by the nearby nacho-making machine, or even some random quantum event determines the position of the gate, and hence determines which of the two streams will win or lose. In any case, the two streams compete; the victor earns the right to send its stuff sliding down the output tube, and the loser returns home to wait for another opportunity. This architecture, like the one before it, explains how a machine with one output tube can behave "water-ishly" and "cola-ishly" on different occasions.

Although social psychologists enjoy a
good competition as much as anyone, they rarely call on the competitive design, which is for them a relatively minor variant of the selective design. In both cases, one process controls behavior and one does not. In the selective design, the noncontrolling process is dormant, and in the competitive design it is active but ultimately ineffective. Because social psychologists are generally in the business of explaining observable behavior, they tend to worry more about the nature of the controlling process than about that of the noncontrolling process. The noncontrolling process has no readily observable consequences, and thus social psychologists have no compelling reason to postulate its occurrence. Cognitive psychologists, on the other hand, are often more concerned with the nature of mental events than with the observable behaviors to which they give rise, and thus their models often do include competitive designs. For example, when people hear polysemous words such as "bank" (which can mean "riverside" or "financial institution"), they seem to recognize only one of the word's meanings. But Marcel (1981) suggests that both meanings are initially activated by the utterance, and that a gating mechanism then quickly considers the appearance of the word "boat" in an earlier sentence, allows "riverside" into consciousness, and sends "financial institution" back from whence it came. The fact that a process is launched may be quite important, even if that process fails to control behavior.

Consolidative Designs

Both the selective and competitive designs can explain why a soda machine (or a soda jerk) acts one way on some occasions and a very different way on others. In the first case, the selection happens early, before one of the processes ever gets started. In the second case, the selection happens later, after the processes are initiated but before they eventuate in a behavioral output. But inner processes need not battle for control of the output tube. Rather, inner processes may be simultaneously activated by a single stimulus, and the system's behavior may be understood as a joint function of both processes. Consider, for example, a soda machine that does not deliver just two kinds of drinks, but instead delivers an array of drinks ranging from a cupful of oozing syrup to a tasty cola to a somewhat watery cola to a glass of stale tap water. How might such behavioral variety be explained? One possibility is that the machine has two inner nozzles, and that in response to the push of a button, one nozzle spurts a very stout cola and the other nozzle spurts carbonated water. The two spurts then merge and are directed into the output tube, so that when all goes well, a perfectly balanced stream of cola is extruded. When all does not go well (e.g., when the machine is tilted, or when one of the nozzles is a bit clogged with airborne dust, or when the tapping sequences is like this rather than like that), the result is a soft drink that is too hearty or too thin.

In the last few decades, philosophers, psychologists, and neuroscientists alike have come to think of the brain as a massively parallel system that "generates reality" by integrating the results of computations that are performed by discrete, distributed modules (e.g., Fodor, 1983; Gazzaniga, 1988; McClelland & Rumelhart, 1986). The identity and location of an object in space may be computed by different neural systems (Ungerleider & Mishkin, 1982), but fortunately for us, those computations are consolidated before they reach consciousness. As such, we see "a toaster on the table" rather than "something on the table" or "a toaster everywhere at once." In social psychology, consolidative designs are so plentiful that we often don't recognize them as designs at all. For example, no theorist suggests that our impressions of others are based on either their verbal behavior, their nonverbal behavior, or their category membership. Rather, different processing mechanisms are thought to make sense of these different kinds of information and then to consolidate the results of their computations before sending an integrated impression to consciousness (e.g., Carlson, 1992). Just as a soda machine may blend the water and the cola somewhat differently across instances, such that some cups of soda are a bit more watery than others, so the informational outputs of different modules may be blended slightly differently across instances and hence may give rise to a smooth continuum of inferences and actions. Sometimes our impressions are dominated by a person's nonverbal behaviors; sometimes they are merely tinged by it. A consoli-
dative design can give rise to the full spectrum of possibilities.

**Corrective Designs**

Soda machines with consolidative interior designs are usually preset to blend the two inner streams according to the manufacturer's recipe for *le cola magnifique*, and the occasional cup of goop is generally regarded as a disappointment rather than an innovation. One way to reduce such disappointments is to reengineer the machine so that its design is corrective rather than consolidative. Imagine a machine that has a reservoir filled with perfect cola. A button press directs a stream of the substance from the reservoir to the output tube. Alas, because even the most perfect beverage undergoes subtle changes as it sits in its reservoir waiting for a customer to order it, the machine has a sensor located between the reservoir and the output tube. After it receives a button press, this sensor quickly samples and measures the sugar content of the cola stream as it surges forward. If the sensor determines that the surging cola is too sweet, it signals a second nozzle (located just in front of the output tube) to squirt just a tad of water into the surging cola stream before it hits the output tube. In both the corrective and the consolidative machines, the outputs of the two inner nozzles are being blended. But the corrective machine’s blends are especially well balanced because the output of one process serves as the input for the other.

Just as the competitive design is a variant of the selective design, the corrective design is a variant of the consolidative design. In both the consolidative and corrective designs, the system’s output is a mixture of the products of its inner processes. But there are two important differences between these designs. First, in the case of the consolidative design, some initiating event (such as a button press) activates both processes simultaneously, and each process’s contribution to the final output is determined by the formula for their admixture. Second, although the mixture may vary from occasion to occasion, this variability is always the unanticipated consequence of some annoying external condition, such as the tilt of the machine, random fluctuations in the teenager’s thumb pressure, or the amount of dust in the air. In the case of the corrective design, the initiating event activates just one process, and that process activates a second process. The second process modifies, adjusts, or corrects the first, but it does so *sensitively*; that is, on each occasion it uses information about the state of the first process to determine the proper mixing formula. The corrective design is in this sense a “smart consolidator” that can hold a system’s behavior relatively constant by using the second process to compensate for momentary variations in the product of the first process. Corrective designs are among social psychology’s favorites: The sequential-operations model (Gilbert, Pelham, & Krull, 1988), the Spinozan model (Gilbert, 1991), Fiske and Neuberg’s (1990) continuum model, Devine’s (1989) model of stereotyping, and Wegener and Petty’s (1997) flexible-correction model are just a few examples.

<table>
<thead>
<tr>
<th>ARE BOTH PROCESSES ACTIVATED?</th>
<th>DO BOTH PROCESSES CONTROL OUTPUT?</th>
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<tbody>
<tr>
<td>Selective Design</td>
<td>NO</td>
</tr>
<tr>
<td>Competitive Design</td>
<td>YES</td>
</tr>
<tr>
<td>Consolidative Design</td>
<td>YES</td>
</tr>
<tr>
<td>Corrective Design</td>
<td>SOMETIMES</td>
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**FIGURE 1.2.** Features of the four elementary interior designs.
THINNING THE MULTITUDES

Three things should be clear from this tour de guts. First, there are many more than four ways to hook up a dual-process system. The selective, competitive, consolidative, and corrective designs are among the most familiar to psychologists, but gates and sensors and nozzles can always be added, removed, and rearranged to produce any number of other equally amazing machines. Second, it should be clear that a good detective may often use a machine's behavior to learn something about the machine's interior design. For example, if every time a machine delivers a delicious cup of cola it also emits a gurgling sound from somewhere in the vicinity of the water reservoir, then the good detective can be fairly certain that the water reservoir is being affected in some way by the cola-inducing button press, and that the selective design is therefore not a plausible architecture for this machine. Similarly, if over many occasions the machine's output comprises a smooth continuum of beverages that range from syrup to water, then both the selective and competitive designs may be effectively dismissed, because each produces just two distinct drinks and not a rainbow of blends.

But the third and most important clear thing is this: Although a talented detective may be able to rule out one or more architectures, no detective can rule in just one (Anderson, 1978). When inferences about architecture are informed only by knowledge of inputs (tap tap) and outputs (spurt spurt), then the conceptual Erector Set of gates, sensors, and other optional accessories affords the creative tinker an endless number of ways to link the tapping to the spurtling (see Braitenberg, 1984). To be sure, there are behaviors that a particular architecture cannot possibly perform, and hence behaviors that can be used to rule out that particular architecture. But there is no behavior that can be performed by only one architecture, and hence no behavior that can unequivocally determine the nature of the machine's design. If we learn that an animal flies, then we know it cannot be designed like a turtle or a Chevrolet. Nonetheless, it could well be designed like any one of the known or unknown varieties of birds or insects, or like something else entirely. The ability to fly tells us how an animal is not designed, but it can never tell us precisely how an animal is designed, because there will always be more than one design that can do flying. Extending the list of criterial behaviors does not solve the problem ("It flies, lays eggs, has teeth, and votes Republican"), because the talented tinker can always design two slightly different animals, both of which can accomplish everything on the list.

The conclusion should be sobering: If dry psychology is an attempt to deduce a machine's true interior design by observing its behavior, then dry psychology is a game with no winning moves. And getting dry psychology all wet won't solve that problem. Emerging technologies are now allowing us to peek inside the head, and we might naively hope that someday soon we will find ourselves looking at the designs that until now we have merely inferred from behavior. But that won't happen. Because when we look inside the container of multitudes, we do not find ourselves looking at designs, but at the marvelous meatloaf that implements the designs—which are not, after all, real, meaty things that can be looked at, but descriptions in "Erector Set language" of how real meat makes real behavior. The microscopic behaviors of the wet gray stuff that constitutes the system (like the macroscopic behaviors of the system itself) provide much useful information, which allows us to rule out more designs more effectively than ever before. But if we are to avoid being disappointed at the end of a long day of brain science, we need to recognize at its dawn that knowledge of a brain's doings cannot reduce the number of plausible designs to one, any more than knowledge of inputs and outputs can. Just as different designs may underlie a single pattern of taps and spurts, so a single pattern of electrochemical activity or nervous connections can be the foundation for many different designs. Behaviors are real, brains are real, and designs are ways of thinking about and talking about—and hence understanding—the relation between these real things.

Now most of us don't like to play games they can't possibly win, and if we buy the foregoing arguments, we may be tempted to give up the design game altogether and concentrate our efforts instead on the mapping of macroscopic and microscopic spurts: "When Jacob thinks about whitefish, this brain re-
gion lights up. When he doesn’t, it doesn’t.
Next question?” Alas, that’s not a winning
move either. Neural behaviorism is no more
interesting than the full-body behaviorism
that psychologists abandoned several decades
ago, and a psychological science that special-
izes in design-free descriptions of neural ac-
tivity, bodily movements, words, deeds, or social
interactions is a science whose intellectual
achievements are destined to be no deeper
than “The shin bone is connected to the thigh
bone.” Psychology tried giving up the design
game once, and the results were a generation
of disaffected cognitive revolutionaries and an
extraordinary number of well-trained pi-
geons. Psychology-as-We-Know-It is the de-
sign game, and if we find that we can’t make
the winning move, then we need to change
our minds about what it means to win. Spe-
cifically, rather than defining dry psychology
as a game in which players win by deducing
the mind’s One True Design, we might think
of it instead as a game in which players earn
points by making observations that eliminate
one false design after another—a game in
which we measure molar and molecular hu-
man activity with our scanners, chronome-
ters, rating scales, and eyes, and then use
these measurements to say what the human
mind cannot possibly be. For instance, if our
measurements allowed us to conclude that the
mind cannot possibly be a device that, say,
represents information before believing it, or
has conscious intentions before it acts on
them, or knows the causes of its own reac-
tions to events in the world, then those mea-
urements could eliminate certain designs and
hence eliminate myths about the mind that we
might otherwise be tempted to embrace.
There would still be an infinite number of
plausible designs, of course, but in each case,
one design would be discredited and gone for
good.

Is that progress? If our experiments rule
out some implausible designs but leave an in-
finite number of plausible alternatives, do
they accomplish anything at all? Yes, they do,
and to understand how they do requires that
we consider two different conceptions of sci-
cientific progress. Most of us think of science as
a long, slow journey from ignorance to cer-
tainty, which can be represented as movement
along a fragment with a fixed origin and a
fixed endpoint. (See the top panel in Figure
1.3, but don’t look at the bottom panel.)
When one moves along a fragment, one may
estimate one’s progress by the distance one
has traveled from the origin or by the distance
remaining until the endpoint. Both ways of
reckoning produce the same estimate of pro-
gress because the two distances are perfectly
reciprocal, and one can measure the journey
by asking, “How far have we come?” or “Are
we there yet?” The latter question makes per-
fectly good sense because there is a “there” to
get to, and if any distance remains between it
and one’s present position, then one is most
certainly not yet “there.” The fragmentary
view of the design game suggests that one
may measure one’s progress by counting the
number of plausible designs that remain when
an experiment is finished. If the number is
more than one, then the traveler has every
right to be crabby.

But if we accept the notion that there are
always several plausible designs that can ac-
count for a particular set of behavioral ob-
servations, then we are acknowledging that we
can be perfectly ignorant of—but never per-
fectly certain about—the mind’s true design.
In that case, scientific progress is best con-
strued as a journey along a vector—a line
with a fixed origin but no endpoint. (Now see
the bottom panel of Figure 1.3 and pretend
you didn’t peek earlier.) As our experiments
Teach us more and more about what the
mind’s not, we move further and further from
the origin. If we use the “Are we there yet?”
heuristic and calculate our progress in terms
of the distance remaining, then we will mis-
takenly conclude that we have not moved be-
cause we are, as we were, infinitely far from
our final destination. Indeed, no matter what
kinds of experiments we do, we cannot see
progress in the design game if we insist on
measuring the distance between here and etern-
ity. After a few such measurements, even the
most devoted among us would probably give
up such a journey and send our pigeons.

What a shame. Because if for just a mo-
ment we had glanced backward instead of
forward, we would have noticed something
wondrous. Although perfect knowledge was
drawing no closer, our perfect ignorance was
disappearing at a pulse-pounding rate. In-
deed, the Victorian view of science suggests
that the only meaningful way to measure
progress in the design game is to count the
number of implausible designs that have been eliminated by a day of honest work, and not to calculate the distance remaining to some final solution. Just as adventurers evaluate their journeys by the lands they have visited and not by the worlds without end that they’ve yet to explore, so psychologists may evaluate their progress by the myths they’ve dispelled and the ignorance they’ve vanquished, rather than by their proximity to a complete understanding of the human mind.

CONCLUSION

The vectorian view suggests that an essay does not have a conclusion so much as it has one brief section that just happens to be furthest from the title. This chapter has done the easy work by arguing that the mind can profitably be thought of as a container of multitudes, and that the goal of dry psychology is to invent plausible descriptions of the relations between these multitudes without anointing one of them. But abstract argument is cheap, and the chapters that follow this one do the much more difficult work of describing in detail how particular parts might interact by design and give rise to particular complexities. The authors of these chapters are all good detectives who have gathered considerable evidence of the mind’s doings and then constructed compelling accounts of how the mind might do them. Each chapter tells us something valuable about what the mind’s not, and thus leaves us less ignorant than we
were before. In this world, at least, who could ask for more?

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