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CHAPTER 20

The Human Unconscious
A Functional Perspective

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Dual-process theories have many advantages. They divide the world into two categories (e.g., systems, types of processes), and two is a quantity that our minds can easily grasp. They usually tell simple, intuitively compelling stories: There are good and bad guys. Conscious and unconscious. Systematic and heuristic. Rule-based and associationist. Hot versus cool. Slow and fast. Importantly, dual-process models have had a very productive career in the young history of experimental psychology. As the success of the first edition of this volume shows, they have inspired generations of scientists interested in higher level cognition and have led to many important discoveries about our minds. It is with great sadness, then, that we report that we do not have a dual-process theory to propose here.

We are interested in what it means to be human—that is, in the mental functions that make us who we are. Mammals, not reptiles. Great apes, not monkeys. Humans, not chimps. We suspect that there are many such functions, but here we focus on one type that seems very intuitive: functions that require human consciousness (as far as we know, other animals do not have the kind of consciousness that we have). Examined from this perspective, our experimental approach in the last decade might look weird at the outset: We examined high-level functions that are performed by *non*conscious processes. This approach should have allowed us to map the functional limitations of nonconscious processes, thereby providing hints about where we should look for the unique functions of consciousness. Examined from this perspective, our project was not very successful. Papers from various laboratories around the world, including ours, made it clear that many functions that were traditionally assumed to be uniquely conscious can take place nonconsciously. One brick after another, the wall that separates conscious from nonconscious processes has shrunk. We feel it was a very informative shrinkage.

In this chapter we take this shrinkage seriously.

Using it as our point of departure we suggest a simple idea, one that is even simpler than a dual-process theory: It divides the world into *one* category, not two. Our idea is also simpler in that it focuses on just one of the attributes that have been associated with dual-process models, namely, conscious awareness. We suggest that every fundamental, basic-level cognitive function can occur nonconsciously. In other words, we

propose that there is no fundamental cognitive function that, strictly speaking, requires consciousness.

If our theory of mind is more or less intact, then your head is currently in one of two positions. You either furrow your eyebrows, murmuring to yourself, *they cannot be serious,* or else you shake your head from one side to the other, telling yourself, in disbelief, *they cannot be serious.*[1] After all, there are so many functions that obviously require consciousness that it does not even take a second to come up with a set of five. You can get a dozen in less than a minute, which is better than the amazing deals proposed by Dunkin' Donuts. Just to give you a flavor, here is taste of our donuts:

- *Planning.* Whether it is parenting, going on vacation, or simply eating dinner, we spend quite a lot of time consciously planning our next moves, those that we think will come after them, and those that actually come after them. Is the timing good for having children, or shall we wait until after the postdoc (tenure, world recognition, Nobel prize)? Where shall we go after spending 4 nights in London? Is Paris the best, or is it Rome? Shall we fly or take the train? And what's for dinner tonight? Salad, organic steaks and fresh fruits, healthy all around, or something that the children actually eat, like chicken fingers and fries. Not healthy maybe, but edible for all.

- *Goal pursuit.* Goal pursuit includes planning, of course, but it encompasses much more. When we choose to write a chapter and sit to stare the screen, we need to know how well we do. Does a paragraph count as a good morning's work? How about one sentence? Shall we close the door, or simply go home? Is it time for a radical change in plans? In other words, goal pursuit also includes choices between means; monitoring the environment for feedback, the processing of this feedback and, accordingly, the flexible change of plans.

- *Self-control.* Everyone who has ever had a weakness—and who hasn't?—must have experienced conscious difficulties in overcoming it. From alcohol to donuts, and from sex with interns to taking the day off, the challenge is identical: How do we overcome temptations and follow the route suggested by our high-level goals? We must have the type of consciousness we have in order to do so, no? Can dogs pass the famous Mischelian marshmallow test? Can they really give up one bone now for two later?

- *Culture.* Some animals can pursue goals and may even have rudimentary plans and self-control. Certainly some chimps can. But, by and large, animals do not have culture. As far as we know, they do not have literature, classical music, and pop culture. No Picassos, Einsteins, or Lady Gagas. No God. *Homo sapiens* is the only species (that we know of) that has a generative language and systematic formal systems that handle abstract, symbolic computations (e.g., math). Yes, after months of training, Herb Terrace's chimps learned abstract numbers and could utter a few hundred signs, but they could not *really* talk, and they could not add and subtract; they couldn't *really* do math (Terrace, Petitto, Sanders, & Bever, 1979).

If conscious chimps cannot read or do math, can our unconscious processes do so?

- *Thinking.* Here we are, sitting in our office, staring at the screen and thinking thoughts. Conscious thoughts, needless to say. Some are about the chapter we are writing, but others (most?) are not. We consciously develop an idea of how to begin a long-due chapter for a great edited book. We consciously think where to go from this beginning. We consciously weigh the strength of the argument (and, oh, by the way, we consciously think: *Is it time for coffee already?*). Thoughts must be conscious, mustn't they? After all, we sit here and type thoughts . . . that come our mind as they come . . . some are almost ready, well phrased . . . and sometimes the argument seem to hold. Sometimes our fingers seem to be thinking for us—but where is the conscious thought behind our fingers?

This is a set of just five examples, and we could easily expand it as much as you would like. In all likelihood you, the reader, can immediately add a few functions that we did not not list (we beg you: do it; write them down and come back to them later; otherwise they won't let you read this chapter quietly). After all, consciousness appears to be causally involved in many processes, virtually all of the time. It therefore seems to

be a necessary requirement for many of the functions that make us human, with all our faults and advantages.

Before we go on, let us just put one fear to rest. Our argument does not imply that consciousness does not make a difference. That it does not affect our lives. That whether you are your wakeful, conscious, cheerful, lovely self, or a zombie bereft of any phenomenology, does not matter. In all likelihood, it does. We cannot be easily dismissed as epiphenomenologists, who argue that consciousness has no causal relationship with mental and physical reality. How and why it interacts with reality is, at least for us, one of the most fascinating questions scientists of the mind ask themselves in the beginning of this new millennium.

So we are not epiphenomenologists. What are we, then?

INITIAL POSITION AND DEFINITIONS

The principle we propose is very simple: Unconscious processes can carry out every fundamental, basic-level function that conscious processes can perform. In a recent paper on this topic, Hassin (2013) paraphrased President Obama's 2008 slogan "Yes we can," and referred to our approach as "Yes It Can," or YIC. In that sense, our unconscious processes are like the 2008 candidate Barack Obama, who coined the slogan "Yes we can." An important implication of YIC is that a scientific answer to the mystery of consciousness would not be in the form of *Consciousness is necessary for F*, where *F* is a fundamental cognitive function.

As we note later in the chapter, the fact that a function can occur nonconsciously does not mean that it will always occur nonconsciously (Bargh, 1994). We then suggest a number of factors that can alter the likelihood that a process would be performed nonconsciously. If conditions are met, the function will be performed nonconsciously. If not, it will either be performed consciously or not at all. We will end the chapter by succinctly discussing some implications of our theorizing to the question with which we opened this chapter: What is it that consciousness gives us that makes us who we are?

Why would we even begin to think that YIC is a reasonable stance? We can see at least two good reasons. First, consciousness is notoriously limited in its processing capacity (Baars & Ave, 1997; Baddeley, 2007; Kahneman, 1973). Like any other precious resource, we simply have very little of it. Even reading this simple sentence captures most of your consciousness (or did we *catch your* mind wandering?). So while you read this, what happens to your goals (*find a new computer*), plans (*find out how to prepare* coq au vin *for dinner*), your political grievances (*wait until you have a government like ours if nothing comes easily to mind*), solving mysteries (*so how does the mind work, after all?*), goals (*vacation on Long Island*), plans (*movie tonight?*), and so forth? What happens to all of this mental hustle and bustle when you read a simple sentence?

One possible answer is *nothing, zero, zilch.* When a topic is out of your conscious sight, it is also out of your mind. No consciousness, no progress. Given the number of mental chores in our mental to-do list, however, this does not seem like the most efficient and advantageous arrangement. It will be much better for you if, when you read this chapter, you can also work on other issues that require your attention. This *argument from resources* gives initial credence to YIC.

Second, consciousness as we experience it today seems to be a recent development in the evolution of our species (Dennett, 1996; Reber, 1992; Rozin, Sprague, & Epstein, 1976). It is hard to imagine our consciousness without the kind of language that we have at our disposal, without our evolved system of formal, abstract mental representations (not to mention the iPhone). If what we believe we know about the speed of evolutionary changes is correct[2], then it seems unlikely that much of our mind/brain is dedicated to consciousness. Thus, if there is a fundamental cognitive function that you need at your disposal, it had better function nonconsciously. This *argument from evolution* gives YIC some added face-value validity.

But cognitive scientists are not easily swayed by arguments. In the end, we always say that it is an empirical question. Can you, or can you not, make plans for cooking *coq au vin* without knowing that you do? Can you, or can you not, add the prices of cof-

fee, a muffin, and a side of bacon without consciously going through the arithmetic motions?

Cognitive scientists like data, and our approach in this chapter is to give you data. We review developments in cognitive and social psychology, as well as in motivational psychology and the cognitive neurosciences. These developments, we argue, support YIC. Unfortunately, arguments and data, even when both are strong, are not proof. Unlike our linear algebra professor, at the end of this chapter we will not be able to declare triumphantly: Q.E.D. (*quod erat demonstrandum,* that which was to be demonstrated). But it seems to us that the argument we make is not weak, and that the method we propose is rather generic. We believe, then, that our arguments and data suggest that YIC is a possibility worthy of your consideration. And, yes, even the function of consciousness you harbor right now—and you must, because everyone we talk to has his or her pet function of consciousness—can occur without awareness.

A few definitions are in order before we go on. We use the term *cognition* in a broad sense that includes not only the processes that traditionally fall under the category of "cognition," but also those that are often referred to as "motivation" and "emotion." We use the adjective *high-level* to describe processes that are postperceptual and involve complex considerations and cognitive control. Sometimes examples can do a better job than definitions (Wittgenstein, 1963), so here is a partial list: inhibition, shifting, working memory (WM), inferences, causal reasoning, attribution, metaphor comprehension, narrative construction, and logic. Last, cognitive functions vary in their fundamentality, that is, in how inherent they are to normal cognitive functioning, and in their level of abstractness (Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976). YIC, as we have proposed it, concerns fundamental, basic-level functions. The fact that we lack taxonomies of cognitive functions renders this definition somewhat vague but we suspect that even without accepted taxonomies these issues are quite consensual. Thus, for example, we are likely to agree that the function of combining emotional cues (e.g., vocal and facial) is more fundamental than the function that maps a certain sound to a keypress. Likewise, the function of inhibiting unnecessary materials from WM seems more basic level than that of deleting from WM recent information about one's annoying aunt Nitza. We therefore use the term *fundamental function* as shorthand for *fundamental, basic-level function.*

Last, it is important to distinguish between *subliminal perception/priming* and *unconscious cognition* (see Bargh & Morsella, 2008). In investigating subliminal priming, one attempts to find out the extent to which nonconsciously perceived stimuli can be processed, while mapping their possible effects (for recent reviews, see Kouider & Dehaene, 2007; Van den Bussche, Van den Noortgate, & Reynvoet, 2009). Scientists who study unconscious cognition examine unconscious processes without limiting themselves to subliminality: Awareness of the relevant processes and/or their products is the main issue here (for recent overviews, see Bargh, 2007; Gawronski & Payne, 2010; Hassin, Uleman, & Bargh, 2005). The evidence that is reviewed here comes from both lines of research.

ADOPTING A FUNCTIONAL STANCE

There are intellectual discussions within the cognitive sciences that stand to gain much from adopting a functional stance—a stance that grounds the study of cognition in an understanding of cognitive functions (Marr, 1982). What is a cognitive function? One identifies a cognitive function of a process *P* when one gives a teleological answer to the question *What is it that P does?* Here are a few examples. One function of memory is to store information for later use. One function of self-control is to overcome temptations, and one function of fear is to focus our attention on fear-eliciting objects.[3]

Why should one adopt a functional stance? One answer would be that the cognitive sciences are functional in nature: They are *about* understanding the functions of the mind/brain, and how they are implemented (Marr, 1982). While we think that adopting a functional approach is a good move in the cognitive sciences in general, for our current discussion it has an additional advantage: It does not allow us to commit the frequent mistake of confounding a functional

characterization of a mental process with a description of its characteristics. To take just one example, if one is interested in emotion regulation, one needs to offer a functional definition of it (e.g., emotion regulation is the function that takes an emotional mental state *X* and turns it into *Y*). Whether or not the processes that implement this function are necessarily conscious (and/or intentional and/or effortful, etc.) is an empirical question, not a definitional one. In other words, one cannot include these characteristics in the definition of the function one studies, unless one wants to restrict oneself to a specific subset. Here, then, we adopt a functional approach to the study of unconscious processes.

In the following sections we describe recent advances in the cognitive sciences vis-à-vis the functional abilities of nonconscious processes. And here is a spoiler: The reviews will suggest that functions that were traditionally assumed to require consciousness do not, strictly speaking, require consciousness.

EXECUTIVE FUNCTIONS

Executive functions are cognitive functions that regulate other cognitive functions, and they are commonly associated with self-control (or "willpower") and the prefrontal cortex (Miyake & Friedman, 2012). Importantly, executive functions are often thought of as being closely associated with (or even requiring) conscious processing (e.g., Baars, 2002; Dehaene & Naccache, 2001). Our review in this section focuses on two functions that have relatively precise operational definitions and have been studied extensively vis-à-vis conscious awareness: inhibition and shifting.

Inhibition

The executive function *inhibition* is the "ability to deliberately inhibit dominant, automatic, or prepotent responses when necessary" (Miyake et al., 2000, p. 57). Many cognitive tasks rely on inhibition, including celebrity tasks such as the Stroop (Stroop, 1935) and the stop-signal (Logan, 1994). A recent account has even suggested that inhibition is closely linked to a general factor that explains variance shared by other executive functions (Miyake & Friedman, 2012).

In recent years Victor Lamme, Simon van Gaal, and their colleagues have repeatedly shown that inhibition can be triggered by subliminal stimuli (Wokke, van Gaal, Scholte, Ridderinkhof, & Lamme, 2011; van Gaal, Ridderinkhof, Fahrenfort, Scholte, & Lamme, 2008; van Gaal, Ridderinkhof, Van den Wildenberg, & Lamme, 2009; for a review see van Gaal, de Lange, & Cohen, 2012). In one of their first experiments, participants engaged in a go/no-go task in which they were asked to respond rapidly to a target, and to withhold responses if a no-go stimulus had been presented before the target (van Gaal et al., 2008). Critically, on some trials this no-go stimulus was weakly masked and therefore conscious, whereas on others it was strongly masked and therefore subliminal. The results show that the subliminal priming of a no-go stimulus increased the likelihood of withholding responses, and that it increased reaction times to responses that were not withheld. These results have been extended by showing that subliminally triggered inhibition is correlated with activity in the prefrontal cortex (van Gaal et al., 2008), that the magnitude of unconscious inhibition is correlated with participants' ability to consciously inhibit responses (van Gaal et al., 2009), and that subliminally triggered inhibition does not rely on a strong preexisting association between the no-go signal and inhibition (Wokke et al., 2011). Taken together, these data allow us to conclude that inhibition does not require consciousness.

Shifting

Defined as "shifting back and forth between multiple tasks, operations, or mental sets" (Miyake et al., 2000, p. 55), and associated with various task-switching paradigms, *shifting* is an executive function that has been studied quite extensively vis-à-vis conscious awareness. To examine nonconscious shifting, researchers use a modified task-switching paradigm. In a "regular" task-switching experiment there are cues that indicate whether to perform Task A or Task B. In the modified version, the task cues are preceded by subliminal primes. The prime

may be either identical to the task cue (e.g., both signal participants to perform Task A; congruent trials) or different (e.g., the prime signals Task B, whereas the task cue signals Task A; incongruent trials). Results from this paradigm show that participants are slower to respond on incongruent (vs. congruent) trials (Mattler, 2003), and that subliminal primes lead to activation in brain areas that are associated with the task that they prime (Lau & Passingham, 2007). Later studies used various paradigms that allowed for a wider generalization and yielded similar results (Reuss, Kiesel, Kunde, & Hommel, 2011; Zhou & Davis, 2012). Considered together, these results strongly suggest that shifting does not require conscious awareness.

And a Bit More . . .

Our choice of executive functions was one of convenience; inhibition and shifting are not only central executive functions, but they have also been studied extensively in relation to nonconscious processing. But is it possible that researchers are "looking under the lamppost," and that we cannot generalize from these examples to executive functions more generally? A thorough discussion of the structure of executive functions is well beyond the scope of this chapter.[4] But to take one concrete example, Miyake and colleagues (2000) propose that there are three main executive functions: inhibition, shifting, and updating and monitoring of WM representations. Can the latter operate outside of conscious awareness, too?

Our lab's work on implicit WM suggests that the answer is positive (Hassin, Bargh, Engell, & McCulloch, 2009). To examine implicit WM Hassin et al. developed a paradigm in which small disks that are either empty (bagel-shaped) or full appear one at a time in various locations on a computer screen. Participants' task is to respond with one key press if a disk is empty and another key press if the disk is full. The disks appear in sequences of five, separated by a fixation square. In Pattern sequences, the locations of the disks create a pattern (e.g., a zigzag). In the Broken Pattern condition, the locations of first four disks are identical to those of pattern sequences, but the fifth disk breaks the patterns. Pattern and Broken Pattern sequences are equally probable, so the likelihood of a "pattern move" from the fourth to the fifth disk is identical to the likelihood of a "broken pattern" move. Hence "simple" implicit learning across sequences cannot help performance in this task.

Extracting the patterns and gaining from them requires active maintenance of ordered information (the locations of disks), context-relevant updating of information (with incoming disks), and goal-relevant computations (i.e., pattern extraction and anticipation formation). The extracted information is immediately available to control behavior and cognition, in the service of current goals (of being fast and accurate). These functions are traditionally associated with WM (Hassin, 2005), yet across a set of five experiments that used various probing techniques we failed to find any evidence of awareness.

These data, then, strongly suggest that monitoring and updating can occur outside of conscious awareness. Yet, we want to mention here two limitations of this research. First, we did not use subliminal stimuli, that is, the disks themselves were visible (for a study that does use subliminal stimuli, see Soto, Mäntylä, & Silvanto, 2011). Second, while our task requires some forms of monitoring and updating, it falls short of meeting all of the functions described by Miyake and colleagues (2000). Personally, we see no a priori reason to assume that the latter processes do not occur nonconsciously, but this is an open empirical question.

GOAL PURSUIT

Intuitively, goal pursuit seems to involve quite a bit of conscious processing: from the first stages of goal adoption (should one pursue a career in architecture or become an actor?) to means selection (MIT or Harvard?) to monitoring progress (how good was my exhibition in PS1?) and correction (go back to the drawing board) to overcoming obstacles (appeal decision of the MOMA curator) and reevaluation (maybe fatherhood, after all?). It is hardly surprising, then, that goal pursuit traditionally was assumed to be a consciously controlled process (Ajzen, 1991; Bandura, 1986; Deci & Ryan, 1985; Locke & Latham, 1990).

Research on automatic goal pursuit, however, suggests that goal pursuit is not necessarily conscious. In one of the first empirical papers on the subject, Bargh, Gollwitzer, Lee-Chai, Barndollar, and Trötschel (2001) used word search tasks to prime the goal of cooperation. In this priming technique, participants were asked to find a list of words in a matrix of letters. In the experimental condition, many of these words were cooperation-related. In the control condition the primes were replaced by goal-neutral words. Participants then went on to play a commons resource dilemma, in what was allegedly a separate, unrelated experiment. The results showed that participants who had been primed with the goal of cooperation cooperated more than those who had not been primed. Yet they did not consciously realize that a goal had been primed, or that they were more committed to cooperation.

Using various priming methods, psychologists have primed goals such as solving puzzles, achievement, obtaining sex, and impression formation. In some of these studies, the goals were primed subliminally (see Bijleveld, Custers, & Aarts, 2011; Fishbach, Friedman, & Kruglanski, 2003). In others, evidence for unawareness comes from debriefings in which participants' phenomenology was thoroughly examined. A vast majority of these studies failed to find differences in goal-related phenomenology between participants in the priming and control conditions. In other words, while motivation priming is strong enough to affect behavior, it does not seem to affect subjective reports (for recent reviews, see Custers & Aarts, 2010; Dijksterhuis & Aarts, 2010; Fishbach & Ferguson, 2007). In light of this research, it seems safe to suggest that one goal can be activated nonconsciously, and that it can then go on to be pursued outside of conscious awareness.

But we rarely pursue only one goal at a time. Think of yourself now: You read this chapter hoping (we hope) that it will help you to obtain a goal. You are also a scientist (maybe), with publication, mentoring, and teaching goals. You are likely to have a few goals related to your roles as a family member (e.g., mother, son, sibling, nephew), and you may have other goals such as losing weight, having fun, and preserving the environment, to mention just a few. The upshot of this clearly is that at any given point in time we pursue multiple goals, and some of them compete for our attention. If we cannot handle goal conflict nonconsciously, our consciousness is likely to be flooded with conflicts it needs to resolve.

Recently Tali Kleiman and I demonstrated that goal conflicts can occur outside of conscious awareness (Kleiman & Hassin, 2011). In one set of studies we primed a cooperation goal in the context of a commons resource dilemma in which the dominant goal is competition (selfishness; Brewer & Kramer, 1986; Fehr & Fischbacher, 2003). Since cooperation is the nondominant goal, priming it should increase the conflict between these goals. Indirect markers of conflict (i.e., variability in repeated decisions, increase in reaction times and arousal) showed that, indeed, priming resulted in increased conflict. Yet, across six experiments we failed to detect differences in explicit measures of conflict. One of the experiments used a trial-by-trial assessment of conflict, yet failed in documenting it too. A mini-meta analysis of all the experiments in this set, with 233 participants, still did not provide evidence for changes in phenomenology.

CONCEPTUAL INFORMATION INTEGRATION (AND MORE)

Integrating and manipulating abstract units of meaning (e.g., numbers, words, objects) is a set of cognitive functions that is widely considered to require consciousness (Baars, 2002, 2005; Baumeister & Masicampo, 2010; Greenwald, 1992; Morewedge & Kahneman, 2010). Two recent studies that used subliminal presentations considerably challenged this view.[5] In the first, participants were instructed to compute the sum and average of supraliminally presented sets of four numbers (e.g., 7, 4, 3, 2; Van Opstal, de Lange, & Dehaene, 2011). Unbeknownst to them, the target sets were preceded by subliminally primed sets (e.g., 9, 6, 5, 8). The results showed that the sum and average of the subliminally primed sets affected the responses to the target sets, thereby providing evidence for the integration of numbers. The nature of the task did not allow the authors to argue for nonconscious arithme-

tic computations, but we review evidence for arithmetic later in this section.

The second paper provides evidence for the semantic integration of multiple objects in a visual scene (Mudrik, Breska, Lamy, & Deouell, 2011). In this study participants were presented with pictures that were masked by continuous flash suppression (CFS), which consists of a presentation of a target stimulus to one eye and a simultaneous presentation of rapidly changing masks to the other eye. The rapidly changing masks dominate awareness until the target breaks into consciousness (Costello, Jiang, Baartman, McGlennen, & He, 2009; Jiang, Costello, & He, 2007; Yang, Zald, & Blake, 2007). Importantly, this suppression may last seconds, thereby allowing prolonged cognitive processing (Tsuchiya & Koch, 2005). Participants in this study were asked to press a button as soon as they saw the pictures or any parts of them. Thus, the dependent variable was how long it takes a stimulus to break suppression and appear in consciousness. The results showed that incongruent pictures (e.g., a person shooting a tennis racket out of a bow) broke suppression before congruent pictures (e.g., a person shooting an arrow out of a bow). Put differently, incongruent pictures appeared in consciousness before congruent pictures. Note that in order to differentiate between congruent and incongruent pictures, participants had to identify at least two objects (e.g., the racket and the bow) and combine these two units of meaning into one (incongruent) whole.

The evidence from these two articles, then, suggests that abstract units of meaning can be integrated without consciousness, thereby challenging the modal view, which holds that conscious awareness is a necessary condition for performing this function.

Two recent sets of experiments significantly extend these initial results by providing evidence for nonconscious reading of multiple-word expressions and for nonconscious arithmetic (Sklar et al., 2012). In the first series, participants were presented with multiple-word expressions that were masked by CFS. The expressions could be either semantically consistent (e.g., *John made coffee*) or not (e.g., *John ironed coffee*). Participants were asked to press a button as soon as they saw verbal stimuli or any parts of them (e.g., a letter), and the duration of suppression from awareness served as the dependent variable. The results clearly showed that semantically inconsistent word combinations broke suppression faster than semantically consistent expressions. In another study in this set, Sklar et al. used affective value of verbal expressions to examine word integration. In this set of experiments, Sklar et al. compared the subliminal processing of short verbal expressions with affective tones that ranged from being very negative (e.g., baby in the oven, concentration camp) to neutral (e.g., parking lot), to mildly positive (e.g., ironed shirt). The dependent variable was again suppression duration, or how long it takes stimuli to break suppression and appear in consciousness. The results clearly showed that affective value of verbal expressions affects suppression duration, such that the more negative an expression is the faster it breaks suppression. They therefore suggest that multiple words were integrated into verbal expressions outside of conscious awareness.

In the second series of studies (Sklar et al., 2012), CFS-masked arithmetic problems (e.g., 9 – 3 – 2 =) were presented to participants, followed by supraliminal presentation of a target number (e.g., 4). Participants were asked to name the target numbers, and Sklar et al. measured how long it took them to begin pronunciation. There were two conditions. In the compatible condition, the target was the solution to the primed problem (e.g., subliminal 9 – 3 – 1 was followed by supraliminal 5), whereas in the incompatible condition it was not (e.g., the target was 6). The result of a series of experiments showed that compatibility made a difference: Participants were quicker in the compatible condition. These results strongly suggest that the problems were solved, and objective and subjective measures assured that there was no awareness of the primes.

To conclude, while early evidence might have suggested that consciousness is necessary for integrating abstract units of meaning, recent evidence seem to challenge this view significantly by providing evidence for the integration of numbers, words, and visual objects (for more functions, see Hassin, 2013).

IS THAT ALL?

The functions we have reviewed are but a small fraction of the functions of our high-level cognitive processes. They are meant to exemplify a principle and a way of conducting our science, rather than an exhaustive list of the functions that operate nonconsciously (according to our best data to date). The point we want to make is simple: When one adopts a functional stance, examining high-level cognition through the lenses of the functions it performs, one can conceptually and empirically dissociate the functions and their characteristics. Adopting this view quickly reveals that a host of functions that were traditionally associated with conscious awareness can also occur nonconsciously.

The argument that nonconscious processes have *the ability* to perform a function *F* does not imply that they will always (or even frequently) do so, however. It is a statement about what these processes *can* do, not about what they *actually* do. To learn more about the actualities, one has to ask *when* can one expect nonconscious processes to perform *F*. In the case of scientists, the likelihood of producing a great paper increases with their basic abilities, motivation, and experience. Here we propose to treat nonconscious processes the same way we treat scientists: with careful attention to details. Specifically, we suggest that abilities, motivation, and experience determine whether a certain function will or will not occur nonconsciously *at a given point in time*.

Ability

People who are good at math can compute without calculators what the rest of us can hardly do with calculators. People who are good self-controllers can inhibit impulses that, uninhibited, may ruin the careers of others, and those with good analytic skills get SAT scores that make us all look like fools. Executive functions and WM capacity are known to be important determinants of high-level conscious cognitive processes (Conway & Kane, 2005; Redick, Heitz, & Engle, 2007; Ricks, Turley-Ames, & Wiley, 2007). Generally speaking, those of us with large WM capacity do better than those with smaller capacity. Is it reasonable to expect that there is a nonconscious parallel to these kinds of processes, one that determine the abilities of nonconscious processes?

Recent research suggests that there might be. As reviewed earlier in more detail, we have recently shown that WM can operate outside of conscious awareness (Hassin, Bargh, Engell, et al., 2009; Hassin, 2005), and a number of laboratories have shown that executive functions can operate nonconsciously (see the earlier section, "Executive Functions"; also see Hassin, Bargh, & Zimerman, 2009; Soto et al., 2011). It seems to us that it is reasonable to assume that there are individual differences in the capacity for high-level, nonconscious processes of this sort, and that variation in implicit WM capacity and nonconscious executive functions would be determinants of high-level, nonconscious processes.

Motivation

Evidence for the role of motivation (and needs) in the processing of subliminal stimuli has begun to emerge in the area of subliminal persuasion. To take just one example, priming a certain brand of drink leads to increased drinking of this brand, but only if subjects have the relevant need, that is, if they are thirsty (Karremans, Stroebe, & Claus, 2006; see also Bermeitinger et al., 2009; Strahan, Spencer, & Zanna, 2002). In our laboratory we used goal priming to examine similar issues: We have shown that achievement priming increases the likelihood that subliminal primes will affect choice (Milyavsky, Hassin, & Schul, 2012).

Given the important role of motivation in human behavior more generally, we see no reason to suspect that motivation is not a key determinant of nonconscious processes. Hence, we suggest that one needs to motivate the unconscious to perform tasks, in the same way that one needs to motivate consciousness to engage in effortful processing.

Experience

The vast automatization literature (Bargh, 1994; Kahneman & Treisman, 1984; Schneider & Shiffrin, 1977) suggests that the more automatic a process becomes, the more likely it is to occur effortlessly and noncon-

sciously (e.g., Barrouillet & Fayol, 1998). One implication of these findings is that there are *developmental trajectories* in the capabilities of the unconscious, a result that has two implications for the current discussion. First, it suggests that at different points in life, our nonconscious processes can perform different functions. Second, given that different individuals are exposed to different environments and develop different skills, one should expect *individual differences* in the capabilities of nonconscious processes. To the best of our knowledge, there is very little data on the subject.

Generally speaking, then, YIC holds that every fundamental, basic-level cognitive function that one can perform consciously in one's head, one will also be able to perform nonconsciously in one's head, given that one has the relevant ability, motivation, and experience. For example, in state-of-the-art techniques such as CFS we can present subliminal stimuli for up to 2 seconds. YIC holds, then, that given enough motivation, every arithmetic function that one can do consciously in 2 seconds one will be able to do under CFS.

ON CONSCIOUSNESS

So at last we get to discuss the implications of our view and review for the scientific understanding of the functions of consciousness. In the introduction we mentioned that we are not epiphenomenologists; that is, we are not arguing that consciousness does not make a difference, that it lacks any causal powers. Here is a basic intuition we believe all of us share: Some of us would be willing to dye our hair orange for $500, would require $1,000 for complete body waxing, would eat cockroaches for $20,000, and would be willing to consider losing a finger for $1,000,000. Healthy normal people, under normal circumstances (who don't need the money to save the life of their child, etc.), would never agree to lose their consciousness. In other words, even if nonconscious processes can perform every fundamental, basic-level cognitive function, we would not give up our phenomenology. It seems to us that we would be completely different creatures without it, and maybe we are wrong, but we prefer the creatures we are right now.

One interesting question is why do we have the feeling? Another is how is it that consciousness makes a difference, and to what? (If it does, we must note that we view this assertion as a hypothesis. Until proven wrong, though, we are sticking to it.)

YIC holds that every fundamental, basic-level cognitive function that can be carried out consciously can also be carried out nonconsciously. But the ways in which these functions are achieved—their implementation—may be different. In other words, nonconscious (vs. conscious) functions may use different algorithms, different representations, and different recruitment of brain networks. This postulation should not be taken to imply a dual-process model. We do not propose that there are two different and distinct mind/brain systems—one conscious, the other not—that perform (the same) cognitive functions independently of each other. Conscious awareness, rather, is seen here as a contingent property of fundamental functions (or of stages of their implementation). Yet given the differences we mentioned earlier, it is entirely possible (and sometimes even likely) that conscious processes will play out differently than nonconscious ones. The following example conveys some of these intuitions.

Imagine, for example, that you are interviewing for your dream academic job. The chair of the department turns out to be a little weird. Before you leave her office, she tells you that the department has voted, and that their decision appears on her computer screen. She then excuses herself, and you are left in her office, alone, and her screen basically stares at you. In one possible scenario, the message *THE JOB IS ALL YOURS* is flashed subliminally (assume, for the sake of argument, that people can read short sentences even if they are presented subliminally). In the other scenario, the message is simply there, on the screen, for you to see. We contend that it is unlikely that the two messages will have the same effect. Yes, as scientists, we may be able to show that you have an elevated galvanic skin response (GSR) in response to the subliminal message, but not to a scrambled version of it (ALL JOB THE YOURS); that you will be happier after

nonconsciously reading the message (treating yourself, perhaps, to a donut) than after the scrambled one; and so forth. But only in one scenario would you leave the room ecstatic, and only in one scenario would you spend the afternoon daydreaming about how to decorate your office in William James hall. Only in one scenario would you be so engrossed in fantasizing that you would accidentally bump into a woman, offer her coffee as compensation, tell her enthusiastically about your new job, and find yourself, 5 hours later, agreeing to accept her offer and come work under her at the White House. Only in one scenario, would you find yourself a year later, after your President loses the election, without an academic job, thinking about what to do in life.

So even if one assumes that both messages are read and understood, whether or not reading is accompanied by conscious awareness is likely to play out differently.

Another source of differences between conscious and nonconscious processes has to do with the conditions that enable their operation. In a previous section we discussed three factors that determine the likelihood that a nonconscious process will kick in: experience, motivation, and ability. Suppose a function *F* begins operating nonconsciously when experience reaches a level of E_j; motivation, a level of M_j; and ability, A_j. Suppose, furthermore, that for the same function to run consciously, it requires motivation M_i, where $M_i > M_j$, and ability A_i, where $A_i < A_j$. In this hypothetical example, $F_{\text{conscious}}$ will differ from $F_{\text{nonconscious}}$, simply because they will run in different situations.

You may object by arguing that, really, $F_{\text{conscious}}$ and $F_{\text{nonconscious}}$ are similar here. And you may have a point. But note that the fate of a creature without phenomenology will be different than that of a creature with phenomenology, thereby suggesting that having a phenomenology makes a difference.

Another objection to YIC may hold that, with all due respect to nonconscious processes, the great works of culture (broadly defined to include everything from Picasso to Einstein to Eminem) require consciousness. This objection is not confined to great works of art; it also applies to more mundane contributions such as letters to the *New York Times,* a caring e-mail to a friend, a fun note left on your spouse's pillow, or a joke one makes at a party. There are two points we wish to make here. First, note that all of these works of art require nonconscious processes. Take nonconscious processes away and you are left with . . . what? This point is often overlooked: Without the hard work of nonconscious processes, consciousness would have very little to work with. While you can imagine completely nonconscious contributions (e.g., this sentence has not been planned or thought of before it is actually typed), it is much more difficult to imagine these contributions without nonconscious processes.

Second, ask yourself why you are so certain that consciousness is a necessary prerequisite for the creation of complex cultural works such as paintings and scientific theories. Do we have data to support it? The answer, we believe, is negative. True, we know of no scientific theory that was developed by a person in a vegetative state. Similarly, we know of no theory developed by animals with consciousness that is very different than our own, say chimps. But note that being in a vegetative state involves much more than losing consciousness, and there are many differences between chimps and us, not just in the structure of phenomenology. To answer the question of whether Picasso could have painted a Picasso without being aware of it, we must have Picasso devoid of consciousness, and only consciousness. We do not yet posses the technology that allows us to knock down consciousness, and only consciousness; hence, this experiment cannot be conducted. Given the intricacies of the human mind, we are not optimistic about the feasibility of developing such a technique.

CODA: BACK TO DUAL-PROCESS MODELS

This is a book about dual processes, but we offered no dual-process model. Yet we believe that the current contribution is relevant to our theories of the mind in general, and to dual-process models in particular. In various guises, the dichotomy between conscious and nonconscious processes (implicit vs. explicit, etc.) is central to many dual-

process models. Even when it is not explicitly stated, it often lurks in the back of the minds of authors and readers alike. Using a functional approach, this chapter calls for a reevaluation of the default (if often tacit) assumption that associates high-level cognitive processes and conscious awareness. Defaults are very powerful in our lives. They shape how we see and think about the world. They are often very helpful, chopping through uncertainty to provide us with a comprehensible view of the world. One cannot imagine efficient cognitive processes without defaults. Yet defaults do not come without a price: They direct our conceptual attention, and resources, toward certain avenues, while leading us to ignore others. They help us make leaps that are not always justifiable. They conceal truths. Changing defaults has the potential of releasing constraints from our exploration space and shedding new light on existing data and theories. We hope that the tools we propose here—YIC and the functional approach—will help us reexamine our defaults, leading to improved understanding of the unconscious mind and the functions of consciousness.

NOTES

1. Well, there is always a third option: that you are basically emotionless, flatly telling yourself, yawning, "Oh, no, not this topic again." If this is the case, then it is time for you to move on. We'll be talking about unconscious processes and consciousness for the next 10 pages or so.
2. Relatively recent work on genetics and epigenetics may suggest that this view should be updated (Jablonka & Lamb, 2005).
3. These definitions *are meant as demonstrations* of the stance; they are not meant to be exhaustive.
4. But see Miyake et al. (2000) and Miyake and Friedman (2012).
5. Evidence with nonsubliminal stimuli is abundant, yet, naturally, it is less conclusive in terms of access to consciousness. Unfortunately, reviewing this evidence is beyond the scope of this chapter. To give readers a taste, it includes inferences (Uleman, Adil Saribay, & Gonzalez, 2008), integration of information during decision making (Dijksterhuis, Bos, Nordgren, & Van Baaren, 2006), and insight formation (Metcalfe & Wiebe, 1987; Metcalfe, 1986). For relatively recent overviews see Dijksterhuis (2010), Bargh (2007), and Hassin, Uleman, and Bargh (2005).

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