To cite this chapter:

Moors, A., Spruyt, A., & De Houwer, J. (2010). In search of a measure that qualifies as implicit: Recommendations based on a decompositional view of automaticity. In B. Gawronski & K. B. Payne (Eds.), *Handbook of implicit social cognition: Measurement, theory, and applications* (pp. 19-37). Guilford Press.

CHAPTER 2

In Search of a Measure That Qualifies as Implicit

Recommendations Based on a Decompositional View of Automaticity

Agnes Moors, Adriaan Spruyt, and Jan De Houwer

In recent years, investigators interested in measuring attributes of individuals, such as their attitudes toward stimuli (e.g., products, minorities), have increasingly turned to implicit measures such as the affective priming task (e.g., Fazio, Jackson, Dunton, & Williams, 1995) and the Implicit Association Task (Greenwald, McGhee, & Schwartz, 1998). We analyze the term *implicit measure* with the aim of formulating recommendations for investigators in search of a measure that qualifies as implicit.

To analyze the term *implicit measure* requires an answer to three questions: (1) What is implicit? (2) What is a measure? (3) To which aspect of the measure does the term *implicit* refer? With regard to the first question, De Houwer (2006; De Houwer & Moors, 2007, Chapter 10, this volume; De Houwer, Teige-Mocigemba, Spruyt, & Moors, 2009) proposed to replace the concept of implicit with the concept of automatic. Regardless of whether one accepts that both concepts have exactly the same meaning (e.g., one might argue that the concept automatic is broader than the concept implicit), it is useful to replace the question of implicit measures with the question of automatic measures (and thus to broaden the question). With regard to the second question, De Houwer argued that the term *measure* can be used in two senses. In the first sense, it refers to a procedure (e.g., a priming task) designed to measure an attribute of the person (e.g., his or her attitude toward the stimuli presented as primes). In the second sense, it refers to the outcome or effect of the measurement procedure (e.g., the size of a priming effect to a particular stimulus) and is supposed to reflect the attribute of the person. With regard to the third question, De Houwer argued that in the phrase "implicit measure" the term *implicit* is not used as a predicate of the measurement procedure but as a predicate of the measurement outcome or the effect (it tells us how the effect came about) or of the processes underlying the measurement outcome (it tells us what the processes that produced the effect are like).[1]

This definition of the term *implicit measure* has important implications for investigators in search of a measure that qualifies as implicit. To classify a particular measurement outcome as implicit, one has to generate (or review) empirical evidence supporting that the processes underlying the measure are automatic. Before we can illustrate how to assess the automaticity of processes underlying certain measurement outcomes, we need to take a few preparatory steps. In the first part, we clarify our view of automaticity. In the second part, we consider one popular group of measurement outcomes, irrelevant feature effects, and address the question of what processes underlie these effects. In the third part, we consider the affective priming effect as one example of an irrelevant feature effect that

has been used as an implicit measure. We review a number of concrete arguments to diagnose the automaticity of the processes underlying affective priming effects.

AUTOMATICITY

We advocate a feature-based view of automaticity, defining automaticity as an umbrella term for a number of features such as uncontrolled, unconscious, efficient, and fast. In this section, we first list definitions for a variety of automaticity features (see Moors & De Houwer, 2006, 2007, for a review). Next, we argue that automaticity features inform us about the conditions under which processes operate. In addition, we propose to extend the set of operating conditions beyond those that derive from automaticity features. Finally, we defend a decompositional view with regard to the relations among automaticity features or, more broadly, operating conditions (see also Bargh, 1992).

Definitions of Automaticity Features

The features to be defined in this section are (un)controlled, (un)intentional, (non)autonomous, goal (in)dependent, (not) purely stimulus driven, (un)conscious, (non)efficient, and (slow) fast (Table 2.1). The first five features in this list are somehow related to goals. We call them the family of goal-related features. Perhaps the most central of these is the feature *controlled*. To say that a process is controlled implies that one has a goal regarding the process and that activation of this goal causes the end state put forward in the goal. Processing goals can be of the promoting type (i.e., the goal to engage in the process) or of the counteracting type (e.g., the goals to alter, stop, or avoid the process). In the case of a promoting goal, the end state is the actual occurrence of a process. In the case of a counteracting goal, the end state is a change, the interruption, or the prevention of a process. To say that a process is *uncontrolled* can refer to different cases. It can refer to the case in which the goal about the process is present but the effect is absent. It can also refer to the case in which the effect is present (i.e., that the process occurs, changes, is interrupted, is prevented) but the goal about the process is absent. For instance, a process can be called uncontrolled when it is interrupted but the person did not have the goal to interrupt it. Uncontrolled can also describe the case in which both the goal and the desired effect are present but the effect was not caused by the goal. Imagine that you have the goal to kneel down to tie your shoes. Suppose that you do kneel down not because of your goal but because you are pushed by a person walking by. In this case, both the goal and the desired effect are present, but it would be wrong to regard this act as controlled because the goal did not cause the desired effect. Concluding that a process or act is controlled thus requires demonstration of a causal relation between goal and effect, something that might not always be easy to achieve.

Several other goal-related features are closely related to the feature (un)controlled. To say that a process is *intentional* means that one has the goal to engage in a process and that this goal results in the occurrence of the process. Intentional is identical to controlled in the promoting sense. Intentional processes are thus a subset of controlled processes. Likewise, *unintentional* processes are a subset of uncontrolled processes.

The feature autonomous is also related to the feature controlled. Moors and De Houwer (2006) defined *autonomous* as uncontrolled in terms of every possible processing goal. A process is autonomous when it is not caused by a promoting goal (i.e., uncontrolled in the promoting sense or unintentional) and when a counteracting goal does not result in the envisioned effect (i.e., uncontrolled in the counteracting sense).

Another feature that is closely related to (un) intentional is the feature *goal (in)dependent*. Intentional processes are a subclass of goal-dependent processes (because intentions are a subclass of goals; intentions are goals that have an act or a process as their content). A process that is caused by a goal is goal dependent. This goal may be either the proximal goal to engage in the process or a remote goal. In the first case, the process is intentional; in the second case, the process is unintentional but goal dependent. For instance, the act of moving one's arm toward an apple may be caused by the proximal goal to move one's arm (in this case the act is intentional) or directly by the remote goal to eat the apple (in this case the process is unintentional but goal dependent). Another scenario is that the remote goal causes the proximal goal and that the latter, in turn, causes the process. For example, the goal to eat an apple may cause the goal to move one's arm toward the apple, and this may, in turn, cause the arm to move toward the apple. A process that is not caused by a (proximal or remote) goal is goal independent.

A subset of goal-independent processes are *purely stimulus-driven* processes. These are processes that, in addition to being goal independent (i.e.,

TABLE 2

Features

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Efficient

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Fast

Slow

TABLE 2.1. (Non)automaticity Features: Types and Ingredients

		Ingredients		
Features	Types	Conditions	Effect	Causal connection
Controlled in the promoting sense = intentional		Promoting goal present	Effect present	Present
Controlled in the counteracting sense		Counteracting goal present	Effect present	Present
Uncontrolled in the promoting sense (note: only in case a2 and b2 uncontrolled in the promoting sense = unintentional)	(a1)	Goal pertaining to process absent	Effect absent	Not applicable
	(a2)	Goal pertaining to process absent	Effect present	Not applicable
	(b1)	Goal pertaining to process present	Effect absent	Not applicable
	(b2)	Goal pertaining to process present	Effect present	Absent
Uncontrolled in the counteracting sense	(a1)	Goal pertaining to process absent	Effect absent	Not applicable
	(a2)	Goal pertaining to process absent	Effect present	Not applicable
	(b1)	Goal pertaining to process present	Effect absent	Not applicable
	(b2)	Goal pertaining to process present	Effect present	Absent
Goal dependent		Goal present	Process present	Present
Goal independent	(a)	Goal absent	Process present	Not applicable
	(b)	Goal present	Process present	Absent
Purely stimulus driven		Stimulus (+ usual background conditions) present	Process present	Present
Autonomous = uncontrolled in promoting and counteracting sense		Promoting goal absent	Process present	Not applicable
		Promoting goal present	Process present	Absent
		Counteracting goal present	Effect absent	Not applicable
Conscious	A-conscious	Intentional aspect present		
	P-conscious	Phenomenal aspect present		
Unconscious		Consciousness (A and/or P) absent		
Efficient		Minimal amount of attentional capacity present		
Nonefficient		Large amount of attentional capacity present		
Fast		Minimal amount of time present		
Slow		Large amount of time present		

do not causally depend on any type of goal), also do not depend on other factors such as awareness or attention. The occurrence of these processes depends only on the presence of a stimulus and certain basic conditions that ensure that the stimulus can be physically registered (e.g., in case of visual stimuli, that the eyes are not closed). It should be clear from the prior discussion that it is difficult, if not impossible, to demonstrate that a process is entirely goal independent or purely stimulus driven. The best one can do is demonstrate that the process does not depend on certain goals or other conditions and make these goals and conditions explicit.

Now that we discussed all goal-related features, we turn to the features *conscious* and *unconscious*. It is notoriously difficult to define the concepts of *conscious* and *unconscious*. Many theorists have distinguished two aspects of consciousness: an Intentional aspect and a phenomenal aspect (see also Hofmann & Wilson, Chapter 11, this volume). The Intentional aspect refers to the fact that consciousness is about something, that it has content; the phenomenal aspect is subjective feeling. The first depends on attention, whereas the second escapes attention. Some theorists have even posited that both aspects can be separated, thus arguing for two types of consciousness (Block, 1995). Note that the word "Intentional" is written here with a capital to distinguish it from the feature intentional discussed above.

It is important to keep in mind that the concepts *conscious* and *unconscious* can be used as a predicate of several things. They can be applied to (1) the stimulus input of a process, (2) the output of a process, or (3) the process itself (e.g., Bargh, 1994). Processes that operate on conscious input can be unconscious themselves. Therefore, it is important to always specify what the concepts *conscious* and *unconscious* are a predicate of (see later discussion).

Another correlate of (non)automaticity is the feature *(non)efficient*. A process is efficient when it consumes little or no attentional capacity. Attention can be said to have two aspects: quantity and direction. Efficiency is related to the quantity aspect. Efficient processes operate without or with very little of this quantity. It should be noted that processes that depend on the *direction* of attention do not necessarily use a large *quantity* of capacity. Consider, for example, the observation that Stroop interference effects sometimes diminish when relevant and irrelevant features were spatially separated (e.g., Kahneman & Chajczyk, 1983). This indicates that in a standard Stroop task processing of the irrelevant feature requires it to be in the focus of attention. Nevertheless, it is possible that it sufficed with a very small amount of attention and, therefore, still deserves to be called efficient. Attention may be directed at the process or at the stimulus input on which the process operates. One should thus clearly indicate whether one uses the term *efficient* as a predicate of the critical process or of the initial perceptual process that operates on the raw stimulus input.

The final feature that we consider is the feature *fast (slow)*. A fast process is one with a short duration. The duration of a process should not be confounded with the duration of the stimulus input on which the process operates. Slow processes may be triggered by briefly presented stimuli. The feature fast is clearly gradual. There is no objective threshold for calling something fast or slow, so investigators need to rely on conventions.

Features Provide Information about Operating Conditions

Most theorists accept that the features discussed are not fixed features of processes. A process can be unintentional on some occasions but intentional on others. This has led to the proposal to view and redefine features of (non)automaticity in terms of operating conditions (Bargh, 1992). For example, a process is uncontrolled in the promoting sense (unintentional) when it operates under the condition of the absence of a (causally efficacious) promoting goal. A process is uncontrolled in the counteracting sense when it operates under the condition of the presence of a counteracting goal. A process (or input or output) is unconscious when it operates under the condition of a lack of awareness of the process (or input or output). A process is efficient when it operates under the condition of minimal attentional capacity. A process is fast when it can be completed under the condition of minimal time.

It is important to note that the range of possible conditions that influence the occurrence of processes can be extended beyond conditions that derive from automaticity features. One example of a condition that is not included in the automaticity concept is *salience*, the quality of a stimulus (or stimulus feature) to stand out relative to other stimuli (or stimulus features) (Itti, 2007). Salience is a property of a stimulus, but a stimulus is always salient for a person. Thus, salience corresponds to the subjective intensity of a stimulus relative to other stimuli. This factor must be delineated from the objective intensity[2] of a stimulus

relative to other stimuli. Salience of a stimulus can be influenced by external factors such as the objective intensity, clarity, frequency, and size of a stimulus but also by internal factors such as goals, expectations, attention, and recency (whether or not a representation of the stimulus was recently activated). The salience of a stimulus is likely to influence the occurrence of processes that use the stimulus as their input: The more salient a stimulus, the more likely it is to serve as the input of processes. To broaden our definition of implicit measures even further: An implicit measure is a measurement outcome that is based on processes that operate under suboptimal conditions, such as when there is no promoting goal, when there is a counteracting goal, when there is minimal time, when there is minimal attentional capacity, when the stimulus input is unconscious, and when the stimulus input is not salient.

Relations among Operating Conditions

Various feature-based views of automaticity differ with regard to the features they emphasize most and the amount of coherence they assume among features. The best known feature-based view is the all-or-none view. This view assumes a perfect coherence among the features of each mode: Automatic processes hold all automatic features; nonautomatic processes hold all nonautomatic features. Thus, evidence for the presence of one feature of one mode can be generalized to the remaining features of that mode. It has become clear, however, that the all-or-none view is incorrect. Studies have demonstrated that most processes possess a combination of automatic and nonautomatic features. An alternative view that we advocate is the decompositional view (Bargh, 1992; Moors & De Houwer, 2006). This view assumes no (a priori) coherence among groups of features. Thus, the presence of features should be investigated separately and cannot be inferred from the presence of other features. The decompositional view rests on two central assumptions with regard to the interrelations among features.

A first assumption is that automaticity features can be conceptually separated, that is, they can be defined in such a way that they do not share ingredients. In the definitions presented previously, we did point out that there is partial conceptual overlap among several pairs of goal-related features. Intentional processes are a subset of controlled processes as well as a subset of goal-dependent processes. Unintentional processes and autonomous processes are both subsets of uncontrolled processes. Purely stimulus-driven processes are a subset of unintentional processes. On the other hand, we do not assume conceptual overlap among different types of controlled processes that are based on different types of goals. (Un)controlled in the promoting sense does not overlap with (un)controlled in the counteracting sense. In our definitions, we also avoided conceptual overlap among goal-related features and the feature (un)conscious. It is often assumed that consciousness is an ingredient of control (in the promoting and counteracting sense). To be in control seems to ask for a conscious subject. However, recent research has convincingly demonstrated that goals to engage in or to counteract a process can also be activated and implemented in an unconscious way (Moskowitz, Li, & Kirk, 2004). Hence, one can have control without being aware of it. Our definitions also avoid conceptual overlap among all other feature sets (goal-related features and efficient; unconscious and efficient; fast and efficient; fast and goal-related features).

A second assumption on which the decompositional approach rests is that automaticity features do not influence each other in a one-to-one fashion. That is, one feature is not a necessary and/or sufficient condition for another feature. We do acknowledge, however, that there are relations among features or operating conditions. This is because the central ingredients of the features or operating conditions (e.g., goals, consciousness, time, attention, and salience) can influence each other (see Figure 2.1; see also Moors & De Houwer, 2007). Examples are that (1) goals influence the direction of attention; (2) the direction of attention influences the content of consciousness; (3) the amount of attention spent, the objective stimulus intensity, salience, and time influence the possibility of consciousness; (4) the presence of a salient and/or conscious stimulus (or process) influences the possibility of implementing a conscious goal of the promoting (or of the counteracting) kind; and (5) goals, expectations, the direction and amount of attention, and objective stimulus intensity influence salience.

Importantly, the relations among these ingredients are not one-to-one relations. With regard to example 1, attention may be directed by other factors than goals, such as expectations and salience. With regard to example 2, there may be aspects or types of consciousness (e.g., phenomenal consciousness) that are not dependent of the direction of attention. The relations mentioned in example 3 show that consciousness of a stimulus (or process) is dependent of the interplay among several

ingredients. The role of these ingredients may be additive. This means, for instance, that a decrease in presentation time can be compensated by an increase in stimulus intensity and/or an increase in attention. Likewise, a decrease of stimulus intensity (e.g., when the stimulus is degraded) can be compensated by an increase in presentation time and/or an increase in attention. Similar claims can be made with regard to the relations described in example 5.

The assumptions of a lack of conceptual overlap and a lack of one-to-one relations justify the decompositional approach to investigate features separately. Indeed, it only makes sense to invest effort in the separate study of features when they do not have conceptual overlap and when they are not related in a one-to-one fashion. If consciousness would be included in control, evidence for the presence of control would be evidence for the presence of consciousness. If conscious input would be necessary for control, evidence for the absence of conscious input would be evidence for the absence of control. If attention would be sufficient for consciousness, evidence for the presence of attention would be evidence for the presence of consciousness. The additional point that conditions are interdependent has the implication that it is ultimately not very informative to have knowledge about a single operating condition. It is best to progressively investigate and map out the larger set of interdependent conditions at stake. The present section delivers the following recommendations for the issue of implicit measures. When calling a measure implicit, one should specify the features of automaticity (or operating conditions) one has in mind or, even better, accompany them with empirical arguments (De Houwer, 2006). In addition, one should attempt to uncover the interrelations among the features (or conditions).

UNDERLYING PROCESSES

The question of which processes underlie measurement outcomes cannot be answered in general. Different types of measurement outcomes have different underlying processes (see De Houwer & Moors, Chapter 10, this volume). We choose to discuss the underlying processes for one popular group of measurement outcomes: irrelevant feature effects, that is, effects observed with irrelevant feature tasks. In this section, we first explain what irrelevant feature tasks are (i.e., the procedure) and how they can be used to measure attributes. We then discuss the processes that underlie irrelevant feature effects. We argue that two processes are necessary for obtaining an irrelevant feature effect. We also note that both processes can be described at a higher or lower level of analysis, and that several automaticity features can be applied to entire processes or to parts of them.

Irrelevant feature tasks are experimental tasks consisting of a series of trials. On each trial, one or more stimuli are presented. Two features of the stimulus or stimuli are manipulated: a relevant feature and an irrelevant feature. The relevant feature is the feature that participants are asked to respond to; the irrelevant feature is a feature that participants are not asked to respond to but that is of interest to the investigator. For example, an affective priming task consists of a series of trials. On each trial, two stimuli are presented sequentially: a prime stimulus and a target stimulus. The relevant feature is some feature of the targets (e.g., valence, lexical status, nonaffective semantic feature); the irrelevant feature is the valence of the primes. Participants are asked, for example, to respond to the valence of the targets but not to the valence of the primes. Trials are created with different combinations of prime valence and target valence. Congruent trials are those on which prime and target have the same valence (positive–positive or negative–negative). Incongruent trials are those on which prime and target have an opposite valence (positive–negative or negative–positive). The typical result is that performance (reaction times, accuracy) is better on congruent than on incongruent trials.

Irrelevant feature tasks have been used for several purposes, including as a tool for measuring attributes of persons (e.g., their attitudes toward stimuli, i.e., the valence that they assign to the stimuli). Suppose an investigator wants to measure an individual's attitude toward a category of stimuli (e.g., alcoholic drinks). He or she may set up an affective priming task in which primes are exemplars of the category under study and exemplars of a contrasting category (e.g., nonalcoholic drinks). Targets are stimuli with a well-established positive or negative valence. Relying on the knowledge that the typical result in affective priming tasks is that performance is better on congruent than on incongruent trials, the reaction times on the targets can be used to infer the valence of the primes for the individual (and hence his or her attitudes toward the primes).

The occurrence of an effect in an irrelevant feature task is typically dependent on two steps. In the first step, the irrelevant feature is processed. In the second step, the output of the first step influ-

ences responding to the relevant feature. In other words, there are always at least two processes that contribute to irrelevant feature effects. The first process is concerned with the processing of the irrelevant feature. The second process is concerned with the influence that the output of the first process has on the response to the relevant feature. The second process is the one that translates the output of the first process into an effect or measurement outcome. For example, in the affective priming task, the first process is the evaluation of the prime (also called the processing of the prime valence). This process takes the prime as its input and produces a positive or negative valence as its output. The second process is involved in the influence of the prime valence on the target response.

In irrelevant feature tasks, the second process is typically dependent on the first process. The second process uses the output of the first process as its input. As a consequence, when the first process has not been completed and an output is not produced, the second process has no input and cannot operate.[3] The failure to find an irrelevant feature effect can thus have two causes. First, it is possible that the first process fails to occur (e.g., the prime valence was not processed). As a consequence, the second process also fails to occur (e.g., because there is no prime valence to influence the target responses). Second, it is possible that the first process occurred but the second process did not (e.g., the prime valence was processed but it did not influence the target responses).

Both the processing of the irrelevant feature and the translation process can be described at different levels of analysis. At a high level, a process can be described as the relation between input and output. For example, in an affective priming task, the process of evaluating the primes relates the prime stimulus to a positive or negative valence (represented in memory). The translation process relates the prime valence to a target response of a certain quality (fast vs. slow and correct vs. incorrect). At a lower level, a process can be described in terms of the mechanisms and the format of the representations that intervene in the transition of input into output.

There is disagreement about the nature of the low-level process underlying evaluation of the primes (see De Houwer, 2009). Some authors have argued that evaluation is always a constructive process, based on the weighing of information coming from a variety of sources (context, past experiences; e.g., Schwarz, 2007). Others have argued that once an evaluation is constructed, an association is formed in memory between a representation of the stimulus and a representation of valence. A subsequent encounter with the stimulus leads to an activation of the stimulus representation and spreads to the associated valence representation (Fazio, 2007). The association in memory between the stimulus representation and the valence representation is what Fazio calls an attitude. Evaluation, in Fazio's view, is nothing but the activation of this attitude.

There are also rivaling accounts of the nature of the low-level process underlying translation. In the case of affective priming, some authors (e.g., De Houwer, Hermans, & Spruyt, 2001; Fazio, 2001; Spruyt, Hermans, De Houwer, & Eelen, 2002; Spruyt, Hermans, De Houwer, Vandekerckhove, & Eelen, 2007; Spruyt, Hermans, De Houwer, Vandromme, & Eelen, 2007) have argued that encoding of the primes preactivates encoding of targets with the same valence. Because of the preactivation of same-valence targets (in congruent trials), processing of and responding to these targets are facilitated compared with opposite-valence targets (in incongruent trials). Other authors (De Houwer, Hermans, Rothermund, & Wentura, 2002; Klauer & Musch, 2003; Klauer, Rossnagel, & Musch, 1997; Klinger, Burton, & Pitts, 2000; Wentura, 1999) have argued that the prime valence activates the tendency to give a positive or negative response. This response tendency either corresponds (on congruent trials) or conflicts (on incongruent trials) with the correct target response and thus facilitates or hinders responding.

Whether a process is described at one level of analysis or another, it is still the same process. Therefore, operating conditions apply equally to processes described at lower or higher levels of analyses. This being said, the description of internal operating conditions (i.e., the presence of a goal to engage in or to counteract a process, the presence of awareness of a process, and the presence of attention directed to a process) all include reference to a process (or part of a process). It is reasonable to assume that the processes figuring in the descriptions of these conditions are high level but not low level. For example, a person can become aware of the fact that she evaluates a stimulus (i.e., high-level process) but probably not of the fact that her evaluation is based on memory retrieval (i.e., low-level process). As another example, a person can have the (conscious or unconscious) goal to counteract her stereotypical evaluations (i.e., high-level process) but probably not the goal to stop the flow of activation in her memory network (i.e., low-level process).

Automaticity features can be used not only as predicates of effects and processes underlying those effects but also as predicates of parts of processes, that is, inputs and outputs. For example, considering the evaluation process in affective priming, participants can be conscious or unconscious of (1) the process (that they are evaluating the primes), (2) the input of the process (that a stimulus input is present and/or which one), and (3) the output of the process (that prime valence is produced and/or which one). It may be noted that the output of some processes is a representation, whereas the output of other processes is an observable response. For example, in affective priming, the output of the evaluation process is a valence representation, whereas the output of the translation process is a target response. The recommendation of the present section for the issue of implicit measures is that, in addition to listing the automaticity features that apply (i.e., the recommendation of a previous section), it is necessary to specify what the features are a predicate of: an effect, a process (process 1 or process 2), or a part of a process (an input or an output).

ARGUMENTS FOR THE AUTOMATICITY OF THE PROCESSES UNDERLYING AFFECTIVE PRIMING EFFECTS

The present section shows how investigators may proceed when the aim is to evaluate the extent to which outcomes obtained with certain tasks are implicit. We illustrate this with one popular irrelevant feature task: the affective priming task. Our aim is to exemplify how the recommendations formulated in the previous sections can be followed. That is, we consider two processes that we identified as central in the production of an affective priming effect: the evaluation of the primes (process 1) and the process that translates the prime valence into the target responses (process 2). For each process (and/or their parts), we review empirical arguments for a set of conditions that are related to automaticity features: time (related to fast), a promoting goal (related to unintentional), a counteracting goal (related to uncontrolled in the counteracting sense), awareness (related to unconscious), and attentional capacity (related to efficient). We also discuss evidence for one operating condition that is not included in the automaticity concept: the salience of valence. In addition to evidence for individual conditions, we discuss evidence for the interrelations among pairs of conditions.

Time

On a typical affective priming trial, the prime is presented very briefly and immediately followed by the target. Consequently, the time between the onset of the prime and the onset of the target (i.e., stimulus-onset asynchrony [SOA]) is very brief. Affective priming effects have been obtained with SOAs less than 300 msec (Fazio, Sanbonmatsu, Powell, & Kardes, 1986; Hermans, De Houwer, & Eelen, 1994, 2001; Klauer & Musch, 2003; Klauer et al., 1997; Klauer, Teige-Mocigemba, & Spruyt, 2009; Spruyt, Hermans, De Houwer, Vandromme, & Eelen, 2007) and even with a negative SOA of −100 msec (i.e., when targets precede primes; e.g., Fockenberg, Koole, & Semin, 2006). In addition, participants are typically instructed to give speeded responses to the targets, which results in short response times. The occurrence of a priming effect under the condition of a short SOA combined with short response times supports the idea that both the evaluation process and the translation process can be completed fast. In addition, affective priming effects tend to disappear when the SOA exceeds 300 msec (but see Klauer et al., 1997, 2009). This may indicate that the output of the evaluation process (process 1), the prime valence, remains active only for a restricted period of time, beyond which it is unable to exert an influence on the target responses (process 2). It may also indicate that, with longer SOAs, participants do not evaluate the primes.

The occurrence of a priming effect indicates that the processes of evaluation (process 1) and translation (process 2) take place in the time interval between the onset of the prime and the onset of the target response. The duration of the evaluation process equals the time between the onset of the prime and the onset of the target response minus the time required for the translation process and the preparation of the target response. The duration of the translation process equals the time between the onset of the prime and the onset of the target response minus the time required for the evaluation process and the preparation of the target response. It is important to note that the evaluation process may extend beyond the SOA and that the translation process may start before the onset of the target. This implies that it is not possible to draw precise conclusions about the individual duration of the processes of evaluation and translation. It is only possible to mention the maximum duration of the sum of both processes or to give approximations of their individual durations. Another implication is that the use of a short SOA

is not a sufficient argument to conclude that the processes of evaluation and translation are fast. It must be complemented with the argument that response times were short as well. To make sure that response times are short, investigators may ask participants to respond as fast as possible or to respond before an early predetermined response deadline (Draine & Greenwald, 1998; Klauer & Teige-Mocigemba, 2007; Moors, De Houwer, Hermans, & Eelen, 2005).

Whether or not a particular time interval between prime onset and response onset is sufficient for the completion of the processes of evaluation and translation is likely to be influenced by other characteristics of the procedure. For example, the complexity of the target task (e.g., categorization of words vs. pronunciation of words) is likely to determine the time required for processing of the target and hence the time that is left for evaluation and translation. Another factor is the nature of the prime stimuli. Extracting the valence of the primes may take longer in the case of written words or compounds of words (e.g., Deutsch, Gawronski, & Strack, 2006) than in the case of simple pictures. On a final note, the feature fast is a gradual notion. Whether some process is called fast or slow depends on a standard for comparison that one has in mind and for which there may be consensus. Arguing that a process is fast, without specifying a maximal or approximate duration, is not very informative unless there is a strong consensus about the standard for comparison used.

Promoting Goal

Priming researchers have argued that the processes underlying affective priming do not require a promoting goal or intention (i.e., the goal to engage in the process; e.g., Bargh, Chaiken, Raymond, & Hymes, 1996). It may be noted that in most cases the claim is that these processes do not require a *conscious* goal to engage in them. Recently, however, several researchers have questioned this view, at least with regard to the evaluation process. They have argued that the process of evaluation does require a promoting goal (e.g., Spruyt, De Houwer, & Hermans, 2009). This goal may be conscious or unconscious. Empirical arguments for both views are discussed separately.

Before turning to these arguments, we wish to note that, depending on the content of the goal, the same process can be labeled (1) intentional or (2) goal dependent but unintentional. The process of evaluating the primes can be identified as intentional when it caused by the goal to evaluate the primes. It can be identified as goal dependent but unintentional when it is caused by another goal (e.g., the goal to evaluate the targets). We wish to add that the process of evaluating the primes can also be identified as intentional when it is caused by the goal to evaluate stimuli in general (see following discussion). Given the fact that primes belong to the class of stimuli, the goal to evaluate stimuli can simply be applied to the primes. Put differently, the process of evaluating stimuli, including the primes, is intentional when it is caused by the goal to evaluate stimuli, which include primes. It must be recognized, however, that it is difficult to verify the content of goals.

Evaluation and Translation Do Not Require a Promoting Goal

To demonstrate that the processes of evaluation and translation do not require a promoting goal or the goal to engage in them, researchers should find evidence that (1) the processes are present and (2) the goals to engage in them are absent. Support for point 1 is delivered by the occurrence of a priming effect. Support for point 2 is delivered by specific characteristics of the procedure. We discuss these procedural characteristics for each of the two processes separately.

EVALUATION PROCESS

The affective priming task is an irrelevant feature task; that is, participants are asked to respond to and, therefore, to process some feature of the targets (relevant feature) and not the valence of the primes (irrelevant feature). As a consequence, they are not encouraged to adopt the goal to process the valence of the primes. In addition, processing of the prime valence is not useful for increasing performance on the target task. Even in priming tasks in which participants have to respond to the *valence* of the targets, the prime valence differs from the target valence on half of the trials. Thus, participants cannot rely on the valence of the primes to predict the valence of the targets. It is possible, however, that the instruction to evaluate the targets induces in participants the goal to evaluate stimuli in general, which they apply not only to the targets but also to the primes. In that case, evaluation of the primes can be labeled intentional (see prior discussion). Another scenario is that the goal to evaluate the targets directly causes evaluation of the primes without the intermediate goal of evaluating stimuli in general or the primes

in particular. In that case, evaluation of the primes can be labeled goal dependent but unintentional.

Stronger support for the unintentional nature of the process of prime evaluation comes from priming studies in which participants performed a nonaffective target task. With a nonaffective target task, participants are less encouraged to focus on the valence of stimuli in general, including the valence of the primes. Affective priming effects have been reported when participants were asked to name the targets (e.g., Bargh, 1994; Spruyt et al., 2002; Wentura & Frings, 2008). It must be noted, however, that many efforts to replicate these effects have failed (e.g., Klauer & Musch, 2001; Spruyt et al., 2002; Spruyt, Hermans, Pandelaere, De Houwer, & Eelen, 2004). Affective priming effects have also been obtained with other nonaffective target tasks. For example, Wentura (2000) obtained affective priming effects when using a lexical decision task. Positive and negative targets were intermixed with pronounceable nonwords, and participants had to categorize targets as words or nonwords. For another example, Klauer and Musch (2002) conducted affective priming experiments in which participants were asked to determine whether primes and targets matched (say "yes") or mismatched (say "no") with regard to a nonaffective feature (color, grammatical category, letter case, or location). They observed that performance on these nonaffective target tasks was influenced by the match or mismatch in valence between primes and targets.

In the studies discussed previously, activation of the goal to evaluate the primes (or stimuli in general) may have been discouraged, but it was not actually prevented. Some investigators have argued that the use of short SOAs (including short prime durations) combined with short response times prevents implementation of the goal to evaluate the primes (or stimuli in general) should the participant have such a goal (e.g., Hermans et al., 2001). This seems a reasonable claim, but the question is, how short is too short? In the case of short SOAs and subliminal prime presentations, it is likely that implementation of the *conscious* goal to evaluate the primes is hindered (but not implementation of the *unconscious* goal to evaluate the primes). Affective priming effects obtained with subliminal prime presentations (e.g., Draine & Greenwald, 1998) thus support the idea that participants can evaluate the primes without the conscious goal to do so. In the case of short SOAs but supraliminal prime presentations, it is less clear whether implementation of the conscious goal to evaluate the primes (process 1) is hindered. It is possible that participants formed a so-called implementation intention (Gollwitzer, 1993). This is an association between a goal and the particular circumstance in which the goal is to be implemented. In this case, the association is between the goal to evaluate the prime (or stimuli in general) and the moment of prime ptesentation. Gollwitzer showed that when an implementation intention is in place, the actual implementation of the goal may happen instantly upon detection of the predetermined circumstances. Thus, short SOAs with supraliminal prime durations may be sufficient for implementation of the conscious goal to evaluate the primes (or stimuli in general). To conclude this section, we wish to call into question the search for fixed time intervals that do or do not allow the implementation of conscious goals. Whether or not a particular time interval is sufficient for the implementation of these goals is dependent on the presence of other conditions, such as the nature of the target task and the nature of the prime stimuli (cf. prior discussion).

TRANSLATION PROCESS

Several arguments that support the possibility of the unintentional nature of the evaluation process (process 1) extend to the translation process (process 2). Procedural characteristics that discourage participants from pursuing the goal to evaluate the primes (or stimuli in general) most likely also discourage them from pursuing the goal to use the prime valence to influence the target responses. Likewise, procedural characteristics (such as short time intervals) that prevent implementation of the conscious goal to evaluate the primes (or stimuli in general) can be expected to also prevent implementation of the conscious goal to use the prime valence to influence the target responses.

Turning it around, it is possible that participants pursue the goal to evaluate the primes (or stimuli in general) but not the goal to use the prime valence to influence the target responses. In addition, given that the translation process can only set in when the evaluation process is completed, it can be assumed that there are time intervals that allow implementation of the goal to engage in the evaluation process but not the goal to engage in the translation process. Short time intervals (created by short SOAs and short response times) with supraliminal prime presentations may be long enough to permit implementation of the conscious goal to evaluate the primes but not long enough to also implement the (conscious or unconscious) goal to use the prime valence to influence the

target responses. It may be noted, however, that investigators have often generalized conclusions about process 2 to process 1 (e.g., Fazio et al., 1986). They have taken Neely's (1991) conclusions from semantic priming research that short SOAs of 300 msec and less do not allow strategic influencing of target responses to also mean that these short SOAs do not permit intentional evaluation of the primes. Another problem already mentioned is that short SOAs must be combined with short response times in order to conclude that the available time interval was short.

Evaluation Does Require a Promoting Goal

Several researchers have questioned that the evaluation process can be unintentional. In the previous section, we listed procedural characteristics that may discourage pursuing the goal to evaluate the primes (or stimuli in general). In many of these experiments, however, one can still point at procedural characteristics that may encourage pursuing such a goal. It can be argued that in all these experiments valence was somehow salient (i.e., more subjectively intense than other features), and that this induced the (conscious or unconscious) goal to process valence (Lavender & Hommel, 2007; Moors, 2007; Spruyt et al., 2008).[4] It is important to note that the assumption that salience of valence induces the goal to engage in evaluation is at present not verified. It is possible that the salience of valence is a condition that influences processing directly, without the mediation of goals. Arguments for the idea that the salience of valence is a necessary condition for obtaining an affective priming effect are discussed in the next section.

Salience

Many affective priming studies have procedural characteristics that may increase the salience of valence (i.e., the subjective intensity of valence relative to other stimulus features). The mere fact, for example, that all stimuli in a prototypical affective priming study have a polarized valence might be sufficient to increase the salience of valence (see also Moors, 2007; Moors & De Houwer, 2006; Spruyt, Teige-Mocigemba, Everaert, & Klauer, 2008). Differences in the salience of valence can be held responsible for the mixed results that are obtained with the naming task (see prior discussion). When targets were words and participants were asked to name (i.e., pronounce) them, affective priming effects have sporadically been found (e.g., Bargh et al., 1996; Hermans et al., 1994), but most studies produced null findings (e.g., Klauer & Musch, 2001; Spruyt et al., 2004). In contrast, when primes and targets were pictures and participants were asked to name the target pictures, affective priming effects were readily obtained (e.g., Spruyt et al., 2002; Spruyt, Hermans, De Houwer, Vandromme, & Eelen, 2007; Spruyt & Hermans, 2008; Spruyt, Teige-Mocigemba, et al., 2008; Wentura & Frings, 2008). Spruyt and colleagues (2002) have explained this data pattern in terms of the memory model of Glaser and Glaser (1989; see also Glaser, 1992). According to this model, pictures have privileged access to a semantic system (i.e., a memory system that contains semantic information), whereas words first need to access a nonsemantic lexical system before they can activate semantic information. Crucially, the naming of pictures requires processing of semantic information, whereas the naming or pronunciation of words does not. Pronunciation can be based on lexical information alone. Given the assumption that valence is stored within the semantic system (e.g., Bower, 1981; De Houwer & Hermans, 1994; De Houwer & Randell, 2002; Fiske & Pavelchak, 1986), one can thus expect that picture naming is more likely to entail the processing of valence than word naming. This might explain the finding that affective priming effects are more reliable in the picture–picture naming task than in the word–word pronunciation task. This data pattern can, however, also be explained by assuming that pictures and words differ in the extent to which they render valence salient. Pictures that are used in affective priming research are typically either extremely positive (e.g., a picture of an attractive woman cuddling a baby) or extremely negative (e.g., a picture of a corpse). It seems implausible that this salient manipulation would go unnoticed by the participants. Thus, the divergent findings that are obtained with the picture–picture naming task and the word–word pronunciation task might be due to salience effects. To the best of our knowledge, however, this hypothesis has not yet been verified empirically.

In addition to the polarized valence of the stimuli, there may be other characteristics of the procedure that increase the salience of valence. One such characteristic is the nature of the response set. In affective priming studies in which an affective target task is administered, valence is salient because participants are asked to process valence. In the studies of Klauer and Musch (2002) discussed previously, participants were asked to judge whether the primes and the targets matched or

mismatched with regard to a nonaffective feature (color, grammatical category, letrer case, or location). It could be argued, however, that the response labels "yes" and "no" still had a positive and negative valence, which led to an increase in the salience of valence (Moors, 2007; Spruyt, De Houwer, et al., 2008; for related arguments, see Eder & Klauer, 2007; Eder & Rothermund, 2008). Tentative studies conducted at our lab suggest that this is at least a viable hypothesis (Spruyt, De Houwer, et al., 2008). In an experiment modeled after Klauer and Musch (2002), in which participants had to determine whether valenced primes and targets matched or mismatched with regard to a nonaffective feature, we manipulated the degree to which the response labels had valence. In one condition, participants were asked to respond with valenced response labels (e.g., "flower" vs. "cancer"). In another condition, participants were asked to respond with neutral response labels (e.g., "square" vs. "circle"). Results showed a significant impact of the (task-irrelevant) affective match between the primes and the targets only in the condition with valenced response labels.

Storbeck and Robinson (2004) manipulated the salience of valence relative to the salience of other features of the stimulus material. They obtained nonaffective semantic priming effects but not affective priming effects when the stimulus material varied with regard to valence as well as a more salient nonaffective semantic feature (religion vs. texture). They only obtained an affective priming effect when all stimuli were chosen from the same semantic category (e.g., religion) and when an affective target task was administered.

Simmons and Prentice (2006) manipulated the salience of valence by manipulating the attention directed to the primes.[5] They obtained stronger priming effects when participants were instructed to attend to the primes than when participants were instructed to ignore the primes. Gawronski, Cunningham, LeBel, and Deutsch (in press) conducted a priming task in which primes varied on two variables that are related to valence: race and age. In one condition, participants had to count the number of black and white faces; in the other condition, they had to count the number of old and young faces. Affective priming effects were found only for the variable that participants had to focus on.

Spruyt and colleagues (2008) manipulated the salience of valence by varying the degree to which the context had valence. In their series of priming studies, they manipulated both affective and nonaffective semantic congruency (see also Spruyt, De Houwer, Hermans, & Eelen, 2007). They were able to show that priming effects occurred only for features that were made salient. In their Experiment 3, for example, participants were presented with prime and target words that were all positive or negative exemplars of the categories of objects or humans (e.g., *gun*, *mother*). They were asked to pronounce the targets as quickly as possible on experimental trials but to categorize them on filler trials. In one condition targets in the filler trials were categorized as positive or negative and in a second condition as object or human. Priming effects on the critical pronunciation trials emerged only for the stimulus feature (valence vs. animacy) that was rendered salient by the task in the filler trials (i.e., the context).

Taken together, the results discussed in this section suggest that affective priming effects are found only when valence is made salient by some characteristic of the procedure (target task, stimulus set, prime task, context). It is important to note that evidence for the idea that valence must be salient in order to be processed can never be conclusive. This idea is valid until the opposite is proven. The same can be said about the idea that evaluation requires a promoting goal. Nevertheless, these ideas become increasingly plausible with increasing amounts of corroborating evidence.

Counteracting Goal

Priming researchers have assumed that the processes underlying affective priming occur despite the presence of a counteracting goal (Wittenbrink, 2007). Recently, however, several researchers have questioned this assumption. They have argued that the processes of evaluation and translation can be counteracted when participants have the (conscious) goal to do so. Empirical arguments for both views are discussed separately.

Evaluation and Translation Occur Despite the Presence of Counteracting Goals

To demonstrate that the processes of evaluation and translation are not controlled in the counteracting sense requires showing that (1) the goals to counteract (stop, alter, or avoid) the processes are present and (2) the processes are not counteracted (not interrupted, not altered, or still present).

We argued previously that the mere fact that the valence of the primes is task irrelevant in an affective priming task supports the idea that the processes of evaluation and translation do not re-

quire a promoting goal. The task irrelevance of the prime valence has also been invoked as an argument for the idea that these processes occur despite the presence of counteracting goals. During the course of an affective priming task, participants may notice that primes and targets have an opposite valence on a substantial part of the trials. They may even notice that the valence of the primes interferes with giving speedy responses to the targets. If so, they may adopt the goal to avoid evaluating the primes (process 1) or the goal to suppress the influence of prime valence on target responses (process 2). To the extent that participants indeed had the goal to avoid evaluating the primes (process 1) or the goal to suppress the influence of prime valence on target responses (process 2), the occurrence of an affective priming effect demonstrates that participants were not successful in their attempts.

Another argument for the idea that evaluation of the primes occurs despite the presence of a counteracting goal comes from affective priming studies in which participants received the explicit instruction to ignore (i.e., avoid processing) the primes (e.g., Hermans et al., 1994, Experiment 1; Klauer & Musch, 2003). The occurrence of a priming effect in these studies indicates that participants were not successful at ignoring the primes. The arguments discussed so far are rather indirect. In none of these studies was it verified whether participants actually pursued the goal to avoid processing the primes or, better, the prime valence.

Only a handful of studies investigated in a more direct manner whether, and under which other conditions, participants were successful or unsuccessful at counteracting the processes of evaluation and translation. In the present section, we only discuss results showing that counteraction was unsuccessful. Results showing that counteraction was successful are discussed in the next section. Degner (2009) found that affective priming effects were unaffected when participants pursued the conscious goal to counteract the influence of prime valence on target responses (process 2) and when a short response deadline (< 600 msec) was installed. This finding suggests that participants were unsuccessful at counteracting the translation process under the additional condition of a lack of time. It must be noted that the prediction that counteracting goals have no influence (under certain conditions) amounts to demonstrating a null finding. This is not the case with studies that demonstrate that counteracting goals lead to an ironic increase in the effect (Wegner, 1994). For example, Payne, Lambert, and Jacoby (2002) investigated the influence of racial primes (black/white faces) on the perceptual discrimination of objects (guns/tools). They obtained an enhanced stereotype-congruent influence when participants were instructed either to use or to avoid using the primes as a cue compared with when participants did not receive instructions regarding the primes. Moreover, the effects increased when the response deadline decreased. Similarly, Glaser and Banaji (1999; see also Glaser, 2003) reported reverse priming effects (i.e., faster responses on incongruent than on congruent trials) when using primes with a strong valence and when participants had a high motivation to respond accurately.

Evaluation and Translation Are Counteracted in the Presence of Counteracting Goals

The goal to counteract a process is successful when the process is actually counteracted. Whether an attempt to counteract a process is successful depends, first, on the goal at stake. The goal to avoid a process is successful when the process is absent. The goal to alter (e.g., to diminish) a process is successful when the process is altered (e.g., diminished). The goal to stop a process is successful when the process is stopped at some point. A process that is stopped halfway is not entirely absent. As such, it may still exert an influence on subsequent processing. To determine the absence or diminution of a process is difficult. All that investigators can observe is the size of priming effects. The absence of a priming effect may mean that (1) process 1 is absent and, as a consequence, process 2 is absent as well; (2) process 1 is present but diminished, causing the absence of process 2; or (3) process 1 is present (not diminished), but process 2 is absent. A diminished priming effect may indicate that (1) process 1 is diminished, causing the diminution of process 2; or (2) process 1 is present (not diminished), but process 2 is diminished. Despite this complex set of possibilities, most studies show the absence of a priming effect and conclude that the underlying processes (evaluation and/or translation) are successfully counteracted (without further specification).

Teige-Mocigemba and Klauer (2008) showed that priming effects disappeared when participants pursued the conscious goal to alter (fake) their evaluation of the primes (process 1). Moreover, they showed that priming effects disappeared for specific primes when participants were motivated (with monetary reward) to minimize the influence of these primes on target responses (pro-

cess 2). Likewise, Degner (2009) found that priming effects disappeared when participants pursued the conscious goal to counteract the influence of prime valence on target valence (process 2) and when no response deadline was installed. These findings suggest that both processes 1 and 2 can be controlled in the counteracting sense.

Taken together, the results presented here and in the previous section suggest that the processes underlying affective priming sometimes are and sometimes are not controlled in the counteracting sense. Both positions can perhaps be reconciled if additional conditions are taken into account. One additional condition is time. Degner (2009; cf. prior discussion) showed that participants' ability to successfully counteract process 2 depended on the presence or absence of a response deadline. Another additional condition is sufficient attentional capacity. This is suggested by the studies of Klauer and Teige-Mocigemba (2007) discussed later (in the Attention section).

Consciousness

Participants can be conscious or unconscious of the affective priming effect (that performance is better on congruent than incongruent trials). They can also be conscious or unconscious of the processes that we identified as underlying the affective priming effect: evaluation and translation. For each of these processes, it is useful to distinguish among the input, the output, and the process itself (i.e., the relation between input and output). With regard to the evaluation process (process 1), participants can be aware or unaware of (1) the input, that is, the prime; (2) the output, that is, the valence of the prime; and (3) the process itself, that is, the fact that the primes generate valence. With regard to the translation process (process 2), participants can be aware or unaware of (1) the input, that is, the prime valence; (2) the output, that is, the quality of the target responses (speed, accuracy); and (3) the process itself, that is, the fact that the valence of the primes influences the quality of the target responses. Given our (high-level) definition of a process as the relation between input and output, unawareness of input or output is sufficient to conclude that the process is unaware as well. We reiterate that only processes described at a high level of analysis can serve as the object of awareness. Processes described at a low level of analysis (the particular mechanisms and format of representations) are, in all likelihood, not available for introspection.

Several studies have demonstrated affective priming effects when primes were presented subliminally so that participants were unaware of the input of the evaluation process (e.g., Abrams & Greenwald, 2000; Abrams, Klinger, & Greenwald, 2002; Banse, 2001; Croizet, 1998; Greenwald, Klinger, & Liu, 1989; Greenwald, Klinger, & Schuh, 1995; Hermans, Spuyt, De Houwer, & Eelen, 2003; Klauer, Eder, Greenwald, & Abrams, 2007; Klauer, Mierke, & Musch, 2003; Klinger et al., 2000; Otten & Wentura, 1999). This indicates that the evaluation process can operate on unconscious input and, by inference, that the evaluation process itself can operate unconsciously. What about the output of the evaluation process? It is not impossible that when the prime is unconscious the positive or negative valence generated by the prime does become conscious.

In case participants are unaware of the valence generated by the primes (output of process 1, input of process 2), they must logically also be unaware that this valence influenced the quality of their target responses (process 2). It is still possible, however, that they are aware of (some aspects of) the output of process 2. For instance, they may be aware that a particular target response is fast and that it is accurate.

Attention

We distinguished between two aspects of attention—amount and direction—and argued that only the first is related to the feature efficient. Research about the role of each aspect of attention for the processes underlying affective priming is discussed next.

Amount of Attention

Priming effects obtained with a standard affective priming task do not provide arguments about the feature efficient. In a standard affective priming task, the irrelevant feature (prime valence) and the relevant feature (target valence) are not presented simultaneously. It is thus possible that participants spend all their attentional capacity on evaluating the primes before spending all their attentional capacity on preparation of the target responses. The degree of capacity consumption is best operationalized as dual-task interference. In dual-task studies, participants perform a primary task simultaneously with a secondary task that is assumed to consume attentional capacity. If manipulation of the amount of capacity used by the

secondary task does not influence performance on the primary task, it is concluded that the processes underlying the primary task are efficient. For example, Hermans, Crombez, and Eelen (2000) had participants perform an affective priming task (the primary task) while simultaneously reciting a series of digits (the secondary task). They found that manipulation of the mental load imposed by the digit series did not influence the magnitude of the priming effect. This suggests that both the evaluation process (process 1) and the translation process (process 2) are efficient. Klauer and Teige-Mocigemba (2007) investigated efficiency by comparing groups of participants with working memory capacity that was larger versus smaller than average. Increases in mental load led to an increase of the priming effect in the smaller capacity group but not in the larger capacity group. This finding is consistent with the idea that participants use attentional capacity to counteract the influence of prime valence on target responses. A lack of attentional capacity (in the case of high mental load for participants with smaller capacity) produces a failure to counteract the translation process, leading to an increase in the affective priming effect. If this interpretation of the findings of Klauer and Teige-Mocigemba is correct, they provide support for a relation between the features efficient and controlled in the counteracting sense. In addition, the fact that an affective priming effect occurred in both capacity groups is consistent with the idea that the processes underlying this effect (evaluation and translation) are efficient. Taken together, the results indicate that the processes of evaluation and translation are efficient but that the processes that counteract them are nonefficient. It must be kept in mind that efficiency is a gradual notion. It is impossible to determine whether a secondary task exhausts all processing resources. Therefore, it can never be demonstrated that the processes underlying the primary task (the affective priming task) are totally independent of attentional capacity.

Direction of Attention

Musch and Klauer (2001) presented primes and targets at different locations on a computer screen. Affective priming effects occurred when target location was uncertain and participants had to distribute attention over the two locations where prime and target could be presented. When target location was certain and attention was focused on the location of the target only, affective priming effects vanished completely. These results suggest that evaluation of the prime depends on attention being directed to the location of the primes.

Several of the studies discussed in the Salience section suggest that evaluation of the primes requires not only that attention is directed at the *location* of the primes but also that attention is directed at the *valence* of the primes. This is akin to the distinction between the spatial versus conceptual direction of attention (Logan, 1985).

CONCLUSION

We analyzed the term *implicit measure* with the aim of formulating recommendations for investigators in search of a measure that qualifies as implicit. On the basis of earlier suggestions by De Houwer (e.g., 2006), we started from a broad definition of implicit measure as a measurement outcome that is automatic or based on automatic processes. In the first section, we argued for a feature-based and decompositional view of automaticity, which urges us to investigate automaticity features separately instead of inferring the presence of one feature on the basis of another. We further argued that automaticity features refer to the conditions under which a process can operate. This proposal opened the door for the study of operating conditions that do not derive from automaticity features (e.g., salience). This led to an even broader definition of implicit measure as a measurement outcome that is based on processes that operate under (to-be-specified) suboptimal conditions, such as when there is no promoting goal, when there is a counteracting goal, when time is scarce, when there is little attentional capacity, when the stimulus input is unconscious, and when the stimulus input is not salient. A further point that we have emphasized is that operating conditions are not independent of each other. Thus, in addition to investigating operating conditions separately, it is ultimately important to investigate the interrelated set of operating conditions that pertain to the processes underlying the measurement outcome.

In the second section, we considered irrelevant feature effects as one popular type of implicit measures. We identified two processes that underlie the production of irrelevant feature effects: one that is concerned with processing of the irrelevant feature and one that is concerned with the influence of the irrelevant feature on responding to the relevant feature. This analysis led us to conclude that, in addition to specifying the operating con-

ditions at stake, investigators should specify the process (or the part of the process) that the operating conditions pertain to.

In the third section, we provided an example of how our recommendations can be (started to be) put into practice. We considered one irrelevant feature task, the affective priming task, which has prime valence as the irrelevant feature and target valence as the relevant feature. Affective priming tasks can be used to measure people's attitudes toward the primes (i.e., the valence they assign to the primes). The valence of the primes is inferred from the quality of the target responses (speed, accuracy) that follow the primes: A prime is positive/negative when it leads to facilitation of positive/negative target responses relative to negative/positive target responses. We identified two processes that underlie the affective priming effect: the process of evaluating the primes (short, the evaluation process or process 1) and the process by which the prime valence influences the quality of the target responses (short, the translation process or process 2). We listed empirical arguments related to operating conditions with the following ingredients: time, a promoting goal, salience, a counteracting goal, consciousness, and the capacity and direction of attention. We also documented the idea that several of these ingredients are interdependent. For example, some studies showed that conscious control in the counteracting sense is possible when there is sufficient time and/or sufficient attentional capacity.

In summary, we have the following recommendations for researchers who want to investigate or evaluate the implicitness (in a broad sense) of irrelevant feature effects: It is necessary to be specific about the operating conditions at stake and the process (or the parts of the process) that these features pertain to. It is ultimately important to investigate the interplay among several operating conditions.

Finally, we discuss the implications of our view for the issue of the predictive validity of implicit versus explicit measures (see Perugini, Richetin, & Zogmaister, Chapter 14, this volume). It has been argued that the conditions under which an attribute is measured inform us about the conditions under which the attribute influences processing and behavior in real life (cf. De Houwer, 2006). This is because measurement of the attribute (e.g., the attitude toward the primes) is itself based on the influence that the attribute has on behavior (e.g., the target responses). Attributes revealed by implicit measures are expected to influence processing and behavior that occur under suboptimal conditions; attributes revealed by explicit measures are expected to influence processing and behavior that occur under optimal conditions. For example, implicit attitudes are expected to influence behavior when opportunity (time, attentional capacity) and motivation (intention) are low. Explicit attitudes are expected to influence behavior when opportunity and motivation are high (cf. Fazio's, 1990, motivation and opportunity as determinants model). We believe that specifying the (extended set) of optimal and/or suboptimal conditions at stake and detailing the interrelations among them can help optimize the predictive power of the measure under consideration. In addition, we believe that process 1 and process 2 should be distinguished here also. It is not enough to call a measure implicit or explicit and to detail the operating conditions. One must also indicate the process that the conditions pertain to. Thus, the claim that attributes revealed by implicit/explicit measures are expected to influence processing and behavior when conditions are suboptimal/optimal is not specific enough. It is better to argue that attributes that are generated under such and such condition in the laboratory are likely to be generated under similar conditions in real life; and that attributes that influence processing and behavior in the lab under such and such conditions are likely to influence processing and behavior under similar conditions in real life.

ACKNOWLEDGMENTS

Agnes Moors and Adriaan Spruyt are Postdoctoral Fellows of the Research Foundation, Flanders, Belgium. Preparation of this chapter was supported by Grant No. BOF/GOA2006/001 of Ghent University and by Methusalem Grant No. BOF09/01M00209 of Ghent University to Jan De Houwer.

NOTES

1. It must be noted, however, that measurement outcomes and measurement procedures are not unrelated. An implicit measure is an outcome based on automatic processes, and the automaticity of these processes is inferred from characteristics of the measurement procedure that produce the measurement outcome.
2. Objective stimulus intensity corresponds to luminance in the visual domain, to amount of decibels in the auditory domain, and to amount of pressure in the tactile domain.
3. This claim can be nuanced to make it more consistent with accumulative process models of priming. According to these models, the output of the

evaluation process, the prime valence, builds up gradually. Partial completion of the evaluation process delivers a minimal representation of valence, which already influences target responses. With each gradual step, the representation of the prime valence is strengthened and so is its influence on the target responses. One could thus argue that the evaluation process need not be fully completed before the translation process can set in. In any case, it remains true that the evaluation process must deliver a minimal output before the translation process can set in. In other words, the partial evaluation process delivering a minimal output must be completed before the (partial) translation process can set in.

4. Goals can enter this picture as a determinant of salience or as a mediating variable between salience and the process. In other words, salience can both be caused by a goal and cause activation of a goal. This leads to several possible scenarios for the causation of a process. One scenario is that the goal to process some feature causes processing of the feature. A second scenario is that the salience of a feature causes processing of the feature. A third scenario is that the goal to process a feature increases salience of the feature, which, in turn, causes processing of the feature. A fourth scenario is that the salience of the feature causes activation of the goal to process the feature, which, in turn, causes processing of the feature. A final scenario is that the goal to process a feature increases salience of the feature, which, in turn, increases activation of the goal to process the feature, which, in turn, causes processing of the feature. The last scenario can be extended to resemble a feedback loop between goal activation and salience, in which the probability that the process occurs increases with each cycle.
5. The relation between attention and salience is probably as complex as that between salience and goals (see Note 4). Attention to a stimulus feature may increase the salience of the feature. Salience of a stimulus feature may increase attention to the feature. The possible scenarios for the causation of a process are analogous to what we presented in Note 4. If we would consider the possible causal relations among goals, attention, and salience, the range of possible scenarios for the causation of processes would even increase.

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