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Automatic appraisal of motivational valence: Motivational affective priming and Simon effects

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We investigated whether motivationally determined stimulus valence can be processed in an automatic way, as is assumed in many appraisal theories (e.g., Frijda, 1986, 1993; Lazarus, 1991; Scherer, 1993a). Whereas appraisal theorists typically use conscious self-report methods to investigate their assumptions, our experiments used indirect experimental methods that leave less room for deliberate, conscious reflections of the participants. Using variants of the affective priming and Simon paradigms, we demonstrated that intrinsically neutral, but wanted stimuli facilitated responses with a positive valence, whereas intrinsically neutral, but unwanted stimuli facilitated negative responses. In addition, the second experiment proved to be supportive of another assumption made by appraisal theorists according to which a relation exits between different (automatic) outcomes of motivational appraisal (positive-negative) and different action tendencies (approach-withdrawal).

Appraisal theories of emotion (e.g., Frijda, 1986; Lazarus, 1991; Leventhal & Scherer, 1987) postulate that appraisal of the emotion-evoking stimulus is a necessary intervening step between the perception of that stimulus and the emotion evoked. Appraisal is the cognitive evaluation process that is needed to distinguish emotional from nonemotional events. Appraisal not only constitutes a necessary antecedent for emotion *per se*. Most appraisal theories put forward several components of appraisal that serve as criteria to differentiate between specific emotions. Two main classes of appraisal components are event-related appraisals and reaction-related appraisals. Our focus will be on two event-related appraisal components that have been proposed as criteria to distinguish positive from negative emotional events: the processing of intrinsic stimulus

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valence (cf. Scherer's intrinsic pleasantness check, 1984), and the processing of stimulus valence dependent on motivation (cf. Scherer's goal conduciveness subcheck, 1984; Smith & Lazarus' appraisal of motivational congruence or incongruence, 1993). Whereas intrinsic stimulus valence can be defined as the valence of a stimulus when it is considered in (relative) isolation, motivational stimulus valence refers to the valence of a stimulus as determined by its interaction with the motivational context. For example, a food stimulus may have a positive motivational valence when a person is hungry, whereas that same stimulus may receive a neutral or even a negative motivational valence when the person is saturated. Motivational stimulus valence can be conceptualised as the result of a comparison process between a factual, encountered stimulus situation, on the one hand, and a desired situation (as prescribed by concerns or goals), on the other. When the factual stimulus and the desired situation overlap, the stimulus can be assumed to have a positive motivational valence; when there is a mismatch, motivational stimulus valence is negative (Frijda, 1986). Intrinsic valence, on the other hand, is independent of the person's concerns or current goals. Intrinsic stimulus valence can be innate or may be acquired through conditioning or other learning processes (Scherer, 1988). Intrinsic stimulus valence can be conceptualised as a tag associated with a stimulus representation in a semantic memory network, which will become activated on presentation of the stimulus (De Houwer & Hermans, 1994; Fiske & Pavelchak, 1986). Intrinsic and motivational stimulus valence can be considered as two different aspects of a given stimulus, which do not necessarily converge. For instance, muscle pain may be appraised positively by an athlete who believes it to be an indication of thorough previous practice, whereas out of this context muscle pain receives a negative evaluation (Lazarus, 1991).

It should be noted that whereas most appraisal theories incorporate what we called an appraisal of motivational valence (e.g., Frijda, 1986; Roseman, 1984; Scherer, 1984; Smith & Lazarus, 1993), there is disagreement with respect to intrinsic appraisal. A number of theorists do not include an appraisal component of intrinsic valence (e.g., Lazarus, 1991; Roseman, 1984). Moreover, only few theorists accept intrinsic valence assessments as a sufficient antecedent for emotion (e.g., Ellsworth, 1991; Scherer, 1999). For instance, Lazarus (1991) disagrees with the idea that intrinsic valence in itself, without referring to motives, is capable of eliciting real emotions. He contains that the inherent pleasantness or unpleasantness of a stimulus should be considered as pure knowledge, which requires an additional evaluation in the light of concerns before it will result in an emotion.

Many appraisal theorists assume that appraisal does not necessarily involve conscious, controlled processing, but that it may also occur at an unconscious, automatic level of processing (e.g., Bargh, 1990; Ekman, 1992; Frijda, 1993; Lazarus, 1991; Scherer, 1993a). They suggest a dual use of the word ''appraisal''. Appraisal as an antecedent of emotion should not be confused with appraisal as

the cognitive elaboration or labelling that may occur consequently on emotion elicitation and which constitutes an aspect of emotional experience. Whereas appraisal in the second use refers to deliberate, conscious cognitive activity, it is assumed that appraisal in the first use may be often automatic in nature.

Verifying the assumption that antecedent appraisal relies on elementary cognitive processes operating in an automatic manner, has not been a primary goal in appraisal research. Most appraisal research is aimed at discovering which combinations of appraisal components (appraisal patterns) go with which particular emotions (e.g., Frijda, Kuipers, & ter Schure, 1989; Scherer, 1993b; Smith & Ellsworth, 1985), thereby relying on subjective, conscious self-reports of appraisals and emotions. This method is not suited to test hypotheses about the automatic character of appraisals and is probably not very informative about the antecedents of emotions either (Frijda, 1993, 1994; Lazarus, 1991; Oatley, 1992; Parkinson & Manstead, 1993; Russel, 1987; Scherer, 1993a). There have been ample suggestions though, that the assumption of automatic antecedent appraisals should be tested by careful experimental study (Frijda, 1993), making use of methods coming from cognitive psychology to address automatic, unconscious processes (Davidson, 1992). Such methods can be found in both affective priming studies (Bargh, Chaiken, Govender, & Pratto, 1992; Fazio, Sanbonmatsu, Powell, & Kardes, 1986; Hermans, De Houwer, & Eelen, 1994) and affective Simon studies (De Houwer & Eelen, 1998). On closer consideration, these studies only provide evidence for the automatic processing of intrinsic stimulus valence. Often, the presented stimuli are isolated words or pictures with a clearly established valence and their motivational context tends to be kept equal across conditions. The aim of the present research is to use similar methods in order to investigate whether motivational stimulus valence can be processed in an automatic way as well.

Affective priming studies (Bargh et al., 1992; Fazio et al., 1986; Hermans et al., 1994) demonstrated that less time is needed to determine the valence of a target word when the target is immediately preceded by a prime word with the same intrinsic valence as the target (e.g., summer-flower) compared to a prime with an opposing intrinsic valence (e.g., cancer-flower). Affective priming effects have been observed under several conditions that suggest an automatic character of this effect, at least with respect to some automaticity features.[1] Because an affective priming effect can only occur if the intrinsic prime valence is processed, support for the automatic character of the affective priming effect in its turn provides support for the automatic character of the processing of intrinsic prime

[1] Automatic processes are often described as processes that have a rapid and unintentional onset, are uncontrollable, efficient and occur outside of awareness (Bargh, 1992, 1994; Neely, 1977; Posner & Snyder, 1975). Rather than viewing automaticity as a fixed collection of features, we conceive of automaticity as a dimension. We examine the degree to which a process can be regarded as automatic for each automaticity feature separately (Bargh, 1992).

valence. Affective priming effects have been observed when the interval between the onset of the prime and the target (stimulus onset asynchrony, SOA) was short (i.e., 300 ms or less), but not when it was long (i.e., more than 300 ms) (e.g., Fazio et al., 1986; Hermans et al., 1994, Hermans, De Houwer, & Eelen, 2001; Klauer, Roβnagel, & Musch, 1997), which suggests that the processing of intrinsic prime valence is automatic in the sense that it has a *rapid* onset as well as a fast decay. Several findings suggest that intrinsic prime valence can be processed *unintentionally*: Affective priming effects occurred: (a) despite the fact that the intrinsic prime valence was irrelevant for the task of evaluating the targets, and (b) when the participants' task no longer consisted in evaluating the target, but merely in pronouncing or categorising it with respect to a nonevaluative feature (as in a lexical decision task) (e.g., Bargh, Chaiken, Raymond, & Hymes, 1996; Hermans et al., 1994, 2001; but see Klauer and Musch, in press). Unlike an evaluation task, a pronunciation task or a lexical-decision task does not encourage participants to adopt an evaluative tendency towards stimuli in general and therefore neither towards the prime in particular. Furthermore, support for the relatively *efficient* character of the processing of intrinsic prime valence comes from affective priming studies in which a secondary resource-demanding task, simultaneously performed with the priming task, did not appear to reduce the strength of the affective priming effect (e.g., Hermans, Crombez, & Eelen, 2000). Finally, affective priming effects have occurred when the primes were presented subliminally (e.g., Draine & Greenwald, 1998), which supplies evidence for an *unconscious* assessment of intrinsic prime valence.

Another paradigm that has been used to demonstrate the automatic character of the processing of intrinsic stimulus valence is the affective Simon paradigm (De Houwer & Eelen, 1998). In Experiments 1 and 2 of De Houwer and Eelen (1998), words were presented that differed with respect to their intrinsic valence (i.e., relevant feature) as well as with respect to their grammatical category (noun or adjective, i.e., irrelevant feature). Half of the participants had to say POSITIVE to nouns and NEGATIVE to adjectives whereas the other half had to say NEGATIVE to nouns and POSITIVE to adjectives, irrespective of the intrinsic valence of the words. The authors observed that responses were faster when the intrinsic valence of the presented words corresponded to the valence of the response that had to be made, than when both elements were different. Two arguments are supportive of the hypothesis that the intrinsic valence of the words was processed automatically in the sense of *unintentional*. First, the affective Simon effect appeared despite the fact that the intrinsic valence of the words was irrelevant for the task. Second, because the participants were merely asked to link the grammatical category of the presented words to a positive or negative response, they were not prompted to adopt an evaluative approach towards these words. In addition, it can be argued that the processing of intrinsic stimulus valence was relatively *efficient*, as this processing occurred despite the fact that participants were at the same time engaged in the resource-consuming

task of responding to the grammatical category of the words. Furthermore, because in the affective Simon experiments, both the intrinsic valence and the grammatical category are aspects of one single stimulus, they have an onset asynchrony of zero ms. Therefore, the observation of an affective Simon effect indicates a *rapid* onset of the processing of the intrinsic valence of the words.

As stated earlier, the appraisal of motivational stimulus valence constitutes the key element of appraisal theories of emotion. In line with Bargh (1990), Frijda (1993), Lazarus (1991), and Scherer (1993a), we put forward the assumption that automaticity is not an exclusive feature of the processing of intrinsic stimulus valence, but that it also applies to the processing of motivational stimulus valence. The aim of the present study is to test this assumption, for which purpose we will use variants of the affective priming (Experiment 1) and Simon paradigms (Experiment 2).

EXPERIMENT 1

Our first experiment was a variant of the affective priming experiment, in which the intrinsic valence of the primes was kept neutral, whereas their motivational valence was manipulated as follows. On each trial, the priming phase was preceded by a goal-inducing phase. At the beginning of the goal-inducing phase, a rewarded colour was defined (yellow or blue). Then participants were engaged in a task in which they tried to gain the rewarded colour. (At this point, the outcome of the goal-inducing task was not yet revealed.) During the priming phase of each trial, a prime stimulus (a row of Xs) printed in either yellow or blue was presented. Because the participants were told that the colour of the prime reflected their outcome of the goal-inducing task, we assumed that primes would have a positive motivational valence when the prime colour corresponded to the rewarded colour and a negative motivational valence when both colours differed. Importantly, the rewarded colour varied randomly from trial to trial. Keeping the rewarded colour fixed over trials would involve the risk of changing the motivational valence of the primes, defined as the result of a comparison process, into a conditioned intrinsic valence which can be retrieved from memory.[2] Each prime stimulus was followed by an intrinsically positive or

[2] De Houwer, Hermans, and Eelen (1998) observed affective priming effects when nonwords were used as primes that were previously associated with (intrinsically) positive or negative words during a conditioning phase. Although prime valence in these experiments was recently learned, subjects had the opportunity (during the conditioning phase) to attach a fixed valence in memory to the nonword primes and to subsequently retrieve this valence from memory at every presentation of these primes (during the priming phase). Therefore, we are inclined to regard valence that is episodically associated with a stimulus through conditioning as intrinsic valence. In the present experiments, the rewarded colour varies randomly from trial to trial. Therefore, subjects are prevented from attaching a fixed valence in memory to either of the colours. On each trial the comparison of a desired situation (rewarded colour) with a factual situation (prime colour) needs to be made in order for the motivational valence to result from it.

negative target and participants were asked to name the target valence as fast as possible. Evaluating the target was the primary task of the experiment and we expected target responses to be faster as well as more accurate on trials with a match between motivational prime valence and intrinsic target valence (positive-positive or negative-negative) compared to trials where both elements were opposite (positive-negative or negative-positive).

Method

Participants. A total of 20 economics students (9 men, 11 women) at the University of Leuven participated in this experiment in order to partially fulfil course requirements. They were all native Dutch speakers.

Materials. On all trials, a series of five Xs was used as the prime stimulus. Target stimuli for the practice trials were eight positive and eight negative words. In addition, ten positive and ten negative words served as targets for the experimental trials. All target words were chosen from the Dutch affective rating list of Hermans and De Houwer (1994). *t*-tests showed that positive and negative targets for the experimental trials differed significantly on the affective dimension, $t(11.7) = -25.59$, $p < .0002$, but not on the familiarity dimension, $t < 1$, nor with respect to the number of letters, $t < 1$. In addition, the difference between the affective judgement and the centre of the affective scale was calculated for each target. *t*-tests showed that the affective-extremity scores thus obtained did not differ for positive and negative targets, $t < 1$. Stimuli were written in uppercase letters of 7 mm high and 5 mm wide in the centre of a black screen. They were presented on a 70 Hz SVGA screen connected to an IBM-compatible pentium computer. The time between the onset of the target and the onset of the verbal response was registered using a voice key which generated a signal that stopped a highly accurate (beyond 1 ms) Turbo Pascal Timer (Bovens & Brysbaert, 1990). Participants were seated in front of the computer screen at a distance of approximately 60 cm.

Procedure. Participants were tested individually and instructed orally about the course of the experiment. The experiment consisted of 176 trials: 16 practice trials followed by 160 experimental trials. Each trial consisted of two phases: a goal-inducing phase followed by a priming phase. At the beginning of the goal-inducing phase, one out of two game rules appeared on screen. According to one rule, the colour yellow would yield 10 points, whereas the other rule stipulated that the colour blue would provide 10 points. The order of appearance of both game rules was randomised across trials. Next, the letters Y (designating yellow) and B (designating blue) were displayed in quick alternation[3] (each letter

[3] Actually, as our participants were Dutch, the letters G and B were displayed, indicating ''geel'' (yellow) and ''blauw'' (blue).

remained on screen during approximately 140 ms). Participants were instructed to attempt to press the space bar of the keyboard at the exact moment at which the letter corresponding to the rewarded colour for that particular trial was shown. For instance, on trials in which yellow was the rewarded colour, participants had to try to hit the space bar when the letter Y appeared on screen. This phase was presented to the participants as a skill game. Both the game rule and the alternating letters remained on screen until the space bar was pressed.

During the priming phase of each trial, a prime stimulus (a series of five Xs) was presented during 200 ms, 500 ms after the response for the goal-inducing task was made. The prime stimulus was printed in either yellow or blue. Participants were told that the colour of the prime stimulus corresponded to the letter they had actually pressed during the first phase of the trial. As such, the colour of the prime would provide feedback about their performance in the goal-inducing phase. In reality, however, the prime colour was determined independently of the moment at which the participants pressed the space bar. Rather it corresponded to the rewarded colour on only 50% of all trials. Due to the high rate at which the letters alternated during the goal-inducing task, participants were unable to detect the noncontingency between their key-press responses and the colour of the primes. The motivational valence of the primes was positive when the prime colour and the rewarded colour corresponded (i.e., when 10 points were won), and negative when they differed (i.e., when no points were won).[4,5] After an interstimulus interval of 100 ms, a target word was presented. Consequently, the SOA between prime and target was 300 ms. Target words had either a positive or a negative intrinsic valence. The task of the participants in this phase was to evaluate the target as fast as possible by saying aloud POSITIVE or NEGATIVE. Target words remained on screen until a response was registered. If no response was registered within 300 ms, the target disappeared automatically. At the end of each trial, the experimenter pressed a code indicating which kind of response the participant had given, or a separate code for voice-key failures. The intertrial interval was 1000 ms. Participants were given the opportunity to take a brief break after the practice trials as well as after every 40 experimental trials. At the end of the experiment, a fictitious game score was displayed on screen.

We manipulated rewarded colour (yellow vs. blue), prime colour (yellow vs. blue), and intrinsic target valence (positive vs. negative) resulting in an eight-cell within-subjects design. Within the 16 practice trials, all eight cells were

[4] In order not to discourage participants too much, trials with negative motivational valence corresponded to not winning points rather than to loosing points.

[5] One might wonder to what concern a reward of 10 points (which is not linked to a more substantial reward such as money) applies. We believe the underlying concern that is addressed in these experiments is the need for achievement. Subjects are not interested in gaining points as such, they are rather concerned with succeeding the task especially in front of the experimenter who closely watches them during the task.

presented twice in random order. Each of the 16 practice targets appeared once in the 16 practice trials. The 160 experimental trials were divided in four blocks of 40 trials. Within each block, all eight cells were presented five times. Each of the 20 experimental targets appeared twice in the 40 experimental trials of each block. Both practice and experimental targets were assigned randomly to their corresponding cells. Trials were presented in a random order with the following restrictions: (a) the rewarded colour could be the same on no more than six consecutive trials, (b) the prime colour could be the same on no more than six consecutive trials, and (c) target valence could be the same on no more than four consecutive trials. As dependent variables, reaction times as well as numbers of errors were measured.

Results

Practice trials, trials on which reaction times were under 150 ms or over 2000 ms (0.44%) and trials on which the experimenter noticed problems with the voice-key (4.22%) were discarded from all analyses. For each participant, mean reaction times as well as number of errors were calculated. For the calculation of the mean reaction times, trials on which an incorrect response was given were omitted as well (2.75%). Analyses of variance (ANOVAs) were conducted on the mean reaction times and mean numbers of errors separately, using target valence (positive vs. negative) and motivational prime valence (positive vs. negative) as within-subjects variables.

As expected, the ANOVA of the mean reaction times revealed a significant interaction between motivational prime valence and target valence, $F(1, 19) = 21.77$, $MS_e = 651.79$, $p < .0002$. Table 1 shows that reaction times where shorter on trials with an overlap between motivational prime valence and intrinsic target valence compared to trials on which both elements differed. Furthermore, significant main effects were found for motivational prime valence, $F(1, 19) = 4.42$,

TABLE 1
Mean reaction times (ms), mean number of errors, and (standard deviations) involved in the interaction between motivational prime valence and (intrinsic) target valence in Experiment 1

		Motivational prime valence	
	Target valence	*Positive*	*Negative*
Reaction times	Positive	639 (102)	679 (110)
	Negative	775 (115)	762 (115)
Errors	Positive	0.60 (0.60)	1.25 (1.52)
	Negative	1.55 (2.56)	1 (2.27)

MS_e = 800.91, $p < .05$, as well as for target valence, $F(1, 19) = 115.79$, MS_e = 2070.03, $p < .0001$. These main effects entail shorter reaction times for trials with motivationally positive (M = 707; SD = 109) compared to negative primes (M = 720; SD = 112) as well as shorter reaction times for trials with positive (M = 659; SD = 106) compared to negative targets (M = 768; SD = 115). Both main effects are analogous to what is generally found in affective priming research.

The ANOVA of the mean numbers of errors revealed a significant interaction effect between motivational prime valence and target valence, $F(1, 19) = 9.57$, $MS_e = 0.75$, $p < .006$. Table 1 reveals fewer errors on trials with a match between motivational prime valence and intrinsic target valence compared to trials with a mismatch between these elements. No other effect reached significance, Fs < 1.

Discussion

The results show a motivational affective priming effect for both the reaction time data and the error data, which means that the motivational valence of the primes influenced both the time and the accuracy to respond to the targets. These results demonstrate that the motivational valence of the primes must have been processed. We further argue that the conditions created by the present experiment suggest that the motivational prime valence was processed automatically, at least in the sense of the following features. First, the observation of a motivational affective priming effect despite the fact that the difference between the onset of the prime and the target was only 300 ms leads to the conclusion that the processing of the motivational prime valence had a *rapid* onset. Second, the fact that motivational prime valence influenced the target responses despite the irrelevance of this valence for the primary task to respond to the targets yields support for the *unintentional* character of the processing of the motivational prime valence. We will further discuss this argument in the general discussion.

EXPERIMENT 2

The second experiment was a variant of the affective Simon paradigm redesigned in such a way that it allowed us to investigate whether motivational stimulus valence can be assessed in an automatic manner. In the same way as in Experiment 1, each trial started with a goal-inducing phase in which a rewarded colour was defined (yellow or blue) in a random fashion and participants had to try to gain this colour. On each trial, the goal-inducing phase was followed by a Simon phase in which a stimulus word with a neutral intrinsic valence was presented in either yellow or blue letters. Because participants were told that the colour of the word reflected their response in the goal-inducing task, the motivational valence of the word was assumed to be positive when its colour corresponded to the rewarded colour and negative when both colours differed. The stimulus word could be either a noun or an adjective and participants were asked to respond to the grammatical category (i.e., relevant feature) with a

positive or negative response, regardless of the colour and thus motivational valence of the word (i.e., irrelevant feature).

In the present experiment, participants were asked to give nonverbal responses with a positive or negative valence. Together with the stimulus word, a manikin appeared on screen and participants were asked to move the manikin towards or away from the word by pressing one of two keys, depending on the grammatical category of the word (see also De Houwer, Crombez, Baeyens, & Hermans, 2001). Half of the participants were instructed to move the manikin towards the stimulus word when it was a noun and away from the stimulus word when it was an adjective. Other participants had to move it towards adjectives and away from nouns. Responding to the grammatical category of the words was the primary task of the experiment. Given the assumption that moving towards (i.e., approach) is linked with positive valence whereas moving away (i.e., withdrawal or avoidance) is linked with negative valence (Lang, 1994), we expected responses to be faster and more accurate on trials with a match between the motivational valence of the words and the valence of the correct response, compared to trials where both elements were opposite. Apart from throwing light on the automatic processing of motivational valence, the observation of a motivational affective Simon effect would also be informative about the relationship between motivational valence assessments and response tendencies. Our prediction that positive motivational appraisals facilitate approach responses whereas negative motivational appraisals facilitate withdrawal, is in line with the assumption implied in many appraisal theories that different outcomes of motivational appraisal lead to different modes of action tendency (e.g., Frijda, 1986).

Method

Participants. A total of 32 economics students (22 men, 10 women) at the University of Leuven participated in this experiment for partial fulfilment of course requirements. They were all native Dutch speakers.

Materials. All stimulus words had a neutral intrinsic valence according to the Dutch affective rating list of Hermans and De Houwer (1994). Twelve nouns and twelve adjectives were used for the practice trials; ten nouns and ten adjectives were used for the experimental trials. *t*-tests showed that experimental nouns and adjectives did not differ on the affective dimension, the affective extremity dimension, the familiarity dimension, nor with respect to the number of letters, all ts < 1. Stimulus words were written in white uppercase letters of 7 mm heigh and 5 mm wide against a black screen. The manikin consisted of a circle for the head, a square for the body, and four lines for the limbs. It was about 11 mm high and 9 mm wide. All visual stimuli were presented on a 70 Hz SVGA screen connected to an IBM-compatible pentium computer. Presentations were controlled by a Turbo Pascal program that operated in graphics mode. The

time between the onset of the word and the first key-press was measured using a highly accurate Turbo Pascal Timer (Bovens & Brysbaert, 1990).

Procedure. The experiment consisted of 104 trials: 24 practice trials followed by 80 experimental trials. Each trial consisted of two phases: a goal-inducing phase and a Simon phase. The goal-inducing phase of the trials in the present experiment was identical to the goal-inducing phase of the trials in Experiment 1. During the Simon phase a stimulus word was presented in the centre of the screen. This word could be either a noun or an adjective and was printed in either yellow or blue letters. As in Experiment 1, participants were told that the colour of the word reflected their response on the goal-inducing task. However, the actual relation between the rewarded colour and the stimulus colour was determined independently of the participant's response to this task. Motivational stimulus valence was positive when the stimulus colour and the rewarded colour corresponded and negative when both colours differed.

Before the stimulus word appeared, a warning tone (1000 Hz) was presented followed by a manikin that appeared either in the centre of the upper or lower half of the screen. The warning tone was presented 500 ms after the response for the goal-inducing task and was followed by the manikin after 200 ms. The stimulus word was added 750 ms after the onset of the manikin. The position of the manikin was counterbalanced with regard to the grammatical category and the motivational valence of the stimulus words. During this phase, half of the participants had to move the manikin towards the stimulus word when it was a noun, and to move it away from the stimulus word when it was an adjective. The other participants had to approach adjectives and to withdraw from nouns. Participants could make the manikin move upwards by pressing the key ''8'' and downwards by pressing the key ''2'' of the numeric part of the keyboard. Labels with an upward and a downward arrow were attached to these keys. Each time one of the keys was pressed, the manikin moved 20 pixels in the appropriate direction. By alternating the length of the legs each time a key was pressed, it actually appeared as if the manikin walked across the screen. All visual stimuli remained on screen until the manikin had reached the centre of the screen or had reached the edge of the screen. The intertrial interval was 1500 ms. Participants were given the opportunity to take a brief break after the practice trials as well as after 40 experimental trials. At the end of the experiment, a fictitious game score was displayed on screen.

We manipulated rewarded colour (yellow vs. blue), stimulus colour (yellow vs. blue), and grammatical category (noun or adjective), resulting in an eight-cell within-subjects design. Within the 24 practice trials, all eight cells were presented three times in a random order. All 24 practice words appeared once in the 24 practice trials and were assigned randomly to their corresponding cells. Within the 80 experimental trials, all eight cells were presented ten times. All 20 experimental words appeared four times and were assigned randomly to their corresponding cells. Trials were presented in a random order with the restriction

that neither the rewarded colour, nor the word colour, nor the grammatical category could be the same on more than four consecutive trials. As dependent variables, reaction times as well as numbers of incorrect responses were measured.

Results

For each participant, mean reaction times as well as numbers of errors were calculated. Practice trials and trials on which reaction times were shorter than 150 ms or longer than 2000 ms (0.43%) were removed from all analyses. For the calculation of the mean reaction times, trials on which an incorrect response was given were deleted as well (2.81%). ANOVAs were conducted on the mean reaction times and mean numbers of errors separately, using motivational stimulus valence (positive vs. negative) and response valence (positive vs. negative) as within-subjects variables.

As we expected, the ANOVA of the mean reaction times revealed a significant interaction between motivational stimulus valence and response valence, $F(1, 28) = 12.47$, $MS_e = 38531.32$, $p < .005$. Table 2 reveals that reaction times were shorter on trials with an overlap between motivational stimulus valence and response valence compared to trials on which both elements differed. Furthermore, significant main effects were found for motivational stimulus valence, $F(1, 28) = 16.95$, $MS_e = 2888.10$, $p < .0004$, as well as for response valence, $F(1, 28) = 12.47$, $MS_e = 10751.22$, $p < .002$. These main effects indicate shorter reaction times for trials with motivationally positive ($M = 869.42$; SD = 199.70) compared to negative stimuli ($M = 908.53$; SD = 195.77) as well as shorter reaction times for trials on which approach responses ($M = 856.61$; SD = 205.28) compared to withdrawal responses ($M = 921.34$; SD = 199.77) were required. The main effect of stimulus valence corroborates findings of previous research.

The ANOVA of the mean numbers of errors revealed a significant interaction effect between response valence and motivational stimulus valence, $F(1, 28) =$

TABLE 2
Mean reaction times, mean number of errors, and (standard deviations) involved in the interaction between motivational stimulus valence and response valence in Experiment 2

		Motivational stimulus valence	
	Response valence	*Positive*	*Negative*
Reaction times	Positive	785 (175)	928 (269)
	Negative	954 (271)	889 (168)
Errors	Positive	0.75 (0.92)	1.13 (1.48)
	Negative	1.69 (2.01)	0.97 (1.15)

7.34, $MS_e = 1.31$, $p < .02$. Table 2 shows smaller numbers of errors for trials with a match between motivational stimulus valence and response valence compared to trials with a mismatch between these elements. These results were in line with our expectations as well. No other effects proved to be significant, Fs < 1.

Discussion

We observed a motivational affective Simon effect indicating that responses were faster and more accurate on trials with an overlap between the motivational stimulus valence and response valence than on trials where both elements differed. These results support the assumption implied in appraisal theories that motivational stimulus valence can be processed in an automatic way, at least in the sense of *rapid*, *unintentional*, and relatively *efficient*. A *rapid* onset of the processing of motivational valence is indicated by the influence of motivational stimulus valence (irrelevant feature) on the processing of the grammatical category (relevant feature) despite the fact that the onset asynchrony between both features was zero ms. *Unintentional* processing of motivational stimulus valence is suggested by the fact that the motivational stimulus valence exerted an influence on the response to the primary task despite the irrelevance of the motivational stimulus valence for the primary task. In addition, because the primary task of responding to the grammatical category of the words was not an evaluation task, participants were not encouraged to adopt an evaluative approach towards the presented stimuli. Finally, the feature of relative *efficiency* applies to the processing of motivational stimulus valence because this processing was not prevented by the fact that participants were already engaged in the resource-consuming primary task of responding to the grammatical category of the words. If the processing of motivational valence would require large amounts of cognitive capacity, the primary task would have prevented the processing of motivational valence.

GENERAL DISCUSSION

Several appraisal theories assume that emotion-antecedent appraisals may take place in an automatic manner. Although different appraisal theories differ with respect to the exact number and type of antecedent appraisal components they postulate, they all include what we called an appraisal of motivational valence (Frijda, 1986; Leventhal & Scherer, 1987; Smith & Lazarus, 1993). Especially for those theories that do not accept intrinsic evaluations as a sufficient antecedent of emotions, evidence in favour of automatic appraisal of motivational valence is crucial. Whereas previous automatic affective priming and Simon research demonstrates only automatic processing of intrinsic valence, the results of the present experiments yield support for automatic appraisal of motivational valence, at least in the sense of *fast*, *unintentional* (Experiments 1 and 2), and relatively *efficient* (Experiment 2).

The present results are, however, not conclusive with regard to the role of intentions. Although several features of the present experiments discouraged an *intentional* processing of the motivational stimulus valence, participants were not actually prevented from intentionally processing this valence. Moreover, although irrelevant for the primary task, motivational stimulus valence was by definition relevant for the goal-inducing task. Participants were told that their response on the goal-inducing task would determine the colour of the prime (Experiment 1) or Simon word (Experiment 2). In other words, the colour of the prime or Simon stimulus would yield feedback with respect to their performance on the goal-inducing task. It was therefore possible that participants had the intention to process the motivational valence of the prime or Simon stimulus. A further restriction of the present studies is that they did not provide information about whether processing of motivational valence can be characterised as *unconscious* and *uncontrollable*.

Despite these limitations, the present experiments provide the first evidence to support the hypothesis that processing of motivational stimulus valence can, to a certain extent, occur automatically. Experiments 1 and 2 clearly showed that motivational stimulus valence was processed rapidly and under conditions that leave little time and opportunity for a controlled processing of motivational stimulus valence to take place. In order for the present effects to occur, participants must have processed the motivational valence of a stimulus within 900 ms (which is about the time between the onset of the motivationally relevant colour and the overt response), while simultaneously performing a demanding primary task under time pressure. This primary task, which demanded that participants processed and responded to the target valence or grammatical category of words, was unrelated to the motivationally relevant information.

The fact that motivational valence was nevertheless processed is even more impressive given the fact that the assessment of motivational stimulus valence minimally requires a comparison between two elements (the rewarded colour and the stimulus colour). Automatic processes are generally assumed to be less complex and to deal with less complex information than consciously controlled processes. Still, it can be questioned how complex automatic processes may nevertheless be. Whereas the processing of intrinsic stimulus valence has been explained as the activation of a valence label associated with the stimulus representation in memory (De Houwer & Hermans, 1994), motivational stimulus valence, as we defined it, minimally requires a comparison process to be operative, including a stimulus on the one hand and a concern or goal on the other hand. Whereas the automatic activation of intrinsic valence in memory is now widely accepted, the present research constitutes a first attempt to demonstrate that the more complex process of comparison involved in the assessment of motivational valence may be performed in an automatic way as well. We find this conclusion to be consistent with suggestions made by Frijda (1993).

The present experiments also provide a methodological contribution to emotion research. It can be argued that the indirect methods we employed provide better access to the rapidly evolving antecedent appraisals described in emotion theory than do direct self-report methods. An important reservation must be made, however, with respect to the conclusions of the present studies. Support for the idea that appraisals of motivational valence in general can be automatic in nature is necessary but not sufficient evidence for the assumption that the appraisals of motivational valence that are part of the emotion process are automatic as well.

Whereas Experiments 1 and 2 investigated the assumption made by appraisal theorists that appraisal of motivational valence can occur in an automatic fashion, the results of Experiment 2 also yield support for another aspect of appraisal theories. The concept of action tendency plays a central role in many appraisal theories. Emotions are often defined as action tendencies (Arnold, 1960) or, more generally, as changes in action readiness (Frijda, 1986). These theories assume that a causal relation exists between different outcomes of motivational appraisal and different modes of action readiness. An overlap between events and concerns will lead to an approach tendency, whereas a discrepancy will result in the tendency to undo this discrepancy by avoiding or withdrawing from the discrepant stimulus or by destroying it. Until now, this assumption has predominantly been tested on the basis of self-report studies (e.g., Davitz, 1969; Frijda et al., 1989). Apart from the limited evidential value of correlative studies for causal relations, self-report data have been characterised as an unreliable source for gaining insight in elementary, unconscious processes. Experiment 2, in contrast, provides support for a relationship between type of motivational appraisal outcome and type of action tendency in a way that circumvents conscious constructions of the participants about this relationship. We investigated the influence of positive and negative motivational valence assessments on approach and withdrawal responses without directly asking the participants about this influence and under conditions that drew the participants' attention away from the motivational valence of the stimuli. Participants were asked to make their response dependent on the grammatical category of the words, regardless of the motivational valence of the words. According to the results, words with a positive motivational valence facilitated approach responses, whereas words with a negative motivational valence facilitated withdrawal responses. In other words, appraising a stimulus as being satisfactory for a current concern facilitated an approach response towards that stimulus; appraising a stimulus as frustrating a current concern facilitated a withdrawal response to occur. Supposing that the facilitation of approach and withdrawal responses are indications of approach and withdrawal tendencies respectively, the results are supportive of the idea that a relationship exists between different outcomes of motivational appraisal and different modes of action tendency. Although the responses in Experiment 2 did not involve actual approach or avoidance behaviour of the participants themselves, participants did have to

make a decision about whether to make an external stimulus (the manikin) move towards or away from another stimulus. Given that the motivational stimulus valence can influence decisions regarding the direction of movement of external stimuli, it is likely it can also influence decisions regarding the direction of movement of the individual itself.

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APPENDIX

Experiment 1

Positive experimental targets	*Negative experimental targets*
charmant (charming)	vals (false)
gelukkig (happy)	wreed (cruel)
oprecht (sincere)	gemeen (mean)
dankbaar (grateful)	vervelend (annoying)
slim (clever)	brutaal (bold)
blij (glad)	egoïstisch (egoistic)
zacht (soft)	agressief (aggressive)
prettig (pleasant)	laf (cowardly)
opgetogen (elated)	hatelijk (hateful)
betrouwbaar (reliable)	vijandig (hostile)
Positive practice targets	*Negative practice targets*
sociaal (social)	oneerlijk (dishonest)
zuiver (pure)	vulgair (vulgar)
warm (warm)	ijdel (vain)
origineel (original)	dom (stupid)
levendig (lively)	boers (peasant)
actief (active)	lastig (troublesome)
wijs (wise)	bazig (bossy)
loyaal (loyal)	slecht (bad)

Experiment 2

Experimental nouns	*Experimental adjectives*
tafel (table)	strikt (strictly)
vijver (pond)	normaal (normal)
bladzijde (page)	gemiddeld (average)
venster (window)	direct (direct)
basketbal (basketball)	modern (modern)
hazelnoot (hazelnut)	rationeel (rational)
autobus (bus)	geregeld (regular)
microscoop (microscope)	spraakzaam (talkative)
winkel (shop)	taai (tough)
kamer (room)	gelaten (resigned)
Practice nouns	*Practice adjectives*
stoel (chair)	verwant (familiar)
papier (paper)	nauwgezet (meticulous)
balpen (ballpoint)	verlegen (shy)
doos (box)	ernstig (serious)
bord (plate)	godsdienstig (religious)
cirkel (circle)	gevat (witty)
stoep (sidewalk)	nederig (humble)
trompet (trumpet)	zwijgzaam (silent)
trapezium (trapezium)	minzaam (likeable)
bril (glasses)	extravagant (extravagant)
boog (bow)	onstuimig (impetuous)
tand (tooth)	plechtig (solemn)