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Response Interference in Compatibility Tasks

Effects of Target Strength in Affective Priming and Stroop

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Abstract. Affective priming (AP) is a well-established phenomenon in which performance to a valenced target is typically better when it is preceded by an affectively congruent prime than when it is preceded by an incongruent prime. Several studies have emphasized a strong similarity between AP and Stroop suggesting that both are driven by response interference. The present study investigated this hypothesis by testing whether a general prediction of the response interference model was verified in the two tasks. This prediction refers to target strength and states that the size of compatibility effects should increase as the strength of the relevant information decreases. In four experiments, we show that this general prediction of the response interference model was verified in AP and Stroop when the strength of the relevant information was manipulated at the perceptual level (Experiments 1 and 2), while the opposite pattern was observed when this variable was manipulated at the semantic level (Experiments 3 and 4). While the results do not undermine the hypothesis that AP and Stroop effects are governed by response interference, they suggest that the model should be refined in order to account for differential effects of target strength in compatibility tasks.

Keywords: affective priming, stroop, target strength, response interference, compatibility

Compatibility tasks are a class of experimental tasks designed for the study of automaticity and attention (e.g., Fitts & Posner, 1967). In these tasks, the compatibility between a particular dimension of the stimuli and the responses and/or between two dimensions of the stimuli is manipulated (Proctor & Reeve, 1990). The color Stroop paradigm, in which participants have to name the inkcolor in which a word is written, is certainly the most well-known instance of compatibility tasks (Stroop, 1935; see MacLeod, 1991, for an extensive review). Performance is typically worse when the word and the inkcolor differ (incompatible or incongruent condition) than when the word is related to the inkcolor (compatible or congruent condition). Kornblum and colleagues (Kornblum, Hasbroucq, & Osman, 1990; Kornblum & Lee, 1995) introduced a theoretical framework that allows for a formal description of any compatibility task (see also De Houwer, 2003). For instance, the stimuli of the Stroop task are characterized by two features, their color and their meaning, the responses being characterized by the color to which they refer. The color of the word is the *relevant dimension* as participants' responses are directly based on this feature; the meaning of the words is the *irrelevant dimension* as such a feature influences participants' responses even though they should not take it into account.

Effects obtained in compatibility tasks when contrasting performance in the incongruent and the congruent conditions are simply explained by the *response interference* model (Eriksen & Eriksen, 1974). The core idea of this model is that while the response tendency triggered by the relevant information and the one triggered by the irrelevant information are the same on congruent trials, these two response tendencies are different on incongruent trials. Because the irrelevant response is a potential response, there is interference at the response selection level on the incongruent trials. The time needed for the executive system to solve such interference (i.e., to inhibit the irrelevant response) gives rise to the compatibility effect (Kornblum et al., 1990).

The affective priming (AP) task was introduced by Fazio, Sanbonmastu, Powell, and Kardes (1986) in order to investigate the automaticity of attitudinal processing (see Klauer & Musch, 2003, for an extensive review). AP is a variant of semantic priming in which the affective congruency between primes and targets is manipulated. Participants have to decide whether the target is positive or negative (i.e., evaluative decision task). In congruent trials, the prime and the target share the same valence (positive-positive or negative-negative) whereas in incongruent trials, both stimuli have opposite valences (positive-negative or

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negative-positive). AP effects were initially thought to be driven by a spreading activation mechanism which was primarily developed in order to account for semantic priming effects (Neely, 1976, 1977). However, Klauer, Roβnagel, and Musch (1997) latter proposed the *AP-Stroop similarity hypothesis* according to which the AP task is fundamentally more similar to the Stroop task than to the semantic priming task. In this line of reasoning, De Houwer (2003) suggested that when considering the valence of the target as the relevant dimension of the global stimulus formed by the pair *prime-target* and the valence of the prime as the irrelevant dimension (the response being evaluative), the AP task can be actually described as a compatibility task. Moreover, De Houwer (2003) formalized the similarity between the AP task and the Stroop task by showing that according to the framework of compatibility, both tasks can be described by the same structure.

The hypothesis that the AP effect is driven by response interference was especially tested through the AP-Stroop similarity hypothesis.[1] In fact, two studies reported that phenomena known to occur in the Stroop task were also found in the AP task. The first phenomenon refers to the fact that the magnitude of compatibility effects tends to increase as the proportion of congruent trials increases (i.e., consistency proportion effect). This effect has been reported in the Stroop task (e.g., Logan & Zbrodoff, 1979). Klauer et al. (1997) showed that such effect also occurred in the AP task for short SOAs (0 and 200 ms). The second phenomenon corresponds to the fact that response times to the n trial in which the relevant information is the same as the irrelevant information in the $n-1$ trial tend to be slower than response times to cases in which these two features are different. This negative priming effect has been repeatedly found in the Stroop task (e.g., Neill, 1977; Tipper, 1985). Wentura (1999) reported that negative priming effects also occurred in the AP task. In sum, these two studies support the AP-Stroop similarity hypothesis and the idea that AP is driven by response interference.

The Present Study

The present research was aimed at testing further the AP-Stroop similarity hypothesis, by testing whether a general prediction of the response interference model was verified in these two tasks. This model makes two general predictions regarding information strength. First, it predicts that the magnitude of compatibility effects should increase as the strength of the irrelevant information increases. The second straightforward prediction of the response interference model is that compatibility effects should increase as the strength of the relevant information decreases.[2] In both cases, the duration of the interference increases since the relevant response has to "struggle" more to overcome the irrelevant response. Previous studies reported evidence suggesting that the first prediction was actually verified in the Stroop task and the AP task (Klauer, Teige-Mocigemba, & Spruyt, 2009; Klauer et al., 1997; Logan & Zbrodoff, 1979; Simmons & Prentice, 2006). To our knowledge, the second prediction has never been explicitly tested neither in the AP task (with the evaluation task) nor in the Stroop task.

Noteworthy, the strength of information (relevant or irrelevant) can be manipulated either perceptually or semantically. Indeed, as any given information is carried by a physical stimulus, the strength of the information can be manipulated either through the properties of the stimulus or through the properties of the information itself. The former case refers to what is commonly called target degradation in priming research (e.g., Holcomb, 1993). De Houwer, Hermans, and Spruyt (2001) tested the effect of degradation in affective priming using the pronunciation task. Although previous studies that used the pronunciation task revealed a mixed pattern of results, De Houwer et al. (2001) showed that AP effects could be reliably obtained with this task when target words were degraded (e.g., %L%O%V%E%).[3] On the other hand, the manipulation of the strength of information at the semantic level refers to the strength of the association between the stimulus and the relevant semantic feature (e.g., the word LOVE is more positively connoted than the word PLATE).

Basically, we systematically compared the AP task and the Stroop task under the prediction of the response interference model according to which the magnitude of compatibility effects should increase when the strength of the relevant information is reduced. Importantly, a necessary condition for such an empirical comparison is that the two tasks must be procedurally comparable. In fact, any dissociation observed between these tasks could be merely ascribed to procedural differences rather than to processual differences. Actually, in their respective standard forms, the AP and the Stroop tasks differ on three main procedural parameters: SOA, stimulus-response set size, and global stimulation. First, whereas the relevant and the irrelevant information are temporally separated in the standard AP task (i.e., SOA > 0), they are presented simultaneously in the standard Stroop task (i.e., SOA = 0). Second, the

1 Another indirect evidence supporting the response interference account of AP is that the magnitude of AP effects is larger when the executive system is busy with another task (Klauer & Teige-Mocigemba, 2007). In this case, the duration of the interference on incongruent trials – which is solved by the executive system – is thought to be longer as this system has to deal with two tasks.

2 Note that Klauer and Musch (2002) already formulated these two predictions for the AP task by assuming that "... according to traditional models of Stroop effects (Logan & Zbrodoff, 1979), affective priming effects mediated by the Stroop mechanism should increase as the strength of prime evaluations increases and that of target evaluations decreases." (p. 813).

3 Semantic priming effects are also larger for degraded targets than for undegraded targets (Neely, 1991).

stimulus-response set includes two elements in the standard AP task (i.e., POSITIVE vs. NEGATIVE) while its size is generally larger in the standard Stroop task (e.g., GREEN vs. RED vs. YELLOW vs. BLUE). Third, regarding global stimulation, relevant and irrelevant information are presented as two different perceptual objects in the standard AP task (i.e., prime and target), whereas they are features of the same perceptual object in the standard Stroop task. A second point regarding global stimulation is that while the irrelevant information corresponds directly to one of the response categories in the Stroop task, this information is an exemplar of one of the response categories in the AP task. In the present experiments, AP and Stroop were compared while being systematically matched on these procedural parameters.

Experiments 1 and 2 tested the prediction of the response interference model with the relevant information being manipulated at the perceptual level, while this information was manipulated at the semantic level in Experiments 3 and 4. Experiments 1 and 3 relied on SOA 250, Experiments 2 and 4 relied on SOA 0. All of the experiments had a 2 × Task (AP vs. Stroop) × 2 Relevant Information Strength (Strong vs. Weak) × 2 Congruency (Congruent vs. Incongruent) mixed design with repeated measures on the second and third factors.

Experiment 1

The purpose of Experiment 1 was to test whether a same prediction of the response interference model regarding the strength of the relevant information was verified in the AP task and in the Stroop task, this factor being manipulated at the perceptual level. The two tasks were matched for the main procedural parameters in order to keep the empirical comparison informative. First, regarding SOA, the Stroop task was equated with the AP task by using a Stroop priming task in which a color word is used as prime and a color patch is used as target (e.g., Cheesman & Merikle, 1986; Merikle & Joordens, 1997). Second, the Stroop task was equated with the AP task on stimulus-response set size by reducing the size of this set to two (GREEN vs. RED). Third, the two tasks were also matched for the global stimulation by presenting relevant and irrelevant information as two different perceptual objects (i.e., prime and target) in both tasks. In addition, the overlap between irrelevant information and response categories was also equated by using the words corresponding to the two response categories as primes in both tasks. Finally, the AP task and the Stroop task were matched on target set size and target repetition (i.e., targets were presented the same number of times in both tasks).

In the AP task, targets were black-and-white smiley-like faces expressing either happiness or sadness. In the Stroop task, targets were color patches. The strength of the relevant information was perceptually manipulated in the same way in both tasks. In fact, random white pixels were added to the targets in the weak condition while these stimuli were normally presented in the strong condition. Assuming that AP and Stroop effects are driven by response interference, we expected these effects to be modulated by the strength of the relevant information. More precisely, we expected the AP effect to be larger when targets were perceptually degraded and the Stroop effect to be larger when patches used as targets were weakly colored.

Method

Participants

A total of 48 undergraduate students (32 females and 16 males; mean age 21.5 years) participated in this experiment (24 participants for each task).[4] All participants were native speakers of French and reported normal or corrected-to-normal vision.

Affective Priming Task

Materials and Procedure

Stimuli used as primes were the two individual words POSITIF (French word for *positive*) and NEGATIF (*negative*). Stimuli used as targets were four black-and-white happy or sad smiley-like faces (i.e., black eyes and mouth on a white circle). In the strong condition, faces were normally displayed while in the weak condition white pixels were randomly added on 50% of the black pixels representing the eyes and the mouth. In other words, targets appeared as perceptually degraded in the weak condition. The prime words were 206 pixels (7.0 cm) × 80 pixels (2.7 cm) size and were presented in white uppercase letters. The target pictures were 206 pixels (7.0 cm) × 155 pixels (5.3 cm) size. Stimuli were presented against the black background of a 19-inch computer monitor (100 Hz, 24 bits/pixel, screen resolution 1024 × 768). The software used for stimuli presentation and response times recording was DirectRT v2004.3.27 (Jarvis, 2004). The experiment was run on a Pentium IV 2.60 GHz computer.

Each trial comprised the appearance of a central fixation for 500 ms, followed by an empty screen for 500 ms. The prime appeared for 200 ms, followed by an empty screen for 50 ms (SOA = 250 ms). Then, the target was presented and remained on the screen until the participant's response (see Figure 1A). The participants responded by pressing the keyboard keys "SHIFT – Left" (NEGATIVE) or "SHIFT – Right" (POSITIVE) (i.e., evaluative decision task). The experiment included two blocks of 48 trials. Each

[4] One should note that in all experiments, assignment of participants to the two groups (i.e., AP group and Stroop group) was not truly random. Indeed, the recruitments of task samples were completely separated. Noteworthy, this does not appear as problematic since our experiments revealed similarities between AP and Stroop rather than differences despite the absence of true random assignment to tasks.

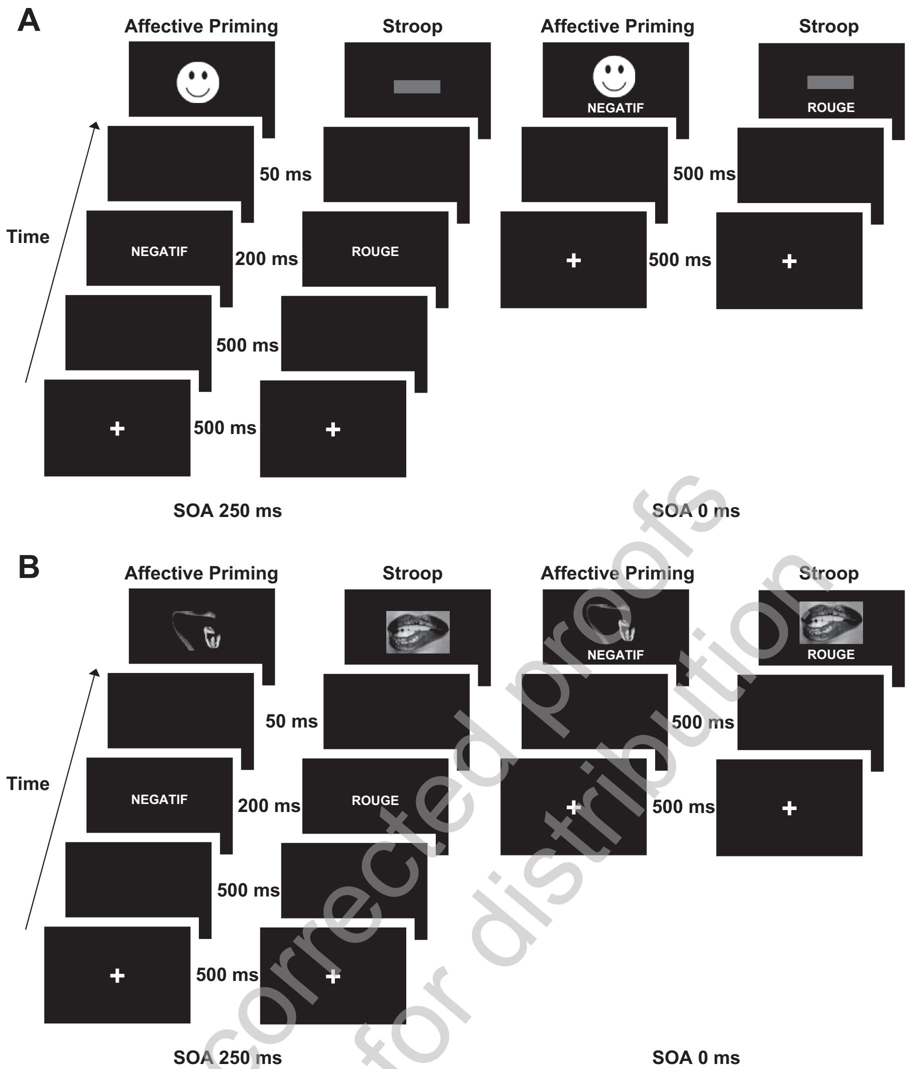


Figure 1. Schematic description of the trials as a function of Task (Affective Priming, Stroop) and SOA (250 ms, 0 ms) in Experiments 1 and 2 (perceptual manipulation of the strength of the relevant information, panel A), and Experiments 3 and 4 (semantic manipulation of the strength of the relevant information, panel B).

target appeared an equal number of times in each block and the presentation order of the trials within each block was randomized. In each block, primes were randomly assigned to the targets, the only restriction on this assignment was that there must be an equal number of trials per condition. This semi-randomization was realized for each block and each participant separately. Intertrials interval was 1,500 ms.

Stroop Task

Materials and Procedure

Stimuli used as primes consisted of the two individual words ROUGE (French word for *red*) and VERT (*green*). Stimuli used as targets were four patches colored in red (RGB, 255, 0, 0) or in green (RGB, 0, 255, 0). In the strong color condition, patches were uniformly colored while in the weak color condition, they were printed in white with 50% of the pixels being colored (colored pixels were randomly determined). Therefore, targets in the latter condition were half less colored than targets in the former condition so that they appeared as weakly colored. The prime words were 206 pixels (7.0 cm) × 80 pixels (2.7 cm) size and were presented in white uppercase letters. Patches were 206 pixels (7.0 cm) × 80 pixels (2.7 cm) size. All stimuli were displayed against a black background with the same equipment as that used in Experiment 1.

The same timing as that in the AP task was used (see Figure 1A). The participants responded by pressing the keyboard keys "SHIFT – Left" (GREEN) or "SHIFT – Right" (RED). The experiment also included two blocks of 48 trials. In each block, primes were randomly assigned to the targets, the only restriction on this assignment was that there must be an equal number of trials per condition. This semi-randomization was realized for each block and each participant separately. Intertrials interval was 1,500 ms.

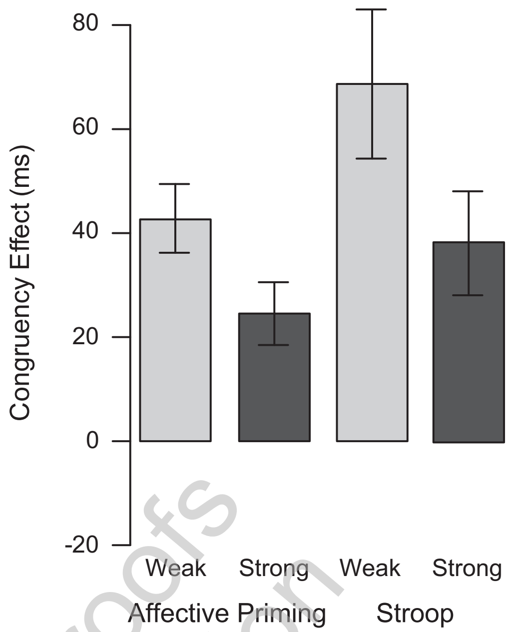
Results and Discussion

Reaction Time Data

Data from trials on which an incorrect response was given on the target (5.87%) were excluded from the analysis, together with all response latencies shorter than 250 ms or longer than 1,500 ms (1.03%). Remaining data (93.10% of all observations) were analyzed in a 2 (Task) × 2 (Relevant Information Strength) × 2 (Congruency) ANOVA with repeated measures on the last two factors. This analysis yielded a significant main effect of each of the three factors: Task, $F(1, 46) = 8.41$, $p < .01$, $M_{\text{Affective Priming}} = 602$ ms, $M_{\text{Stroop}} = 560$ ms, Relevant Information Strength, $F(1, 46) = 76.66$, $p < .001$, $M_{\text{Strong}} = 551$ ms, $M_{\text{Weak}} = 611$ ms, and Congruency, $F(1, 46) = 28.73$, $p < .001$, $M_{\text{Congruent}} = 559$ ms, $M_{\text{Incongruent}} = 603$ ms. Task and Relevant Information Strength interacted significantly, $F(1, 46) = 17.49$, $p < .005$. The effect of Relevant Information Strength was actually larger in the Stroop task, $F(1, 23) = 66.55$, $p < .001$, $\eta^2 = .743$, than in the AP task, $F(1, 23) = 14.21$, $p < .001$, $\eta^2 = .382$. Furthermore, the analysis revealed a significant Relevant Information Strength × Congruency interaction, $F(1, 46) = 17.49$, $p < .001$, indicating that the effect of Congruency was larger in the weak condition, $F(1, 47) = 47.91$, $p < .001$, $\eta^2 = .505$, than in the strong condition, $F(1, 47) = 28.95$, $p < .001$, $\eta^2 = .381$. As this two-way interaction was similar in both tasks, the three factors did not interact significantly, $F < 1$. More precisely, in the AP task, Relevant Information Strength and Congruency interacted significantly, $F(1, 23) = 4.47$, $p < .05$, indicating that the effect of Congruency was larger in the weak condition, $F(1, 23) = 42.20$, $p < .001$, $\eta^2 = .647$, than in the strong condition, $F(1, 23) = 15.92$, $p < .001$, $\eta^2 = .409$. The same was true for the Stroop task in which the Relevant Information Strength × Congruency interaction was also significant, $F(1, 23) = 4.03$, $p < .05$. Indeed, the Stroop effect was larger in the weak condition, $F(1, 23) = 22.84$, $p < .001$, $\eta^2 = .498$, than in the strong condition, $F(1, 23) = 15.06$, $p < .001$, $\eta^2 = .396$ (see Figure 2).

Error Data

The analysis of errors revealed only a significant main effect of Task, $F(1, 46) = 18.14$, $p < .001$, $M_{\text{Affective Priming}} = 95.69\%$, $M_{\text{Stroop}} = 90.10\%$, and Congruency, $F(1, 46) = 22.96$, $p < .001$, $M_{\text{Congruent}} = 94.86\%$, $M_{\text{Incongruent}} = 90.94\%$ (see Figure 2).



Congruent				
RTs (ms)	596	573	571	496
Correct (%)	96.9	97.6	91.4	93.6
Incongruent				
RTs (ms)	639	598	640	535
Correct (%)	94.0	94.3	87.7	87.8

Figure 2. Mean congruency effect, RTs and accuracy in Experiment 1 as a function of Task, Relevant Information Strength, and Congruency. Error bars indicate standard errors.

Experiment 1 produced a clear pattern of results. The general prediction of the response interference model according to which the size of compatibility effects should increase as the strength of the relevant information decreases was fully verified in the AP task and the Stroop task. On the one hand, the 25 ms AP effect obtained in the strong condition increased to 43 ms in the weak condition. These results are in line with previous findings that showed that perceptually degraded targets tended to produce stronger AP effects (De Houwer et al., 2001). Noteworthy, these findings were obtained with the pronunciation task, so that our results generalize the effects of target degradation in AP to the evaluation task. On the other hand, the Stroop results revealed for the first time the effects of target degradation in the Stroop task. The magnitude of the Stroop effect was clearly larger in the weak condition (69 ms) than in the standard strong condition (39 ms). In total, the findings of Experiment 1 reinforce the idea that AP and Stroop are governed by response interference (Klauer & Musch, 2003) as both tasks verified a general prediction of this model.

Experiment 2

The results of Experiment 1 are informative to the extent that they reveal that the same manipulation regarding target strength produces the same effect in AP and Stroop. To test the generality of this finding, we conducted a second experiment in which AP and Stroop were matched differently for SOA. While in Experiment 1 the two tasks were matched for SOA following the standard AP task (i.e., SOA > 0), they were matched for this procedural parameter following the standard Stroop task in the present experiment (i.e., SOA = 0). Besides this, the stimulus materials and the other parameters of the procedure were the same as those used in Experiment 1.

Method

Participants

A total of 24 undergraduate students (14 females and 10 males; mean age 22 years) participated in this experiment (12 participants for each task). All participants were native speakers of French that reported normal or corrected-to-normal vision and none of them took part in the previous experiment.

Affective Priming Task

Materials and Procedure

The stimulus materials were the same as those used in Experiment 1. Each trial began with a fixation cross at the center of the screen for 500 ms. Then, the prime and the target appeared simultaneously and remained on the screen until the participant's response (i.e., SOA = 0). One of the two stimuli appeared above the center of the screen while the other stimulus below the center of the screen, the distance separating the two stimuli being 100 pixels (3.4 cm) (see Figure 1A). Such a distance allowed the encoding of the two stimuli at the same time without any saccade. The location of each stimulus was randomly determined in each trial. The other parameters of the procedure were the same as those used in Experiment 1.

Stroop Task

Materials and Procedure

The materials were the same as those used in Experiment 1. The same timing as that in the AP task was used. One of the two stimuli appeared above the center of the screen while the other stimulus below the center of the screen, the two stimuli being separated by 150 pixels (5.1 cm). The location of each stimulus was randomly determined in each trial.

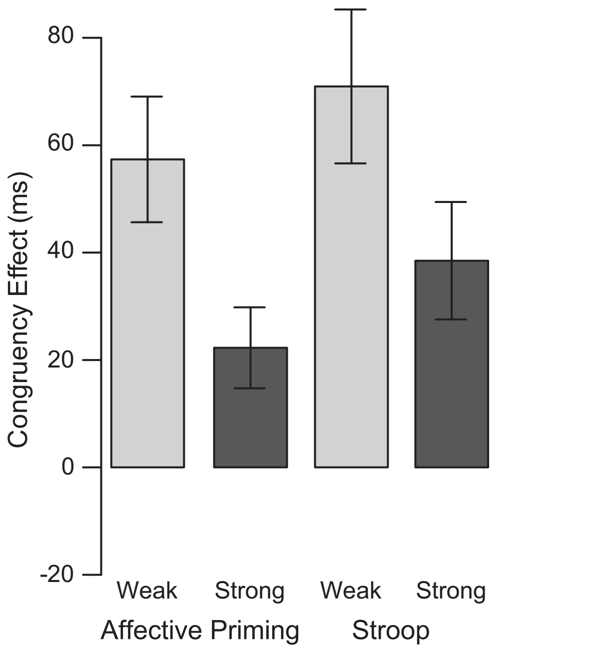
Results and Discussion

Reaction Time Data

Data from trials on which an incorrect response was given on the target (7.04%) were excluded from the analysis, together with all response latencies shorter than 250 ms or longer than 1,500 ms (0.98%). Remaining data (91.98% of all observations) were analyzed in a 2 (Task) × 2 (Relevant Information Strength) × 2 (Congruency) ANOVA with repeated measures on the second and third factors. This analysis yielded a significant main effect of Relevant Information Strength, $F(1, 22) = 117.98$, $p < .001$, $M_{\text{Strong}} = 592$ ms, $M_{\text{Weak}} = 662$ ms, and Congruency, $F(1, 22) = 45.38$, $p < .001$, $M_{\text{Congruent}} = 603$ ms, $M_{\text{Incongruent}} = 651$ ms. Task and Relevant Information Strength interacted significantly, $F(1, 22) = 18.60$, $p < .001$, as the effect of Relevant Information Strength was larger in the Stroop task, $F(1, 11) = 99.23$, $p < .001$, $\eta^2 = .900$, than in the AP task, $F(1, 11) = 21.83$, $p < .001$, $\eta^2 = .665$. In addition, the analysis revealed a significant Relevant Information Strength × Congruency interaction, $F(1, 22) = 18.60$, $p < .001$, indicating that the effect of Congruency was larger in the weak condition, $F(1, 23) = 49.12$, $p < .001$, $\eta^2 = .681$, than in the strong condition, $F(1, 23) = 20.86$, $p < .001$, $\eta^2 = .476$. This two-way interaction was not qualified by a significant three-way interaction between Task, Relevant Information Strength, and Congruency, $F < 1$. Indeed, the Relevant Information Strength × Congruency interaction was found in the AP task, $F(1, 11) = 17.88$, $p < .005$, in which the effect of Congruency was larger in the weak condition, $F(1, 11) = 23.74$, $p < .001$, $\eta^2 = .683$, than in the strong condition, $F(1, 11) = 8.80$, $p < .05$, $\eta^2 = .445$, and also in the Stroop task, $F(1, 11) = 5.97$, $p < .05$, in which the effect of Congruency was larger in the weak condition, $F(1, 11) = 24.74$, $p < .001$, $\eta^2 = .692$, than in the strong condition, $F(1, 11) = 12.67$, $p < .005$, $\eta^2 = .535$ (see Figure 3).

Error Data

The analysis of errors revealed almost the same pattern as that observed on RTs. There was a significant effect of Relevant Information Strength, $F(1, 22) = 15.31$, $p < .001$, $M_{\text{Strong}} = 95.83\%$, $M_{\text{Weak}} = 91.34\%$, and Congruency, $F(1, 22) = 7.77$, $p < .05$, $M_{\text{Congruent}} = 95.11\%$, $M_{\text{Incongruent}} = 92.07\%$. The analysis also yielded a significant Relevant Information Strength × Congruency interaction, $F(1, 22) = 4.78$, $p < .05$. The interaction between these two factors reached significance in a one-tailed F-test in the AP task, $F(1, 11) = 3.21$, $p < .05$, in which there was an effect of Congruency in the weak condition, $F(1, 11) = 7.63$, $p < .05$, but not in the strong condition, $F < 1$. The same pattern was apparent in the Stroop task in which Relevant Information Strength and Congruency interacted significantly (one-tailed), $F(1, 11) = 3.29$, $p < .05$, as there was an effect of Congruency in the weak



Congruent				
RTs (ms)	606	589	654	564
Correct (%)	92.3	96.5	95.5	96.2
Incongruent				
RTs (ms)	663	612	725	603
Correct (%)	88.4	95.6	89.2	95.1

Figure 3. Mean congruency effect, RTs and accuracy in Experiment 2 as a function of Task, Relevant Information Strength, and Congruency. Error bars indicate standard errors.

condition, $F(1, 11) = 6.82$, $p < .05$, but not in the strong condition, $F < 1$ (see Figure 3).[5]

The results of Experiment 2 are straightforward and replicate those of Experiment 1. AP and Stroop effects were modulated by the strength of the relevant information in the direction predicted by the response interference model. Both error and latency data indicate the crucial interaction between Relevant Information Strength and Congruency. Indeed, compatibility effects were significantly larger in the weak condition (AP effect = 57 ms, Stroop effect = 71 ms) than in the standard strong condition (AP effect = 23 ms, Stroop effect = 39 ms).

To summarize, Experiments 1 and 2 showed that the prediction of the response interference model according to which the magnitude of compatibility effects should increase as the strength of the relevant information decreases was verified in AP and Stroop. This effect was found at SOA 250 and SOA 0. Accordingly, these findings provided further evidence in favor of the idea that AP and Stroop effects are driven by response interference (Klauer & Musch, 2003).

Experiment 3

Experiments 1 and 2 are conclusive to the extent that they show that the reduction of the strength of the relevant information produces the same effect in AP and Stroop. As this variable was manipulated at the perceptual level in these two experiments, we basically tested the effect of target degradation in AP and Stroop in these two experiments. We showed that as predicted by the response interference model, degraded targets produced stronger effects in both tasks. In order to test further the generality of our findings, we also tested whether the effect of relevant information was verified when its strength was reduced at the semantic level. For that purpose, we used non-perceptually degraded stimuli as targets which were either strongly or weakly associated with the corresponding relevant semantic category, at SOA 250 (Experiment 3) and SOA 0 (Experiment 4).

Method

Participants

A total of 34 undergraduate students (26 females and 8 males; mean age 21.5 years) participated in this experiment (17 participants for each task). All participants were native speakers of French that reported normal or corrected-to-normal vision and none of them took part in the previous experiments.

Affective Priming Task

Materials and Procedure

Stimuli used as primes were the two individual words POSITIF (*positive*) and NEGATIF (*negative*). Stimuli used as targets were 32 IAPS pictures (8 strong positive, 8 strong negative, 8 weak positive, 8 weak negative) (Lang, Bradley, & Cuthbert, 2005; see Appendix A). In this set of stimuli, the mean evaluation of strong positive stimuli ($M_{\text{Strong Positive}} = 7.68$) differed significantly from the mean evaluation of weak positive stimuli ($M_{\text{Weak Positive}} = 5.60$), $t(14) = 11.25$, $p < .001$, and the mean evaluation of strong negative stimuli ($M_{\text{Strong Negative}} = 2.23$) differed significantly from the mean evaluation of weak negative stimuli ($M_{\text{Weak Negative}} = 4.33$), $t(14) = 11.35$, $p < .001$. The prime words were 206 pixels (7.0 cm) × 80 pixels (2.7 cm) size and were presented in white uppercase letters. The target

[5] Note that here a one-tailed test is justified as the Relevant Information Strength × Congruency interaction (a) has a clear direction (i.e., the congruency effect was stronger for weak compared to strong targets), (b) this interaction was predicted. One should also remind that an F-value with one degree of freedom in the numerator is equivalent to a t test (with t = square root of F, here, a t test for dependent samples using the incongruent – congruence difference as dependent variable and Relevant Information Strength as predictor; see Maxwell & Delaney, 1990).

pictures were 206 pixels (7.0 cm) × 155 pixels (5.3 cm) size. The same timing as that in Experiment 1 was used (i.e., SOA = 250, see Figure 1B). The participants responded to the target picture on each trial by pressing the keyboard keys "SHIFT – Left" (NEGATIVE) or "SHIFT – Right" (POSITIVE). The experiment included 8 blocks of 32 trials. Each target appeared one time in each block and the presentation order of the trials within each block was randomized. In each block, primes were randomly assigned to the targets, the only restriction on this assignment was that there must be an equal number of trials per condition. This semi-randomization was realized for each block and each participant separately. Intertrials interval was 1,500 ms.

After having completed the AP task, participants performed a valence rating task in which they rated the valence of the 32 targets used in the AP task on a scale ranging from 1 (*Strongly Negative*) to 9 (*Strongly Positive*). Stimuli were presented once in a random order.

Stroop Task

Materials and Procedure

Stimuli used as primes consisted of the individual words ROUGE (*red*) and VERT (*green*). Stimuli used as targets were 32 black-and-white pictures of objects/scenes which were associated either to the red color or to the green color (8 strong red, 8 strong green, 8 weak red, 8 weak green) (see Appendix B). A group of 16 students was asked to classify each of the 32 targets as red or green and to rate the extent to which it was associated to the corresponding color by using a scale ranging from 1 (*Weakly associated to the corresponding color*) to 7 (*Strongly associated to the corresponding color*). Ratings revealed that the mean evaluation of strong red stimuli ($M_{\text{Strong Red}} = 6.44$) differed significantly from the mean evaluation of weak red stimuli ($M_{\text{Weak Red}} = 4.67$), $t(14) = 3.62$, $p < .005$, and the mean evaluation of strong green stimuli ($M_{\text{Strong Green}} = 5.93$) differed significantly from the mean evaluation of weak green stimuli ($M_{\text{Weak Green}} = 4.60$), $t(14) = 5.51$, $p < .001$. The prime words were 206 pixels (7.0 cm) × 80 pixels (2.7 cm) size and were presented in white uppercase letters. The target pictures were 206 pixels (7.0 cm) × 155 pixels (5.3 cm) size. The same timing as that in the AP task was used (see Figure 1B). The participants were instructed to respond to the color denoted by the black-and-white picture on each trial by pressing the keyboard keys "SHIFT – Left" (GREEN) or "SHIFT – Right" (RED). The experiment included eight blocks of 32 trials. In each block, primes were randomly assigned to the targets, the only restriction on this assignment was that there must be an equal number of trials per condition. This semi-randomization was realized for each block and each participant separately. Intertrials interval was 1,500 ms.

Following the Stroop task, participants performed a color rating task in which they rated the extent to which each of the 32 targets used in the previous task was associated to the corresponding color. Stimuli were presented once in a random order.

Results and Discussion

Priming Tasks

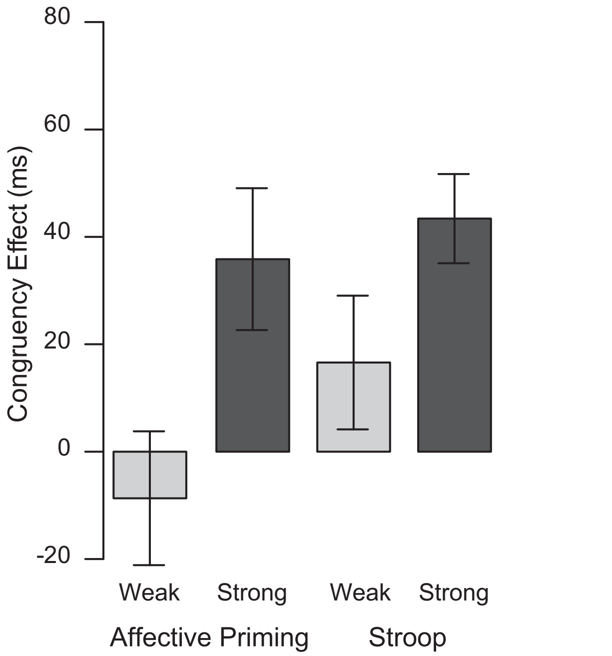
Reaction Time Data. Data from trials on which an incorrect response was given on the target (6.04%) were excluded from the analysis, together with all response latencies shorter than 250 ms or longer than 1,500 ms (0.77%). Remaining data (93.19% of all observations) were analyzed in a 2 (Task) × 2 (Relevant Information Strength) × 2 (Congruency) ANOVA with repeated measures on the last two factors. This analysis yielded a significant main effect of Relevant Information Strength, $F(1, 32) = 30.16$, $p < .001$, $M_{\text{Strong}} = 618$ ms, $M_{\text{Weak}} = 651$ ms, and Congruency, $F(1, 32) = 11.15$, $p < .005$, $M_{\text{Congruent}} = 624$ ms, $M_{\text{Incongruent}} = 645$ ms. Furthermore, the analysis revealed a significant Relevant Information Strength × Congruency interaction, $F(1, 32) = 12.10$, $p < .005$, indicating that there was an overall effect of Congruency in the strong condition, $F(1, 33) = 26.74$, $p < .001$, but not in the weak condition, $F < 1$. This two-way interaction was not qualified by a significant three-way interaction between Task, Relevant Information Strength, and Congruency, $F < 1$. Indeed, Relevant Information Strength and Congruency interacted similarly in the AP task, $F(1, 16) = 6.31$, $p < .05$, and in the Stroop task, $F(1, 16) = 6.72$, $p < .05$. More precisely, in the AP task, there was a significant effect of Congruency in the strong condition, $F(1, 16) = 7.42$, $p < .05$, but not in the weak condition, $F < 1$. Similarly, there was an effect of Congruency in the strong condition of the Stroop task, $F(1, 16) = 27.81$, $p < .001$, but not in the weak condition, $F(1, 16) = 1.81$, *NS* (see Figure 4).

Error Data. The analysis of errors revealed only a significant main effect of Relevant Information Strength, $F(1, 32) = 17.30$, $p < .001$, $M_{\text{Strong}} = 96.29\%$, $M_{\text{Weak}} = 92.21\%$ (see Figure 4).

Rating Tasks

Valence. Regarding positive targets, the mean evaluation of weakly valenced targets, $M_{\text{Weak Positive}} = 6.23$, $SD = 1.10$, was lower than the mean evaluation of strongly valenced targets, $M_{\text{Strong Positive}} = 7.68$, $SD = 1.71$, $t(14) = 6.04$, $p < .001$. Regarding negative targets, the mean evaluation of weakly valenced targets, $M_{\text{Weak Negative}} = 3.60$, $SD = 0.80$, was higher than the mean evaluation of strongly valenced targets, $M_{\text{Strong Negative}} = 2.38$, $SD = 1.48$, $t(14) = 4.43$, $p < .001$. These results confirmed the *a priori* distinction between strongly and weakly valenced targets.

Color. Within the set of red targets, weak targets, $M_{\text{Weak Red}} = 5.01$, $SD = 0.91$, were significantly less associated to the red color than strong targets, $M_{\text{Strong Red}} = 6.63$, $SD = 0.21$, $t(14) = 4.89$, $p < .001$. The same pattern was



Congruent				
RTs (ms)	673	618	624	579
Correct (%)	92.2	95.0	94.1	97.2
Incongruent				
RTs (ms)	664	654	641	622
Correct (%)	89.5	96.1	93.1	96.8

Figure 4. Mean congruency effect, RTs and accuracy in Experiment 3 as a function of Task, Relevant Information Strength, and Congruency. Error bars indicate standard errors.

observed in the set of green targets in which weak targets, $M_{\text{Weak Green}} = 4.71$, $SD = 0.57$, were less associated to the green color than strong targets, $M_{\text{Strong Green}} = 5.88$, $SD = 0.31$, $t(14) = 5.09$, $p < .001$. Again, these ratings confirmed the distinction between strong and weak targets.

Experiment 3 produced an unexpected pattern of results. AP and Stroop effects were actually modulated by the strength of the relevant information but in the opposite direction to that predicted by the response interference model. While a typical 36 ms AP effect was found in the strong condition, no AP effect was apparent in the weak condition. The same was true in the Stroop task in which the effect of Congruency reached significance only in the strong condition (43 ms). Noteworthy, the rating data showed that strong and weak targets were truly perceived differently regarding the strength of their association with the corresponding semantic category. Moreover, the low overall rate of errors in each task indicated that targets were reliably classified (6.8% in the AP task, 4.7% in the Stroop task). Therefore, Experiment 3 suggested that when testing the general predictions of the response interference model regarding information strength, it could be that the level at which this variable is manipulated matters. Indeed, the main difference between the two previous experiments and Experiment 3 was that the strength of the relevant information was reduced at the perceptual level in the former whereas it was reduced at the semantic level in the latter. Actually, this procedural difference might lead to major processual differences (see General Discussion).

Experiment 4

The present experiment was aimed at testing the robustness of the results of Experiment 3, with SOA 0. The parameters regarding the presentation of the stimuli were the same as those used in Experiment 2 (i.e., SOA = 0). The stimulus materials and the other parameters of the procedure were the same as those used in Experiment 3 with the only exception that participants did not perform the rating task after the priming task.

Method

Participants

A total of 40 undergraduate students (29 females and 11 males; mean age 21 years) participated in this experiment (20 participants for each task). All participants reported normal or corrected-to-normal vision and none of them took part in the previous experiments.

Materials and Procedure

The timing and the presentation of the stimuli in each task were the same as those used in Experiment 2 (see Figure 1B). The stimulus materials and the other parameters of the procedure were the same as those used in Experiment 3.

Results and Discussion

Reaction Time Data

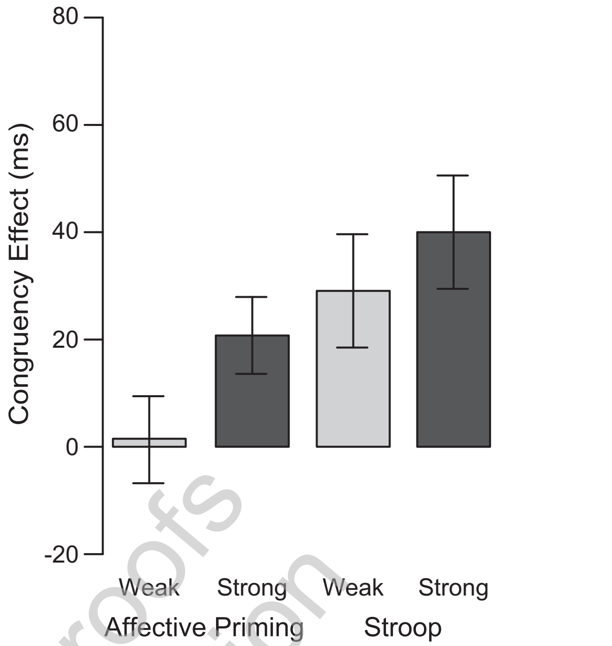
Data from trials on which an incorrect response was given on the target (8.50%) were excluded from the analysis, together with all response latencies shorter than 250 ms or longer than 1,500 ms (1.37%). Remaining data (90.14% of all observations) were analyzed in a 2 (Task) × 2 (Relevant Information Strength) × 2 (Congruency) ANOVA with repeated measures on the second and third factors. This analysis yielded a significant main effect of Relevant Information Strength, $F(1, 38) = 54.50$, $p < .001$, $M_{\text{Strong}} = 646$ ms, $M_{\text{Weak}} = 681$ ms, and Congruency, $F(1, 38) = 19.18$, $p < .001$, $M_{\text{Congruent}} = 652$ ms, $M_{\text{Incongruent}} = 675$ ms. The effect of Task was marginal, $F(1, 38) = 2.91$, $p = .09$, $M_{\text{Affective Priming}} = 680$ ms, $M_{\text{Stroop}} = 647$ ms. Task and Congruency interacted significantly, $F(1, 38) = 4.98$,

$p < .05$, as there was an overall effect of Congruency in the Stroop task, $F(1, 19) = 17.40$, $p < .001$, while this effect was only marginal in the AP task, $F(1, 19) = 3.10$, $p = .09$. In addition, the analysis revealed that the Relevant Information Strength × Congruency interaction reached significance in a one-tailed *F*-test, $F(1, 38) = 3.79$, $p < .05$. This interaction reflects the fact that the effect of Congruency was larger in the strong condition, $F(1, 39) = 22.16$, $p < .001$, $\eta^2 = .362$, than in the weak condition, $F(1, 39) = 4.86$, $p < .05$, $\eta^2 = .111$. More precisely, Relevant Information Strength and Congruency interacted in the AP task, $F(1, 19) = 5.26$, $p < .05$, so that there was an effect of Congruency in the strong condition, $F(1, 19) = 8.58$, $p < .005$, but not in the weak condition, $F < 1$. The interaction between these two factors did not reach significance in the Stroop task ($F < 1$) as the effect of Congruency did not differ between the strong condition, $F(1, 19) = 14.39$, $p < .005$, $\eta^2 = .431$, and the weak condition, $F(1, 19) = 7.53$, $p < .05$, $\eta^2 = .284$. The interaction between the three factors did not reach significance, $F < 1$ (see Figure 5).

Error Data

The analysis of errors revealed a significant effect of Relevant Information Strength, $F(1, 38) = 27.63$, $p < .001$, $M_{Strong} = 93.72\%$, $M_{Weak} = 89.65\%$, and Congruency, $F(1, 38) = 13.55$, $p < .001$, $M_{Congruent} = 93.30\%$, $M_{Incongruent} = 90.07\%$. There was also a significant Task × Relevant Information Strength interaction, $F(1, 38) = 6.17$, $p < .05$, indicating that the effect of Relevant Information Strength was larger in the AP task, $F(1, 19) = 26.62$, $p < .001$, $\eta^2 = .584$, than in the Stroop task, $F(1, 19) = 4.39$, $p < .05$, $\eta^2 = .188$. The Relevant Information Strength × Congruency interaction did not reach significance, $F(1, 38) = 1.75$, $p = .19$. Indeed, the effect of Q6 Congruency did not reach significance neither for weak targets, $F(1, 39) = 2.83$, $p = .10$, nor for strong targets, $F(1, 39) = 1.17$, $p = .28$. More precisely, the congruency effect in the AP task was not significant in both the weak targets condition, $F(1, 19) = 1.96$, $p = .18$, and the strong targets condition, $F(1, 19) = 1.22$, $p = .28$. The same pattern was observed in the Stroop task in which the effect of Congruency did not reach significance neither for weak targets, $F(1, 19) = 2.65$, $p = .12$, nor for strong targets, $F(1, 19) = 2.01$, $p = .16$. Finally, the main effect of Task was not significant, $F(1, 38) = 1.89$, $p = .18$ (see Figure 5).

Experiment 4 was aimed at replicating the findings of Experiment 3 with SOA 0. As in the latter experiment, an AP effect was obtained in the strong condition (21 ms) but not in the weak condition. On the other hand, the Stroop effect was not modulated by the strength of the relevant information since its magnitude did not significantly differ between the strong condition (40 ms) and the weak condition (29 ms). Noteworthy, the absence of AP effect in the weak condition could not be due to the fact that weak targets were unreliably categorized in the AP task while they were reliably categorized in the Stroop task as there was no main effect of Task on errors.



Congruent				
RTs (ms)	697	652	650	609
Correct (%)	90.0	94.4	94.0	94.8
Incongruent				
RTs (ms)	699	673	679	649
Correct (%)	85.1	92.7	89.5	93.0

Figure 5. Mean congruency effect, RTs and accuracy in Experiment 4 as a function of Task, Relevant Information Strength, and Congruency. Error bars indicate standard errors.

One should note that contrary to what was observed in Experiment 3, the Stroop effect was not modulated by the strength of the relevant information in Experiment 4. The only difference between these two experiments was that a SOA 0 was used in Experiment 4. Actually, one could assume that when a color word (i.e., prime) is presented simultaneously with a picture (i.e., target) which color has to be identified, the strength of weak intrinsic targets tends to increase either by assimilation effect in congruent trials or by contrast effect in incongruent trials. Therefore, the discrepancy regarding the Stroop effect between Experiments 3 and 4 could be related to the fact that weak targets in the Stroop task in Experiment 4 were actually perceived as strong targets, so that the Stroop effect was not modulated by the strength of the relevant information. This hypothesis is supported by the fact that Task and Relevant Information Strength interacted significantly on errors in Experiment 4, indicating that the effect of Relevant Information Strength was larger in the AP task than in the Stroop task, while this interaction was not apparent in Experiment 3.

Q7 To summarize, Experiments 3 and 4 showed that the magnitude of compatibility effects was modulated by the strength of the relevant information in the opposite direction to that predicted by the response interference model. In fact, AP and Stroop effects were eliminated when targets were weakly associated to the corresponding semantic feature (with the exception of the Stroop effect for SOA 0).

General Discussion

Over the last few decades, the study of the underlying mechanisms of AP has led to a binary theoretical view (Fazio, 2001). Given its procedural similarity with semantic priming, AP was initially thought to be governed by spreading activation, suggesting that AP effects originated at the level of encoding (Fazio et al., 1986; Hermans, De Houwer, & Eelen, 1994). However, recent evidence has supported a response interference account of AP (e.g., De Houwer, Hermans, Rothermund, & Wentura, 2002; Klauer & Teige-Mocigemba, 2007; Klauer et al., 1997). This alternative account is conceptually based on the structural similarity between the AP task and the Stroop task (De Houwer, 2003) and it is mainly supported by studies which reported that effects typically found in the Stroop task were also found in the AP task (consistency proportion effect, Klauer et al., 1997; negative priming effect, Wentura, 1999). Actually, it is thought that AP effects are better understood as being driven by so-called "Stroop-like" processes of response interference (Gawronski, Cunningham, LeBel, & Deutsch, in press; Klauer & Musch, 2003).[6] Indeed, the Stroop task is the prototypical compatibility task that is thought be governed by response interference (e.g., De Q8 Houwer, 2003; Duncan-Johnson & Koppel, 1981; Scheibe, Shaver, & Carrier, 1967).

The aim of the present study was to test further the hypothesis according to which response interference is the underlying mechanism of both AP and Stroop. For that purpose, we tested whether a general prediction of the response interference model was verified in these two tasks. This prediction states that the magnitude of compatibility effects should increase as the strength of the relevant information decreases. Noteworthy, this variable can be manipulated in two different ways. In fact, the strength of the relevant information can be first reduced by decreasing the perceptual strength of the physical stimulus. Experiments 1 and 2 confirmed that target degradation actually modulated the magnitude of AP and Stroop effects in the direction predicted by the response interference model. Indeed, the size of the two effects was larger when targets were perceptually degraded (i.e., weak relevant information) than when targets were normally displayed (i.e., strong relevant information). One should note that De Houwer et al. (2001) already reported similar effects of target degradation in AP with the use of the pronunciation task. Given that AP effects obtained with this task are known to be unreliable (e.g., Klauer & Musch, 2001; Spruyt et al., 2004), De Houwer et al. (2001) found AP effects only when target stimuli were degraded. On the other hand, the findings of Experiments 1 and 2 also revealed that the effects of target degradation in the Stroop task were identical to those observed in the AP task. Noteworthy, the similar effects of target degradation in AP and Stroop were found at SOA 250 and SOA 0 thereby strengthening their robustness. The response interference model accounts for these findings as follows. Basically, this model assumes that compatibility effects come from incongruent trials in which interference occurs between relevant and irrelevant information. In standard incongruent trials in which the relevant and the irrelevant information are strong (i.e., extreme stimuli are typically used as primes and targets), it takes a certain amount of time for the executive system to select the relevant response to the detriment of the irrelevant response. On the basis of this competition process, it is clear that the duration of the interference depends on the strength of the relevant information and that of the irrelevant information. In particular, the weaker is the strength of the relevant information, the longer is the interference.

The strength of the relevant information can be also manipulated through the strength of association between the stimulus and the corresponding relevant semantic category. Experiments 3 and 4 were aimed at testing the prediction of the response interference model regarding the strength of relevant information when it was manipulated at the semantic level. Unexpectedly, these experiments revealed globally the opposite pattern to that predicted. Actually, an AP effect was obtained in the strong condition but no effect was found in the weak condition regardless of SOA. On the other side, at SOA 250, a Stroop effect was found in the strong condition but not in the weak condition. At SOA 0, the size of the Stroop effect did not differ between the weak and the strong condition. As mentioned above, the fact that the Stroop effect was not modulated by the strength of relevant information in Experiment 4 may be related to the fact that weak targets in this experiment were actually perceived as strong targets. These results call for several remarks.

First, while the findings of Experiments 1 and 2 are straightforwardly explained by the response interference model, those of Experiments 3 and 4 are not. Seen from another angle, the present experiments revealed differential effects of perceptual manipulation of the strength of the relevant information and semantic manipulation. Although

[6] It should be noted that Klauer's theoretical position on AP does not rely on response interference exclusively. In fact, while Klauer assumes that AP effects are primarily due to response interference, he acknowledges that additional mechanisms also contribute to the AP effect such as what he called affective-matching (Klauer & Musch, 2002; 2003) as well as a component operating at a more central stage of categorizing stimuli that is removed from peripheral response interference (e.g., Klauer, Musch, & Eder, 2005; Klauer, Teige-Mocigemba, & Spruyt, 2009).

the discrepancy between these two effects seems to be incompatible with the response interference model at first glance, one could actually explain these results on the basis of this model using one main assumption. This hypothesis refers to the difference between the processing of weak perceptual targets and processing of weak semantic targets. One could assume that while the processing of a weak perceptual target gives rise to an early categorization (which is updated over time), the processing of a weak semantic target gives rise only to a late categorization. Indeed, many studies have shown that weak visual signals (e.g., subliminal stimuli) are likely to produce early activations in the visual cortex and that early categorizations can be made on the basis of weak perceptual evidence, thereby suggesting the efficiency of perceptual processes (Kouider & Dehaene, 2007). On the other hand, processing of a weak semantic target requires a certain amount of time to recover the relevant semantic information so that the stimulus is categorized lately. From there, one could reconstruct the scenario that happened in the incongruent trials of the weak perceptual condition and the one that happened in the incongruent trials of the weak semantic condition. In the former case, from the moment that an irrelevant response and an early relevant response are produced, the two responses enter an interference process. Since this early response is much weaker than the irrelevant response, the duration of the interference is consequent. In the latter case, the irrelevant response is produced before the – late – relevant response. While the relevant response is produced, the irrelevant response remains inactive and its strength decreases. By the time the relevant response is produced, the irrelevant response is no more active. This scenario could explain why compatibility effects were attenuated in the weak semantic condition.

With less speculation, it could be merely argued that, if not explained by response interference, the reduction of the magnitude of compatibility effects observed in Experiments 3 and 4 could be explained by the spreading activation model (Neely, 1976, 1977). One could actually assume that in the semantic network, nodes representing exemplars that are weakly associated (e.g., LOBSTER) with a node representing a semantic feature (e.g., red color) receive less activation from this node when it is activated than nodes representing exemplars that are strongly (e.g., STRAWBERRY) associated with it. Therefore, the reduced compatibility effects that were found in the weak semantic condition could have been due to the fact that targets were less pre-activated in congruent trials. However, several studies revealed the limits of the spreading activation account of AP (e.g., Klauer & Musch, 2001). In particular, it has been shown that the AP effect is primarily due to mechanisms that occur at the response selection level rather than to processes occurring at the level of encoding (Klauer, Musch, & Eder, 2005).

Second, as mentioned above, the response interference model makes two general predictions regarding information strength, one about the irrelevant information, the other about the relevant information. While the present research was focused on the effects of the relevant information strength, Simmons and Prentice (2006) investigated those of the irrelevant information strength. In this regard, one should note that when the strength of the information is manipulated at the semantic level, the findings of Experiments 3 and 4 suggested that the prediction of the response interference model regarding the strength of the relevant information was not verified in the Stroop task while Simmons and Prentice (2006) reported that the prediction of this model regarding the strength of the irrelevant information was verified. Indeed, the response interference model predicts that compatibility effects should decrease as the strength of the irrelevant information decreases. Simmons and Prentice (2006) showed that Stroop effects were actually weaker when the irrelevant information was weak (e.g., GRASS) than when it was stronger (e.g., GREEN). On the other hand, this modulation was not verified in the AP task as these researchers reported AP effects of comparable sizes for moderate and extreme valenced primes (see also Klauer et al., 2009). Noteworthy, remembering that Fazio and colleagues (Fazio et al., 1982, 1983) argued in their early studies that AP was sensitive to attitude accessibility rather than valence extremity, the dissociation between AP and Stroop reported by Simmons and Prentice (2006) may be only apparent.[7] Anyway, understanding why the predictions of the response interference model tend not to be verified in the AP task when information strength (both relevant and irrelevant) is manipulated at the semantic level remains an open issue.

In sum, the present experiments showed two important findings. First, the manipulation of target strength produced the same effects in the AP and the Stroop tasks through four experiments (with the exception of Experiment 4 in which the Stroop effect was not modulated by target strength). This result is in line with previous studies that showed that similar experimental manipulations produced similar effects in AP and Stroop (Klauer et al., 1997; Wentura, 1999). It also reinforces the idea that the similarity between the two tasks goes beyond the structural level to reach the processual level (De Houwer, 2003). Indeed, the modulation of AP and Stroop effects reported in Experiments 1 and 2 is perfectly explained on the basis of the response interference model. Second, while the response interference model predicts that the size of compatibility effects should increase as the strength of the relevant information decreases regardless of how it is manipulated, our findings revealed differential effects of perceptual and semantic manipulation of this variable. While the perceptual manipulation gave rise to the predicted pattern, the semantic manipulation led to the opposite pattern. Actually, such discrepancy between observations and predictions might not be surprising since although effective, the response interference model is a qualitative model that is not sufficiently specified in order to make accurate predictions regarding fine-grained

[7] We thank one of the reviewers for this comment.

experimental manipulations. Further theoretical research is needed in order to refine this model and to test its ability to account for the behavior of compatibility effects.

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Appendix

A. International Affective Picture System Number of the Pictures Used as Targets in the Affective Priming Task (Experiments 3 and 4)

Weak Positive: 2025, 2214, 2506, 5731, 7057, 8211, 8311, 8465
Strong Positive: 1463, 1750, 2165, 2260, 2311, 2341, 5760, 7325
Weak Negative: 1302, 2752, 2780, 2810, 5940, 5970, 9210, 9635.2
Strong Negative: 1525, 2800, 3068, 3181, 3350, 6313, 6821, 9561

B. Pictures Used as Targets in the Stroop Task (Experiments 3 and 4)

Strong Red: Red phone cabine, Firetruck, Coca cola bottle, Strawberries, Lips, No entry sign, Stop sign, Tomato
Weak Red: Candle, Swiss knife, Ferrari car, Flames, Lobster, Red Fish, Red rose, Lipstick
Strong Green: Tree, Grasshopper, Leaf, Golf course, Hulk, Green bean, Clover, Lettuce
Weak Green: Martian, Cards playmates, Watering, Lizard, Blackjack playmates, Shrek, Stadium, Football field

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