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The Relation Between Perception and Behavior, or How to Win a Game of Trivial Pursuit

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The authors tested and confirmed the hypothesis that priming a stereotype or trait leads to complex overt behavior in line with this activated stereotype or trait. Specifically, 4 experiments established that priming the stereotype of professors or the trait *intelligent* enhanced participants' performance on a scale measuring general knowledge. Also, priming the stereotype of soccer hooligans or the trait *stupid* reduced participants' performance on a general knowledge scale. Results of the experiments revealed (a) that prolonged priming leads to more pronounced behavioral effects and (b) that there is no sign of decay of the effects for at least 15 min. The authors explain their results by claiming that perception has a direct and pervasive impact on overt behavior (cf. J. A. Bargh, M. Chen, & L. Burrows, 1996). Implications for human social behavior are discussed.

> I am a camera with its shutter open, quite passive, recording, not thinking.
>
> —Christopher Isherwood

Some time ago, a few members of the Department of Social Psychology of the University of Nijmegen visited a soccer match. After they had parked their car, they walked the remaining mile to the stadium. The psychologists, behaving calmly and orderly as ever, were surrounded by hundreds of soccer fans and hooligans, many of whom were yelling and shouting. After some time, one of the members of the department engaged in somewhat unusual behavior. He saw an empty beer can, and, in what seemed to be an impulsive act, he kicked it as far away as possible. During the next few minutes, he and a slightly embarrassed colleague pondered on possible explanations.

One explanation is that, upon seeing soccer hooligans, one may—without being aware of it—start to act like them. That is, the activation of the representation of soccer hooligans leads to the tendency to behave similarly. Recent research showed that this is indeed possible. The mere perception of a person or a group of persons triggers a mechanism producing the tendency to behave correspondingly. In a series of studies, Bargh, Chen, and Burrows (1996) demonstrated such unconscious and unintentional effects of perception on social behavior. It was established that priming someone with a trait (e.g., rudeness) or a stereotype (e.g., elderly, African American) indeed leads to behavior in line with the activated constructs (see also Carver, Ganellen, Froming, & Chambers, 1983; Neuberg, 1988). For example, priming participants with the stereotype of the elderly made participants walk more slowly than participants who were not primed (Bargh, Chen, & Burrows, 1996, Experiment 2).

In our view, the notion that behavior is under direct perceptual control is of central importance for the understanding of human behavior. After all, upon meeting someone, one usually makes several categorizations instantly. One infers personality traits from the behavior of others spontaneously (Winter & Uleman, 1984). One activates stereotypes automatically (Devine, 1989). Hence, it is not immoderate to conclude that social interaction usually involves the activation of trait constructs and stereotypes. In this light, the findings of Bargh, Chen, and Burrows (1996), establishing that people's actions are unintentionally affected by these activated traits and stereotypes, do warrant further exploration.

With the present research, we want to make two contributions. First, we address the question of whether the effects of perception on behavior are confined to relatively simple actions or whether one can also evoke more complex behavioral patterns this way. Second, we explore the parameters of the perception–behavior link. Specifically, we study the relation between the strength of the prime and the strength of the resulting behavioral effect. Furthermore, we investigate the decay function of the effects of perception on behavior.

In should be noted in advance that throughout this article, we use the term *perception* rather loosely. The object of investigation is perception, or the activation of perceptual representations. In our research, as well as in most of the research we discuss and in most social cognition research in general, the researcher does not activate representations (e.g., a stereotype) by presenting participants with the real object of perception (e.g., a group member). Instead, the researcher uses priming manipulations to activate these perceptual representations. Hence, for the sake of simplicity, receiving priming (including the somewhat unorthodox priming manipulations we use) is treated as functionally equivalent to perception. We realize, how-

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ever, that our priming procedures do not literally reflect social perception processes.

Perception and Overt Behavior

The notion that perception (or the activation of a perceptual representation) may lead to corresponding overt behavior has been recognized since long ago by some of our most influential thinkers (see, e.g., Arnold, 1946; Charcot, 1886; James, 1890; Koffka, 1925; Piaget, 1946). Underlying this idea is the assumption that apart from perceptual or cognitive representations (e.g., traits, stereotypes), behaviors are mentally represented as well and that these perceptual and behavioral representations are somehow intimately linked. Indeed, many theorists (e.g., Bargh, in press; Berkowitz, 1984; Carver & Scheier, 1981; Mischel, 1973; Schank & Abelson, 1977; Vallacher, 1993) have discussed this possibility. Prinz (1990), in a review of the research on the "common coding" hypothesis, explained why mere perception can affect overt behavior relatively easily:

> Acts are completely commensurate and continuous with percepts. Percepts and acts both refer to events with comparable attributes. Both are characterized by location (in space and time) and contents (in terms of physical and non-physical properties), the only difference being that percepts refer to ongoing, actor-independent events and acts to to-be-generated, actor-dependent events. (pp. 171–172).

Research by Rosch and Mervis (1975; see also Carver & Scheier, 1981) supports the notion of common coding of percepts and acts. Participants in their study were asked to generate attributes of a target word. Participants listed not only perceptual attributes but also behavioral responses. Carver and Scheier (1981), in discussing the research by Rosch and Mervis (1975), provided a nice example. The target *apple* elicited "red," "round," and "grows on trees" but also "you can eat it." Hence, it seems that, in line with the common coding hypothesis, actions are encoded in much the same way as other (perceptual) attributes of a given stimulus (see Carver & Scheier, 1981, p. 121). This suggests that perception and action have shared representational systems, again, an idea that has been postulated by several other researchers (e.g., Bandura, 1977; Koffka, 1925; Piaget, 1946).

Toward Priming Complex Behavior

The available evidence for effects of the activation of mental representations on overt behavior is largely confined to areas of behavior of a relatively elementary nature, such as arm movements (Eidelberg, 1929; Smeets & Brenner, 1995). The early research of Eidelberg (1929) can be taken as an example. Eidelberg (1929; see also Prinz, 1990) instructed participants to point at their nose at the verbal instruction "nose" and to point to a lamp upon hearing the word "lamp." During this task, the experimenter also pointed to his nose or to the lamp. As soon as the experimenter started to make mistakes (pointing at his nose after the instruction "lamp"), participants made mistakes too, although they were explicitly instructed to follow the verbal instructions and not the experimenter's movements. Thus, it seems that the activation of a mental representation of a specific movement (here, the perception of a movement) resulted in the tendency to actually make this movement. Another domain in which perception has been shown to affect action is speech production. It was shown that people unconsciously take over accents of others (Dell, 1986). Moreover, people that are primed with a certain syntax tend to use this syntax when producing a sentence (e.g., Bock, 1986, 1989), even when the syntax is grammatically incorrect (Levelt & Kelter, 1982). Speech production, thus, is also partly under perceptual control.

Recently, Bargh and colleagues went a step further. Bargh, Chen, and Burrows (1996) reported an experiment in which participants were subliminally primed with the stereotype of African Americans. Participants thus primed behaved more hostile toward a confederate (see also Carver et al., 1983). In comparison with participants in a control condition, primed participants showed more aggressive facial expressions, and, more pertinent to our present argument, they expressed more verbal hostility. Hence, the influence of perception on behavior goes beyond relatively simple, motoric responses (e.g., arm movements).

We want to take another step by establishing the generalizability of the perception–behavior link to behavior of an even greater complexity. The question is, can very complex behavior be evoked by mere perception? The relation between perception and behavior in, for instance, the studies by Eidelberg (1929) was assumed to be very direct. The mental representation that is activated refers directly to behavior (cf. the "common coding hypothesis" formulated by Prinz). For more complex behaviors, this relation is, of necessity, more complicated. If, for instance, we activate the mental representation of intelligence, this should, according to the same principle, result in the onset of "intelligent behavior." However, unlike arm movements, intelligence is not a behavior. If one assumes, though, that more abstract constructs such as intelligence refer to classes of behavior, or behavioral patterns (such as harder thinking or better concentration) on a more concrete level, and if one further assumes that behavioral representations are hierarchically structured so that abstract behavioral constructs can activate more concrete behaviors, it is conceivable that the activation of a more abstract mental representation also leads to overt behavior in line with the primed construct. Below, we attempt to explicate the assumed underlying process in some detail.

Theoretically, one can understand the unconscious instigation of complex behavior on stereotype activation as the unrollment of a partly hierarchically structured chain of events. As stereotypes are associated with traits (e.g., Hamilton & Sherman, 1994; Stangor & Lange, 1994), the priming of a stereotype would activate the related trait constructs (Blair & Banaji, 1996; Devine, 1989; Dijksterhuis & van Knippenberg, 1996; Dovidio, Evans, & Tyler, 1986; Macrae, Stangor, & Milne, 1994). In our view, the activation of a trait (e.g., aggressive) may, in turn, activate a number of behavioral representations characteristic of the trait involved (e.g., looking angrily, speaking in an offensive tone of voice, and maybe even wanting to hit someone or something). In fact, in recent research on emotions, such action components have been shown to be evoked by emotion concepts (Frijda, Kuipers, & ter Schure, 1989). We assume that traits are also associated with behavioral representations that constitute instantiations of the trait in question. Suggestive evidence to that effect may be found in early spontaneous trait inference research in which, although the claim of spontaneous linkage

is in the reverse direction, trait cues facilitate recall of behavioral episodes (Winter & Uleman, 1984; Winter, Uleman, & Cunnif, 1985). As a result of the existence of the trait–behavioral representation links, the priming of a stereotype may elicit the unconscious tendency to perform more or less complex behaviors typical of the traits associated with this stereotype. Thus, for instance, the activation of the trait *intelligent* (either by directly priming the trait or by priming a stereotype that contains this trait) may lead to the activation of a set of concrete behavioral representations stored under it (e.g., to concentrate on a problem, to adopt an analytical approach, to think systematically about possible solutions).

The presumed hierarchical linkage of mental representations with concrete behaviors has already been argued to exist. There are existing theories that conceive of the mental representation of goals and behavior as hierarchical structures with associations between more abstract classes of behaviors (e.g., eating and drinking) by means of intermediate levels (e.g., going out for a meal) to very specific actions (e.g., moving my arm to grab the raw herring with onions). Several theorists assume that behavior on all (or at least many different) levels of abstractness is mentally represented (e.g., Carver & Scheier, 1981; Martin & Tesser, 1989; Powers, 1973; Vallacher & Wegner, 1985, 1987; Wegner & Vallacher, 1987; see also Schank & Abelson, 1977). As Carver and Scheier (1981) noted, "in any set of perceptions the level of analysis to which one is attending dictates the level of behavioral standard that becomes salient. And what standard becomes salient dictates what action (if any) is subsequently taken" (p. 128). Thus, we assume that the activation of a stereotype leads to a broad set of behavioral tendencies in line with this stereotype. In concrete terms, just as the representation of "I'm hungry" leads to eating and later to moving one's arm to grab the food, it is conceivable that the representation of intelligence leads to a quite differentiated set of more concrete behavioral representations at a lower level.

The Present Research

As was mentioned at the outset, we hope to make two contributions with our research. First, we tested the effects of perception on action for behavior that is clearly more complex than earlier demonstrations. Second, we explored some parameters of the effects of perception on behavior.

Complex Behavior: Priming Ability-Related Performances

To demonstrate the effect that stereotype activation can lead to complex behavior or a behavioral pattern in line with this stereotype, we attempted to affect people's performance on an ability-related task. With regard to performance on an ability-related task such as, for instance, a general knowledge task, it may be argued that the mental activation of the concept of intelligence (or knowledgeability) might enhance one's performance (cf. Bargh, Gollwitzer, & Barndollar, 1996), whereas the mental activation of stupidity might reduce it, compared with one's average performance under normal circumstances. In our experiments, we aimed to increase or decrease performance on a general knowledge test by priming participants with the stereotype of either professors or soccer hooligans. The prime of professor, then, may lead to a set of more specific behavioral changes, such as higher concentration, more analytical and systematic thinking, and more confidence in one's own knowledgeability, whereas the hooligan prime may lead to reduced concentration and sloppier thinking.

It should be noted in advance that effects on performance, specifically improvements, are obviously constrained by objective limitations (e.g., it seems unlikely that one could all of a sudden play the violin merely upon hearing Beethoven's Violin Concerto in E), but given natural within-person variations in task performance over time, theoretically, perceptions or mental representations of superior or inferior performance may have corresponding effects on the person's performance. Thus, if one is a reasonably skilled violin player, one may indeed play better after hearing Beethoven's violin concertos.

We hypothesized that priming a stereotype (professor, hooligan) would affect task performance in line with traits (intelligence, stupidity) associated with the stereotype; specifically, we predicted that these stereotype primes would lead to increased or decreased performance on a general knowledge task. As with the Beethoven example, this general prediction presumes that individual task performance, including performance on ability-related tasks, may vary over time. Specifically, it is assumed that although there obviously exist circumstances that hamper task performance, there may also exist (social and mental) conditions that temporarily enhance one's level of performance. The occurrence of both task performance facilitation and debilitation is documented in the social facilitation and inhibition literature (e.g., Zajonc, 1965). Mostly, social facilitation and inhibition effects are theorized to be mediated by capacity and motivational mechanisms (e.g., Manstead & Semin, 1980; Sanders, 1981), but for the present purpose, it suffices to realize that base-rate performance levels tend to be suboptimal, allowing not only for further deterioration but also for enhancement (see also Bargh, Gollwitzer, & Barndollar, 1996). Hence, in general terms, it is conceivable that priming mechanisms may improve as well as impair human task performance.

Parameters

For exploratory reasons, we include tests of some of the parameters of the relation between perception and behavior in the experiments. First, we investigate the relation between the magnitude of the prime and the magnitude of the behavioral effect. Furthermore, we try to shed light on the decay function of behavior evoked by perception. For both parameters, we briefly present the tentative hypotheses formulated on the basis of earlier findings.

As for the relation between strength of prime and strength of effect, the relevant earlier findings come from studies investigating the relation between priming and social judgment. On the basis of the literature on the effects of priming on judgments, one may hypothesize that the more intense or more prolonged the instigating perception, the more intense the resulting behavior (see Higgins, Bargh, & Lombardi, 1985; Srull & Wyer, 1979, 1980, for such results in the domain of social judgments). In concrete terms, considering that these predictions hold for the effects of priming on behavior, it may be argued that one may

walk slowly after being primed with the stereotype of the elderly (cf. Bargh, Chen, & Burrows, 1996), a bit faster when one is primed with the stereotype of psychologists, again faster when one is primed with Carl Lewis for 1 min, and, more important, still faster when one is primed with Carl Lewis for 15 min. We test this hypothesis pertaining to the relation between magnitude of perceptual input and magnitude of behavioral output in the context of ability-related performance.

Furthermore, we try to shed light on the decay function of behavior evoked by perception. Like Bargh, Chen, and Burrows (1996), we assume that in this respect the effects of perception on behavior represents a different mechanism than the effects of automatic goal priming on behavior. In a test of their automotive model, Bargh, Gollwitzer, and Barndollar (1996) primed participants with either achievement or affiliation goals. They obtained evidence that participants behaved accordingly but only on the earlier trials of the dependent variables. Later, no trace of the primed goal was found. However, unlike goal-directed action, the behavior we are considering is not instigated to lead to a desired outcome. Therefore, there is no reason to assume that it ends when a specific state is reached. It does not contain a "stop mechanism," so to speak. Once instigated, it is "left to operate by default" (Bargh, Gollwitzer, & Barndollar, 1996, p. 4). It follows from this reasoning that once instigated, the termination of perception-induced action (e.g., walking very slowly, in the Bargh, Chen, & Burrows, 1996, study) is left to other mechanisms (e.g., a conscious decision to walk faster upon being told that the bus leaves in a minute), or it may be overruled by competing behavioral effects set off by other perceptual cues (e.g., bumping into Carl Lewis). In sum, in the absence of external intervention, there is, theoretically, no reason to expect decay over time. We tested this hypothesis in our experiments.

The Experiments

In the experiments, we investigated the impact of stereotype priming on overt behavior. In Experiments 1 and 2, participants were primed with the stereotype of professors, of which intelligence and knowledgeability are central features. We hypothesized that on a subsequent, ostensibly unrelated, general knowledge task, the participants' performance would be enhanced when compared with performance in no-prime and intelligence-irrelevant control conditions. In Experiment 3 participants were primed with the stereotype of soccer hooligans. As soccer hooligans are perceived as stupid (see, e.g., Dijksterhuis & van Knippenberg, 1996), the primed participants' performance on the general knowledge scale was expected to decrease when compared with the no-prime control condition. In Experiment 4, we investigated whether priming participants directly with traits (intelligent and stupid) led to the same effects as priming participants with stereotypes associated with these traits (professor and hooligan).

In Experiments 1, 2, and 3, we also studied stability of the prime effect over time; that is, we looked at potential (absence of) decay over time. Another manipulation was added to Experiments 2 and 3: whether the magnitude of the effects varies depending on the length of the prime. In these experiments, participants who were primed for a long period of time (9 min) were compared with participants who were primed for a short period (2 min).

Experiment 1

In the first experiment, participants were primed with the stereotype of professors. We expected these primed participants to perform better on a general knowledge task, in line with the attributes of the stereotype of professors, such as intelligence and knowledgeability. We compared these results with two conditions, one in which participants were not primed and one in which participants were primed with secretaries, a stereotype supposedly unrelated to knowledgeability and intelligence. Both were treated as control conditions.

The priming procedure consisted of a task seemingly unrelated to the rest of the experiment (cf. Bargh & Pietromonaco, 1982; Dijksterhuis & van Knippenberg, 1996, 1997; Higgins, Rholes, & Jones, 1977; Macrae et al., 1994). One may note that our priming manipulation differs from the one used by Bargh, Chen, and Burrows (1996) in that our participants were aware of the content of the prime. However, of critical importance for our test of unconscious effects of stereotype activation on behavior is the fact that participants should be unaware of the link between the priming manipulation and the task on which the resulting effect is measured. In our experiments, participants should not have been aware of the fact that the prime may have influenced their performance. Whether participants were aware of the specific content of the prime itself (e.g., a professor) is irrelevant for our purposes (see, e.g., Bargh, 1994; Bargh & Pietromonaco, 1982; Dijksterhuis & van Knippenberg, 1996; Higgins & King; 1981; Higgins et al., 1977; Macrae et al., 1994; Niedenthal & Cantor, 1986; Srull & Wyer, 1979, 1980, for a similar argument).

The general knowledge task consisted of a questionnaire with 42 difficult multiple-choice questions borrowed from the game Trivial Pursuit (1984/1987).

Method

Participants and design. Sixty undergraduate students of the University of Nijmegen were randomly assigned to one of three experimental conditions: a professor prime condition, a secretary prime (control) condition, or a no-prime control condition. Participants received 5 Dutch guilders (Dfl) (approximately U.S. $3) for participating.

Procedure and materials. Participants were told that they would participate in a number of unrelated pilot studies. The pilot studies were allegedly for the purpose of gathering stimulus materials for forthcoming experiments. Upon entering the laboratory, participants were placed in cubicles containing an Apple Macintosh (LCIII) computer. Participants were told that all instructions would be provided by the computer. Subsequently, the experimenter started the computer program and left the cubicle. After some general instructions were provided, the computer randomly assigned participants to one of three experimental conditions: Participants either were primed with the stereotype of professors or the stereotype of secretaries or were not primed at all. The latter participants started with the questionnaire containing the dependent variable immediately.

The priming procedure we used was the same procedure used earlier by Macrae et al. (1994) and by Dijksterhuis and van Knippenberg (1996). Participants were asked, by the computer, to imagine a typical professor (or secretary) for 5 min and to list the behaviors, lifestyle,

and appearance attributes of this typical professor (or secretary). Participants were requested to list their thoughts on a blank sheet of paper that had been provided by the experimenter when participants entered their cubicles. Participants were told that this information would be used for forthcoming experiments of the Department of Social Psychology. The choice for stereotypes of professors and secretaries was based on a pilot study in which 40 participants rated these (and other) groups on 56 traits. In this pilot study, 9-point scales were used, with poles labeled *professors* [*secretaries*] *are not at all* ___ (1) and *professors* [*secretaries*] *are very* ___ (9). Professors were perceived as intelligent (M = 7.78) and as knowledgeable (M = 7.56). Secretaries were chosen as an additional control condition. They were rated near the midpoint of the scale (i.e., as neutral) with respect to the traits intelligent (M = 5.05) and knowledgeable (M = 4.83).

After they had completed the priming procedure, participants were asked to start with a second, purportedly unrelated task. The computer program asked the participants to open an envelope that was on the table next to the computer. This envelope contained a booklet with 42 multiple-choice questions, each with four choice options. The booklet consisted of six pages. On each page, seven questions were listed. Participants were told that the Personality Department was currently developing a "general knowledge" scale. This scale consisted of five subscales, each containing 42 questions. The subscales ranged from *very easy* (1) to *very difficult* (5). At that time, we told participants, we were testing the differences in difficulty between the five subscales. For ethical purposes we told all participants that they would receive the most difficult subscale (prestudies indicated that students answered about 50% correctly, indicating that the questions were fairly difficult, considering that a score of 25% would be obtained by mere guessing). Participants were asked to answer the questions by choosing one out of four options. They were told that there were no time constraints. They were asked to push a button before they started and after they finished. This was done to measure the time participants spent on the task.

The 42 questions were all taken from the game Trivial Pursuit. For each question, in addition to the correct answer, three incorrect choice options were also provided. Examples of questions and choice options are "Who painted *La Guernica?*" (a. Dali, b. Miro, c. Picasso, d. Velasquez), "What is the capital of Bangladesh?" (a. Dhaka, b. Hanoi, c. Yangon, d. Bangkok) and "Which country hosted the 1990 World Cup soccer?" (a. the United States, b. Mexico, c. Spain, d. Italy). The right answer was option a on 11 questions, option b on 11 questions, option c on 10 questions, and option d on 10 questions. To control for possible order effects, we constructed six different booklets. In different versions, each page appeared as the first page, as the second page and so on, to the last page. Ten copies were made of all six versions. The booklets were randomly distributed among the participants.

After completing the questionnaire, participants were debriefed carefully. First, participants who were primed were asked which departments were conducting the experiments. With just three exceptions, participants correctly recalled that the first experiment was conducted by the Department of Social Psychology, whereas the second experiment was conducted by the Department of Personality. Subsequently, participants were asked whether the first task might have influenced performance on the second task. None of the participants believed the first task to have affected the second. In sum, none of the participants indicated suspicion as to the actual relation between the tasks. In fact, upon being told about the hypothesis, many participants found it very hard to believe that the priming procedure might have influenced their performance on the general knowledge task. After the debriefing, participants were thanked, paid, and dismissed.

Results and Discussion

Number of correct answers. We expected that priming would influence performance on the general knowledge task. Specifically, we hypothesized that participants who had been primed with the professor stereotype would outperform the other participants, who either had been primed with the stereotype of a secretary or had not been primed at all.

We counted the number of correct answers for each participant. The percentages were subjected to a 3 (prime: no prime vs. secretary prime vs. professor prime) between-subjects analysis of variance (ANOVA). The predicted main effect was highly significant, $F(2, 57) = 5.64$, $p < .007$. The percentages of correctly answered questions are listed in Table 1. As can be seen, participants primed with the stereotype of professors (M = 59.5) outperformed those who were primed with the stereotype of secretaries (M = 46.6), $F(1, 57) = 10.45$, $p < .003$, and the no-prime control participants (M = 49.9), $F(1, 57) = 5.84$, $p < .02$. There were no differences between participants primed with the stereotype of secretaries and no-prime control participants, $F(1, 57) = .46$, $p < .50$.

To examine possible decay over time, we divided the overall score in three scores. The first score represented the proportion of correct answers on the first two pages of the booklet, the second score represented the proportion on pages 3 and 4, and the third score represented the proportion on the last two pages. These proportions are listed in Table 1.

Table 1 shows that there might be some reason to assume decay of the priming effects during the completion of the questionnaire. The differences between experimental conditions with respect to the proportions of correct answers are more pronounced for the first four pages (Score 1 and Score 2) than for the last two pages (Score 3). To test the significance of the decay, we compared linear and quadratic trends of the professor prime condition with the control conditions. A downward linear trend may be seen as an indication of immediate decay (i.e., decay that starts immediately after the priming procedure ends). A quadratic trend might be indicative of delayed onset of decay (e.g., after a few minutes). We subjected the scores to a 3 (prime: no prime vs. secretary prime vs. professor prime) × 3 (time phase: Score 1 vs. Score 2 vs. Score 3) within-participants ANOVA. The within-subject score was analyzed in terms of linear and quadratic trends. First, there were no interaction effects of prime with time phase, neither with the linear trend, $F(2, 57) = .80$, $p < .46$, nor with the quadratic trend, $F(2, 57) = 1.70$, $p < .20$. Also, comparisons between the professor prime condition and the two other conditions revealed no significant interactions, so there is no apparent relative decay of enhanced performance of the professor prime condition compared with the other two conditions.

Speed. For exploratory purposes, we measured the time participants spent on the questionnaire. Unfortunately, the time of the first 11 participants was not recorded because of a technical

Table 1
Experiment 1: Number of Correct Answers (Percentages)

Prime	All questions	Score 1	Score 2	Score 3
No prime	49.9	51.3	46.1	52.3
Professors	59.5	60.0	62.1	56.4
Secretaries	46.4	44.4	46.4	48.4

problem. Therefore, only 49 participants were included in the analyses. The time participants spent on the task was subjected to a 3 (Prime: no prime vs. secretary prime vs. professor prime) between-subjects ANOVA. We obtained a main effect, $F(2, 46) = 3.62$, $p < .04$. Participants primed with the stereotype of secretaries were considerably faster (M = 6 min, 16 s) than both participants primed with the professor stereotype (M = 8 min, 3 sec) and no-prime control participants (M = 7 min, 54 sec). These differences were reliable: for secretaries versus professors, $F(1, 46) = 5.73$, $p < .03$; for secretaries versus no-prime controls, $F(1, 46) = 4.91$, $p < .04$. There were no differences between participants primed with professors and no-prime control participants, $F(1, 46) = 0.11$, *ns*. It may be conjectured that the specific content of the stereotype of secretaries was responsible for this speed of processing effect. Obviously, secretaries deal with a lot of paper work. It is not unlikely that secretaries are perceived as efficient workers who manage to handle a lot of problems in a short period of time. If this is the case, priming this stereotype would lead participants to complete forms and questionnaires with greater speed. However, because we did not test these possible attributes of the stereotype of secretaries in our pilot study, the validity of this post hoc explanation can not be verified with the current data.

The results of Experiment 1 lend support to our prediction. Participants who were primed with the professor stereotype, of which intelligence and knowledgeability are central features, showed enhanced general knowledge in comparison with participants who were not primed and with participants who were primed with a stereotype supposedly unrelated to intelligence and knowledgeability. The results on the speed of completion of the booklets provided tentative additional support for the idea that priming a social category leads one to behave as a (stereotypical) member of this social category (cf. Bargh, Chen, & Burrows, 1996). In other words, the activation of a perceptual representation leads one to behave accordingly.

Although the data on decay were not even close to statistical significance, the conclusion that there was no decay of the effects may be premature. It is possible that the somewhat weaker professor priming effect on the final pages was just the first sign of decay. The mean time that participants primed with the stereotype of professors spent on the task was about 8 min. It is conceivable that the onset of decay was at, say, 6 min and that it would have become plainly visible if only the task has lasted longer. In sum, the picture is not clear. Therefore, we attempted to give decay a better chance in Experiment 2.

Apart from the decay function of the observed effects of stereotype activation on behavior, we also studied the relation between the duration of the prime and the magnitude of the resulting behavioral effect.

Experiment 2

Experiment 2 served three goals. First, we tried to replicate the findings of Experiment 1. Second, we made a more serious attempt to show (lack of) decay of priming effects. To do this, we asked participants to answer more questions (60) while at the same time we fixed the processing pace. Participants were requested to answer questions by pushing a button on the keyboard. Every question appeared on the screen for 15 s. After 15 s, the next question appeared, regardless of whether participants had answered the previous question. This way, all participants answered questions for exactly 15 min. Third, we examined the relation between strength of the prime (or, more precisely, the length of the prime) and the duration and magnitude of the effect. Therefore, apart from a no-prime control condition, we used a condition in which participants were primed for 2 min and one condition in which participants were primed for 9 min. The priming procedure was (apart from its length) the same as in Experiment 1. We used only the stereotype of professors in Experiment 2.

Method

Participants and design. Fifty-eight undergraduate students of the University of Nijmegen were randomly assigned to one of three experimental conditions: a 2-min prime condition, a 9-min prime condition, or a no-prime control condition. Participants received Dfl. 5 (approximately U.S. $3) for participating.

Procedure and materials. The procedure was largely the same as in Experiment 1. Participants were again told that they would participate in two unrelated pilot studies, one conducted by the Department of Social Psychology and the other by the Department of Personality. Participants were placed in individual cubicles containing an Apple Macintosh (LCIII) computer. A computer program provided the instructions. Participants in the two priming conditions were asked to imagine a typical professor and to list the behaviors, lifestyle, and appearance attributes of this typical professor on a blank sheet provided by the experimenter at the beginning of the experiment. Participants were either given 2 min or 9 min to complete this task. One third of the participants were not primed and started to answer the questions of the general knowledge scale immediately.

After the priming procedure ended, participants were asked, by the computer, to complete the general knowledge scale. We used the 42 questions of the scale of Experiment 1 and added 18 new questions to the list. These 60 questions were presented on a computer screen in random order. This time, the choice options were labeled 1, 2, 3, and 4. Participants had to answer by pushing the corresponding button. All questions appeared on the screen for 15 s, whether an answer was given or not. The screen indicated how many seconds a participant had left to answer the question.

Funneled debriefing again indicated that participants were not suspicious. We first asked participants which departments were involved in these experiments. This time, all participants recalled the right departments. Subsequently, we asked participants whether the first task could have influenced the second. As in Experiment 1, no participants suspected the first stage to have influenced the second. In sum, the tasks were perceived as unrelated. After debriefing, participants were thanked, paid, and dismissed.

Results and Discussion

Number of correct answers. The computer recorded the number of correct answers. No answer (2.7%) was, of course, treated as a wrong answer. The percentages of correct answers are listed in Table 2. It can be seen that, as in Experiment 1, priming improved performance. Furthermore, the length of the prime influenced the magnitude of the effect.

The percentages of correct answers were subjected to a 3 (prime: no-prime vs. 2-min prime vs. 9-min prime) between-subjects ANOVA. This analysis yielded a significant main effect, $F(2, 55) = 8.18$, $p < .002$. Simple contrasts revealed that

Table 2
Experiment 2: Number of Correct Answers (Percentages)

Prime	All questions	Score 1	Score 2	Score 3
No prime	45.2	45.2	45.9	44.6
2 min	51.8	49.1	51.2	55.0
9 min	58.9	59.2	58.9	58.6

participants primed for 9 min (M = 58.9) outperformed those who were primed for 2 min (M = 51.8), $F(1, 55) = 4.09$, $p < .05$, and those who were not primed (M = 45.2), $F(1, 55) = 16.36$, $p < .001$. In addition, participants primed for 2 min answered more questions correctly than no-prime control participants, $F(1, 55) = 4.83$, $p < .04$.

Decay. In an attempt to detect possible decay, we partitioned the overall score into three different blocks, each representing the percentage of correct answers to 20 consecutive questions (i.e., questions answered correctly in a 5-min interval). These scores are listed in Table 2. These scores were subjected to a 3 (prime: no-prime vs. 2-min prime vs. 9-min prime) × 3 (score for the first 5 min, score for the second 5 min, score for the last 5 min) within-participants ANOVA. The within-subject variable was analyzed in terms of of linear and quadratic trends. Again, no reliable Prime × Linear Trend interaction, $F(2, 55) = 1.97$, $p < .15$, and no reliable Prime × Quadratic Trend interaction, $F(2, 55) = .10$, $p < .91$, were obtained. We compared the condition in which participants were primed for 2 min with the no-prime control condition. The Prime × Linear Trend interaction was marginally significant, $F(1, 55) = 2.98$, $p < .10$. However, as can be seen in Table 2, this interaction is caused by the fact that participants who were primed improved their performance over the course of time. Hence, this statistically weak effect may be interpreted as evidence against decay. The Prime × Quadratic Trend interaction was not reliable, $F(1, 55) = .09$, *ns*. The comparison between scores for no-prime control participants and participants primed for 9 min revealed no significant Prime × Linear Trend interaction, $F(1, 55) = .03$, $p < .85$, and no significant Prime × Quadratic Trend interaction, $F(1, 55) = .15$, $p < .71$. In sum, this examination of the scores indeed revealed that performance was stable over time under all experimental conditions.

In Experiment 2, then, the results of Experiment 1 were replicated. Participants primed with the stereotype of a professor performed better on a general knowledge task than no-prime control participants. Furthermore, the length of the prime influenced the strength of the effect. Participants primed for 9 min outperformed participants primed for 2 min. As expected, it seems that prolonged perceptual input leads to stronger behavioral effects (cf. Srull & Wyer, 1979, 1980, who found such effects in the judgmental domain).

We did not find any evidence for decay of the priming effects during the 15 min participants were occupied with the general knowledge task. There is, however, one important difference between the procedures of Experiment 1 and Experiment 2. In Experiment 1, participants were allowed to think about the questions for as long (or as short a time) as they wanted to, whereas in Experiment 2, the pace was controlled by the experimenter. It is possible that the fixed pace in Experiment 2 somehow interfered with the occurence of decay. Therefore, we let the participants control their own pace in Experiment 3 (as in Experiment 1).

Experiment 3

In Experiment 3, we tried to obtain additional evidence for the idea that the length of the prime influences the strength of the effect. Therefore, we again primed participants for 2 min, for 9 min, or not at all.

Again, as in Experiment 2, we use the 60-question version of the general knowledge scale. However, we had the participants process the task in their own pace, as in Experiment 1. This way, we hoped to be able to assess the impact of the somewhat rigid form of presentation used in Experiment 2 on the absence of decay of the behavioral effects.

An important modification in Experiment 3 was the stereotype under consideration. In Experiments 1 and 2, we used positive stereotypes (professors and secretaries). Corresponding behavioral consequences, such as enhanced performance on a general knowledge task, are positive or desirable as well. As we argued, the behavioral effects are assumed to be unconscious and unintentional and, therefore, not confined to only positive effects. This argument is in line with Bargh, Chen, and Burrows (1996), who primed both positive and negative behavior in their experiment. In their view and in ours, evidence for behavioral effects that are negative or undesirable may even constitute a stronger case for the unintentional nature of the effects, simply because usually, people will not engage in undesirable or negative behavior on purpose. Or, in terms of performance on our general knowledge task, nobody really wants to perform poorly on such a task and run the risk of coming across as stupid or dumb. Therefore, in Experiment 3, we use the stereotype of soccer hooligans. Soccer hooligans are associated with stupidity, and hence, activation of this stereotype should have impaired the performance of the participants.

Method

Participants and design. Ninety-five undergraduate students of the University of Nijmegen were randomly assigned to one of three experimental conditions: a 2-min prime condition, a 9-min prime condition, and a no-prime control condition. Participants received Dfl. 5 (approximately U.S. $3) for participating.

Procedure and materials. Apart from the stereotype used, the priming procedure used in Experiment 3 was the same as in Experiment 2. All instructions were again provided by a computer program. Here, we primed participants with the stereotype of soccer hooligans. This choice was based on a pilot study in which 40 participants rated social groups on traits. Nine-point scales were used, with poles labeled *soccer hooligans are not at all* ___ (1) and *soccer hooligans are very* ___ (9). Soccer hooligans were rated low on intelligence (M = 2.12) and low on knowledgeability (M = 1.98). As in Experiment 2, participants were primed for 2 min, for 9 min, or not at all.

We used the same 60 questions as in Experiment 2. However, as in Experiment 1, the questions were listed in a booklet, and participants were allowed to work on the task at their own pace. On each page, 6 questions were listed. We made 10 different versions so that all pages were 10 times page 1, 10 times page 2, and so on, to the last page. Again, we measured the time participants spent on the booklet.

The debriefing procedure was the same as in Experiments 1 and 2. Answers on the questions again indicated that participants perceived the priming task and the general knowledge task as unrelated, distinct tasks. After debriefing, participants were thanked, paid, and dismissed.

Results and Discussion

Number of correct answers. The number of correct answers was counted for each participant. As can be seen in Table 3, where percentages are given, priming again influenced performance. As expected, performance was worse after priming. The number of correct answers was subjected to a 3 (prime: no-prime vs. 2-min prime vs. 9-min prime) between-subjects ANOVA. The main effect was significant, $F(2, 92) = 5.50$, $p < .007$. Simple contrasts showed that participants that were primed with the stereotype of soccer hooligans for 9 min performed worse ($M = 43.1$) than participants who were primed for 2 min ($M = 48.6$), $F(1, 92) = 4.22$, $p < .05$, and worse than no-prime control participants ($M = 51.3$), $F(1, 92) = 10.58$, $p < .003$. The difference between the scores for no-prime control participants and participants primed for 2 min failed to reach significance, $F(1, 92) = 1.35$, $p < .24$.

For every participant, we calculated three different scores, one for the first 20 questions, one for Questions 21 to 40, and one for the last 20 questions. A 3 (prime: no-prime vs. 2-min prime vs. 9-min prime) × 3 (score for the first 20 questions vs. score for Questions 21 to 40 vs. score for the last 20 questions) within participants ANOVA on these scores revealed no sign of decay. Neither the Prime × Linear Trend interaction, $F(2, 92) = .88$, $p < .42$, nor the Prime × Quadratic Trend interaction, $F(2, 92) = .57$, $p < .57$, approached significance. Moreover, the comparison between no-prime control participants and participants primed for 2 min revealed no Prime × Linear Trend interaction, $F(1, 92) = .00$, *ns*, and no No-prime × Quadratic Trend interaction, $F(1, 92) = .82$, $p < .37$. The comparison between no-prime control participants and participants primed for 9 min showed a nonsignificant Prime × Linear Trend interaction, $F(1, 92) = 1.28$, $p < .27$, and a nonsignificant Prime × Quadratic Trend interaction, $F(1, 92) = .92$, $p < .35$. Again, one may conclude that performance was stable over time under all experimental conditions.

Speed. The average time participants spent on the booklet was 10 min, 11 s. Although the duration differed between conditions (10 min, 41 s for no-prime control participants; 9 min, 10 s for participants primed for 2 min; and 10 min, 47 s for participants who were primed for 9 min), these differences were not statistically significant, $F(2, 92) = .69$, $p < .50$.

In Experiment 3, we again obtained evidence that activating a stereotype leads to corresponding behavior. By using the stereotype of soccer hooligans instead of the stereotype of professors, we were able to show undesirable behavioral effects (cf. Bargh, Chen, & Burrows, 1996). After being primed with soccer hooligans, participants' performance on a general knowledge task deteriorated. Furthermore, we also obtained additional evidence for the relation between the length of the prime and the strength of the behavioral effect. Participants that were primed for 9 min performed worse than participants that were primed for only 2 min. Again, no sign of decay of the effects was found during the 10 min the participants were occupied with the task.

Table 3
Experiment 3: Number of Correct Answers (Percentages)

Prime	All questions	Score 1	Score 2	Score 3
No prime	51.3	49.6	53.6	50.6
2 min	48.6	48.1	48.5	49.1
9 min	43.1	45.7	42.9	40.8

Experiment 4

Experiment 4 was conducted to investigate whether the activation of traits (e.g., intelligent) would have the same effect as stereotypes associated with these traits (e.g., professor). At the beginning of this article, we argued that stereotypes affect behavior by means of the activation of traits. In concrete terms, activation of the professor stereotype is expected to result in intelligent behavior because activation of the professor stereotype leads to activation of intelligence. It follows from this reasoning that the direct activation of traits should also evoke corresponding behavior.

In Experiment 4 we tested this assumption. Participants were primed either with a stereotype or with a trait and also were primed either with a construct designating intelligence or with a construct designating stupidity. Participants, thus, were primed with the stereotype of professors or with the stereotype of soccer hooligans, or directly with the trait intelligent or with the trait stupid.

Method

Participants and design. Forty-three undergraduate students were randomly assigned to the cells of 2 (direction of prime: intelligent vs. stupid) × 2 (target: stereotype vs. trait) between-subjects design. All participants received Dfl. 5 (approximately U.S. $3) for their participation.

Procedure and stimulus materials. Upon entering the laboratory, participants were placed in cublicles containing an Apple Macintosh (LCIII) computer. They were told that a number of unrelated pilot studies were being conducted for the purpose of gathering stimulus materials for forthcoming experiments. Participants were told that the computer would provide all the experimental instructions. Subsequently, the experimenter started the computer program and left the cubicle.

The computer randomly assigned participants to cells of a 2 (direction of prime: intelligent vs. stupid) × 2 (target: stereotype vs. trait) between-subjects design. For the stereotype-prime conditions, the priming procedure was the same as in the earlier experiments. In this experiment, participants were primed for 5 min. Participants who were primed with a trait (i.e., intelligent or stupid) were asked to think about the concept of intelligence (or stupidity) for 5 min and to list synonyms and behaviors characteristic of this trait. Participants were asked to list their thoughts on a blank sheet of paper that had been provided by the experimenter when they entered their cubicles.

After completing the priming procedure, the second, purportedly unrelated task was administered. The procedure was the same as in Experiments 1 and 3. The only difference was that participants in Experiment 4 were presented with a short questionnaire containing only 20 multiple-choice questions.

After completing the questionnaire, participants were probed for suspicion very carefully. First, participants were asked which departments were conducting the experiments. With one exception, everyone cor-

rectly recalled that the first experiment was conducted by the Department of Social Psychology and the second experiment was conducted by the Department of Personality. Participants were then asked whether the first task might have influenced performance on the second task. None of the participants believed the first task to have affected the second. In sum, none of the participants indicated suspicion as to the actual relation between the tasks. After the debriefing, participants were thanked, paid, and dismissed.

Results and Discussion

The number of questions answered correctly was counted for each participant. These scores were subjected to a 2 (direction of prime: intelligent vs. stupid) × 2 (target: stereotype vs. trait) between-subjects ANOVA. The only reliable effect was the expected main effect of direction of prime, $F(1, 39) = 7.12$, $p < .02$. (see Table 4 for means). Participants primed with intelligence (either by priming professor or by priming intelligent) outperformed participants primed with stupidity (either by priming soccer hooligan or by priming stupid). As in the earlier experiments, priming affected behavior. Participants behaved in line with the activated construct.

On the basis of these results, one may indeed draw the conclusion that the activation of traits, like the activation of stereotypes, evokes corresponding behavior. This finding corroborates the idea of a perception–behavior link discussed at the beginning of this article.

General Discussion

The activation of a mental representation of a social group (e.g., professors) leads to behavior corresponding with specific attributes of the stereotype (e.g., intelligence). In Experiment 1, we primed participants either with the stereotype of professors or with the stereotype of secretaries or not at all. Later, in the second, ostensibly unrelated task, participants completed a list containing 42 general knowledge questions. As predicted, participants primed with the stereotype of professors answered more questions correctly than both participants who had been primed with the stereotype of secretaries and no-prime control participants. Furthermore, participants primed with the stereotype of secretaries completed the questionnaire considerably faster than the other participants. This might be attributed to the specific content of the secretary stereotype. With these results, the findings of Bargh, Chen, and Burrows (1996) were replicated using a different priming procedure, different stereotypes, and a different dependent measure.

With our findings, we also contribute to knowledge about the nature of the relation between perception and behavior. In two experiments, we demonstrated that the magnitude of the behavioral effects simply mirrored the magnitude of the perceptual input. In Experiments 2 and 3, participants who were primed for 9 min showed stronger behavioral effects than participants who were primed for 2 min. In other words, longer priming led to greater behavioral changes. These results underscore the fact that the process under consideration can be characterized as rather passive (cf. Bargh, Chen, & Burrows, 1996). Also, these results parallel findings from experiments in which the relation between perception and judgment is investigated (e.g., Higgins et al., 1985; Srull & Wyer, 1979, 1980).

The present research also showed an absence of decay of the effects of perception on behavior at least for a short period of time. The effects were stable over time at least until participants finished the dependent measure (which took, on average, 8 min in Experiment 1, 15 min in Experiment 2, and 10 min in Experiment 3). At first sight, this finding seems to be at odds with findings from the social judgment domain. An interesting assumption that may resolve this discrepancy is that semantic priming effects decay rather fast unless one is in the process of applying the primed construct one way or another. That is, it is very well possible that if we prime participants with the stereotype of professors, the semantic activation starts to decay immediately under conditions in which the stereotype is not somehow applied (e.g., for making judgments), but conversely, we may find no signs of decay as long as the primed stereotype is being applied in some way.

By changing ability-related performances, we demonstrated the effects of perception on behavior in a new domain. The behavior we studied is considerably more complex than the actions that were investigated in earlier research. It must be granted that the model explaining these results is still a rather crude one, and it needs to be refined in further research. Also, there may be alternative explanations that cannot be rejected on the basis of the current data.

In the next sections, we first discuss possible explanations for the findings as well as suggestions for refinements. Second, we discuss possible mediators of the effects of the intelligence and professor primes on performance on the general knowledge task. Later, we try to reject some alternative explanations. Finally, we ponder on some implications of our findings.

From Perception to Action in Two Steps

In order to explain why priming a trait or a stereotype leads to behavioral changes, it may be fruitful to explicate the route from the activation of a trait (e.g., aggressive) to the behavior (e.g., hitting somebody) in terms of two distinctive steps. First, one must explain why a semantic construct can lead to action—in concrete terms, how aggressive results in aggressive behavior. Second, one has to explain how some abstract behavioral class of actions results in all kinds of more specific behaviors. In other words, how can an abstract term that does not refer to concrete behaviors ("aggressive behavior") result in specific acts?

The first step to be taken is the one from activation of some semantic construct to overt behavior. For example, how does activation of a construct implying "slow" lead to a slower walking speed (see Bargh, Chen, & Burrows, 1996)? It is

Table 4
Experiment 4: Number of Correct Answers (Percentages)

	Direction of prime	
Target	Intelligent	Stupid
Stereotype	55.6	42.5
Trait	46.0	37.9

known that people do not necessarily need an intention in order to act. Actually, action can be instigated by the intention not to act (see Ansfield & Wegner, 1996). It is known that people do not have to be aware of our actions in order for them to occur. Despite this knowledge, more direct routes from perception or cognition to action, although demonstrated empirically, are not well understood.

One way of dealing with the relation among perception, cognition, and action is offered by Vallacher (1993). Vallacher assumes that (complex) behavior must be represented verbally in order to be executed successfully. If one wants to do something (e.g., eat an orange) that requires a specific order of subactions, one engages in action queuing (e.g., first peel it and only then bite). This requires a sophisticated coordination process for which verbal representation seems to be much more appropriate than visual representation. If one assumes that action is verbally represented and combines this with the notion that all sorts of actions are, in evolutionary terms, much older than language, one may even posit that language developed because of the need to execute more complex behaviors. According to this—admittedly very speculative—view, an explanation would be required if priming the semantic concept slow would *not* result in a slower walking speed (see also James, 1890), because after all, evoking action may have been the original function of this concept.

From an evolutionary point of view, it may be argued that the existence of a direct perception–behavior link allows for imitation (cf. Bargh, Chen, & Burrows, 1996). A mechanism that fosters imitation of others is, in terms of evolution, beneficial because it may have survival value, not only for fish and gnus but also for human beings. Unlike fish and gnus, however, humans seem to be capable not only of imitating visually represented, simple actions (e.g., moving as fast as possible in a certain direction). In addition, humans can "imitate" much more complex behavioral patterns because they use abstract concepts such as traits and stereotypes. These concepts permit predictions regarding complex behavior of others and can both improve and speed up imitation processes. In other words, the participants in our experiments may have fallen prey to the same mechanism a gnu uses to escape from a lion, except that human beings can apply this mechanism for much more complex actions.

Obviously, these perspectives are based on very speculative assumptions, and there are alternative approaches to the issue at hand. Whichever perspective one favors, it is clear that a lot of further thinking and research in various areas is needed before the relation between perception (and cognition) and action can be properly understood.

The second step needed to explain our findings is the one from complex and abstract behavior (such as intelligent behavior) to simple actions. This step rests on the notion that behavior is organized and represented hierarchically. This step is relatively well understood, and many theorists have posited the idea (Broadbent, 1977; Carver & Scheier, 1981; Lashley, 1951; Martin & Tesser, 1989; Powers, 1973; Vallacher & Wegner, 1985).[1] Nevertheless, the perceptual representations investigated in this article (traits and stereotypes) are abstract and refer to actions only rather indirectly. To corroborate our assumed route from traits to specific behaviors, it may be worthwhile to assess which behaviors are associated most strongly with a certain trait and to determine whether trait activation would indeed primarily evoke these behaviors.

From Priming Professor to Winning a Game of Trivial Pursuit

To explain the observed priming effects on complex behaviors, we assume that mental representations of traits are associated with behavioral instantiations characteristic of the trait involved. Thus, as we outlined at the beginning of this article, priming a stereotype activates the traits associated with it. The trait activation is assumed to bring about (or maybe even "imply") the activation of a set of behavioral representations. The latter may actually constitute the core of the participants' understanding of what it is like to have that trait.

How can one, on a more concrete level, interpret the obtained priming effects on behavior? Specifically, how can one explain the observed phenomenon that participants primed with the professor stereotype showed significantly better performance on a general knowledge task than participants not so primed?

Obviously, one explanation can be rejected immediately: Participants do not become more knowledgeable as a result of the prime; that is, they do not know things they did not know before merely because they were primed with the word *professor.* The effect must have come about because the prime triggered behaviors beneficial to performance on a general knowledge task that already were part of the participants' behavioral repertoire.

What, then, are the more specific behavioral changes one can expect to occur on the basis of the prime? That is, which more specific actions can be elicited by activating the stereotype of professors, a stereotype of which traits such as intelligence and knowledgeability are central features?[2]

Several behaviors may be evoked that may improve performance on multiple-choice general knowledge questions. First, participants may allocate their effort differently. Assuming that base-rate performances on our general knowledge questions are suboptimal, the prime may automatically and subconsciously induce participants to concentrate on the task and to think harder about possible answers.

Second, the professor prime may induce participants to use smarter and more varied strategies for problem solving. If one is asked "Who painted *La Guernica?*" and the choices are Dali, Miro, Picasso, and Velasquez, one can, for instance, begin with dismissing incorrect options (e.g., "It can't be Velasquez who painted *La Guernica* because I know he was not a modern

[1] As the example about deciding to eat an orange implies, actions must be represented hierarchically to enable their intended execution. It would be silly to assume that one intentionally decides to peel the orange completely independently of the next step: the first bite. Instead, one intentionally decides to eat an orange, which in turn elicits the subactions needed.

[2] Unfortunately, the protocols containing what the participants listed during the priming stage were not very helpful. Because of our instructions, participants wrote down about everything that could possibly be associated with college professors (and even some things that one would never associate with college professors). These protocols are not suitable for a reasonably elegant quantitative analysis.

painter") or thinking of additional cues (such as differences in painting styles between Miro, Dali, and Picasso). Thus, priming participants with the stereotype of professors may lead them to use more of these strategies and also to use them more often.

Third, it is very well possible that participants have an altered "feeling of knowing," which may result in a different use of their own knowledge. An example is that participants might be more confident regarding their own knowledge. It is possible that primed participants rely, because of enhanced confidence, more on the first answer that comes to mind. In general, people have been shown to benefit from awareness of idiosyncratic aspects of their knowledge (see, e.g., Jameson, 1990; Lovelace, 1984; Nelson, Leonesio, Landwehr, & Narens, 1986; Underwood, 1966).

These and other possible effects of the professor prime may, separately or in unison, have enhanced participants' ability to perform well on a general knowledge task. This short list of potentially invoked behaviors is a tentative one; their causal role might be examined in further study in combination with a search for other potentially intervening behavioral mechanisms.

Rejecting Alternatives

During several encounters, colleagues have wondered whether the empirical results under consideration can be explained by a process of spreading activation. Although the idea of spreading activation may play a role in our perception–behavior explanation, we do not endorse a purely semantic spreading activation account of our results. Yet one might try to explain the present findings in terms of priming of semantic constructs. It is possible that our priming manipulation, by means of spreading activation (cf. Collins & Loftus, 1975) increased (in the case of the professor prime) or decreased (in the case of the soccer hooligan prime) the accessibility of general knowledge. Although it is possible that enhanced access to relevant knowledge plays a role in our experiment, we feel it is implausible that it can on its own account for our data.

First, the idea of spreading activation is based on the logic of what may be called "semantic space." Activation of a construct (e.g., mother) leads to activation of a semantically related construct (e.g., caring). This logic implies that the effects of spreading activation diminish when the semantic resemblance of constructs is low or almost absent. The longer the "semantic route" from one construct to the other, the less plausible the possibility that activation of one construct will result in the activation of the other construct. For this reason it is hard to believe that activation of professor would lead to activation of Dali or Hanoi or World Cup soccer (see the examples of the questions used in the *Method* section of Experiment 1). In brief, it seems implausible that the professor concept is semantically related to the right answers on the questions in our general knowledge task.

Quite another way in which the term *professor* may be argued to have activated relevant knowledge is by assuming that a lot of knowledge is acquired through lectures given by professors. Considering that our participants were mostly psychology students, this explanation could have been plausible if our questions had pertained to psychology, because most of this knowledge would indeed be acquired through lectures given by professors. However, the questionnaire did not contain such questions. If knowledge relevant to our questions had been acquired through lectures (instead of by reading books or watching TV, for instance), such lectures probably would have been given by high school teachers, that is, teachers who are not members of the social category of professors.[3] Thus, in sum, it is unlikely that the effects reported are the result of a process of spreading activation.

The second consideration that speaks against knowledge accessibility as an explanation for our results is that this explanation would entail the idea of knowledge inhibition in case of Experiments 3 and 4. In Experiments 3 and 4, participants performed worse on a general knowledge task after being primed with soccer hooligans (or with stupidity). Although there is a some evidence for the existence of spreading inhibition (see, e.g., Anderson & Spellman, 1995; Blair & Banaji, 1996; Dijksterhuis & van Knippenberg, 1996; Neumann & DeSchepper, 1992), this evidence is largely confined to constructs that are clearly inconsistent with each other. For instance, activation of the stereotype of soccer hooligans leads to inhibition of the trait friendly (Dijksterhuis & van Knippenberg, 1996). In other words, inhibition seems to be restricted to constructs that are, in terms of their meaning, almost mutually exclusive. On the basis of this evidence, there is no reason to expect soccer hooligan to inhibit Dali or Hanoi. These terms are no more than merely unrelated to the stereotype. Hence, the assumption of spreading inhibition to account for our data is even more problematic than the assumption of spreading activation. In sum, there is little to say for a purely knowledge activation explanation for our results.

Implications for Human Interaction

As Bargh, Chen, and Burrows (1996) noted, the perception–behavior link may be of crucial importance to our understanding of a large number of social psychological phenomena: Compliance and conformity, emotional and behavioral contagion, empathic reactions, imitating and modeling, mass media effects on behavior, and behavioral confirmation of stereotypes are, according to Bargh, Chen, and Burrows (1996), expected to be at least partly under the influence of the perception–behavior link. In view of the findings that (a) the influence of perception on behavior does not seem to be restricted to desirable behavior, (b) decay seems to be absent—for at least a couple of minutes—all else being equal, and (c) the magnitude (i.e., duration) of the perceptual input is positively related to the magnitude of the resulting behavioral effects, the implications of this mechanism for social behavior may be very important indeed.

It is not feasible, within the confines of the present article, to give an exhaustive account, but let us briefly consider some of the ways in which the perception–behavior link may play a role in human interaction. First, imitating somebody may well trigger automatic empathic reactions (Bargh, Gollwitzer, & Barndollar, 1996). In general, people seem to like other people

[3] This may not be true for other countries. In the Netherlands, however, high school teachers are never referred to as professors. They are always simply referred to as teachers.

who are similar to themselves (e.g., Byrne, 1971; Newcomb, 1961). The perception–behavior link, then, may unwittingly help us to get other people to like us. There is some evidence suggesting that this might be the case. It is established that people are attracted to other people who have similar attitudes (e.g., Newcomb, 1961). As Baldwin and Holmes (1987) showed, people change their attitudes in the direction of the attitude of others upon thinking about these others. In sum, unconscious imitation may serve an important function in everyday interactions: It may enhance cohesion between people in interaction. Specific features of the perception–behavior link, such as that it is not restricted to a limited behavioral domain, that it does not decay over time, and that prolonged perception leads to stronger effects, may all contribute to its success in supporting interaction.

The same mechanisms underlying its success may also cause problems. Because people unconsciously imitate each other, perceptual cues may also trigger undesirable behaviors. Just as friendly behavior evokes friendly behavior in return, hostile behavior will result in hostile behavior in others. As Chen and Bargh (1997) recently established, perception-induced behavior can lead to self-fulfilling prophecies (Darley & Fazio, 1980; Snyder, Tanke, & Berscheid, 1977) and to stereotype confirmation. Encountering people that one perceives as aggressive may inadvertently elicit facial expressions, a tone of voice, or acts evoking aggressive reactions in return. It is quite conceivable that such snowball effects (Gilbert, 1995; Miller & Turnbull, 1986) lead to escalated hostility in a variety of social situations.

These examples show that the perception–behavior link can have both desirable and undesirable consequences in everyday human interaction. Of course, questions remain. For one thing, it is important to gain insight into the range and frequency of these perception-induced behaviors, as well as the prevalence of perceptual action instigators, in order to be able to assess their impact on human behavior. For the time being it seems to us that because of its inconspicuous nature, the pervasiveness of the impact of percepts on human behavior may easily be underestimated. The literature to date, including the present study, has only begun to unravel the first rough features of this intriguing phenomenon.

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