Priming Trait Inferences Through Pictures and Moving Pictures: The Impact of Open and Closed Mindsets

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A newly developed paradigm for studying spontaneous trait inferences (STI) was applied in 3 experiments. The authors primed dyadic stimulus behaviors involving a subject (S) and an object (O) person through degraded pictures or movies. An encoding task called for the verification of either a graphical feature or a semantic interpretation, which either fit or did not fit the primed behavior. Next, participants had to identify a trait word that appeared gradually behind a mask and that either matched or did not match the primed behavior. STI effects, defined as shorter identification latencies for matching than nonmatching traits, were stronger for S than for O traits, after graphical rather than semantic encoding decisions and after encoding failures. These findings can be explained by assuming that trait inferences are facilitated by open versus closed mindsets supposed to result from distracting (graphical) encoding tasks or encoding failures (involving nonfitting interpretations).

Being exposed to behaviors or behavior descriptions gives rise to immediate inferences that go beyond the actually given information. Stepping on one's partner's feet on the dance floor elicits the inference "clumsy." Uttering obscene words on the street elicits the attribution "vulgar." A rather creative answer given by a young student in elementary school may raise the inference "smart." This particular type of priming effect is commonly referred to as spontaneous trait inference (STI)—and it applies to inferences from behaviors to trait-like dispositions that are not strictly implicated (e.g., stepping on someone's feet can well happen to nonclumsy people).

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Behavioral Priming and Spontaneous Trait Inferences

Since the seminal publications of Uleman and colleagues (Newman & Uleman, 1989; Uleman, 1987; Uleman & Moskowitz, 1994; Winter & Uleman, 1984; Winter, Uleman, & Cunniff, 1986), STIs have become a prominent research topic, both practically and theoretically. Practically, the readiness to draw quick and automatic trait inferences can lead to premature and impulsive action, uncritical decisions, and interpersonal conflicts in such diverse areas as personnel assessment, legal decisions, close relationships, consumer behavior, and person perception in sports, politics, and public affairs. However, most pertinent research is motivated theoretically, with special interest devoted to the cognitive process through which behavioral primes trigger spontaneous trait attributions.

Traditional STI Paradigms

In the original cued-recall paradigm (Winter & Uleman, 1984; Uleman, 1987; Uleman & Moskowitz, 1994), participants are first presented with a list of behavior descriptions, such as "Paul stepped on his partners' feet on the dance floor." On a subsequent cued-recall test, correspondent trait words (e.g., *clumsy*), though never mentioned in the list, provide highly effective retrieval cues for recalling the stimulus behaviors, suggesting that traits must have been already inferred spontaneously. Alternatively, Bassili (1989) used a word-fragment completion paradigm, demonstrating that priming a behavior facilitates the generation of a correspon-

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dent trait word from an incomplete letter string. Still another priming method, developed by Uleman, Hon, Roman, and Moskowitz (1996) and then adopted by Overvalle, Drenth, and Marsman (1999), relies on prolonged latencies required to correctly deny a trait term as having *not* appeared in a text if that trait was inferred spontaneously from behaviors described in the text before. Last but not least, Carlston and Skowronski (1994) measured STIs as savings in relearning of traits supposed to be inferred previously.

Enhanced STIs With Pictures

In virtually all previous STI research, and in the vast majority of behavioral priming experiments in general, stimulus behaviors have been presented verbally. To the extent that such "predigested" verbal descriptions impose constraints on the inference process (Fiedler & Semin, 1992; Fiedler, Semin, & Bolten, 1989; Semin & Fiedler, 1988), the obtained findings may tell us more about language comprehension than they do about the inference process proper. STIs may thus reflect semantic constraints of verbal behavior descriptions as opposed to raw observations of original behaviors.

This challenging problem has given rise to the development of a picture-priming paradigm (Fiedler & Schenck, 2001) that also provided the basis for the present investigation. Participants were exposed to photographs of dyadic behaviors reduced to black-and-white silhouettes (cf. Figure 1). An encoding task asked them to verify a specific aspect of the picture; the nature of this task can be manipulated to control the encoding process (see below). A few moments later, participants were asked to identify a trait word that was first hidden behind a black mask and could only be recognized after a few seconds as the mask disappeared gradually in a random, mosaic-like fashion. STI effects were manifested in shorter identification latencies obtained when the trait word matched the meaning of the behavior depicted in the picture before compared with nonmatching control traits. Interestingly enough, STI effects were neither eliminated nor reduced when behaviors were presented pictorially. On the contrary, purely graphical coding led to stronger STIs than did a semantic recoding task. Specifically, when a purely graphical encoding task (i.e., estimating the amount of black area in the picture) distracted participants from semantic interpretation, their speed up in subsequent trait identification after seeing a matching picture was even *stronger* than when the encoding task called for an open verbal interpretation.

A similar advantage of graphical encoding over verbal interpretation was apparent in another experiment. When the encoding task asked participants to verify a purely descriptive aspect of the picture (e.g., with reference to the example in Figure 1: raise his hand), a subsequent trait inference (e.g., of the trait aggressive) was facilitated more than when the encoding task called for the verification of an interpretive verb (*attack*?) or a related or even synonymous trait (hostile?). In other words, encoding operations that involved semantic inferences rather close to the target trait to be inferred were less helpful than distracting encoding operations at a descriptive, pictorial level.

Apart from the demonstration of an advantage of pictorial over semantic encoding, another notable implication is that STI facilitation effects obtained in this paradigm can hardly reflect strategic processes during encoding. If strategic processes were at work—that is, if STIs merely reflected the participants' anticipating the trait inference task and deliberate thinking about matching traits when the primed behavior is presented—then facilitation should be stronger for verbal-semantic encoding (which actually calls for such strategic inferences) compared with a distracting, graphical encoding task. STI effects have been shown to persist even when the semantic attributes to be verified during encoding did not fit the primed behavior, thus leading strategic inferences astray. Moreover, STIs were obtained when matching traits were quite unexpected, appearing in only one sixth of all trials (Fiedler & Schenck, 2001). Together, these findings strongly suggest spontaneous inference processes, although fully excluding all kinds of strategic processes is certainly impossible.

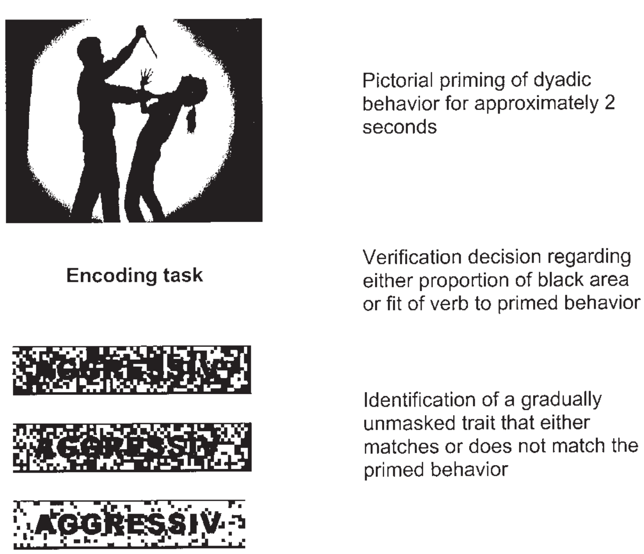

Figure 1. Three stages of the picture-priming paradigm.

Explaining the Picture-Superiority Effect

The present research expands and refines the challenging set of findings depicted so far. We propose a theoretical explanation from which a number of implications can be derived and tested in new experiments. So what psychological process might account for the curious finding that first seeing a physical attack in a black and white picture and then verifying that black area prevails facilitates the subsequent identification of the trait aggressive more than first seeing the picture and then verifying the meaning of the depicted behavior, to attack? One plausible answer would be that a picture-superiority effect is at work. A well-established finding says that memory for pictorially presented stimulus items is superior to memory for the same items presented verbally (Seifert, 1997; Weldon & Roediger, 1987). To explain this phenomenon, researchers have assumed that pictures facilitate categorical access as a precondition for effective coding (Dishon-Berkowitz & Algom, 2000; Glaser, 1992; Seifert, 1997). Recent evidence for stronger evaluative priming with pictorial than verbal primes (Spruyt, Hermans, De Hower, & Eelen, 2002) corroborates that picture superiority is not confined to explicit memory tasks but may also facilitate priming and implicit memory.

Modality Effect or Inference-Prone Mindsets?

Although the label "picture-superiority effect" is certainly applicable to the findings at hand, they need not be explained as a modality effect proper. Rather than assuming a universal advantage of graphical over verbal memory codes, one might assume that behaviors presented as pictures rather than words instigate qualitatively different encoding processes—a point that has implications for priming research in general (Fiedler, 2002). Although priming phenomena continue to be explained in terms of the accrual of activation in a similarity-based semantic network, the available empirical evidence seems to tell a more refined story. The influence of priming on judgments of a target often does not increase but can decrease, vanish, or reverse with growing amounts of activated information about the target because of long or intensive presentation (Stapel, Koomen, & Ruys, 2002) or because of explicit attention and awareness (Lepore & Brown, 2002; Lombardi, Higgins, & Bargh, 1987). Other evidence shows that priming effects may not accord with the rules of semantic similarity that underlie the semantic-network metaphor (Ratcliff & McKoon, 1988, 1996). There is also strong evidence for the contention that priming depends crucially on the elicited mental procedures or mindsets; that is, what individuals mentally do with the primed information. The cognitive outcome has been shown to depend on the attribution of primes (Jacoby, Kelley, & Dywan, 1989; Wittlesea & Price, 2001), the inclusion or exclusion of a prime from a category (Schwarz & Bless, 1992), the search for common versus distinctive features in memory (Mussweiler, 2001), and the contribution of metacognitive correction procedures (Martin, 1986; Stapel et al., 2002).

Priming States as Open Mindsets

Granting this shift of emphasis in priming accounts from activation strength to mental procedures, we suggest the following hypothetical account for the enhanced STI effect obtained with pictures. We start from the basic assumption that a behavioral prime (as in Figure 1) opens a mental episode that entails an interpretational problem. As long as the priming episode is open rather than closed, mental resources are allocated to the resolution of the interpretational problem, creating a busy mindset that supports active inference generation triggered by the prime stimulus. However, as soon as any (semantic, contextual, attributional) interpretation of the prime has been found, the mental episode is closed and the critical priming period is over. Mental resources are reallocated, and a different mindset no longer fosters inference generation. Now a closed mindset may even inhibit persevering inference attempts, thus protecting the cognitive system from interference with other jobs (cf. Carr & Dagenbach, 1990; Ratcliff & McKoon, 1996). Note that such a role played by open versus closed mindsets is much in line with the famous Zeigarnik (1927) effect; that is, the enhanced memory due to persisting motivation resulting from incomplete mental tasks (Lewin, 1935; Martin, Tesser, & McIntosh, 1993; Rothermund, 2003).

In accordance with this basic assumption, we arrive at the following tentative account for the enhanced STI effect after purely graphical encoding. The initial exposure to a behavioral prime in a picture evokes a mental episode that calls for interpretation. A purely graphical, distracting encoding task (e.g., judging the proportion of black area or a purely descriptive aspect such as raising a hand; cf. Figure 1) can be assumed to distract from the interpretation process and to leave the priming episode incomplete, thus leaving an open mindset. As an open, busy mindset is assumed to support inferential activity, subsequent trait inferences should be facilitated. In contrast, a semantic encoding task that offers a meaningful label for the primed behavior (e.g., to attack, hostile) should give closure to the primed episode, inducing a closed mindset that does not facilitate or may even inhibit subsequent inferences. Thus, the simple assumption of closed versus open mindsets, resulting from incomplete versus complete interpretations of primed episodes, respectively, provides a sufficient account for the counterintuitive finding that distracting encoding decisions may cause more facilitation than do semantic decisions pointing straight to the trait concept to be inferred.

It should be noted that we are attaching fewer assumptions to the notion of a mindset than have other recent mindset approaches (e.g., Gollwitzer, Heckhausen, & Steller, 1990). By referring to open versus closed mindsets, we do not entail any surplus assumptions beyond the processing status of the priming episode, which is either complete (closed) or still ongoing (open). This operational distinction goes without loss of generality. The only other assumption is that the cognitive system adapts to the active mindset, allocating extra resources to inferential activity only when the mindset is open and the interpretation job is incomplete.

Explanatory and Predictive Value of the Mindset Account

Although the mindset account depicted so far appears to be simple and easy to understand, the crucial question is whether it is correct or empirically valid. Can the mindset account apply to explanations of other findings in the STI and priming literature? Does it give rise to distinct new predictions that one can then test empirically?

Indeed, the present account can assimilate a number of findings. The proposed functions of open versus closed mindsets may explain the influence of several moderators that studies have shown to reduce or eliminate normal priming effects. For instance, "blatant" primes (cf. Martin, 1986) may be ineffective because an obvious task context gives a complete and sensible interpretation to the priming episode, which can thus be closed. Likewise, the stronger impact of unaware primes (Lombardi et al., 1987; Strack, Schwarz, Bless, Kübler, & Wänke, 1993) may reflect their uninterpreted, incomplete, Zeigarnik-like status (Zeigarnik, 1927). As the likelihood of completing the interpretation of a priming episode increases with presentation time, one can explain stronger priming effects obtained with short and degraded rather than long and explicit prime presentation (Stapel et al., 2002).

Although we do not claim to provide a comprehensive explanation for all these moderators, the hypothesis we are proposing is at least compatible with existing data. The purpose of the present research is to further substantiate the mindset account in a series of experiments devoted to testing distinct implications, which follow from natural operational definitions of open versus closed mindsets, but which can be hardly derived from traditional conceptions of priming in associative networks organized by semantic similarity.

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Deriving Distinct Testable Predictions for the Present Investigation

To delineate these implications, we first have to be more explicit about the picture-priming paradigm and its terminology. As already mentioned (cf. Figure 1), an experimental trial involves three stages: Stage 1. the presentation of a behavioral prime in a picture; Stage 2. an encoding task that calls for the verification of a graphical feature or a semantic feature that either fits the primed behavior or does not; and Stage 3. the identification of a gradually appearing trait that either matches the primed behavior or does not. Let the term *prime* refer to the picture presented in Stage 1. The verification task at the encoding stage (Stage 2) can be used to manipulate open versus closed mindsets. The trait identification task (Stage 3) serves to measure the latency of trait inferences. The crucial manipulation of mindsets is simple and straightforward. We assume that there is only one reasonable way of inducing a closed mindset; namely, in cases in which the attribute to be verified (Stage 2) fits the meaning of the primed episode (Stage 1), affording a successful interpretation. Thus, when the interpretation “to attack” is verified, the mindset can (by definition) be closed. The only other way of reaching closure is to wait until the priming expires, which can take a very long time (cf. Sohlberg & Birgegard, 2003) and is hardly feasible.

There are two sensible ways, though, of operationalizing open mindsets: Either let participants verify a distracting, purely graphical attribute that does not afford any meaningful interpretation or let them fail on an attempt to verify a semantic attribute that does not fit the primed episode (e.g., to disregard, not fitting Figure 1). Thus, although the mindset construct is not directly observable, convergent validation can be obtained from two independent operationalizations—graphical encoding tasks and failures on nonfitting semantic encoding tasks. We expected that both ways, graphical encoding (i.e., distraction from interpretation) and encoding failures on semantic encoding tasks (i.e., aberrant interpretations) could produce stronger facilitation of subsequent trait inferences than could successful semantic encoding tasks.

In addition to these counterintuitive predictions, another noteworthy implication—the simultaneous facilitation of multiple trait inferences—can be derived from the notion that open mindsets allocate resources for inferential activities. At the time when this adaptive resource allocation occurs, the cognitive system cannot know which particular trait will have to be inferred. Rather than preparing for the inference of only one specific trait, a busy mindset must be “open” for multiple inferences at the same time. Therefore, another distinct implication is that, with reference to Figure 1, an open mindset should not merely facilitate the identification of the trait “aggressive” in the active person, or subject of the behavioral episode, but at the same time it should facilitate the identification of the trait “fearful” in the passive person, or behavioral object. To highlight this idea of multiple simultaneous inferences, we later use dynamic film clips rather than static pictures for behavioral priming, greatly increasing the uncertainty of the trait to be identified. If an open mindset still facilitates such unpredictable trait inferences, this would again hinder strategic processes. Another interesting implication would be that STI effects do not involve a competition or decision between conflicting attributions, to either subject traits or objects traits, or internal versus external origins, as in the fundamental attribution bias (Ross, 1977). Rather, to the extent that simultaneous STIs reflect open mindsets, they should simultaneously support divergent attributions.

Before we turn to empirical data, let us address the three major implications—graphical encoding advantage, encoding-failure advantage, and multiple simultaneous STIs—and the theoretical insights that can be gained from testing these implications empirically.

Graphical Encoding Advantage

The counterintuitive prediction of a graphical encoding advantage is tested in a way that goes beyond the mere replication of earlier findings. The between-participants design used by Fiedler and Schenck (2001) did not allow for a direct comparison of STIs under graphical versus verbal encoding conditions within the same participants. Moreover, the traits to be inferred always referred to the agentive, subject role in the picture (e.g., the aggressor in Figure 1) and never to the passive person (e.g., the victim). This might have still rendered strategic inferences more likely than in the present experiments in which the traits to be inferred can refer to either person, in an unpredictable fashion.

Multiple Trait Inferences

As open mindsets should facilitate multiple inferences at the same time, STI effects are predicted for any person reference when the trait to be inferred matches the behavior primed in the picture. Participants should be prepared to infer, on some trials, matching traits referring to the subject person (S) who plays the agentive role in the dyadic stimulus behavior and, on other trials, matching traits that refer to the object person (O), the passive role in the dyadic scene. To highlight preparedness for multiple simultaneous inferences, regardless of the focus on a particular target person, we included a manipulation of the type of verb (in the verbal encoding mode) supposed to elicit either S or O inferences. Drawing on the notion of implicit verb causality (Brown & Fish, 1983; Fiedler & Semin, 1988; Holtgraves & Raymond, 1995; Rudolph & Försterling, 1997), we included two classes of verbs. S action verbs (AV_S) refer to manifest actions of the S person (e.g., “to attack”) and are known to imply S causation. S state verbs (SV_S) refer to subjective mental or affective states in S (e.g., “to hate”) and usually imply an external cause in O. O states (SV_O), in turn, describe states in O (e.g., “to be afraid of”) and imply S causation (examples again referring to Figure 1). Controlled, strategic inferences might follow the implicit causality of the verb (inferring S traits for S actions and O states vs. O traits for S states) or the linguistic reference of the verb to be verified (inferring S traits for S actions and S states vs. O traits for O states). However, to the extent that multiple STIs are obtained independently of semantic verb constraints, this would corroborate the notion of multiple simultaneous inferences resulting from an open mindset.

Encoding Failure Advantage

Granting the expected findings for the first manipulation of open mindsets, based on a graphical encoding task, one might suggest that this might not reflect an influence of mindsets proper but a genuine modality effect (i.e., superiority of the graphical modality; Weldon & Roediger, 1987). We therefore need to provide conver-

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gent validation from another operational definition of open mindsets. Although a graphical encoding task distracts participants from a meaningful interpretation of the prime episode, an equally straightforward way to prevent closure is to let participants fail on a verbal encoding task that does not offer a fitting interpretation of the primed behavior. The counterintuitive prediction is that encoding failures on such nonfitting trials should lead to stronger STIs than should verifying a fitting verb offering a meaningful interpretation that leads to a closed mindset.

To be sure, this prediction requires a note of qualification. One should not expect trait identification latencies to depend exclusively on the mindset and associative links from the prime to the target trait not to matter at all. Thus, having just seen a picture showing a hostile attack and having verified a fitting behavior (to attack), there should be two opposing tendencies: A closed mindset should reduce inferential activity, but the associative link should support the inference of a highly related trait (i.e., aggressive) of the person recognized to attack someone. By comparison, failure of an attempt to verify a nonfitting behavior (e.g., to follow) should leave the mindset open (facilitative) but lead semantic associations astray (inhibitory). Because of this confound of two opposing tendencies, one should thus not exhibit too strong an advantage of nonfitting trials in a direct comparison. A more sensitive test, though, may be possible when the attention focus of the encoding task differs from the person reference of the trait identification task. For instance, when the behavior to be verified (to attack) refers to S (e.g., the aggressor), whereas the trait to be inferred is not an S trait (aggressive) but refers to O (fearful), then the semantic cue should be weaker and the advantage of open mindsets should be more evident.

Priming and Trait Inferences From Moving Pictures

Last but not least, the present investigation pursues another goal; namely, to expand the methodology of priming effects to film clips rather than static pictures. Although the computer and video technology needed to realize dynamic film priming is inexpensive and easily available, it is hardly ever used in behavioral priming studies. Moving pictures appear to come much closer to the ideal of priming realistic raw behaviors than do verbally predigested descriptions, which strongly impose semantic interpretations, or static pictures (see Figure 1), which show unambiguous, almost staged behaviors, putting almost equally strong demands on trait inferences as on verbal stimulus descriptions. To overcome this situation, in the last experiment we use film clips long and complex enough to be considered truly raw behaviors. Using film clips should not only increase realism and external validity but also further increase the unpredictability of multiple S and O trait inferences that have to be accessible simultaneously.

Experiment 1

Our main purpose in the first experiment, using static pictures for priming, was to demonstrate the superiority of purely graphical encoding over verbal-semantic encoding in a within-participant design. Target traits could refer to S or O, in an unpredictable fashion, thus allowing for a first test of multiple simultaneous inferences. Only preliminary evidence was obtained on the third prediction, regarding the impact of encoding failures.

Method

Participants and design. Forty-four male and female undergraduate students of the University of Heidelberg, Germany, were randomly assigned to three experimental groups, which received different verb types (AV_S, SV_S, or SV_O) on verbal encoding trials. Within-participant, we varied the following factors across subsets of 72 trials (see Table 1): identification status (traits either matched the primed behavior or not), encoding mode (graphical vs. verbal), and within the verbal encoding mode, verification status (i.e., the verb to be verified fitted vs. did not fit the primed behavior). Moreover, the person reference of the trait to be identified was varied, pertaining either to the S or to the O role in the dyadic behavior.

Materials. Thirty-six stimulus pictures, each one depicting a dyadic social behavior, had been selected from a larger picture pool in previous research (Fiedler & Schenck, 2001). For a basic set of 18 of these 36 pictures, we had successfully pretested all combinations of a matching S trait adjective (e.g., *aggressive* for Figure 1) and a matching O trait adjective (*fearful*), an S referent action verb (AV_S such as *attack*), an S referent state verb (SV_S, such as *boil with rage*), and an O referent state verb (SV_O, such as *fear*), which had to be consensually rated as fitting the behavior in the picture.

Table 1
Mean Identification Latencies (and Standard Deviations) as a Function of Trial Type and Experimental Group, Experiment 1

		Identification latency, ms			
Trial type	No. of trials	Overall *M* (*SD*)	AV_s *M* (*SD*)	SV_s *M* (*SD*)	SV_o *M* (*SD*)
Graphical match S	9	3,687 (355)	3,734 (352)	3,613 (353)	3,723 (346)
Graphical match O	9	3,757 (329)	3,734 (358)	3,856 (337)	3,663 (240)
Verbal match fit S	9	3,700 (320)	3,693 (351)	3,744 (322)	3,655 (269)
Verbal match fit O	9	3,750 (298)	3,779 (307)	3,778 (294)	3,683 (283)
Verbal match no fit S	9	3,668 (319)	3,635 (319)	3,720 (249)	3,642 (383)
Graphical nonmatch	9	3,875 (309)	3,861 (331)	3,932 (310)	3,819 (268)
Verbal nonmatch no fit	9	3,720 (379)	3,720 (406)	3,791 (373)	3,634 (331)
Verbal nonmatch fit	9	3,807 (321)	3,807 (351)	3,836 (312)	3,770 (292)

Note. AV_s = subject person action verbs; SV_s = subject person state verbs; SV_o = object person state verbs; S = subject person; O = object person.

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We constructed a 72-trial stimulus series for each participant by using each stimulus picture twice for priming. Eight types of trials, each one comprising nine items, can be distinguished, as shown in Table 1. One presentation of the 36-picture set was required to prime only matching traits, nine S and nine O traits following graphical encoding tasks and nine S and nine O traits following verbal encoding tasks involving fitting verbs. The second presentation of the 36 pictures was used for four other types of trials, including nine new nonmatching traits following graphical coding, nine new nonmatching traits following encoding of a fitting verb, nine new nonmatching traits following encoding failures with nonfitting verbs, and nine new matching traits (all S referent) following encoding failures with nonfitting verbs.

Note that this within-participant design is incomplete and suboptimal because the number of available picture-trait-verb combinations is restricted and because more than 72 trials turned out to be unfeasible. As a consequence, the proportion of matching traits after graphical primes was higher (18 of 27) than after verbal primes (27 of 45). Also, the number of matching traits following verbal fits was higher (18 of 27) than after nonfitting verbs (9 of 18). These contingencies may create expectancies, suggesting an alternative interpretation that is ruled out in Experiment 2.[1]

Within the matching trials, the assignment of picture subsets to graphical and verbal encoding tasks and to S and O traits was counterbalanced across participants, such that each S and O trait appeared equally often in graphical and verbal encoding trials. The variation of S versus O traits only pertained to matching trials. All traits used for nonmatching trials were chosen to represent agentive traits that, in this respect, are somewhat closer to S than to O. Nonmatching traits were always of the same valence as the primed behavior, to rule out evaluative priming. The assignment of 18 nonmatching traits (to the no-fit verbal-semantic and the graphical encoding condition) was also counterbalanced. The remaining two trial types (9 matching and 9 nonmatching traits after nonfitting verbs) were constantly based on the same stimulus subsets because of material constraints (i.e., because new matching traits were not available for all pictures). However, previous research yielded equivalent results for STIs with different traits in the match versus nonmatch conditions as it did with the same traits preceded by matching versus nonmatching pictures (cf. Fiedler & Schenck, 2001).

Word frequency counts (using the CELEX database; Baayen, Piepenbrock, & Gulikers, 1995) warranted that the trait words used for matching and nonmatching trials did not differ in familiarity or in linguistic base rate. Similarly, there were no frequency differences between S traits and O traits. Specifically, the mean word frequencies for the relevant trait subsets were as follows (all relative to 1,000,000 words): matching S traits, 13.8; matching O traits, 16.4; and nonmatching traits, 9.5. Thus, trait terms were generally quite infrequent and unlikely to cause familiarity effects. Paired comparisons yielded no significant difference. Frequencies of S trait words were very close to O traits.

Procedure. The experiment was carried out in a computer laboratory, in which up to 6 participants could work simultaneously. The experimental instructions, presented on the computer screen, explained that the task consisted of an extended series of trials and required as much attention and concentration as possible. At the beginning, a picture would appear on the screen showing some behavior involving two persons. A few moments later, participants would have to answer a yes-no verification task about the preceding picture. The type of question varied over trials, asking the participant either to decide whether a specific behavior could be seen (verbal task) or whether the black area in the black-and-white picture was larger than the white area (graphical task). Finally, participants were to identify a word that was first hidden behind a mask and that appeared only slowly as more and more pieces of the mask were removed. Participants were instructed to identify the word as soon as possible. Prior to the 72 trials, 2 practice trials served to familiarize participants with the task. The order of the remaining trials was random, under the constraint that each block of 8 consecutive trials included exactly 1 trial of each type (as specified in the *Materials* section).

Stimulus pictures were presented as black silhouettes on white background, depicting a social scene in which two persons, S and O, were involved. Pictures had a resolution of 320 $\times$ 200 pixels and filled the whole screen. The distance between the participant's eyes and the screen was approximately 60 cm. After 1,500 ms the picture disappeared and the screen remained black for another 1,000 ms before a yes-no encoding question, which could be answered by the "x" and "." keys on the computer keyboard marked with paper strips labeled "yes" and "no," respectively. Depending on the encoding mode condition, this question either referred to a graphical property ("Is the black area in the picture larger than the white area?") or to a verbal-semantic property ("Has the following behavior been shown?," followed by a fitting or nonfitting verb). Participants were instructed to respond as quickly as possible.

After this verification task, a trait adjective began to develop slowly on the screen. Trait adjectives were represented in bitmap graphics format (350 $\times$ 65 resolution presented on a 640 $\times$ 480 resolution screen) in black letters on an approximately 4 $\times$ 12-cm blue rectangular frame. At first, this rectangular frame was fully covered by a black mask. Small rectangular parts of the mask were then removed randomly, making a growing portion of the stimulus visible (cf. Figure 1). Speed and rectangle size were calibrated such that the whole uncovering process lasted about 7,500 ms. The experienced uncovering process took place in the central 2,500 ms; before 2,500 ms identification was impossible, and after 5,000 ms normal reading was possible. Participants were instructed to press any key as soon as they had recognized the trait word. The identification latency between stimulus onset and keystroke was recorded. After the keystroke, the presentation would stop and participants had to write down the trait word in a list that could later be checked for correctness of trait identifications. There were virtually no errors. The next trial could be started with a further keystroke.

Results and Discussion

Prior to all data analyses, the raw identification latencies were trimmed to values between 2,500 ms and 5,000 ms, the time window through which the full recognition process took place. Latencies falling below or above this range were set to the minimum or maximum value, respectively. This procedure, which affected only 6.4% of all latency data, is in line with the state of the art (Ratcliff, 1993) and quite appropriate to the present task. It should be mentioned that logarithmic transformations of latencies and within-participant normalization left the results virtually invariant. The resulting mean identification latencies are given in Table 1, averaging across participants within experimental groups and across the nine data points of each trial type. Table 1 also includes overall means across all three groups. Let us first consider planned comparisons pertaining to the three major predictions.

Graphical encoding advantage. An STI score can be simply computed as the average latency difference between trials on which the trait to be identified did not match the primed behavior and trials on which the trait matched the primed behavior. Separate STI scores were computed within each participant for graphical and verbal trials and, within both encoding modes, for S and O trait inferences, using the same nonmatch baseline. Overall, mean STI scores are in the range of 100 ms, reflecting shorter identification latencies for matching than nonmatching traits. Of major interest is the comparison of graphical and verbal trials. Theoretically, graph-

[1] We are grateful for an unknown reviewer's raising this important point.

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ical encoding trials are characterized by the opening of a behavioral prime and a graphical task that leaves the prime open. The resulting mindset should produce strong STI effects. Consistent with this expectation, across all participants, mean STI scores after graphical encoding were significantly positive for S trait inferences, $M = 187.49$ ms, $t(43) = 5.15$, $p < .001$, and for O trait inferences, $M = 117.52$ ms, $t(43) = 3.77$, $p < .001$.

Given a verbal-semantic encoding task, to assume a closed mindset through successful semantic interpretation of a primed episode, we must look at matching trials involving a fitting verbal verification task. For a nonmatching baseline, however, it is more appropriate to consider nonmatching trials with no fit on the verification task. A "fit" on nonmatching trials would mean to elaborate on an irrelevant, misleading behavior primed, whereas nonmatching no-fit trials are neutral in terms of both the behavior primed and the verb verified. Note that computing verbal-semantic STI scores this way entails an intuitively sharp contrast between trials on which matching traits (e.g., aggressive) have to be identified after seeing an aggressive act and verifying a fitting verb (e.g., *attack*) versus trials on which nonmatching traits (e.g., jealous) have to be identified after being exposed to an irrelevant behavior (e.g., cheating) and verifying a nonfitting verb (e.g., *fear*). In spite of this impressive contrast, but consistent with the notion of a graphical encoding advantage, the resulting STI scores after verbal coding were not significantly different from zero for S traits, $M = 20.01$ ms, $t(43) = 0.53$, as well as for O traits, $M = -29.60$ ms, $t(43) = -.89$.

For a comparison of graphical and verbal encoding, the STI scores were subjected to a two-factor Encoding Mode (graphical vs. verbal) × Trait Reference (S vs. O) analysis of variance (ANOVA). The results are summarized in Figure 2 (left chart). The encoding mode main effect was clearly significant, $F(1, 43) = 17.83$, $p < .001$, reflecting the predicted graphical encoding advantage. Thus, the counterintuitive prediction receives support that purely graphical encoding leads to stronger STI effects than successful verbal interpretations, consistent with the notion that stronger priming effects result from open mindsets (graphical coding) than from closed mindsets (fitting verbal interpretation).

Multiple inferences: S and O traits. Theoretically, an open mindset should facilitate inferences in more than one direction. This suggests two testable implications. First, STIs should support inferences of S traits and O traits at the same time, as already confirmed by the contrasts reported so far. Second, the double STI for S and O traits should be particularly pronounced after purely graphical encoding, as confirmed by the graphical encoding advantage and the absence of an Encoding Mode × Trait Reference interaction in the ANOVA (cf. Figure 2). However, although STIs generalize across S and O, a significant trait reference main effect, $F(1, 43) = 5.72$, $p < .05$, indicates somewhat faster S than O inferences.

Influence of verb type. Although the verb-type manipulation only pertained to verbal encoding, the impact of the constant verbal type—to verify only S actions (AV_S), S states (SV_S) or O states (SV_O)—may have carried over to graphical encoding trials. It thus seemed reasonable to cross the between-participants factor, verb type, with both within-participant factors in the same ANOVA. Figure 2 shows that the major pattern generalized across experimental groups. The only moderating influence of verb type was apparent in a weak Verb Type × Inference Direction interaction, $F(2, 43) = 3.61$, $p < .05$. Stronger STI effects for S than O traits were mainly due to participants verifying affective states (SV_S or SV_O) rather than manifest actions (AV_S), which appear to support both S and O trait inferences.

Verification: Fit versus no fit. The comparison of graphical and verbal encoding provides only one operational test of the assumption that open mindsets support subsequent inferences. As to the second way of inducing open mindsets, through encoding failure on nonfitting verification tasks, the present experiment did not allow for a very sensitive test, for several reasons. First, trials involving nonfitting verbs were quite rare and less likely to be

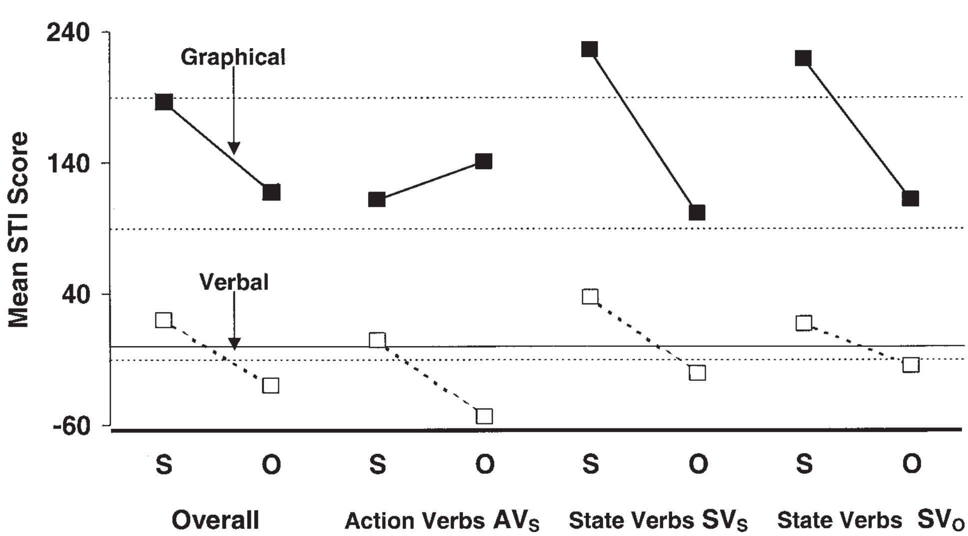

Figure 2. Mean spontaneous trait inferences (STI) scores obtained in Experiment 1 as a function of encoding mode (graphical vs. verbal), trait reference (subject [S] vs. object [O]) and verb class used for the verification task (subject person action verbs [AV_S], subject person state verbs [SV_S], object person state verbs [SV_O]).

paired with a matching trait than fitting trials. Second, the static pictures used for behavioral priming did not really guarantee encoding failures on nonfitting trials. Even when the verb to be verified (e.g., *ignore*) did not fit the picture, the verbal verification task may have sensitized the participant for the best-fitting verb, which may not have been difficult to find. Third, the direct semantic link of a fitting verb to a corresponding trait (e.g., *attack* → aggressive) may have worked against any no-fit advantage reflecting open mindsets.

In spite of these limitations, we conducted the following tentative test of the closure manipulation through verification fit. We ran another ANOVA, confined to verbal-semantic trials, based on raw latencies rather than STI difference scores and pooling across S and O inferences. Two repeated-measures factors were included, identification status (match vs. nonmatch) and verification status (fit vs. no fit).[2] Both main effects were significant: for identification status, $F(1, 43) = 10.54$, $p < .01$, repeating the STI effect, and for verification status, $F(1, 43) = 5.30$, $p < .05$, reflecting shorter latencies on nonfitting trials across both matching and nonmatching trials. The interaction was negligible, $F(1, 43) = 1.07$, and no F test involving the verb-type factor was significant (see Table 2 and Figure 3). Thus, although encoding failures on nonfitting trials did not increase the STI effect—presumably because of the counteracting facilitation effect of the strong semantic link created on fitting trials, which should facilitate matching trait and inhibit nonmatching trait identification—it is worth noting that STI effects were at least not reduced, suggesting some trade-off between the influence of mindsets and semantic links. Indeed, some facilitative impact of open mindsets seems to be evident in a general speed-up on nonfitting trials across matching and nonmatching traits.

Altogether, these findings provide quite consistent support for the basic implication of the mindset account, showing that open mindsets facilitate inference making. STIs induced by pictures supported inferences in different attributional directions at the same time, though inferences of S traits were somewhat faster than O trait inferences. STIs were stronger after graphical than after verbal encoding, even though the latter entailed a much stronger semantic link to the trait to be identified than the former encoding task. Moreover, after a failure to verify a nonfitting aspect of the primed behavior, subsequent inferences of both matching and nonmatching traits were faster than after successful verification of a fitting aspect, although the STI effect did not increase. As anticipated, this seems to reflect the conflict of two opposing tendencies. Although encoding failures on nonfitting trials may induce an open mindset, the successful verification of a fitting verb (*attack*) creates a strong semantic link that facilitates the identification of a matching trait (aggressive) and inhibits the identification of a nonmatching trait (e.g., dishonest). As a result, the STI effect is enhanced on fitting trials, canceling out any STI advantage that may exist on nonfitting trials because of open mindsets.

Table 2
Mean Identification Latencies (and Standard Deviations) as a Function of Trial Type and Experimental Group, Experiment 2

		Identification latency, ms		
Trial type	No. of trials	Overall *M* (*SD*)	AV_s *M* (*SD*)	SV_o *M* (*SD*)
Graphical match S	9	3,841 (439)	3,808 (423)	3,874 (452)
Graphical match O	9	3,921 (389)	3,802 (384)	4,041 (356)
Verbal match fit S	9	3,943 (535)	3,712 (429)	4,174 (530)
Verbal match fit O	9	3,999 (370)	3,829 (320)	4,169 (337)
Verbal match no fit S	9	—	—	—
Graphical nonmatch S	9	3,952 (429)	3,846 (387)	4,058 (442)
Graphical nonmatch O	9	4,035 (441)	3,955 (452)	4,115 (414)
Verbal nonmatch no fit	9	—	—	—

Note. Reaction times to no-fit trials, which were not used for data analyses, are marked with a dash. AV_s = subject person action verbs; SV_o = object person state verbs; S = subject person; O = object person.

Experiment 2

Before we attempt a more sensitive test of the impact of open mindsets induced through encoding failures in Experiment 3 below—under conditions that reduce semantic countereffects—Experiment 2 addresses a methodological problem and a potential alternative account of the findings from Experiment 1. As already mentioned, one might argue that the graphical encoding advantage reflects an expectancy effect because of the higher proportion of matching traits following graphical (18 of 27) than verbal (27 of 45) encoding (see Table 1). If it is the case that a higher match proportion fosters the identification of matching traits, relative to nonmatching traits, and if such an expectancy effect is responsible for the graphical encoding advantage in Experiment 1, this major finding should be erased in Experiment 2, for the stimulus distribution is changed to result in a *lower* match proportion for graphical trials (18 of 36) than for all verbal encoding trials (27 of 36). Moreover, as the match proportion is now maximized (9 of 9) for fitting verbs—leading *always* to matching and *never* to nonmatching traits—any strategic inference based on match rates should benefit the verbal encoding more than for the graphical encoding condition. Indeed, the extreme match proportion of fitting verbal trials affords a strong test of the suspicion that strategic inferences may be at work.

Another modification pertained to the no-match control condition, for which only graphical encoding trials were used. Thus, we considered each participant's average latency on nonmatching graphical trials at baseline, from which the latencies on matching graphical trials were subtracted to yield a graphical STI score, and from which the latencies on matching verbal encoding trials were also subtracted, to yield a verbal STI score. The content-free, graphical encoding task on nonmatching trials is most suitable for measuring trait identification latencies in the absence of all pictorial as well as semantic priming, thus affording a natural control condition for both graphical and verbal matching trials.

Both changes in the stimulus distribution—concerning the match proportions of verbal and graphical trials and the no-match control—were accomplished by replacing a single nine-trial subset (see Table 2). While eliminating nonmatching trials after fitting verbs, we now included two subsets of nonmatching graphical

[2] Note that for this ANOVA, matching traits on fitting trials were contrasted with nonmatching traits on fitting trials, whereas in the preceding STI analysis, we had compared matching fitting trials with nonmatching nonfitting trials.

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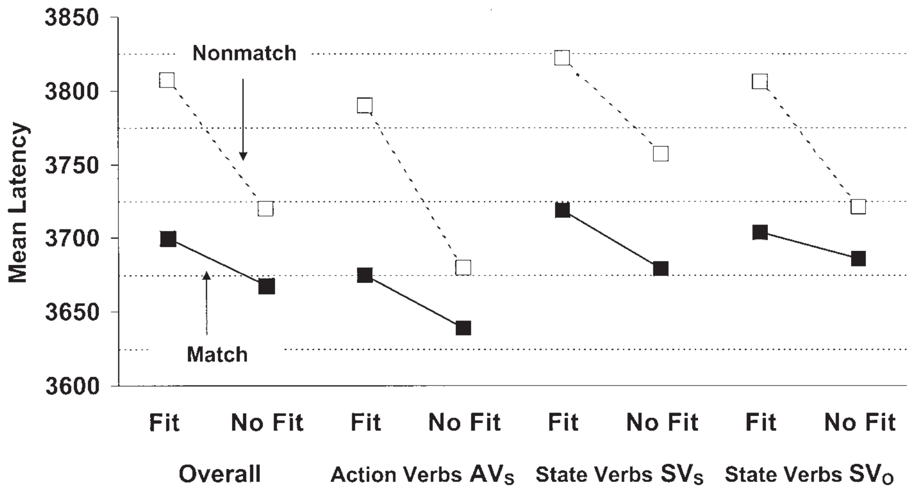

Figure 3. Mean identification latencies (in milliseconds) obtained in Experiment 1 for matching and non-matching traits as a function of verification fit and verb class used for the verification task (subject person action verbs [AV_S], subject person state verbs [SV_S], object person state verbs [SV_O]).

trials. This created the additional advantage of being able to control for the (latent) S versus O reference of nonmatching traits. Whereas one subset represented traits of agentive S persons, the other subset included passive O traits.

Method

Participants and design. Thirty male and female undergraduate students of Heidelberg University were randomly assigned to two groups representing different verb types (AV_S vs. SV_O). All other factors were varied within participants. Half of the 72 trials involved graphical encoding, whereas the other half involved verbal encoding. Within both subsets, the traits to be verified either matched the behavior primed in a picture or did not match. Traits could refer to the S or the O person of the depicted behavior. The influence of verification success could not be analyzed, because fit trials always occurred in the match condition.

Materials and procedure. The same stimulus materials and procedures were used as in Experiment 1, based on the same computer program, except for change in the distribution of the 72 trials across trial types, as already described (cf. Tables 1 and 2). Of 18 graphical nonmatching trials, 9 referred to S traits, and the remaining 9 referred to O traits. No fitting trials with nonmatching traits were included, producing a 100% match rate for fitting verbs. The between-participants factor verb level was reduced to two levels, AV_S and SV_O.

Results and Discussion

Analyses focused on two predictions, concerning the graphical encoding advantage and the multiple STI for S and O trait inferences. The absence of fit-nonmatch trials precluded an examination of encoding failures. Because in this experiment nonmatching traits were available for both (agentive) S persons and (passive) O persons, more refined STI scores could be computed. A graphical STI score for S trait inferences was defined as the average latency on nonmatching S traits on graphical trials minus the average latency of matching S traits, and for O trait inferences, it was defined as the latency on nonmatching O traits on graphical trials minus matching O traits. Recall that the same nonmatching baseline for S and O traits, stemming from graphical encoding trials, was used to compute analogous STI scores for verbal encoding. The remaining two subsets of trials (nonmatching and matching nonfit trials) only served to manipulate the match proportions and were ignored in the analyses. Table 2 gives the mean raw latencies, overall and per trial type.

Graphical encoding advantage. To replicate and validate the advantage of graphical over verbal encoding, we subjected the STI scores to a three-factor Encoding Mode (graphical vs. verbal) × Trait Reference (S vs. O) × Verb Type (AV_S vs. SV_O) ANOVA, with repeated measures on the first two factors. The encoding mode main effect was significant, $F(1, 28) = 6.57$, $p < .05$. Pooling over verb types, the STI scores resulting from graphical encoding were significantly positive for S traits, $t(28) = 1.90$, $p <$ .05 (one-tailed), as well as for O traits, $t(29) = 2.16$, $p < .05$. After verbal encoding, though, STI scores were not significant for either S traits, $t(29) = 0.16$, or O traits, $t(29) = 0.72$.

These findings replicate the graphical encoding advantage under conditions that rule out any expectancy effect due to a higher match-rate among graphical encoding trials. Although the match rate for the verbal-fit trials was maximal (100%), STI effects were stronger for graphical trials. This not only replicates and corroborates a major finding of Experiment 1 but also at the same time disconfirms the claim that strategic inferences can account for the graphical encoding advantage.

Influence of verb type. This is not to say, though, that no strategic processes at all have been at work. A significant Encoding Mode × Verb Type interaction, $F(1, 28) = 12.68$, $p < .05$, indicates that graphical encoding advantage mainly stems from the SV_O condition, but almost disappears with fitting AV_S verbs (see Table 2). Thus, at least when fitting verbs pointed to overtly observable actions in the agentive person S (e.g., *attack*), the created semantic link seemed to be strong enough to facilitate trait inferences of comparable strength as after graphical encoding. The 100% match rate after fitting verbs may have reinforced this facilitation effect strategically. However, when the verb pertains to hidden states in O (e.g., *fear*), the less salient person, pointing to

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an interpretation less concretely visible in the picture, the semantic facilitation component decreases and the graphical advantage is borne out substantially. Thus, whereas the semantic advantage of successful verbal encoding is contingent on being fed with a suitable verb, graphical encoding profits from a general advantage of open mindsets.

Multiple inferences: S and O traits. The generality of graphical encoding effects is evident across trait-reference conditions. The verb type main effect falls short of significance in this experiment, $F(1, 28) = 2.00$, but STIs are again somewhat stronger for S than O inferences. The trait reference factor enters a significant three-way interaction, $F(1, 28) = 4.27$, $p < .05$, though. Whereas STI scores after graphical encoding are generally positive, the semantic advantage of fitting AV_S is mainly evident for inferences of S traits (i.e., traits of the person to which the verb points). It is worth noting that when only matching trials are analyzed, S traits are indeed inferred faster than O traits, $F(1, 28) = 4.15$, $p < .05$.

Experiment 3

We finally return to an experimental test of the counterintuitive prediction of enhanced STI effects after verbal encoding failures. Preliminary findings from Experiment 1 had been encouraging but equivocal, because the encoding-fit manipulation turned out to be complex, causing a trade-off between opposing influences of mindsets and semantic links. Specifically, on matching trials, verifying an aspect that fits the primed behavior not only serves to close a mental episode but also yields a strong semantic cue that helps to disambiguate the primed behavior and the matching trait to be inferred. On nonmatching trials, encoding fit may not only close the mindset but also activate an irrelevant aspect of meaning that distracts from the trait to be inferred. Thus, the disambiguation function should facilitate matching trials and inhibit nonmatching trials. Experiment 3 constitutes an attempt to disentangle the no-fit advantage from the semantic disambiguation advantage.

The task setting was similar to that used in the first two experiments, but it differed in some notable respects. Most important, we used film clips rather than static pictures for behavioral priming, thus moving the paradigm a step toward the presentation of realistic raw behavior, distinct from the verbally predigested behavior descriptions used in most previous research, and the static silhouette-like pictures used in Experiments 1 and 2. Static pictures may be similarly remote from naturally encountered raw behaviors as verbal descriptions; pictures (as in Figure 1) may appear staged and restricted like sentences, entailing the demand to figure out a single, predetermined meaning aspect.[3] In an attempt to overcome this restriction, we resorted to film clips showing entire behavioral episodes.

We were curious as to the strength and robustness of priming effects obtained with such realistic stimuli. Obtaining pronounced priming effects with such complex and ambiguous stimuli would testify to their external validity. Priming need not be confined to impoverished task settings; multiple priming effects emanating from complex stimuli need not cancel out each other. Thus, a basic methodological aim was to demonstrate priming effects based on raw behaviors presented at a realistic level of complexity. Granting success with this methodology, we were interested in substantiating the mindset approach to STIs, particularly the impact of open mindsets resulting from encoding failures. Given the new film materials, such convergent results would have to be obtained with new sets of verbs and trait adjectives, corroborating the generality of findings across different materials.

Use of film clips extended over 15 s or so as behavioral primes raises the problem of how to achieve experimental control over the cognitive encoding and inference process. Within our paradigm, fortunately, this can be accomplished through the encoding task manipulation, which can turn the problem of stimulus ambiguity into a real asset of the design. Imagine you have just watched a video clip involving a good deal of locomotion, a verbal debate between two persons, a number of accompanying context cues, and a temporal trajectory that transforms a start setting into an end setting. Such a complex prime may solicit multiple inferences that are hard to control experimentally. However, now assume that there are two protagonists in the film, carrying labels A and B. An encoding task requires you to verify if a specific A behavior has been presented in the film, such that A is a constant target.

It can be assumed that in such a stimulus context, the semantic disambiguation function of the verification task is even stronger than with static pictures. If the trial involves a fit and you come up with a successful interpretation of the ambiguous film, pointing to one particular aspect in the focal person A, this should probably facilitate the inference of a matching trait that refers to A. The same disambiguation effect will hardly help, or even hinder, the identification of an unrelated A trait on a nonmatching trial. This disambiguation effect of fitting trials should be at least as strong as in Experiment 1 and should again obscure or override the open-mindset advantage expected for nonfitting trials.

However, granting such a complex priming, a constant focus on A, and a successful verification of what this focal person has done in the film, what will happen if the trait to be identified refers to the other person, B? Indeed, this is the condition for teasing apart the mindset influence from the disambiguation effect. Having not found an interpretation for A's behavior, the participants' open mindset should now facilitate the identification of matching traits relevant to the other, nonfocal person (B) in the film. In contrast, participants who have just succeeded in verifying A's behavior should perform worse at identifying B traits, even though the A aspect they have identified is not at all incompatible with a B trait that matches the same action context. Thus, inferences to traits of the unfocused person, which are less contaminated by a disambiguation effect, afford a rather pure test of the influence of open versus closed mindsets.

A strong trait reference main effect can also be predicted; high ambiguity and a constant focus on A should render A trait inferences easier than B trait inferences. As the focal person, A, is the agentive role in the film (corresponding to S), the inference bias toward traits of the agentive person that was already observed in the preceding experiments should be reinforced. We nonetheless expected multiple STI effects for both A and B traits, especially under open mindsets, in accordance with the theoretical rationale.

In Experiment 3, the verb type used for the encoding task was either AV_A or SV_A. Note that both verb types share the same person reference: A; they differ only in implicit causality, which points to A for AV_A but to B for SV_A. Only verbal encoding was used, no graphical encoding, which was not quite applicable to

[3] This problem was raised by Vincent Yzerbyt.

films. Otherwise, Experiment 3 imitates many design features of the first two experiments using new materials and methodological tools.

Method

Participants and design. Sixty-six male and female students of the University of Heidelberg, Germany, participated, either for payment or to fulfill a study requirement. They were randomly assigned to one of four experimental groups, resulting from the orthogonal manipulation of two factors, trait reference and a counterbalancing design factor. Trait reference was manipulated between participants; all traits to be identified referred either to the focal person A or to the nonfocal person B. Verb type was manipulated within participants. The counterbalancing factor determined which one of two stimulus subsets was allocated to verb-type conditions, AV_A or SV_A.

The remaining aspects were varied within participants. Some of the trait words to be identified on different trials matched the behavior shown in the preceding film, whereas others did not. Within the sets of matching and nonmatching trials, the behaviors to be verified during encoding were selected to fit the actually presented behavior on some trials and to show no fit on others. The same match:no-match ratio (2:1) held for fitting as for nonfitting trials, ruling out an alternative account in terms of strategic processes. In addition to the general purpose of demonstrating STIs with moving pictures, we were mainly interested in a sensitive test of the impact of open mindsets induced through encoding failures.

Materials. From an archive of videotaped movies, a larger set of 96 film clips were selected depicting a whole variety of social behaviors, such as an elderly man giving a present to a young woman, a man caressing a tired woman, a woman caring for a young girl, a man shouting at another man, a man feeding a boy with a spoon, or a man beating a woman.

The film clips were digitalized from VHS-tapes into AVI files. The actors were masked with a mosaic filter, a common practice for blurring the image and showing the action without revealing the identity or features of the actors. The mosaic filter divides a selected area into a fixed number of squares and merges all the pixels in this area to one average color, thereby lowering the resolution in this area and showing a blurred version of the area (see Figure 4). The two protagonists in each episode were marked by large letters A and B, respectively, the letters being placed on the corresponding person in the beginning of each clip. All film clips were converted into 24bit MPG1 files, sized 320 × 240 pixels, and presented using the embedded Microsoft Windows Media Player. The video window size being set to 1024 × 768, each film clip was automatically enlarged to fit the monitor's diagonal size.

All stimuli were presented in a pilot study to eight judges who were asked to indicate the most appropriate verbal descriptors for what A does (action), what A feels (state), for the most typical A trait and the most typical B trait. Those 16 film clips for which consensus was sufficient (at least six of eight judges) provided the core set of stimuli (cf. Table 3). These 16 film clips were always presented along with matching traits and fitting verbs to be verified. However, depending on the between-participants manipulation, traits referred either to A or to B. The 16 films were subdivided into two subsets of 8, which were paired with different verb types to be verified. The allocation of subsets to AV_A and SV_A was counterbalanced.

Because we could not find equally suitable verbs for all films, we could not freely manipulate trait match and verification fit within the same film. Altogether, we selected 42 films, of which 16 (i.e., the core set) were presented with matching traits and fitting verbs; 8 different films were presented with nonmatching traits and fitting verbs, 12 were presented with matching traits and nonfitting verbs, and 6 were presented with nonmatching traits and nonfitting verbs (cf. Table 3). Half of the trials within each subset involved AV_A and SV_A, respectively. This verb-type manipulation is mainly relevant to the core set of 16 trials involving fitting verbs and matching traits; it can have little systematic influence when either the verb does not fit or the trait does not match the film or the fitting film-verb pair. We nevertheless balanced the number of action and state verbs within all subsets.

The trait words were again controlled for word frequency. The mean frequencies (and standard deviations) were 17.8 (21.0) per 1,000,000 for matching A traits, 15.0 (25.5) for matching B traits, 35.7 (64.4) for nonmatching A traits, and 21.8 (36.2) for nonmatching B traits. Thus, trait words were generally quite rare and differences between conditions were never significant. Trait words were also comparable in the average number of letters and in valence ratings. So there was no reason to suspect that there were differences in familiarity or readability. Also, any material bias in favor of the core set of 16 items constantly assigned to the matching and fitting condition could only explain constantly stronger STIs for this subset, but can hardly explain any moderating influence of verification fit on STIs,

Figure 4. Graphical illustration of a sample of frames from a film clip used for degraded stimulus presentation in Experiment 3. The excerpt in the lower right frame gives an impression of the degradation effect. A = focal person; B = nonfocal person.

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Table 3
Mean Latencies (and Standard Deviations) in Video Frames as a Function of Experimental Conditions, Experiment 3

		AV_A		SV_A	
Trial type	No. of trials	A *M* (*SD*)	B *M* (*SD*)	A *M* (*SD*)	B *M* (*SD*)
Fit/match	16	85.4 (11.1)	100.8 (10.1)	86.8 (10.8)	100.8 (12.0)
Fit/nonmatch	8	98.9 (13.0)	99.1 (15.5)	98.1 (14.1)	98.2 (15.3)
Difference fit/nonmatch–match		13.5	−1.73	11.3	−2.6
No fit/match	12	93.0 (13.6)	94.5 (12.7)	96.2 (11.3)	96.1 (8.7)
No fit/nonmatch	6	103.2 (11.5)	104.2 (14.1)	100.2 (15.1)	103.5 (14.8)
Difference no fit/nonmatch–match		10.2	9.8	4.0	7.4

Note. AV_A = focal person action verbs; SV_A = focal person state verbs; A = focal person; B = nonfocal person.

defined as the difference between matching trials (using the core set) and nonmatching trials (using other traits).

Procedure. Instructions were similar to Experiment 1. Participants were told to be as attentive as possible. They were carefully explained the structure of experimental trials. They learned that after each film clip, a verb would be presented on the screen and they would have to verify whether they had seen the behavior described by the verb or not, using one of two response keys (i.e., the left and right arrow key pointing to "YES" and "NO," respectively). A few moments later, another word gradually became visible. They were instructed to press the blank bar as soon as they had identified the meaning of the word. To make sure that the word was really identified, they had to type in the identified trait word before the next trial began. Two practice trials preceded the 42 experimental trials.

Results and Discussion

Again, our operational measure of the STI effect was the latency required to identify a gradually appearing trait word a few seconds after a matching behavior had been shown in a degraded film clip, minus the latency of a nonmatching control. For convenience, we quantified identification latencies as the number of picture frames rather than milliseconds, the rescaling factor being 30 frames per second (or 33.3 ms per frame). The maximum number of frames, from onset until the mask was completely removed, amounts to 150 frames.

Pooling across all other conditions, we obtained an overall STI effect with film clips that was remarkably strong. When the behavior portrayed in the preceding film clip matched the trait word, the identification latency was clearly lower ($M = 94.04$ frames) than when the preceding behavior did not match ($M = 100.84$ frames). This difference across all other factors is clearly significant, $F(1, 29) = 13.90$, $p < .001$, and its size, equivalent to about 150 ms, is in the range of one standard deviation, which is usually considered a very strong effect—especially if one bears in mind that reading an emerging word is a highly overlearned skill.

Table 3 provides an overview of the average trait identification latencies as a function of experimental conditions. To analyze these data statistically, we again computed STI scores (average latency on nonmatching trials minus the matching trials) within each participant, separately for each level of the within-participant manipulations, encoding fit and verb type. These STI scores were analyzed in a three-factor Verification Status (fit vs. no-fit) × Verb Type (AV_A vs. SV_A) × Trait Reference (A vs. B) ANOVA with repeated measures on the first two factors. The corresponding mean STI scores are given in Figure 5. Apart from the pervasive STI effect that is evident in generally positive STI scores, a rather strong trait reference main effect, $F(1, 58) = 32.12$, $p < .001$, reflects a marked bias toward the focal, agentive person, A. Given the ambiguity of complex film clips, concentrating on inferences about one focal target person, A, helps to disambiguate the primed information.

To understand the nature of this trait reference main effect, though, it is essential to consider its interaction with verification fit. It should be noted, first, that the verification status main effect was also significant, $F(1, 58) = 4.20$, $p < .05$, indicating slightly stronger STIs for nonfitting than for fitting trials. However, both main effects, for inference direction and verification status, are merely reflective of a strong crossover interaction between both factors, $F(1, 58) = 33.12$, $p < .001$, which is crucial to disentangling the closure function and the disambiguation function of encoding fit. The A-trait advantage is exclusively due to trials involving verification fit, which help to reduce the ambiguity by identifying one particular aspect in A's behavior. In this case, no significant STI effect at all is obtained for B inferences. In contrast, in the no-fit condition, supposed to entail no disambiguation but an open mindset, an equally strong STI effect is obtained for both A and B inferences.

Another way to describe the same interaction is that inferences about traits of the focal person (A) are facilitated through STIs regardless of fit, but inferences to traits of the nonfocal person B are confined to the no-fit condition supposed to induce an open mindset. For B, the advantage of an open mindset (after nonfit) was not overridden by a disambiguation advantage due to encoding fit. The only other significant result is a verb-type main effect, $F(1, 59) = 5.58$, $p < .05$, reflecting slightly enhanced STIs after verifying AV_A than SV_A.

For a final analysis, we decomposed STI scores into their component latencies for matching and nonmatching trials (cf. Table 3). Pooling across verb types, it can be seen that the successful interpretation of a fitting A behavior creates an advantage of A-trait inferences that is confined to matching traits. In contrast, the no-fit advantage in B trait inferences is visible in both a speed-up of matching B traits and a slight slow-down of non-

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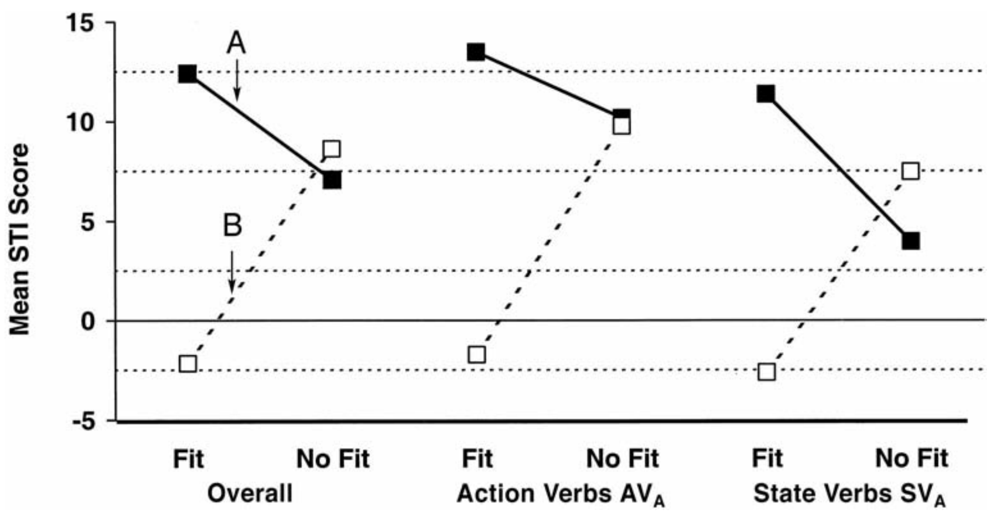

Figure 5. Mean spontaneous trait inferences (STI) scores obtained in Experiment 3 as a function of trait reference (focal person [A] vs. nonfocal person [B]), verification fit, and verb class used for the verification task (object person action verbs [AV_A], object person state verbs [SV_A]).

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matching B-trait inferences.[4] Thus, other than in Experiment 1, a general performance decline on nonfitting trials seems to reflect the importance of disambiguation with complex film priming.

Separate consideration of match and nonmatch latencies also helps to clarify the relation of STI and the fundamental attribution bias. Figure 5 shows that the marked bias toward stronger A than B attributions only originates on matching trials and is not apparent on nonmatching trials in the fitting condition. This indicates that the tendency toward stronger STIs for the focal person originates neither in lexical meaning differences of active and passive traits nor in the salience of active and passive behaviors. Rather, it reflects a selective influence of priming on matching trials that is independent of a general attribution bias.

Apparently, then, the results of Experiment 3 complement the support for the mindset approach obtained in the first two experiments. By using a more refined paradigm, the second operationalization of open mindsets—through encoding failures—can also be shown to enhance STI effects just like the first operationalization—using graphical encoding. Given the considerable ambiguity and complexity of film clips used for behavioral priming, it is no wonder that verifying one specific behavior of the focal person A facilitated inferences of A traits matching exactly the same semantic attribute. However, the unattended target B, who does not gain from successful disambiguation, reflects the genuine no-fit advantage and highlights once more the spontaneous, nonstrategic nature of STIs.

General Discussion

The present investigation used a recently developed paradigm for studying primed trait inferences (STI) from pictures (Fiedler, 2002; Fiedler & Schenck, 2001). This paradigm has some distinct advantages over other methods. STIs can be shown to be independent of language comprehension. The structure of the experimental task—a verification stage followed by an identification stage—permits one to control and isolate encoding processes (target focus, fit, verb type, modality) from subsequent trait inferences operationally. Moreover, pictorial presentation comes closer to operationalizing raw behaviors than symbolically presented verbal behavior descriptions. In this regard, the moving pictures used in Experiment 3 even more approximated natural raw behaviors than the silhouette pictures in Experiments 1 and 2, which may still be considered static and staged.

STI-like priming effects could be demonstrated not only with static pictures but also with realistic film clips—a demonstration that is missing so far from the large literature on priming effects in person cognition. The very fact that behavioral priming effects in general and STIs in particular can be elicited by primes as complex as films enhances the relevance and external validity of the phenomenon. Indeed, the strength of the priming effects obtained with moving pictures is noteworthy. Apparently, presenting several persons and context features in a film scenario facilitates rich inferences with different attributional implications. Participants exposed to pictures in Experiments 1 and 2 could not anticipate to which target person the trait to be identified referred; participants in Experiment 3 were uncertain about which trait was to be identified after being exposed to a film clip with multiple trait implications. Given such a high amount of uncertainty, it is unlikely that expectancy-driven, strategic processes can account for the strong effects of behavioral priming.

However, of more interest than the strength and the nonstrategic nature of priming effects obtained in this paradigm with pictures and films is the theoretical interpretation that we have tried to advance here and that we believe deserves to be pursued in future research. With reference to an old Lewinian principle, we have started from the basic assumption that increased inferential activity

[4] This finding deviates from Experiment 1 in which inferences of nonmatching traits were slightly faster with nonfitting verbs than fitting verbs. This notable deviation might reflect the higher ambiguity and the corresponding disambiguation advantage of fitting trials in Experiment 2.

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can be explained by open mindsets resulting from incomplete mental jobs, quite analogous to the well-known Zeigarnik (1927) effect. Within the general framework of priming experiments, we have distinguished two ways of inducing an open mindset: distracting participants from a meaningful interpretation of the prime through graphical encoding and letting participants fail on an interpretation attempt using a behavioral probe that does not fit the prime. We could only conceive of one reasonable way to induce a closed mindset, through verifying a fitting probe that affords a meaningful interpretation of the prime. We reasoned that both operational definitions of open mindsets should facilitate trait inferences compared with closed mindsets. Altogether, this led to three distinct and rather counterintuitive implications of the mindset account that could be tested empirically. First, the prediction of a graphical encoding advantage derives from the assumption that a purely graphical encoding task leaves the mindset open and should therefore facilitate subsequent inferences. Second, a facilitation effect should also result from encoding failures on nonfitting verbal encoding tasks, the second means of inducing open mindsets. Third, enhanced inference activities due to truly open mindsets should be manifested in multiple inferences to different traits and targets at the same time.

Encouraging empirical support was found for all three major predictions. The graphical encoding advantage was demonstrated in two experiments, substantiating a tentative finding suggested in an earlier investigation (Fiedler & Schenck, 2001). When the encoding task called for the verification of a purely graphical feature in the prime (i.e., the proportion of black area in the picture), inferences of traits (e.g., aggressive) matching the primed behavior (e.g., an attack) were facilitated more than when the encoding task called for the verification of a semantically fitting verb (e.g., *to attack*). Although counterintuitive, the finding makes sense within the mindset account, because verifying a fitting semantic aspect of the primed behavior closes a mental episode, but judging an irrelevant graphical feature leaves the episode open. We assume that as long as an uninterpreted prime episode is still open, a busy mindset will persevere and support inferential activities directed at reducing the incomplete state. During this crucial period, strong STIs can be expected. Once, however, a reasonable interpretation has been found, a closed mindset will no longer support inferential activities. Such a Lewinian account in terms of different mindsets has received convergent validation in a variety of recent experimental approaches (Marsh, Hicks, & Bink, 1998; Marsh, Hicks, & Bryan, 1999; Rothermund, 2003). It can also assimilate evidence for negative priming effects obtained in various paradigms (Carr & Dagenbach, 1990; Macrae, Bodenhausen, & Milne, 1995; Ratcliff & McKoon, 1996; Tipper, 1985). Having just attached one semantic label to the prime stimulus may actually inhibit subsequent access to alternative semantic categories, even related ones.

Evidence for the second prediction, of enhanced inference activities after encoding failures, served to corroborate and cross-validate the graphical encoding advantage, using an independent manipulation of open mindsets. Because no independent assessment of our explanatory construct, open mindsets, is available, it is important to provide such convergent validation based on independent operationalizations of the same construct. Indeed, we can think of no more direct way of manipulating an incomplete, busy, unclosed mindset than through failures on an attempt to complete a mental job (cf. Wicklund & Braun, 1990). Indeed, STIs were more pervasive when the encoding task did not fit the primed category than when the semantic encoding attempt was successful. To be sure, encoding a fitting verb facilitated inferences to specific traits in the focal target person because of a strong semantic link. However, inferences to traits of a nonfocal person that could not profit from such a semantic link showed the remarkable no-fit advantage.

The third major prediction received general support. Multiple simultaneous inferences were evident with respect to traits of different target persons as well as unpredictable traits that could be inferred from complex, ambiguous film clips. Apparently, the facilitative impact of open mindsets is not restricted to inferences of specific traits that can be anticipated strategically, but multiple inferences are supported in parallel. Nevertheless, in spite of this parallel, unconstrained facilitation effect, we also found evidence for weak constraints, manifested in a weak but regular attribution bias toward the agentive subject person, S, as compared with the more passive person, O (cf. McArthur, 1981).

Several implications for future priming research suggest themselves. In future priming experiments, the impact of deliberate Zeigarnik manipulations may be tested. Independent means of assessing current mindsets may be found, perhaps using neuropsychological methods (Ochsner & Lieberman, 2001). Participants high and low in need for closure (Kruglanski & Webster, 1996) may differ in their propensity to behavioral priming effects. One can also speculate whether the notion of closed versus open mindsets can account for a number of moderators that have been shown to reduce priming effects—such as prime awareness (Lombardi et al., 1987), long presentation (Stapel et al., 2002), exclusion (Schwarz & Bless, 1992), or too specific reference (Dijksterhuis et al., 1998)—and that may all share the tendency to induce closed mindsets that interfere with inferential activity.

In doing future research on behavioral priming effects, overcoming the restriction to verbal stimulus information may be a valuable goal. Using films of more extended behavioral episodes may not only cause strong effects, but may also leave more latitude for the study of rich cognitive processes, contingent on attention focus, manipulated salience, different action roles, spatial-temporal contiguity, and the interplay of verbal and nonverbal factors. Modern multimedia hardware and software are now available and affordable to control and manipulate these factors experimentally. We believe that research and theorizing in social cognition can be enriched, and empirical restrictions imposed by verbal stimulus formats can be overcome as more researchers begin to use these new technologies.

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