



## On the relation between spontaneous trait inferences and intentional inferences: An inference monitoring hypothesis

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### ABSTRACT

More than twenty five years after the beginning of research on spontaneous trait inferences (Winter & Uleman, 1984) an intriguing paradox in the impression formation literature remains: if traits are spontaneously inferred, why aren't they used to organize behavioral information and thereby facilitate recall under memory instructions (Hamilton, Katz, & Leirer, 1980)? We hypothesized that organization by traits is more evident under impression formation goals because only in that case then are inferences sufficiently monitored to permit their use in organizing impressions. As a consequence, such monitored traits can then be used strategically as retrieval cues. Merging the main features of the Winter and Uleman and the Hamilton et al. experimental paradigms, Experiment 1 simultaneously replicated the main results of both studies. Using a new recognition paradigm, Experiments 2 and 3 further tested this *inference monitoring* hypothesis by showing that monitoring of trait inferences only occurs under particular processing goals, and is dependent on the availability of cognitive resources.

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### Introduction

The last two decades have witnessed an impressive amount of research investigating spontaneous trait inferences (STIs; see review by Uleman, Saribay, & Gonzalez, 2008). This research has documented that, as a part of comprehending trait diagnostic behavior, perceivers spontaneously (unconsciously and unintentionally) infer that trait concept and link it to the actor. So a person doing a helpful act is tagged as a helpful person, without any deliberation.

Research on STIs was initiated by the now-classic research of Winter and Uleman (1984). In this research, participants read a series of statements, each of which described a behavior performed by an actor, identified by occupation (e.g., “The plumber slips an extra \$50 into his wife’s purse”). Subsequently, on a cued recall task, participants got cues to help recall the stimulus sentences. Winter and Uleman (1984) found that traits implied by the actor’s behavior (generous) were effective retrieval cues, as effective as semantic associates of the actor’s occupation (pipes).

Winter and Uleman tested whether participants spontaneously infer traits from behaviors, even under conditions that do not induce perceivers to deliberately make trait inferences. Therefore they

introduced their study as a memory experiment, with instructions telling participants they should “study the sentences carefully because they would be tested on them later” (Winter & Uleman, 1984, p. 243). These instructions were intended to specifically deter participants from intentionally forming impressions of the target persons, and were drawn from a research tradition that contrasts processing person information under memory versus impression formation instructions. The finding that traits implied by the behaviors were effective retrieval cues, even under memory instructions, was an impressive demonstration of STIs. Subsequent research raised questions of interpretation (Bassili, 1989, 1993; Bassili & Smith, 1986; Brown & Bassili, 2002; D’Agostino & Beegle, 1996) and, to address them, generated new paradigms for studying STIs (e.g., Carlston & Skowronski, 1994; Carlston, Skowronski, & Sparks, 1995; Todorov & Uleman, 2002, 2003, 2004; Uleman, Hon, Roman, & Moskowitz, 1996). Although some of these issues are still actively debated, the accumulated evidence provides compelling evidence that people do in fact spontaneously infer traits of the actor as a part of comprehending that actor’s behavior.

A few years prior to Winter and Uleman’s (1984) publication, Hamilton et al. (1980) reported studies investigating more integrative aspects of the impression formation process. In this research, participants received either impression formation or memory instructions, followed by a series of behavior-descriptive sentences. The behaviors included four items reflecting each of four different personality traits. Hamilton et al. (1980) found that people who are

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given impression formation instructions remembered more of the behaviors than did those given memory instructions. In addition, impression formation evidenced greater clustering in free recall, in terms of the four personality themes represented in the behaviors, than did memory condition participants. Hamilton et al. reasoned that, given the goal of forming an impression, participants strove to identify the trait themes represented in the behavioral information. Thus, as they encoded the behaviors, they identified the trait reflected in each one and stored behaviors reflecting the same trait in the same memory location. Later, when retrieving those behaviors, they went to one trait node, recalled behaviors stored there, then moved to another trait node and recalled those behaviors, etc. Thus the behavioral information was organized in memory by these trait themes (Hamilton, Driscoll, & Worth, 1989). Presumably, then, the impression formation task led participants to think about the trait themes represented in the behaviors and to organize them accordingly in memory. Those themes then guided the recall of the stored information. In the memory condition, the goal of trying to remember behavior-descriptive sentences did not lead people to focus on the trait implied by each behavior or to group them in memory accordingly. Thus, memory condition participants recalled fewer items, and those recalled were not clustered by trait themes. The findings from these studies are well known and have been replicated in subsequent research.

When considering these two lines of research together, however, an interesting paradox appears. According to Hamilton et al. (1980), participants in their memory condition did not process the behavioral information in terms of trait concepts, which therefore prevented organizing information in terms of trait themes, and consequently led to poorer recall performance in this condition (compared to the impression formation condition). Yet in Winter and Uleman's (1984) research, participants (all of whom were explicitly given memory instructions) did make trait inferences spontaneously as they encoded the behaviors. If a similar process occurred for the memory condition in the Hamilton et al. study, then one would assume that the four behaviors representing each of four traits would have generated four STIs for each of these traits. Yet these STIs apparently did not facilitate later recall of those behaviors in Hamilton et al.'s memory condition. Why not? If inferred traits can serve as effective retrieval cues, and if a given trait is activated multiple times by behaviors reflecting a given trait, then it would seem (based on Winter & Uleman, 1984) that these memory condition participants should show effective retrieval of those behaviors. Yet they did not. The present research examines this paradox and tests a conceptual account of it.

There are, of course, several differences between the Winter and Uleman (1984) and the Hamilton et al. (1980) studies, as they relied on different methods and procedures. By themselves, these methodological accounts of the divergent results would only be of modest interest. But if the divergent results reflected different underlying processes, then they present a more interesting challenge, as we would need to know why these differences occur. Our first step, therefore, was to conduct an experiment in which we tried to produce both effects simultaneously in the same study.

More importantly, we believe that different processes do underlie these divergent outcomes. Our analysis builds on a distinction, initially highlighted by Uleman (1999), between spontaneous inferences and intentional inferences. Intentional inferences are explicit in the sense that (a) they can be consciously accessed and verbalized to others and (b) they occur in impression formation settings where one has an intention to understand the (dispositional) sources of social behavior (Gilbert, 1989, 1998; Smith & Miller, 1983). In contrast, there is now good experimental evidence that spontaneous inferences are implicit impressions that occur in the absence of explicit intentions to make sense of others (Uleman et al., 2008).

As a consequence, the output of intentional inferences (i.e., personality traits) is consciously available — even if the inferential processing underlying it is largely unconscious, efficient, and not controlled. In

contrast, spontaneous trait inferences are typically revealed only when previous experiences (i.e., attending to trait diagnostic behaviors) facilitate performance on a subsequent task without consciously accessing the traits. Their influence on social perception is measured indirectly by looking for their impact on memory (Carlston & Skowronski, 1994; Schacter, 1987; Uleman, Blader, & Todorov, 2005).

In this article we highlight several differences between spontaneous and intentional inferences. Specifically, spontaneous and intentional inferences differ in the catalyst for the inference, the extent of monitoring the inference process, and consequently the use of the inference. (a) As to the catalyst for the inference, spontaneous processes can be triggered by mere observation (Uleman, 1999). That is, they may occur simply when attending to some stimulus, as when one quickly infers that a dog is threatening. In contrast, intentional processes are initiated by intentions to make some judgment, decision, or other kind of analysis, as when one evaluates the suitability of a job candidate. (b) Secondly, intentional inferences entail closely monitoring outcomes of the inference process, because they occur for a conscious purpose. Explicit goals produce awareness and monitoring of otherwise unconscious inferences relevant to these goals. (c) A third difference concerns the use of the inference. Intentional inferences are used toward attaining conscious goals. In contrast, spontaneous inferences are not driven by particular goals, even though they may affect later goal-driven behavior.

Our manuscript is organized in the following way. We first describe a study that produces the primary and apparently contradictory findings of both Winter and Uleman (1984) and Hamilton et al. (1980) in the context of one experiment. We then develop our conceptual framework for explaining the simultaneous emergence of these results. This conceptualization is then tested in two additional experiments.

## Experiment 1

In Experiment 1 we combined the most critical aspects of the Winter and Uleman (1984) and Hamilton et al. (1980) studies into one paradigm. Specifically, Participants were presented with 24 behaviors representing four different trait categories under memory or impression formation instructions. Later, participants were asked to recall the behavior-descriptive sentences. For half of the participants, the four traits were provided as memory cues during the recall task.

Following Winter and Uleman (1984), we predicted that, in the memory condition, providing the cues would increase the number of behaviors recalled. In contrast, the cues should make no difference for the impression formation participants because an impression goal itself naturally leads people to organize information by trait themes, which then facilitate recall. The explicit goal of “forming an impression” calls for (seeks out, sets up a framework to receive) traits. So when traits are inferred from behaviors (as they presumably are under both conditions), these trait concepts are attended to more and used to formulate an explicit, communicable impression, i.e., they are monitored more. Thus providing the traits as explicit cues should offer an advantage to memory Participants in retrieving behaviors from memory, because they help reinstate the encoding context (Tulving & Thomson, 1973; Winter & Uleman, 1984) and are otherwise unavailable. But it offers no additional advantage to impression formation Participants since, in this case, the traits are available and already being used.

Comparing recall and clustering levels between impression and memory conditions, provides an opportunity to replicate the findings of Hamilton et al. (1980), in which impression instructions produced both better recall and more clustering. Adding trait-cued recall conditions should clarify the mechanisms. If memory participants recall more behaviors with trait cues, but show no more clustering than without cues, it would suggest that the traits inferred at encoding went unnoticed (were implicit) and were not used for organizing the behaviors in memory. If only impression formation

(but not memory) participants show *trait clustering* at recall, it would suggest that the level of access to traits inferred at encoding was sufficient to permit their use to organize behaviors in memory (Hamilton et al., 1980), i.e., that trait monitoring was higher. The comparison of the recall and clustering levels between the “no cues condition” and the “trait cues condition” provides a non-obtrusive indication of the degree of monitoring of the (largely automatically) inferred traits.

Note that Hamilton et al. (1980) presented all behaviors as describing the same actor, consistent with typical impression formation studies, whereas Winter and Uleman (1984) presented them as describing different actors. We adopted the former approach in this study.

## Method

### Participants and design

One hundred thirty six undergraduate students from the University of California, Santa Barbara, participated for partial course credit. Participants were randomly assigned to the cells of a  $2 \times 2 \times 3$  factorial design, Processing Goal (impression formation vs. memory)  $\times$  Cue Condition (trait cues vs. no cues)  $\times$  Order of trait cues (order 1, order 2, order 3), with all factors between-participants.

### Materials and procedure

Participants received impression or memory instructions, according to condition. Twenty-four behavior-descriptive sentences were then presented in random order. The 24 behaviors and the corresponding implied traits were taken from existing norms by Stroessner (1989). Instructions informed participants that the 24 behaviors were performed by the same target person (“John”). The list of descriptions was composed of behaviors illustrative of four different personality traits (6 intelligent, 6 friendly, 6 musical and 6 athletic). Each sentence was presented for 8 s. After participants read the behavior descriptions, a 5-min filler task was given to eliminate short-term memory effects. Following the filler task, participants were instructed to write as many of the behavior descriptions as they could remember. In the “trait cues” condition, participants were told that, in order to help them in the free recall task, four words would be provided. They were instructed to use those words as memory cues while recalling the sentences. The four trait words (intelligent, friendly, musical, athletic) were then presented together for 15 s in a new screen. Three orders of cue presentation were created. After 15 s the screen disappeared and participants were instructed to write down the behaviors. In the “no cues condition,” participants recalled the behaviors without any reference to cues. Five minutes were allowed for completion of the recall task. After finishing the experiment, participants were fully debriefed and thanked for their participation.

### Dependent variables

Two dependent measures were assessed. First, overall recall performance was measured by the number of behavior gists recalled. Second, to analyze the extent to which participants imposed a trait organization on the stimulus information, we used the adjusted ratio of clustering (ARC) measure (Roenker, Thompson, & Brown, 1971). The ARC score varies between  $-1$  and  $1$  and measures the degree to which a participant recalls items on a list together in accordance to some underlying categories.<sup>1</sup> Because the behaviors reflecting the various traits were presented in a random order, recall organized by trait categories is evidence that participants imposed an organization on the behavior list.

<sup>1</sup> ARC scores can sometimes be negative and this is generally interpreted as a sign of clustering avoidance. This interpretation is debatable but need not concern us here because our average ARC scores were always positive.

**Table 1**

Free recall and ARC scores as a function of processing goal and cues condition (Experiment 1).

	Free recall			Clustering (ARC)	
	No cues	Trait cues		No cues	Trait cues
Impression formation <sup>a</sup>	10.51	11.05	Impression formation <sup>b</sup>	.22	.24
Memory <sup>c</sup>	7.90	10.14	Memory <sup>d</sup>	.02	.11

<sup>a</sup>  $n = 71$ .

<sup>b</sup>  $n = 63$ .

<sup>c</sup>  $n = 65$ .

<sup>d</sup>  $n = 60$ .

## Results

A  $2 \times 2 \times 3$ , Processing Goal (impression formation, memory)  $\times$  Cue Condition (trait cues, no cues)  $\times$  Order of trait cues (1, 2, 3) ANOVA showed no main effects or interactions involving Order for both free recall and ARC scores. Therefore, this factor will not be further considered.

### Free recall

Mean recall performance for each condition is shown in Table 1. The ANOVA yielded a significant main effect for processing goal, ( $F(1, 132) = 6.22$ ,  $MSe = 16.92$ ,  $p = .014$ ,  $\eta^2 = .04$ ), revealing that participants recalled more behaviors under impression ( $M = 10.78$ ,  $SD = .48$ ) than under memory conditions ( $M = 9.02$ ,  $SD = .51$ ). A main effect for cue condition was also obtained with greater recall being generally observed when trait cues were provided ( $M = 10.59$ ,  $SD = .48$ ) compared with the no-cue condition ( $M = 9.20$ ,  $SD = .51$ ), ( $F(1, 132) = 3.87$ ,  $MSe = 16.92$ ,  $p = .051$ ,  $\eta^2 = .02$ ). Although the interaction between cues and processing goals was not significant, we tested our a priori hypotheses with planned contrasts (one-tailed planned comparisons) specific to those predictions. First, a  $t$ -test comparing recall under impression formation and memory goals when no cues were given showed that participants in the impression condition ( $M = 10.51$ ,  $SD = .69$ ) remembered significantly more behaviors than memory participants ( $M = 7.90$ ,  $SD = .75$ ),  $t(132) = 2.55$ ,  $p < .005$ ,  $SD = 4.11$ ,  $\eta^2 = .05$ . These condition and finding replicate Hamilton et al. (1980). Second, a  $t$ -test comparing recall in the memory condition when cues were or were not presented showed that presentation of cues significantly facilitated recall performance ( $M = 10.14$ ,  $SD = .69$ ) compared to the no cue condition ( $M = 7.90$ ,  $SD = .75$ ),  $t(132) = 2.19$ ,  $p = .03$ ,  $SD = 4.11$ ,  $\eta^2 = .04$ . These condition and result replicate the main finding of Winter and Uleman (1984). Central to our analysis is the comparison between cues conditions under each goal. We hypothesized that, whereas cues would facilitate recall in a memory condition (as just reported), they would make no difference for impression participants. As shown in Table 1, participants given impression formation instructions recalled the same number of behaviors with ( $M = 11.05$ ,  $SD = .68$ ) and without trait cues ( $M = 10.51$ ,  $SD = .69$ ),  $t < 1$  (one-tailed planned comparisons).<sup>2</sup> Thus, the recall data conform exactly to our predictions.

### Clustering

The level of clustering in free recall was measured using the adjusted ratio of clustering score (ARC; Roenker et al., 1971). The ARC score cannot be calculated when all items recalled are from the same category or when only one item is recalled from each category. Also,

<sup>2</sup> We used one-tailed planned comparisons in data analysis of the three experiments here reported to test our a priori hypothesis that implied specific differences between conditions. When no differences were expected we also used the same one-tailed planned comparisons since a two-tailed planned comparison could favor confirmation of our hypotheses of no differences.

the ARC score is a biased measure when the number of intrusions is very high. For these reasons, 13 participants<sup>3</sup> were dropped.

The 2 × 2, Processing Goal (impression formation vs. memory) × Cue Condition (trait-cues, no-cues) ANOVA yielded a significant main effect due to processing goal,  $F(1, 119) = 3.71$ ,  $MSe = .19$ ,  $p = .056$ ,  $\eta^2 = .03$ . The level of clustering (see Table 1) was significantly higher under impression instructions ( $ARC = .23$ ) than under memory instructions ( $ARC = .08$ ). More importantly, this difference was marginally significant within the no cues condition ( $ARC = .22$  and  $.02$ , respectively),  $t(119) = 1.52$ ,  $p = .06$ ,  $SD = .44$ ,  $\eta^2 = .02$  (one-tailed planned comparisons). These results replicate the findings reported by Hamilton et al. (1980).

More relevant to our present concerns is the fact that, as predicted, the interaction between processing goal and cue condition was not significant,  $F(1, 119) < 1$ . In the impression formation condition, cues made no difference in the level of clustering exhibited ( $ARC_{\text{nocues}} = .22$  and  $ARC_{\text{cues}} = .24$ ),  $t < 1$ . The mean ARC scores differed significantly from zero independently of cues being provided ( $\neq 0$ ,  $t(31) = 3.75$ ,  $p < .001$ ,  $SD = .35$ ), or not provided ( $\neq 0$ ,  $t(32) = 2.61$ ,  $p = .01$ ,  $SD = .35$ ). This indicates that under an impression formation goal, participants recalled the behaviors clustered by trait, regardless whether trait cues were or were not provided. In the memory condition, trait cues slightly increased trait clustering ( $ARC_{\text{nocues}} = .02$  and  $ARC_{\text{cues}} = .11$ ), but this difference was not significant,  $t < 1$  (one-tailed planned comparisons). Also, this level of clustering did not significantly differ from zero in either case. Thus, given a memory processing goal, even when cues were provided, participants did not use the underlying trait structure to organize recall.

## Discussion

The results of Experiment 1 document, within a single experiment, the paradox we referred to in the introduction to this article. Consistent with Winter and Uleman (1984), providing trait cues implied by the stimulus behaviors facilitated recall of those behaviors. Consistent with Hamilton et al. (1980), impression condition participants recalled more stimulus behaviors and their recall was more clustered according to the implied traits than was true for memory condition participants. Thus, people made spontaneous trait inferences (even under memory instructions) but did not use those inferred traits to organize the behavioral information, and therefore recalled fewer items.

These results are consistent with our hypotheses derived from a distinction between spontaneous and intentional inferences (Uleman, 1999). Spontaneous trait inferences are made as behavioral information is encoded, even under memory instruction conditions. They are not the product of conscious intent, and typically are made without the perceiver's awareness. Nevertheless, when those inferred traits are subsequently presented as retrieval cues, they facilitate recall of the behavioral information (Winter & Uleman, 1984) due to encoding specificity (Tulving & Thomson, 1973). Spontaneous inferences do not require specific intentions at encoding, but simply occur as automated procedures whenever appropriate stimuli are encountered (e.g., Smith, 1984). So these inferences are not purposive or goal-driven in the sense that traits are not intentionally inferred to serve a further purpose. They can be useful for retrieving information associated with them (such as the behaviors from which they were inferred), but are not readily used for other purposes. As the clustering data show, they are not spontaneously used as a basis for organizing behavioral information according to the inferred traits.

<sup>3</sup> These participants were distributed between conditions in the following way: 5 participants from the Impression formation condition with cues; 2 from the memory condition with cues; 3 from the memory condition with no cues; and 3 from the Impression formation condition without cues.

In contrast, intentional inferences are purposive. Because they are triggered by a conscious goal or task, they actively engage attentional processes and participate in more deliberative and purposive analysis than do spontaneous inferences. Consequently they are more accessible to conscious awareness than are spontaneous inferences. Moreover, they are used to facilitate goal completion. The goal of forming an impression of a person is to understand the themes that define that personality. Thus the trait inference process is in the service of that goal, and the inferred traits are used as a basis of organizing that impression. Therefore behaviors reflecting the same underlying trait are stored together in memory and hence are retrieved together, producing the greater degree of clustering in free recall.<sup>4</sup>

In our view, spontaneous and intentional inferences, although sharing the same largely automatic inferential processes that allows for the efficient extraction of traits from trait implying behaviors, differ in attentional focus on the outcomes of these initial processes. Unlike spontaneous inferences, intentional trait inferences (e.g., occurring under impression formation goals) direct attention to the inferred traits, allowing explicit access to them and their subsequent use in goal attainment. In other words, intentional attentional focus monitors the inferential outcomes during encoding and during processing aimed at goal completion (e.g., impression development).

Some well-known research by Chartrand and Bargh (1996; see also McCulloch, Ferguson, Kawada & Bargh, 2008) may seem to contradict our argument about the role of inference monitoring under an impression goal. In their study, participants who have unconsciously primed impression formation goals show no awareness of goal priming, and yet they reproduce the standard pattern of results shown by participants who are explicitly asked to form impressions of the personality of a given target. However, that lack of awareness of the source of goal priming does not in any way challenge our inference monitoring hypothesis. After all, there must be many times in which we "catch" ourselves forming impressions of the personality of a passerby with no idea of what triggered such mental endeavor. What is crucial to our argument is that a goal of impression formation, once explicitly (or implicitly) triggered, will induce monitoring of the degree of ongoing goal attainment (i.e., forming an impression), and thus will make the information relevant to this goal (e.g., inferred traits) available for later strategic use.

## Overview of Experiments 2 and 3

The proposed inference monitoring hypothesis may be seen as a new instantiation of a more general activation-monitoring framework that has been used to explain other inferential phenomena in memory research (e.g., Roediger & McDermott, 1995) that is now extended to the domain of personality trait inferences. A central claim of this approach is that people usually do not directly retrieve information from memory. Rather, activated memory records are evaluated and attributed to particular sources via decision processes occurring at retrieval (Johnson, Hashtroudi, & Lindsay, 1993). One common way to study the cognitive mechanisms of source monitoring is to use experimental memory paradigms in which participants' performance is dependent on their ability to differentiate between test items they actually recall and items that seem familiar or come to mind from other sources.

Therefore, to further study the implications of the inference monitoring hypothesis we developed a memory paradigm in which

<sup>4</sup> Klein and Loftus (1990) have proposed a different interpretation for the trait-behavior clustering results. They are assumed to reflect a retrieval strategy that participants adopt at recall instead of being the result of a trait-behavior organization during encoding. Although we do not fully subscribe to this interpretation, this issue is of little relevance for the inference monitoring hypothesis tested here. The fact remains that trait-behavior clustering only occurs when inferred traits are closely monitored and consciously accessed.

participants are presented with trait-implicating behavior descriptions (including the implied traits or not). As in previous studies (e.g., D'Agostino, 1991; D'Agostino & Beegle, 1996; Winter & Uleman, 1984), each behavior is performed by a different actor. However, in contrast to previous research, the recognition task was a forced choice between two versions of trait implicative behavior descriptions that were identical in every respect except that one included the corresponding trait and the other did not. For each pair, only one was included in the study phase, and participants were instructed to choose the version actually presented during study. By presenting at test the same sentences that were presented during encoding, we keep everything constant at recall except the (presence or absence of the trait) sentences that implied trait. As a result, this forced-choice task guarantees that the best possible cues would be used to prompt the retrieval of the trait inference monitoring processes hypothesized to occur during encoding while controlling for all other aspects concerning memory for the sentences. It is thus a method particularly sensitive to differences in the monitoring of trait inferences which allow us to conduct a rigorous test of the inference monitoring hypothesis, according to which inferred traits are likely to be closely monitored under impression formation but not under memory goals.

Specifically, we reasoned that spontaneous trait inferences are expected to increase false recognition of traits in sentences previously presented without traits due to source confusion, in which internally generated memory traces are confused with externally generated memory traces (Johnson & Raye, 1981; Johnson et al., 1993). Internally generated traces often include a record of the cognitive operations performed in their generation. Hence, the presence or absence of the record of mental operations that generated the memory trace is a useful cue for source discrimination. However, internally generated traces that require little cognitive effort are more likely to be judged later as having been actually presented than those that require more awareness or attract more attention (Finke, Johnson, & Shyi, 1988; Johnson, Raye, Foley, & Foley, 1981). We argue that such is the case for spontaneous trait inferences (easily performed and requiring little attention) versus intentional inferences (that entail more thorough monitoring).

As a result, spontaneous trait inferences at study should lead to more forced choice errors at test, when trait implying sentences (that do not include the traits) is mistaken for sentences that do include the implied traits. However, intentional trait inferences (occurring under impression formation goals) should direct attention to the inferential process, allowing explicit access to the inferred traits.

In sum, according to our inference monitoring hypothesis, an impression formation goal induces participants to allocate attention to the inferred traits during encoding, which should reduce source confusion during the recognition test by providing diagnostic cues for judging whether traits were actually in the studied sentences or were just inferred (Johnson et al., 1993; Lindsay, 2008). Therefore the increased monitoring of the inferences characteristic of intentional, compared to spontaneous, inferences should facilitate discrimination between these two possibilities and therefore increase accuracy of response. Experiments 2 and 3 tested this hypothesis.

## Experiment 2

In *Experiment 2*, participants under memory or impression formation instructions read a series of trait implicative behaviors, each performed by a different actor. Half of the behaviors implied a trait that was not included in the sentence; in the other half the trait was explicitly included in the sentence. After a distracter task participants were asked to choose, in a forced choice paradigm, between two versions of each original sentence, identical in every respect except that one included the implied trait and the other did not. Our main dependent measures were the proportion of false recognitions for trait-implicative descriptions originally presented

without the implied trait, and the proportion of correct recognitions (hits) for trait implicative descriptions originally presented with the implied trait. To test our idea that inference monitoring leads to better memory (i.e., better discrimination between when the traits were and were not present in the sentences), we looked for more hits (for sentences with traits) and fewer false recognitions (for sentences without traits) in the forced choice task.<sup>5</sup>

We hypothesized that the ability to discriminate between hits and false alarms in the forced-recognition task would be better for participants in the impression formation condition than for those in the memory condition. Specifically, if an impression formation goal induces greater inference monitoring, then it should facilitate making this differentiation, resulting especially in a reduction in false recognitions. Thus, we predicted less false recognition under impression than under memory instructions.

Moreover, whereas spontaneous trait inferences stem from relatively automatic processes triggered by trait implying behaviors regardless of participants' conscious goals, the monitoring of such inferences is predicted to be dependent on appropriate processing goals (e.g., impression formation). If this reasoning is correct, then impression formation goals should promote more inference monitoring activity than memory goals without affecting the more automatic component of trait inferences. In other words, the largely automatic initial trait inferences should not be affected by the processing goals manipulation.

To test for this dissociation we used the process dissociation procedure (PDP; Jacoby, 1991). This procedure makes use of an inclusion memory test in which automatic and controlled retrieval act in concert and an exclusion memory test in which the two processes act in opposition (Jacoby, 1991; Jacoby, Toth, & Yonelinas, 1993). Assuming that both retrieval processes contribute to test performance and operate independently, estimates of the contribution of each retrieval component can be obtained by comparing performance across the two conditions.

The PDP procedure has been applied to several tasks in social cognition as a general tool for separating estimates of the contributions of automatic and controlled processes in task performance (Ferreira, Garcia-Marques, Sherman, & Sherman, 2006; Jacoby, Kelley, Brown, & Jasechko, 1989; Jennings & Jacoby, 1993; Lambert et al., 2003; McCarthy & Skowronski, 2011b; Payne, 2001, 2005; Payne, Jacoby, & Lambert, 2005). We used the PDP to assess both the automatic (A) and controlled (C) components of trait inference during impression formation and memory goals by estimating C, which is assumed to reflect the inference monitoring process, and A, which reflects the more automatic trait inference process.

We used sentences that included the implied trait to create the inclusion condition and sentences that did not include the implied trait to create the exclusion condition.<sup>6</sup> More specifically, the proportion of hits in the forced recognition task for sentences previously presented with the implied trait (i.e., choosing the "sentence with trait" when that sentence did include a trait) measures performance in the inclusion condition. Hits on these trials may be based on C or merely on A in the absence of controlled processes,  $(1 - C)$ . Both contribute to the hit rate, which is therefore given by the general equation  $C + A * (1 - C)$ . The proportion of false recognitions for sentences presented without the implied traits (i.e., choosing the "sentence with trait" when that sentence did not include a trait) measures performance in the exclusion condition since, in this case, the two processes act in opposition. In other

<sup>5</sup> Analyzing only false recognitions could result in confusing discrimination with bias, i.e., impression formation. Participants could merely show a stronger tendency to say that the sentences did not include the traits, which would lead to fewer false recognitions, but also to fewer hits and hence not reflect more accurate discrimination.

<sup>6</sup> The sentences used in the inclusion and exclusion conditions were always sentences with neutral continuations.

words, incorrect choices are based on A in the absence of C. Thus false recognition rates are given by  $A * (1 - C)$ .

According to our framework, the C component should reflect the inference monitoring that occurred during encoding. The largely automatic inferential process, triggered by trait-implicating behavior descriptions and reflected in the A component, is expected to occur regardless of intentional inference monitoring. One way to test this hypothesis is to create conditions that promote inference monitoring such as impression formation goals that are supposed to do in comparison to memory goals. We thus predicted that impression formation goals would decrease false recognitions as well as augment the PDP controlled component C, while leaving the automatic component A largely invariant across processing goals. [Experiment 2](#) tested these predictions.

## Method

### Participants

Fifty five undergraduates from the Department of Psychology at the University of Lisbon participated for partial course credit. Participants were randomly assigned to between-subjects replication conditions.

### Design

The design was a  $2 \times 2 \times 4 \times 2$  factorial with Processing Goal (memory or impression formation), Implied Trait (present or absent), List (1, 2, 3, and 4), and Order of items in each list (order 1, order 2) as factors. Instruction Type, List and Order were between-subjects factors whereas Implied Trait was a within-subject factor.

### Stimulus materials

Twenty four trait-implicating descriptions were selected from those developed and pretested by [Ferreira, Morais, Ferreira, and Valchev \(2005\)](#). Descriptions had the following general structure: *trait implying sentence (including or not including the implied trait) + sentence continuation (neutral or situational)*. As such, each description had four different versions. For example, the description, “John is so curious that he asked his father where the stars came from *when he looked at the sky*” (trait-implicating sentence including trait; neutral continuation), had three more versions: “John asked his father where the stars came from *when he looked at the sky*” (trait-implicating sentence without including trait; neutral continuation); “John is so curious that he asked his father where the stars came from *since that was one of the questions on his homework*” (trait-implicating sentence including trait; situational continuation); and “John asked his father where the stars came from *since that was one of the questions on his homework*” (trait-implicating sentence without including trait; situational continuation). (Sentences were presented without italics.) All 24 descriptions implied a different trait and were paired with different targets identified by their first names.

Each behavior description had either a situational or neutral continuation. Varying the continuation was intended to help maintain high attention levels throughout the study phase. Descriptions with neutral continuations were used as target items and descriptions with situational continuations were used as filler items. Neutral continuations in themselves add no relevant information to the behavior descriptions and were used solely to keep these sentences of approximately the same lengths as sentences with situational continuations. We pretested and selected descriptions that implied the same trait with high levels of consensus (for details see [Ferreira et al., 2005](#)).

### Procedure

Each experimental session included 6 to 8 participants. Approximately half of the participants received memory instructions, indicating that they should pay attention to the exact words of the sentences in order to remember them later. The remaining participants received impression formation instructions. They were told to

carefully read the behavior descriptions and to form an impression of the actor in each one since they would be questioned about these actors' personalities afterwards.

In the first part of the experiment, each participant received a booklet containing 24 trait-implicating behavior descriptions, each one including or not including the implied trait and with a neutral or situational continuation. Since each sentence had four different versions (with or without trait, neutral or situational continuation), four different lists of sentences (corresponding to different booklets) were created to manipulate these two aspects orthogonally and between-subjects. Each list was presented in two different random orders. The same list included only one version for each sentence, with the additional constraint that no more than two sentences of the same version were presented in the same serial position. Participants studied the behavior descriptions at their own pace. After finishing reading the booklet, they worked on a distracter task for 10 min.

Participants were then told that for the next task, the original sentences would be presented again but without their continuations. They received a second booklet with each page containing the two versions of the same sentence, one with and the other without the implied trait. Only one of the versions had been presented before. Participants had to choose the version they had seen earlier. They made their choices at their own pace with the constraint that they could not go back and change previously-made choices. Then participants were fully debriefed and thanked for their participation.

### Dependent variables

The dependent measures were derived from participants' performance on the forced-choice recognition task for trait implying (neutral continuation) trials.<sup>7</sup> The manipulation of whether the implied trait was or was not included in the stimulus sentence, and participants recognition responses, allowed us to score their performance for accuracy. Specifically, the dependent variables were the number of hits for trait-implicating sentences that included the trait and the number of false recognitions for trait-implicating sentences that did not include the trait.

To arrive at the individual C and A estimates, the proportions of forced choice errors (false recognitions) on trait-implicating sentences previously presented without traits (exclusion condition) and the proportion of forced-choice hits on trait-implicating sentences presented with the implied trait (inclusion condition) were obtained for each participant, and were then used to compute individual estimates of controlled and automatic processes from PDP Eqs. (1) and (2) ([Jacoby, 1991](#)):

$$\text{Correct choices (hits), for sentences with traits} = C + A * (1 - C) \quad (1)$$

$$\text{Incorrect choices (false recognitions), for sentences without traits} \\ = A * (1 - C) \quad (2)$$

### Results and discussion

Preliminary analyses showed no Order or List effects for PDP estimates of C and A, and no Order or List effects for correct recognitions of traits for sentences that included implied traits (hits), but they showed both Order and List main effects for false recognitions of implied traits for sentences presented without the traits ( $F(1,53) = 3.93, p = .01, MSe = 0.04, \eta^2 = 0.19$ ; and  $F(1,53) = 3.99, p = .05, MSe = 0.05, \eta^2 = 0.07$ , respectively). However, because neither of them interacted with Instruction Type (both  $F_s < 1$ ), the

<sup>7</sup> We centered our analysis in sentences with neutral continuations because situational continuations might have changed the type of processing (e.g., invoke attributional reasoning). Nevertheless the analysis for sentences with situational continuations shows the same results pattern.

**Table 2**

Mean proportion of hits of presented traits and false recognitions of implied traits as a function of processing goals (Experiment 2).

	Hits	False recognitions
Impression formation <sup>a</sup>		
M	.85	.14
SD	.18	.16
Memory <sup>b</sup>		
M	.81	.27
SD	.19	.26

<sup>a</sup>  $n = 25$ .

<sup>b</sup>  $n = 30$ .

following analyses collapsed across these factors. Data analyses testing the experiment's main hypotheses that included both List and Order factors showed the same pattern of results as presented below.

An ANOVA was performed on target hits and false recognitions (not filler items) with Processing Goal as a between-subjects factor and Implied Trait (present, absent) as a within-participants repeated measure. The analysis revealed a significant Implied Trait main effect  $F(1,53) = 224.85$ ,  $p < .001$ ,  $MSe = 0.05$ ,  $\eta^2 = 0.81$ , reflecting high general accuracy: high hits for sentences that included the trait ( $M = 0.83$ ) and low false recognitions for trait-implying sentences without the trait ( $M = 0.21$ ). A Processing Goal X Implied Trait interaction was also significant,  $F(1,53) = 4.69$ ,  $p = .03$ ,  $MSe = 0.05$ ,  $\eta^2 = 0.08$ , such that forming impressions led to both a lower rate of false recognition and a higher hit rate than Memory instructions (see Table 2). More importantly, a one-tailed planned comparison documented the predicted result, namely, that false recognition of implied traits was significantly lower under the impression formation than the memory goal,  $t(53) = 2.22$ ,  $p = .015$ ,  $SD = .22$ ,  $\eta^2 = 0.09$ .

This planned comparison showed that false recognition of implied traits was lower when forming impressions. This result is consistent with our interpretation that impression formation goals direct attention to the inferences during encoding, allowing greater access to the inferred traits and facilitating monitoring by providing diagnostic clues to judge whether traits were actually presented in the stimulus sentences or were only inferred from those behaviors.<sup>8</sup>

#### PDP estimates

Planned comparisons testing our specific hypotheses showed that impression formation when compared to memory goals produced a significant increase in C,  $t(43) = 1.92$ ,  $p < 0.03$ ,  $SD = .28$ ,  $\eta^2 = .08$  but did not affect A,  $t(32) < 1$ <sup>9</sup> (see Table 3).

<sup>8</sup> As already noticed, sentences with situational continuations were used merely as filler items. Although we are not the first to use situational information in combination with target sentences (e.g. Lupfer, Clark, & Hutcherson, 1990; Van Overwalle, Drenth, & Marsman, 1999), the main predictions stemming from the proposed monitoring hypothesis are not dependent on the use of different types of continuations. Therefore, we replicated Experiment 2 using the same material but without continuations (situational or neutral). The same results pattern was found. Forming impressions again led to both a lower rate of false recognition and a higher hit rate. More importantly, false recognition of implied traits significantly decreased under impression formation ( $M = .09$ ) when compared to memory goals ( $M = .14$ ) –  $t(56) = 1.75$ ,  $p = .04$ ,  $SD = .02$ ,  $\eta = 0.05$ ; one-tailed planned comparisons. This replication provided further support for the monitoring hypothesis by showing that our results are not dependent on the use of neutral and situational continuations.

<sup>9</sup> Six participants from the impression formation condition and 4 from the Memory condition of Experiment 2 were not included in the PDP analysis because their performance was perfect. However, computing the estimates including these participants (with C = 1 and A = 0, the most extreme case of control in total absence of automatic processes) did not change the results of either the invariance of  $A - M = .40$  for impression formation condition,  $M = .45$  for the Memory condition;  $t(53) < 1$  – or the increase in  $C - M = .71$  for impression formation condition,  $M = .53$  for the Memory condition;  $t(53) = 2.17$ ,  $p < 0.02$ .

**Table 3**

C and A estimates as function of Instructions (Experiment 2).

	C	A
Impression formation <sup>a</sup>	.58	.71
Memory <sup>b</sup>	.38	.68

<sup>a</sup>  $n = 19$ .

<sup>b</sup>  $n = 26$ .

The invariance of A across processing goals suggests that the automatic component of trait inferences at encoding is the same regardless of memory or impression formation instructions. In both cases traits are being inferred. However, a decrease in false recognition of implied traits was observed for the impression formation condition and this is consistent with higher inference monitoring. By closely monitoring their largely automatic inferential activity, Impression formation participants gained explicit access to its outputs, the personality traits; which led to less false recognitions and better memory discrimination.<sup>10</sup>

### Experiment 3

Whereas spontaneous trait inferences are relatively automatic, we assume that the monitoring of such inferences depends both on appropriate processing goals (e.g., impression formation as in Experiment 2) and also on available cognitive resources. If this reasoning is correct, then a cognitive load at encoding would impair the inference monitoring component of intentional impression formation, but not the automatic trait inference component, leading to more false recognition errors.

Using the same procedure and materials as Experiment 2, Experiment 3 tested this prediction by manipulating cognitive load during the study phase, using a procedure similar to that of Winter, Uleman, and Cunniff (1985). Scarcity of cognitive resources under impression formation should weaken trait monitoring more than the automatic component of trait inferences. To test for this dissociation Experiment 3 used the PDP to test the impact of cognitive load on both the automatic and controlled processes of trait inference during impression formation.

According to our framework, the C component should reflect the inference monitoring that occurred during encoding. The largely automatic inferential process, triggered by trait-implying behavior descriptions and reflected in the A component, is expected to occur regardless of intentional inference monitoring. One way to test this hypothesis is to create conditions that disrupt inference monitoring. Putting participants under a concurrent cognitive load during encoding should have this effect (e.g., Johnson et al., 1993). We predicted that cognitive load would produce an increase in false recognition errors, as well as a decline in the PDP C component, while leaving the automatic component A largely invariant across levels of cognitive load. Experiment 3 tested these predictions.

<sup>10</sup> As noted by two reviewers, other research using the false recognition paradigm and manipulating memory versus impression formation goals (Todorov & Uleman, 2002, Experiment 4; McCarthy & Skowronski, 2011b, Experiment 1, which also used the PDP) failed to find differences in false recognitions and discrimination (and differences in the C component of the PDP, in the case of McCarthy & Skowronski) as function of the two processing goals. We attribute these failures to the lack of sensitivity of the false recognition paradigm to show differences in trait inference monitoring. Since it was not designed to test a hypothesis of inference monitoring, this paradigm fails to provide memory cues diagnostic enough to prompt the retrieval of the trait inference monitoring processes hypothesized to occur during encoding. Future research may further clarify these differences in results.

## Method

### Participants

Seventy eight undergraduates from the Department of Psychology at the University of Lisbon participated in Experiment 3 for partial course credit. Participants were randomly assigned to between-subjects conditions.<sup>11</sup>

### Design

The design was a  $2 \times 2 \times 4 \times 2$  factorial with Cognitive Load (high, low), Implied Trait (present, absent), List (1, 2, 3, 4), and Order of items in each list (1, 2) as factors. Cognitive Load, List and Order were between-subject variables whereas Implied Trait was manipulated within-subjects. Experiment 3 uses the same dependent measures as Experiment 2.

### Materials and procedure

The same 24 descriptions used in Experiment 2 were again used as target items, whereas another 24 from Ferreira et al. (2005) pretesting were used as filler items. Filler items were equivalent to target items (i.e., they appeared in four different versions – trait-implicative descriptions including or not the implied trait and with a neutral or situational continuation) but they did not appear on the recognition test.

The procedure was similar to that of Experiment 2 except for the following features. Only impression formation instructions were used. Instead of using booklets, descriptions were presented on a computer screen. Presentation time of each behavior description was pre-tested to allow enough reading time, and it was set to 6 s. The stimulus information was organized in 12 blocks of four descriptions each (plus an introductory practice block). In each block the two initial descriptions were fillers and the remaining two were target descriptions (12 blocks  $\times$  2 target items per block = 24 targets overall). Since each sentence had four different versions (with or without trait, and with neutral or situational continuation), as in Experiment 2, four different lists of sentences were created to manipulate presence or absence of the implied trait, and type of continuation (neutral or situational), between subjects. Each list was presented in two different random orders. No more than two sentences of the same version were serially presented in any block.

After receiving impression formation instructions, participants were further told that to simulate impression formation in the real world, where one's attention is simultaneously captured by different stimuli, they also had a second concurrent task involving memory for numbers. Before each block, a 2-digit number (low-load condition) or a 7-digit number (high-load condition) was presented for 6 s, followed by the four descriptions. Participants were instructed to form impressions of the actors based on behavior descriptions while rehearsing the numbers. At the end of each block, participants were prompted to write down the number previously presented.

Upon completion, the same procedure used in Experiment 2 was followed. Participants solved a similar distracter task and finally were tested in the same forced-choice paradigm. Then they were fully debriefed and thanked for their participation.

### Results and discussion

Preliminary analyses showed no Order or List effects for PDP estimates of control and automatic processes, and for hits (correct recognitions of traits for sentences that included implied traits) and

<sup>11</sup> Due to erroneous assignments in some of the experimental sessions more participants were assigned to the high load condition than to the low load condition. We ended up with 49 participants in the high load condition and 29 participants in the low load condition.

**Table 4**

Mean proportions for hits of presented traits and false recognitions of implied traits as a function of cognitive load (Experiment 3).

	Hits	False recognitions
High load <sup>a</sup>		
<i>M</i>	.68	.35
<i>SD</i>	.20	.22
Low load <sup>b</sup>		
<i>M</i>	.76	.25
<i>SD</i>	.21	.21

<sup>a</sup>  $n = 49$ .

<sup>b</sup>  $n = 29$ .

false recognitions (of traits for sentences that did not include implied traits), so these results are not discussed further.

An ANOVA was performed with Cognitive Load as the between-subjects variable and Implied Trait and Continuation Type as repeated measures. The analysis revealed an Implied Trait main effect,  $F(1, 76) = 135.86$ ,  $p < .001$ ,  $MSe = .05$ ,  $\eta^2 = .64$ , reflecting high general accuracy: a high level of hits for sentences that included the trait ( $M = .71$ ) and a low level of false recognitions for trait-implicative sentences without the trait ( $M = .31$ ). A Cognitive Load  $\times$  Implied Trait interaction was also significant,  $F(1, 76) = 6.04$ ,  $p = .02$ ,  $MSe = .05$ ,  $\eta^2 = .07$ , indicating that high cognitive load led to both a lower rate of correct recognition of presented traits and a higher rate of false recognition of implied traits (see Table 4 for mean values). Thus, the cognitive load manipulation had the expected effects. More importantly, and as predicted, false recognition of implied traits increased as a result of cognitive load,  $t(76) = 1.99$ ,  $p = .02$ ,  $SD = .22$ ,  $\eta^2 = .05$ .

Participants who made many errors in their memory for the 7-digit numbers may not have been engaged in the cognitive load memory task. Hence, ANOVA and planned comparisons were redone, eliminating participants who made more than 25% errors on the memory task ( $n = 25$ ). The pattern of results was basically unchanged. A Cognitive Load  $\times$  Implied Trait interaction was significant,  $F(1, 51) = 5.30$ ,  $p = .02$ ,  $MSe = .05$ ,  $\eta^2 = .09$ , indicating a lower rate of correct recognition for High cognitive load ( $M = .67$ ) when compared to low cognitive load ( $M = .76$ ) and a higher rate of false recognition under high load ( $M = .35$ ) than under low load ( $M = .25$ ). Cognitive load also led to a significant increase in false recognition,  $t(51) = 1.84$ ,  $p = .04$ ,  $MSe = .21$ ,  $\eta^2 = .06$ .

### PDP estimates

Planned comparisons testing our specific hypotheses showed that greater cognitive load (changing from 2 to 7-digit numbers) produced a significant reduction in C,  $t(74) = 1.96$ ,  $SD = .30$ ,  $p = .03$ ,  $\eta^2 = .05$  (one-tailed planned comparisons), whereas it left A unchanged,  $t(74) < 1$  (Table 5).<sup>12</sup>

Eliminating the 25 participants who made more than 25% errors in recalling the load number and the 2 whose memory was perfect (see Footnote 8) showed the same pattern of results. Cognitive load led to a significant decrease in controlled processes, from C (low load) = .48 to C (high load) = .32,  $t(49) = 1.91$ ,  $p = .03$ ,  $SD = .30$ ,  $\eta^2 = .07$ , but did not affect A,  $t(49) < 1$ .

As predicted, we observed an increase in false recognition of implied traits under high load compared to low load. This result seems to stem from the negative impact of cognitive load on inference monitoring, which is a controlled and effortful cognitive activity. On

<sup>12</sup> Two participants in the Low-Load condition of Experiment 3 were not included in the PDP analysis because their performance was perfect. Following the same procedure as Experiment 2 and computing the estimates including these participants (with  $C = 1$  and  $A = 0$ , the most extreme case of control in total absence of automatic processes) did not change either the invariance of  $A - M = .48$  for the Low Load,  $M = .52$  for the High Load condition,  $t(76) < 1$  – or the decrease in  $C - M = .33$  for the Low Load,  $M = .51$  for the High Load condition,  $t(76) = 2.46$ ;  $p < 0.02$ .

**Table 5**  
C and A estimates as function of cognitive load (Experiment 3).

	C	A
High load <sup>a</sup>	.33	.52
Low load <sup>b</sup>	.48	.52

<sup>a</sup>  $n = 49$ .

<sup>b</sup>  $n = 27$ .

the other hand, the largely automatic component of trait inferences at encoding, was virtually unaffected by cognitive load.

Previous research concerning the effects of cognitive overload on STIs has so far produced mixed results (e.g., Chun, Spiegel, & Kruglanski, 2002; Todd, Molden, Ham, & Vonk, 2011; Uleman, Newman, & Winter, 1992; Winter et al., 1985). The use of PDP to study the distinction between a largely automatic component of trait inferences and the more controlled inference monitoring processes may contribute to clarifying this issue. Only the automatic component of trait inferences should show invariance across different levels of cognitive overload. However, contaminated measures of automatic inferential processes are likely to occur when this component is equated with the performance on certain tasks, instead of using mathematical procedures as in the PDP. The problem is that experimental tasks are rarely (if ever) process-pure measures (Conrey, Sherman, Gawronski, Hugenberg, & Groom, 2005; Jacoby, 1991). As a result, the impact of cognitive overload may vary considerably across different task and experimental conditions used to study the automatic nature of STIs. Use of PDP may help move beyond this problem.

## General discussion

The purpose of the present research was to address an intriguing paradox in the impression formation literature. If traits are spontaneously inferred, even when participants are given memory task instructions (e.g., Winter & Uleman, 1984), why would participants in the memory condition of Hamilton et al.'s (1980) study not use those trait inferences to organize behavioral information and thereby facilitate recall? We hypothesized that organization by traits occurs under impression formation goals because the highly efficient inferences that typically take place without intention are closely monitored, leading to explicit access to and use of the inferred traits that otherwise influence behavior only implicitly.

This *inference monitoring hypothesis* was tested in three related experiments, using three different paradigms selected for their theoretical relevance to the hypothesis. In Experiment 1, we combined the essential features of the Hamilton et al. (1980) and Winter and Uleman (1984) studies into one paradigm and replicated the main findings of both studies. Thus, consistent with Winter and Uleman, cued-recall of stimulus behaviors by participants in the memory condition was facilitated by trait cues implied by these behaviors. Consistent with Hamilton et al., under the same memory instructions participants free-recalled fewer behaviors and there was no sign of significant clustering according to the implied traits. Together, these findings indicate that participants under memory instructions did produce STIs, but the inferred traits were not used to organize the behavioral information. Only participants with impression formation goals showed trait clustering at recall.

STIs are implicit inferences triggered by trait implying behaviors. We believe that, given an impression formation goal, trait inferences are driven by an intention to make sense of the main themes underlying a personality. Intentional trait inferences may share the same overlearned and relatively automatic process involved in spontaneously inferring a trait from a trait-implying behavior (Ham

& Vonk, 2003; Krull & Erickson, 1995). However, the output of these inferences is now closely monitored, allowing explicit access to the inferred traits as well as their use in attaining the goal of forming an impression. Explicit goals produce awareness and monitoring of otherwise unconscious inferences relevant to those goals.

Inference monitoring has further implications for performance in other experimental paradigms often used in STI research, such as the false recognition paradigm (Todorov & Uleman, 2002, 2003, 2004). In this paradigm, spontaneous trait inferences are expected to increase false recognition of traits in sentences previously presented without traits due to source confusion, (Johnson & Raye, 1981; Johnson et al., 1993; Lindsay, 2008). More to the point, internally generated traces that require little cognitive effort are more likely to be judged later as having been actually presented than those that require more awareness or attract more attention (Finke et al., 1988; Johnson et al., 1981). We argue that such is the case for spontaneous trait inferences (easily performed and requiring little attention) versus intentional inferences (that entail more thorough monitoring).

Specifically, monitoring of the inference process, which is characteristic of intentional compared to spontaneous inferences, should direct attention to the inferential process, allowing explicit access to the inferred traits, which subsequently facilitate discrimination between behavior descriptions that include or do not include the implied trait.<sup>13</sup>

Hence, impression formation goals should reduce false recognition of implied traits since these goals actively engage the inference monitoring process. To test this prediction, Experiment 2 used a forced-choice paradigm in which participants' task was to indicate which of two behavior descriptions (with or without the implied trait) had been presented previously. We reasoned that awareness of the inferred trait (due to inference monitoring) should reduce source confusion (Johnson et al., 1993; Lindsay, 2008). In other words, it should help to discriminate between two sources of trait activation: inferential activity during encoding and actually reading the trait in the sentence. As expected, we found better memory performance (and fewer false recognitions) in the forced choice task under impression formation than under memory task goals.

Given the constraints on human attentional resources, we further reasoned that even when adequate processing goals (such as impression formation) are engaged, explicit access to the inferred traits cannot happen if cognitive resources are depleted by another attention-consuming activity. Thus, forming impressions under conditions of high (compared to low) cognitive load was predicted to degrade memory performance in the forced-choice task. Experiment 3 tested this prediction by instructing participants to form impressions based on trait-implying descriptions while rehearsing seven-digit numbers (high-load condition) or two digit numbers (low-load condition). As expected, participants in the high load condition had poorer performance on the forced-choice task and were significantly more prone to false recognition of implied traits than were participants in the low-load condition.

### *Dissociating the impact of automatic inferential activity and inference monitoring on the recognition of trait-implying behaviors*

The notion of a largely automatic inferential process engaged in trait inferences, coupled with effortful inference monitoring, can be reasonably inferred from performance on the forced-choice task in Experiments 2 and 3. However, participants' performance on the forced-choice task cannot be used to test for the invariance of the automatic component of trait inferences across levels of monitoring. To test for this dissociation, in Experiments 2 and 3, we used the

<sup>13</sup> We define inference monitoring as an intentional and effortful activity. However, the broader concept of source monitoring includes many decisions some of them made rapidly and relatively nondeliberatively others involving controlled and deliberate processing and decisions (e.g., Lindsay, 2008).

process dissociation procedure (Jacoby, 1991; Jacoby et al., 1993). Specifically, we used PDP to test the impact of impression formation as opposed to memory instructions (Experiment 2) and the impact of cognitive load (Experiment 3) on the largely automatic process of trait inference and the largely controlled inference monitoring process. It was predicted that cognitive load would affect monitoring, which would lead to a decrease in controlled inferential processes (C), while leaving the automatic component of trait inferences (A) largely unchanged.

Trait-implicative behavior descriptions that included the trait were used as the inclusion condition (since both PDP components converge on the same response in this case) and descriptions that did not include the trait were used as the exclusion condition (since C and A lead to opposite responses in this case). In Experiment 2, impression formation goals significantly increased participants' monitoring ability, as indicated by an increase in C. In Experiment 3, increasing cognitive load while forming impressions of personality, by increasing rehearsal from two to seven numbers, significantly reduced participants' monitoring ability, as indicated by a decrease in control. On the other hand, levels of A were virtually unaffected by memory or impression formation goal settings or by the cognitive load manipulation. This result suggests the presence of a largely automatic process of trait inferences under impression formation (probably the same process involved in the production of STIs) that was largely invariant when comparing participants who were intentionally inferring traits to participants who were merely reading the same trait implying sentences for a later memory test, and across levels of cognitive load. Such process dissociation provides converging support for our inference monitoring hypothesis.

#### *Impression formation goals and the extraction of meaning*

The inference monitoring hypothesis guiding the present experiments is based on the assumption that impression formation goals increase attention to relevant processing outputs (inferred traits), and consequently source monitoring is better under impression formation than memory conditions. This argument might seem at odds with the point of view of the text comprehension literature, in which abstract goals such as forming impressions emphasize extracting meanings (gists) and neglecting surface features (e.g., O'Brien & Albrecht, 1992). Such a contradiction may be more apparent than real. In fact, the sentences used in virtually all research on spontaneous trait inferences are behavior descriptions pre-tested and selected to strongly imply certain personality traits. Our results show that the extraction of such meanings occurs spontaneously in both impression formation and memory conditions. Only when participants go beyond this initial stage of text comprehension and are consciously trying to form impressions of the targets are these abstract meanings explicitly accessed. The result is better discrimination between explicitly saying that someone is curious, or just implying it through a behavior that merely entails curious as one possible (even if highly probable) interpretation. These nuances go unnoticed under memory instructions, in which the extraction of meaning occurs equally spontaneously but only implicitly. In this way inference monitoring accounts for when trait inferences will and will not be used in subsequent tasks (Hamilton et al., 1980; Winter & Uleman, 1984).

It may also be important to note that the goal dependent nature of inference monitoring implies nothing with respect to the "origins" of goal activation. Goals, as mental representations (Bargh, 1990), can be consciously or unconsciously primed. Moreover, others (Chartrand & Bargh, 1996; McCulloch, Ferguson, Kawada, & Bargh, 2008) have shown that impression formation goals can be nonconsciously activated. Nevertheless, under impression formation goals, inferences that typically occur without intention are monitored, leading to explicit access to and use of the inferred traits that otherwise affect behavior only implicitly.

Earlier, in summarizing differences between intentional and spontaneous inferences, we noted that these two kinds of inferences differ in their use. Intentional inferences are purposive; they are made in the course of achieving some goal (e.g., forming an impression). Spontaneous inferences, in contrast, simply occur in the course of comprehending behavior; they occur without intention and (often) without awareness. Once made, however, spontaneous inferences can be used for other purposes, for example, as effective retrieval cues (Winter & Uleman, 1984).

A similar distinction has been drawn by Hamilton (1998) in discussing differences between attributional (causal) and dispositional (descriptive) inferences. Attributional inferences typically are intentional, deliberative, and conscious, made in response to the question "Why?", for the purpose of understanding the cause of some behavior. In contrast, dispositional inferences, while they may be intentional, are often spontaneous, as in STIs, triggered by some behavior but not for the purpose of understanding causality. They involve moving quickly and spontaneously "from acts to dispositions" (Jones & Davis, 1965). It is for this reason that Hamilton (1998) argued that Jones & Davis (1965) Correspondent Inference Theory is a theory of dispositional inference, but not a theory of causal attribution, as correspondent inferences can be made without any consideration of causality. Moreover, STIs are in many respects indistinguishable from intentional inferences (McCarthy & Skowronski, 2011a), and certainly need not involve inferences about causation. Once made, however, the STI can be used for other purposes (as in Winter & Uleman, 1984). In this case, the dispositional inference can then serve an attributional function. If and when the attributional question "Why?" arises, the already-made STI provides a highly accessible answer: the actor is "that kind of person," that is, has a disposition or trait that readily explains the behavior from which the spontaneous inference was based. Traits can be causal concepts (Kressel & Uleman, 2010), but they are not always activated by causal reasoning.

Suppose, for example, you observe (or read) that "Bob carried the heavy boxes for the elderly man." An STI is made that Bob is helpful. This is a dispositional inference but, since it is not based on intentional causal analysis, it is not an attribution. However, if someone asks "Why did Bob help the elderly man?", the accessibility of the already-made STI is likely to facilitate (speed up) generating an explanation ("He is helpful").

Thus an STI, once made, can be used for another purpose. Interestingly, reliance on STIs in this way biases the perceiver toward internal, personal causation, a bias that would produce the kinds of data that generated the well-known fundamental attribution error (FAE). In this case, however, the FAE occurs in the absence of any deliberate consideration of the causes of behavior but is a byproduct of the spontaneous inference process.

#### *Inference monitoring and differences in processing depth*

The notion that intentional and spontaneous inferences involve different levels of inference monitoring may be contrasted with an alternative and somewhat more trivial account of the present results. Namely, it could be argued that, compared to a memory condition, impression formation relative to memory instructions leads to processing the available information in a deeper or more elaborate way. Such an account would readily explain the better recall of impression formation relative to memory participants (Experiment 1) and, in the same vein, it could perhaps be extended to explain the similar advantage of impression formation participants in the forced recognition test (Experiment 2). Moreover, if we presuppose that under impression formation, participants would be more likely to form associations between items that illustrate the same trait than under memory instructions and that these associations are

subsequently used to guide recall, this account could even explain the corresponding differences obtained in clustering (Study 1).<sup>14</sup>

Our inference monitoring account agrees that the processes underlying impression formation and memorization differ in depth of processing or in level of elaboration. But depth of process is not a viable alternative to our inference monitoring hypothesis. Putting aside the well-known limitations of the depth of processing approach (e.g., *Baddeley, 1978*), inference monitoring addresses both a very specific type of elaboration – trait inference monitoring and its consequences. This degree of specificity is necessary to account for our full set of results for several reasons.

First, mere quantitative differences in processing depth cannot readily explain why, in *Experiment 1*, trait inferences would lead these behaviors to be organized in terms of clusters that illustrate the same trait for impression formation participants but not for memory participants. As such, the addition of the above presupposition seems ad hoc. In addition, it would also fail to explain why the provision of trait retrieval cues would make the recall advantage of impression formation participants go away. By assuming explicit access to the traits under impression formation but not under memory conditions, the inference monitoring hypothesis accounts for both of these results.

Second, in the case of *Experiment 2*, the generic depth of processing alternative account could perhaps predict the general recognition performance of impression formation relative to memory participants but *not* the lower level of false recognitions found in the former condition. In fact, a straightforward prediction stemming from this alternative account would be that the increase in processing depth would lead to a decrease in false recognitions. This is because “errors” in the false recognition paradigm (*Todorov & Uleman, 2002*) are typically seen as a measure of trait inferences and thus should be expected to occur not only for spontaneous inferences but also, at least at the same level, when trait inferences are intentionally drawn. Instead, we found less false recognitions for impression compared to memory participants. The proposed inference monitoring hypothesis can reconcile this apparent contradiction. Spontaneous and intentional inferences are indeed equally likely to happen because they share the same initial inferential process.<sup>15</sup> However, this process is closely monitored and its output (traits) is explicitly accessed only under impression formation goals, which allows for better recognition performance.

Third, although the process dissociation results of *Experiments 2 and 3* are difficult to explain in terms of a continuum of depth of processing, they further support an inference monitoring hypothesis. As already mentioned the invariance in the PDP automatic processing component suggests that an initial largely automatic inferential process, occurs regardless of participants' attentional resources or depth of processing. However, a decrease in depth of processing caused by the cognitive load manipulation specifically affected controlled processes (a measure of explicit memory) for the traits, suggesting the impairment of inference monitoring.

#### *Further tests of the inference monitoring hypothesis*

Recently, *Wigboldus, Dijksterhuis, and Van Knippenberg (2003)* used the probe recognition paradigm to present actors of trait implying behaviors associated with category labels that could be stereotype congruent or incongruent with the behaviors. For instance, *the Professor or the garbage man, won the science quiz*. On critical trials the probe word was the trait implied by the behavior (e.g., *smart*).

<sup>14</sup> We are grateful to John Skowronski and Randy McCarthy for making this point in their review of a previous version of this paper.

<sup>15</sup> The notion that STIs and intentional inferences share the same (or similar) initial automatic inferential process is in line with recent fMRI research by *Ma, Vandekerckhove, Van Overwalle, Seurinck, and Fias (2011)*.

Results showed that STIs are inhibited by the activation of an incongruent stereotype, suggesting a more malleable and context independent view of STIs. Thinking more broadly about our inference-monitoring hypothesis in the context of stereotypical expectancies, notice that inference-monitoring has a dual nature. First traits are inferred in a fast and largely automatic way. Then these inferences are monitored (i.e., attention is focused on the output of the inferential process) if there is a conscious goal which trait inferences might advance. Presenting a congruent or incongruent stereotype (e.g., “the professor/garbage man won the chess tournament”) may affect (promote or inhibit) the largely automatic trait inference component of STIs, as research by *Wigboldus et al. (2003)* seems to suggest. However, stereotypes incongruent with the traits implied by the behaviors may also activate inference monitoring, due to the conflicting information, which would decrease false alarms and/or increase response times to correct answers. The same monitoring activity would be more shallow when the stereotypes are congruent with the traits implied by the behaviors, leading to more false alarms in this case. Our future research will test for this and related predictions, to explore the inference-monitoring hypothesis in more socially rich contexts. Like *Wigboldus et al. (2003)*, we believe that STIs have been studied in a social vacuum. Such an approach hardly reflects the social reality outside the laboratory. People usually have knowledge about the social groups to which the actors belong, and about salient social categories, such as their age, gender, and ethnicity.

#### **Conclusion**

The proposed inference monitoring hypothesis not only has fared well empirically in the three experiments we have reported but also possesses considerable theoretical integration power. This hypothesis accounts for the pattern of results presented here in a coherent and integrated fashion. It explains the effect of variables such as processing goals and availability of cognitive resources on memory performance (in these studies, both cued recall and recognition); it describes how STIs and inference monitoring interact; it begins to specify antecedent conditions under which spontaneous inferences are and are not likely to be used and to impact subsequent processes; and it is able to resolve previous apparent contradictions in past research on spontaneous trait inferences and person memory. There is, of course, much more to be done to further clarify the issues explored in the present research. For example, future research could explore the differential impact of spontaneous inferences versus inferences that are monitored and explicitly encoded on subsequent social behavior. Results obtained in these studies suggest real benefits from that further research.

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