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ENCODING FLEXIBILITY REVISITED: EVIDENCE FOR ENHANCED ENCODING OF STEREOTYPE-INCONSISTENT INFORMATION UNDER COGNITIVE LOAD

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This experiment tested two key components of the Encoding Flexibility Model of stereotyping. Results demonstrated that a cognitive load increased the attention paid to stereotype-inconsistent information, and decreased the attention paid to stereotype-consistent information. Cognitive load also enhanced the perceptual encoding of inconsistent information while diminishing the perceptual encoding of consistent information. Implications of these results for the role of efficiency and the interaction of motivation and ability in social cognition are discussed.

The idea that stereotypes perpetuate themselves through confirmatory biases has attained the status of an axiom of social psychology. This principle is affirmed in every major social psychology textbook, and is a central organizational theme in prominent reviews of the stereotyping literature (e.g., Fiske, 1998; Hamilton & Sherman, 1994; Hilton & von Hippel, 1996). A common corollary to this theme is the notion that these confirmatory biases ought to be particularly evident when perceivers suffer from diminished processing capacity.

One such bias concerns the processing of stereotype-consistent and inconsistent information. It has been suggested that, particularly when processing resources are depleted, consistent information is more thoroughly attended to and encoded than inconsistent information. This proposal originates from two separate considerations. First, because it fits with an existing expectancy, stereotype-consistent information is simply easier to

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comprehend than stereotype-inconsistent information and is therefore more likely to be successfully encoded into memory, particularly when resources are low and encoding is difficult. In this way, stereotypes act as passive filters that permit the processing of consistent information and block the processing of inconsistent information under low-capacity conditions (Bodenhausen & Lichtenstein, 1987; Macrae, Hewstone, & Griffiths, 1993; Stangor & Duan, 1991; Stangor & McMillan, 1992).

Second, motivational concerns have been proposed to direct resources away from inconsistent and toward consistent information when resources are low. In particular, principles of selective exposure suggest that people prefer to not attend to information that challenges their beliefs if they do not have the resources to counterargue that information (see Frey, 1986, for a review). In addition, so-called "cognitive miser" views of social cognition suggest that people are further motivated by the desire to exert as little effort as necessary in forming social impressions (for reviews, see Sherman, Lee, Bessenoff, & Frost, 1998; Sherman, Macrae, & Bodenhausen, 2000). Together, these motives have been suggested to lead perceivers to actively avoid stereotype-inconsistent information (which challenges beliefs and is difficult to comprehend) when capacity is depleted, and to shift attention to consistent information (which confirms beliefs and is relatively easily understood). In this way, stereotypes act as active filters that promote the processing of consistent information and diminish the processing of inconsistent information under low-capacity conditions (Bodenhausen, 1988; Bodenhausen & Lichtenstein, 1987; Bodenhausen, Macrae, & Garst, 1997; Fiske & Neuberg, 1990; Hamilton & Sherman, 1994; Macrae, Milne, & Bodenhausen, 1994; Stangor & Duan, 1991; Taylor & Crocker, 1981).

THE ENCODING FLEXIBILITY MODEL

There can be no dispute that there are many self-perpetuating biases in the processing of stereotype-relevant information, and that a number of these biases are more prevalent when processing capacity is depleted (Sherman et al., 1998, 2000). However, recent findings indicate that there are important exceptions to these generalities. These findings cast significant doubt on the motivated "active" filter model and suggest that the comprehension-based "passive" filter model fails to provide a complete account of the processing of consistent and inconsistent information. In particular, Sherman and his colleagues (Sherman, 2001; Sherman & Frost, 2000; Sherman et al., 1998) have provided evidence that attention, in fact, shifts toward inconsistent information and away from consistent information when resources are depleted. To account for these results, Sherman et al. (1998) proposed the Encoding Flexibility Model (EFM) of stereotyping.

According to the model, when resources are low, concerns for efficiency more so than concerns for defense or sloth drive the use of stereotypes. Efficiency is defined as the ratio of product gained (in this case, social information) to energy expended. As such, the EFM argues that processing is not wholly biased toward either consistent or inconsistent information when capacity is low. Rather, different aspects of consistent and inconsistent information are encoded in order to maximize the amount of information gained for the effort expended.

Because it fits with a prior expectancy and is easily understood, consistent information enjoys an advantage in conceptual encoding. That is, perceivers are more able to extract the abstract, gist meaning of consistent than inconsistent information, particularly when resources are depleted. This is precisely the point made by the passive filter models. However, according to the EFM, because consistent information is relatively easy to comprehend and confirms prior knowledge, it receives relatively little attention, and the details of the information are not carefully encoded (see also Johnston & Hawley, 1994; von Hippel, Jonides, Hilton, & Narayan, 1993). Instead, having extracted the basic gist, attention can be redirected toward other items of information that are not so easily understood, including inconsistent information. Thus, as processing capacity is depleted, consistent information enjoys relatively greater conceptual encoding than inconsistent information. At the same time, attention and perceptual/contextual encoding (encoding of the physical details and contextual specifics of the stimulus) shift away from consistent and toward inconsistent information. Together, these flexible encoding processes maximize the joint encoding of consistent and inconsistent information. The conceptual advantage for consistent acts ensures that their essential abstract meaning is extracted for possible use, whereas the attentional and perceptual/contextual shifts toward inconsistent acts aid in the comprehension of these behaviors and help to ensure that, even if their abstract meaning cannot be extracted, at the least they will remain available for later inspection, consolidation, and potential use. These flexible encoding processes are particularly likely to be observed when resources are low, and the need for efficiency is most acute.[1]

There is abundant evidence for a conceptual encoding advantage for consistent information when capacity is depleted. For example, a

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1. A number of theories predict that inconsistent information is processed more thoroughly and encoded more completely than consistent information under normal processing conditions, as perceivers attempt to explain the unexpected events and/or integrate them into their impressions and group stereotypes (e.g., Allport, 1954; Bodenhausen & Wyer, 1985; Fiske & Neuberg, 1990; Hastie & Kumar, 1979; Sherman & Frost, 2000; Srull & Wyer, 1989). However, only the EFM proposes that this difference would be enhanced, rather than diminished, when capacity is depleted.

number of studies have shown that target trait judgments are more stereotypical when target information is learned under low-capacity conditions (e.g., Bodenhausen, 1990; Bodenhausen & Lichtenstein, 1987; Gilbert & Hixon, 1991; Kruglanski & Freund, 1983; Macrae et al., 1993; Pratto & Bargh, 1991). Other research has shown that free recall favors consistent over inconsistent information when the content is learned with diminished capacity (Bodenhausen & Lichtenstein, 1987; Macrae et al., 1993; Sherman & Frost, 2000; Stangor & Duan, 1991). Furthermore, Sherman et al. (1998) showed that stereotypic traits were more likely to be primed by relevant behaviors than counterstereotypic traits under low-capacity encoding conditions. Finally, Wigboldus, Sherman, Franzese, and van Knippenberg (in press) have shown that perceivers are more likely to spontaneously infer traits from consistent than inconsistent behaviors when resources are depleted. Each of these measures reflects the extent to which the meaning of consistent and inconsistent behaviors has been activated during encoding (for reviews, see Roediger, 1990; Sherman et al., 1998).

Evidence of shifts in encoding away from consistent and toward inconsistent information under low-capacity conditions is far less prevalent. As mentioned above, tentative support for the attentional hypothesis was provided by Sherman et al. (1998, Experiments 1 and 2). Relying on reading times and responses to a dual-task probe paradigm, these experiments showed that participants devoted relatively greater attention to inconsistent than consistent information when capacity was constrained compared to when it was full. However, one important limitation of these experiments is that the stimulus behaviors were presented sequentially. Thus, consistent and inconsistent items did not directly vie for attention. The attentional hypothesis would be supported more convincingly if the relative advantage for inconsistent information came at the direct expense of attending to consistent information.

Experiment 3 conducted by Sherman et al. (1998) did present consistent and inconsistent behaviors simultaneously. The results showed that participants enjoying full processing capacity at encoding subsequently recognized inconsistent items slightly more accurately than consistent ones. However, when processing capacity was depleted, the recognition advantage for inconsistent items was much greater. The drawback to this experiment, however, was the use of recognition memory as the dependent measure. Although recognition memory reflects the extent to which information has been accurately encoded and represented in memory, it is not a direct measure of attention. Beyond attention, recognition differences between consistent and inconsistent items may also reflect differences in item familiarity or recollection (e.g., Jacoby, Toth, &

Yonelinas, 1993), differences in perceptual or conceptual encoding (e.g., Richardson-Klavehn & Bjork, 1988), different response criteria for the items, and a variety of other decision processes (e.g., Green & Swets, 1966). Thus, strong evidence for the attentional hypothesis of the EFM remains elusive.

There currently is no evidence to support the perceptual/contextual encoding hypothesis of the EFM. Using a word identification task, Sherman et al. (1998, Experiment 4) provided evidence of greater perceptual encoding of inconsistent than consistent behaviors. However, counter to predictions, this effect was not moderated by the availability of processing capacity. In discussing this result, Sherman et al. noted that implicit measures of perceptual encoding, such as the one used in their experiment, had been shown to be unaffected by variations in attentional demand (Mulligan, 1998; Mulligan & Hartman, 1996), and, as such, could not be expected to show the predicted interaction.

OVERVIEW AND PREDICTIONS

The purpose of the present experiment was to seek direct support for both the attentional and perceptual encoding hypotheses of the EFM. Participants were asked to form an impression of a target that belonged to a stereotyped group. Half of the participants were placed under a cognitive load as they formed their impressions. The information about the target was presented in pairs, with one item on the left side of the screen and one item on the right side. Following the presentation of each pair, an × appeared on either the left or right side of the screen. Participants' task was to press either a key marked "left" or a key marked "right" as quickly as possible upon the appearance of the × to indicate on which side of the screen the × had appeared. Among the pairs of behaviors were four that included one stereotype-consistent and one stereotype-inconsistent behavior. For these pairs, the × appeared on the side of the screen corresponding to the side on which either the consistent or inconsistent item had appeared. Interest centered on participants' latencies to respond to the × as a function of processing capacity and whether the × appeared in the same position as the consistent or inconsistent behavior. These latencies measure the extent to which participants were attending to the consistent and inconsistent items of a pair when the × appeared. The more attention being paid to a particular item, the less time it should take to respond to an X probe that appears in the same position as that item (e.g., Bradley, Mogg, White, Groom, & de Bono, 1999).

When processing capacity is depleted, participants' ability to process both items is significantly constrained. In this case, participants are pressured to attend selectively to one or the other item of the pair. We predicted that the depletion of resources would be associated with an increasing likelihood to attend to the inconsistent rather than the consistent item. As such, compared to participants with full capacity, those in the low-capacity condition should respond relatively more quickly to X probes that appear in the same position as inconsistent rather than consistent items. This prediction is not made by the passive filter model, and is in direct contrast to that of the active filter model, which predicts that, as attentional capacity is diminished, participants ought to increasingly direct attention away from inconsistent information and toward consistent information because it is nonthreatening and easy to comprehend.

Following this initial task, some participants were asked to complete a graphemic cued-recognition measure. In this task, participants were presented with a list of words on a sheet of paper. Some of the words on the sheet were similar graphemically to words that had appeared in the behavioral descriptions during the impression formation task (e.g., *shell* was presented as a cue for the word *shelf*, which had appeared in one of the behavioral descriptions). Participants were asked to circle only the items that looked like words that had been presented in the impression formation task. Of importance, none of the cued words were related to the conceptual meanings of the behaviors (e.g., the word *shelf* is unrelated to the meaning of the sentence: Didn't help the short lady reach for an item on the top shelf).

This is a measure of perceptual rather than conceptual encoding because participants rely on the physical attributes of the cues rather than their semantic content in order to perform the task (e.g., Blaxton, 1989; Mulligan, 1998; Roediger, 1990). The status of this task as perceptual rather than conceptual has been validated in a number of experiments. For example, Challis, Velichkovsky, and Craik (1996) showed that performance on the task was not sensitive to a "levels of processing" (LoP) manipulation. That is, increasing the semantic processing of the stimuli did not enhance performance on the task. Sensitivity to LoP manipulations is one of the key criteria in distinguishing between conceptual and perceptual measures: Conceptual measures are sensitive, perceptual measures are not. In other studies, Mulligan (1998) showed that performance on the task was enhanced for items that were perceptually similar to studied words, but not for items that were semantically related to studied words. This confirms that, as instructed, participants relied on the perceptual features of the cue words, and not their conceptual meanings, in performing the task. Thus, the measure is well established as a measure of perceptual encoding.

The graphemic cued-recognition measure also is an explicit measure of memory because participants are directed to think back to the original information and try to remember it (e.g., Mulligan, 1998; Roediger, 1990). They are aware that their memory is being tested, and they are intentionally trying to remember. Because it is an explicit measure, performance should be influenced by variations in attentional capacity during learning, a prediction confirmed by Mulligan (1998). This is in contrast to the implicit measure of perceptual memory used by Sherman et al. (1998), which failed to provide evidence of sensitivity to attentional capacity. In the current experiment, we expected that, compared to participants with full capacity, those in the low-capacity condition would demonstrate relatively better identification of graphemic cues when the cued words had been included in inconsistent rather than consistent behaviors. Again, this prediction is not made by the passive filter model, and is in contrast to that of the active filter model, which predicts that, as processing capacity decreases, inconsistent information should receive diminished processing of all kinds.[2]

METHOD

PARTICIPANTS

One-hundred and ninety-six Northwestern University students participated in the experiment in exchange for partial credit in an introductory psychology course.[3]

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2. *Nota Bene*: The Encoding Flexibility Model has been misconstrued as necessarily predicting greater attentional and perceptual processing of inconsistent than consistent information when resources are depleted (i.e., a simple main effect in the low-capacity condition). In fact, the model predicts only an interaction; that relatively greater attention and perceptual processing will be devoted to inconsistent information as processing capacity is diminished. Given different behaviors, different stereotypes, different participants, different recent events, etc., inconsistent information may draw more, less, or an equal amount of attention and perceptual processing than consistent information when resources are full (i.e., at baseline). Whatever the baseline, the key prediction is that a cognitive load will shift these processes toward inconsistent information (i.e., there should be an interaction). This prediction is not made by the passive filter model, and is in direct contrast to active filter models, which predict that a cognitive load will shift processing away from inconsistent and toward consistent information.

3. Of the 196 participants, only 92 completed the X probe attention task during stimulus encoding. Thus, whether or not participants performed the X probe task during encoding was a between-subjects factor in considering the graphemic cued-recognition data. This factor produced no effects and was subsequently excluded from analysis of the recognition data.

MATERIALS AND PROCEDURE

Participants were asked to engage in an experiment on impression formation. They were told that they would be reading information that had been drawn from a magazine article about a person named Bob Hamilton, and that we were interested in how people form impressions based on simultaneous exposure to multiple pieces of information. Bob was described as either a skinhead or a priest who lived in Chicago. The descriptions of Bob consisted of 24 behaviors, eight of which were pretested to be kind (e.g., "gave a stranger a quarter to make a phone call"), 8 of which were pretested to be unkind (e.g., "shoved his way to the center seat in the movie theater"), and 8 of which were pretested to be irrelevant to the kind-unkind dimension (e.g., "bought a new shirt"). For participants in the skinhead condition, the unkind behaviors were stereotype-consistent and the kind behaviors were stereotype-inconsistent; the reverse was true for participants in the priest condition. Thus, the same behaviors (and graphemic cue words) served as both stereotype-consistent and inconsistent stimuli, depending on the target.[4]

The behavioral stimuli were presented on participants' computer screens in pairs, with one behavior on the left and one behavior on the right side. Each pair was presented for 3 s. Previous research indicates that such a pace would force participants to be selective in attending to the behaviors, particularly when under load (Sherman et al., 1998). Of the 12 pairs of items, 4 contained consistent and inconsistent behaviors, 4 contained consistent and irrelevant behaviors, and 4 contained inconsistent and irrelevant behaviors. For the key consistent/inconsistent pairs, whether the × appeared on the consistent or inconsistent side of the screen was a between-subjects factor. Two different sets of item pairings were presented as a between-subjects stimulus replication.

For participants completing the X probe task, at the conclusion of the 3-s item presentations, an × appeared on either the left or right side of the computer screens. Participants were instructed to press keys marked "left" or "right" as quickly as possible to indicate on which side of the screen the × had appeared. The response times were recorded by the computers and served as one of the dependent measures. Prior to the impression formation task, these participants were trained in performing the X probe task with a series of pairs of items

4. This experiment was conducted prior to the highly publicized 2002 sexual abuse scandals involving American priests.

that were irrelevant to the main experiment. Participants not performing the X probe task simply read the item pairs and formed an impression of the target.

As they formed their impressions and performed the X probe task, half of the participants were placed in a low-processing capacity condition. These participants were further informed that the experiment was concerned with people's ability to perform multiple tasks at the same time. A cognitive load was manipulated by asking these participants to hold an 8-digit number in memory as they performed the impression formation and X probe tasks. This manipulation has been used successfully in past research to deprive participants of processing resources (e.g., Sherman & Frost, 2000; Sherman et al., 1998). As a means of assessing compliance, these participants were asked to write down the 8-digit number on a slip of paper at the end of the impression formation/X probe task.[5]

At the end of the impression formation/X probe task, participants were given a 5-min filler task in which they were asked to solve a series of puzzles. Finally, following the procedure established by Mulligan (1998), participants were given a sheet of paper with 50 words on it. They were informed that some of the words looked like words that had appeared in the behaviors during the impression formation task. After being given a few experiment-irrelevant examples, they were asked to circle those words. Among these words were four that were graphemically related to words that had appeared in kind behaviors and five that were related to words that had appeared in unkind behaviors from the kind/unkind pairings. The proportions of these words identified served as the other dependent measure.[6]

RESULTS

X PROBE REACTION TIMES

To test the hypothesis that relatively greater attention is paid to inconsistent than consistent information when capacity is depleted, reaction times to X probes that followed the presentation of consistent/inconsis-

5. Because no participants incorrectly reported more than four of the digits, all were retained for analyses (e.g., Sherman et al., 1998).

6. During analyses, it was discovered that one of the filler items in the recognition task was, in fact, graphemically related to a word from an unkind behavior. Thus, analyses included the five words from unkind behaviors and the four words from kind behaviors.

tent pairings were analyzed.[7] All means are reported in milliseconds. Incorrect responses to the X probe (2%) and reaction times greater than 2.5 standard deviations above the mean for all responses (4%) were removed from analyses. As a result, two participants' reaction time data could not be analyzed due to empty cells. The remaining latencies were submitted to a 2 (target: skinhead vs. priest) × 2 (processing capacity: high vs. low) × 2 (type of item preceding the X probe on the same side of the screen: consistent vs. inconsistent) × 2 (stimulus replication: A vs. B) × 2 (site of probe: left vs. right side of screen) Analysis of Variance (ANOVA) with repeated measures on the last factor. This analysis yielded the predicted interaction between processing capacity and item type, $F(1, 74) = 4.42$, $p < .05$ (see Figure 1). Somewhat surprisingly, subsequent analyses demonstrated that in the high-capacity condition, participants required more time to respond to X probes following inconsistent ($M = 494$) than consistent ($M = 426$) items, suggesting that greater attention was paid to the consistent items of the pairs, $F(1, 37) = 5.84$, $p < .05$. However, as expected, this pattern was reversed in the low-capacity condition, with participants requiring more time to respond to X probes following consistent ($M = 458$) than inconsistent ($M = 439$) items, although the simple effect was not reliable. Further analyses demonstrated that responses to X probes following inconsistent items were marginally faster in the low-capacity than the high-capacity condition, $F(1, 36) = 3.07$, $p < .10$. In contrast, responses to probes following consistent items were slower in the low- than the high-capacity condition, although not reliably so. This interaction demonstrates that, compared to their counterparts with full-processing capacity, participants with limited capacity devoted relatively greater attention to the inconsistent than the consistent item in the pair.

7. Only data from the consistent/inconsistent pairs were analyzed. The irrelevant items were different from the consistent/inconsistent items in two key ways. First, these items lacked relevance for any particular trait and were much less rich in terms of social meaning. Second, the irrelevant items were much shorter than the consistent/inconsistent items. Thus, any differences found in the processing of the irrelevant and consistent/inconsistent items could be attributable to either of these factors, rather than to stereotype relevance per se. As a reminder, the consistent and inconsistent items were identical to one another, their stereotypicality determined by the group membership of the target. As such, comparisons between these pairs of items are perfectly controlled for extraneous variables across target type.

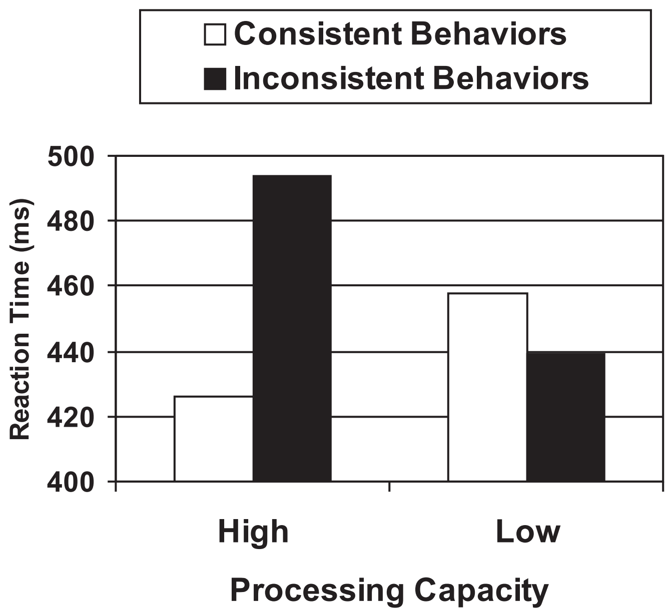

FIGURE 1. Mean X probe reaction time latencies as a function of processing capacity and stereotypicality of the behavior preceding the probe.

GRAPHEMIC CUED-RECOGNITION TASK

To test the hypothesis that diminished processing capacity enhances the perceptual encoding of inconsistent relative to consistent behaviors, the proportions of correct probes circled corresponding to words in consistent and inconsistent behaviors were analyzed. One participant failed to complete this task and was excluded from analyses. These proportions were submitted to a 2 (target: skinhead vs. priest) × 2 (processing capacity: high vs. low) × 2 (probe type: probes corresponding to words contained in consistent vs. inconsistent behaviors) ANOVA with repeated measures on the last factor. This analysis demonstrated the predicted interaction between processing capacity and probe type, F (1, 191) = 4.27, $p < .05$ (see Figure 2). Subsequent analyses demonstrated that in the high-capacity condition, participants recognized a greater proportion of consistent (M = .26) than inconsistent (M = .23) probe words, although this difference was not reliable. In contrast, in the low-capacity condition, participants recog-

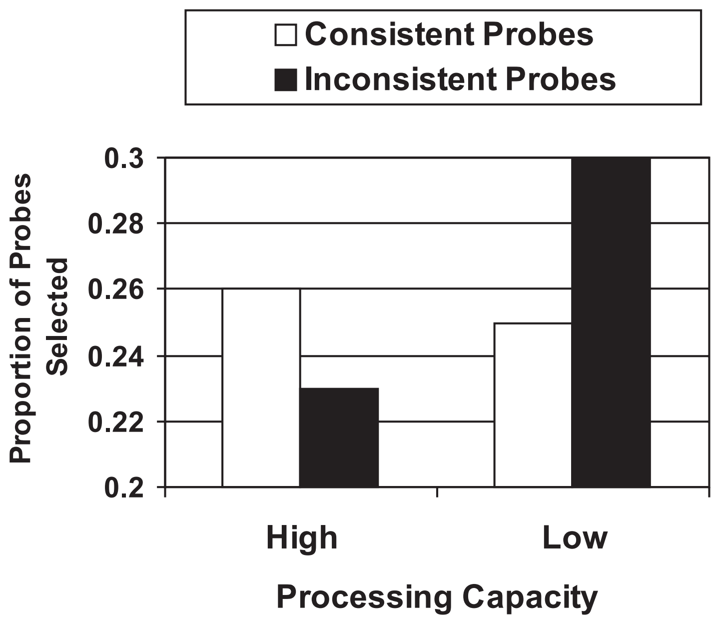

FIGURE 2. Mean proportion of graphemic cues selected as a function of processing capacity and the stereotypicality of the behaviors to which the cues referred.

nized a greater proportion of inconsistent (*M* = .30) than consistent (*M* = .25) items. This difference was marginally reliable, $F(1, 98) = 3.62$, $p = .06$. Further analyses demonstrated that inconsistent probes were recognized with significantly greater accuracy in the low- than the high-capacity condition, $F(1, 191) = 4.82$, $p < .05$. In contrast, consistent probes were more poorly recognized in the low- than the high-capacity condition, although not reliably so. This interaction demonstrates that, compared to their counterparts with full-processing capacity, participants with limited capacity encoded relatively greater perceptual detail of the inconsistent than the consistent item in the pairs.

DISCUSSION

Although there is no denying the power of confirmatory biases in the processing of stereotype-relevant information, the data produced by this experiment suggest the need for a more subtle analysis of these biases. In particular, the results provide strong support for the Encoding Flexibility Model. When there was direct competition between the encoding of stereotype-consistent and -inconsistent behavior, the imposition of a cognitive load increased the relative attention devoted to the inconsistent behavior. These data were produced with the most direct measure of attention yet used to test the EFM.[8]

The results from the graphemic cued-recognition measure provide the first support for the perceptual/contextual encoding hypothesis of the EFM. The imposition of a cognitive load enhanced the encoding of the perceptual details of inconsistent compared to consistent behaviors. By no means should these data be taken to imply that memory will typically favor unexpected events that have been encoded under cognitive load. Quite to the contrary, many studies have shown that free recall favors consistent information when the stimuli have been learned under low-capacity conditions (Bodenhausen & Lichtenstein, 1987; Macrae et al., 1993; Sherman & Frost, 2000; Stangor & Duan, 1991). The key distinction between the findings is that free recall is the prototypic measure of conceptual processing (which is enhanced for expected information under cognitive load), whereas graphemic cued-recognition is a measure of perceptual memory (which is enhanced for unexpected information under cognitive load).

8. An alternative explanation for these results is that when participants were under cognitive load, they first processed the consistent item and then processed the inconsistent item. Because the inconsistent item was always processed second, that is where attention was focused when the X probe appeared. We view this explanation as unlikely for two reasons. First, although this process seems plausible when the consistent item was on the left side of the screen (which was highly likely to be read first), it is less so when the consistent item was on the right side of the screen. In the latter case, the suggestion is that perceivers first processed the inconsistent item sufficiently to recognize that it did not fit their expectancies. Upon doing so, they directed their attention to the consistent item on the right side of the screen. Finally, having processed the consistent item, they shifted attention back to the inconsistent item, where it remained until the X probe appeared. One problem with this explanation is that it seems unlikely that this could all occur within 3 s, particularly in the low-capacity condition. At the least, one might expect attention to be more likely to be resting on the inconsistent item when the × appeared when that item was on the right side of the screen. However, no such interaction with probe site was observed. A second problem with this explanation is that it has trouble accounting for the cued-recognition data. If attention shifted to the inconsistent items only at the last moment, after the consistent items had been processed, then how is it that the details of the inconsistent behaviors were encoded more thoroughly in the low-capacity condition? Finally, it is worth noting that even if the consistent items were always read first, no other model predicts that attention would subsequently shift to inconsistent items. Passive filter models make no prediction, and according to active filter models, attention would simply remain with the consistent items until the X probe appeared.

Note that support for the EFM does not require that participants attend more carefully to the inconsistent than the consistent item when resources are depleted. What is required is a reliable shift of attention away from consistent and toward inconsistent information in these conditions compared to high-capacity conditions. Likewise, support for the EFM does not require greater perceptual encoding of inconsistent than consistent items when resources are depleted. What is required is a relative increase in the perceptual encoding of inconsistent relative to consistent information in these conditions. These effects are precisely what are demonstrated by the capacity × item type interactions. Neither finding is predicted by passive filter models, and both findings are clearly inconsistent with active filter models, which predict that all processing will shift away from inconsistent and toward consistent information when capacity is low.

ON EFFICIENCY

In the stereotyping literature, much has been made of the role that stereotypes play in efficient processing. However, the active filter model that has formed the basis for much of this analysis is somewhat curious as a model of efficient processing. When capacity is depleted, the model proposes to achieve efficiency through diminished information gain. That is, when resources are depleted, perceivers maintain efficiency by simply avoiding processing stereotype-inconsistent information that is difficult to process. Although such a strategy would certainly conserve resources, it also diminishes the amount of information obtained. Thus, the savings in expenditure is offset by a loss in production. Overall, this cognitive miser approach would seem to yield a marginal increase in efficiency, at best.

In contrast, the EFM proposes that perceivers allocate their resources more strategically when resources are low to maximize the amount of information gained for the effort expended. Whereas consistent behaviors enjoy a conceptual encoding advantage, attention and perceptual encoding shift toward inconsistent behaviors. Beyond maximizing the overall extraction of information, these encoding tradeoffs simultaneously promote stability and plasticity in stereotypic expectancies. The conceptual advantage for consistent information reinforces the expectancy, whereas the shifts in attention and perceptual processing help to maintain vigilance that the expectancy may be in need of revision. The dual pursuits of stability and plasticity in expectancies have been argued to be central components of an adaptive cognitive system (e.g., Johnston & Hawley, 1994; McClelland, McNaughton, & O'Reilly, 1995; Sherry & Schacter, 1987; Tulving, Markowitsch, Kapur, Habib, & Houle, 1994).

These results also have implications for dual process models of stereotyping. These models have proposed that increases in stereotype use are associated with decreases in individuation, particularly in the encoding of stereotype-inconsistent information (Brewer, 1988; Fiske & Neuberg, 1990). However, the current and previous results show that decreases in processing capacity may simultaneously increase both stereotyping (through conceptual encoding advantages for consistent information) and individuation (through attentional and perceptual encoding shifts toward inconsistent information). These data argue that stereotype use and individuation should be conceived as two separate but related continua, rather than as mutually exclusive processing modes (see also Nelson, Acker, & Manis, 1996). Movement along the two continua may proceed along different dimensions of encoding at the same time. Thus, stereotyping may be increased via conceptual processing while individuation is simultaneously increased via attentional and perceptual processing.

ON MOTIVATION

Finally, the present results challenge the preeminent understanding of the relationship between processing motives and processing capacity embodied in the selective exposure component of the active filter model. According to that view, processing goals are dependent upon sufficient capacity. Moreover, confirmatory processing is assumed to be the default processing style when resources are depleted. Hence, the suggestion is that perceivers may pursue the goal of encoding all relevant (including inconsistent) information only if they have enough resources to permit it (e.g., Bodenhausen, Macrae, & Sherman, 1999; Fiske & Neuberg, 1990; Pendry & Macrae, 1994). When resources are scarce, even perceivers who may have been initially motivated to fully individuate a target are expected to abandon that motive and revert to confirmatory processing because it is easier and/or because it allows them to leave desired conclusions unchallenged. In contrast, the EFM proposes that processing ability and motivation are independent, although related. Specifically, although diminished capacity may influence the manner in which a particular goal is pursued, it does not change the basic motive of the perceiver. Thus, an accuracy-motivated perceiver will not abandon the goal to process all relevant information when resources are low, but may well have to pursue the goal in a more efficient manner. The results from the present experiment are consistent with this analysis.

As we have noted elsewhere, however, we do not mean to suggest that attention and perceptual processing will always shift toward inconsistent information when resources are depleted. To be sure, perceivers are not always motivated by accuracy. We would expect that perceivers with a defensive processing orientation, for example, would maintain that goal when capacity-depleted, but would pursue it in a more efficient manner. As such, these persons might be expected to filter out inconsistent information in these conditions. Indeed, Plaks, Stroessner, Dweck, and Sherman (2001) showed that "entity theorists" attended more carefully to stereotype-consistent than inconsistent information, and that this was particularly true under low-capacity conditions. In contrast, "incremental theorists" attended more carefully to inconsistent information when capacity was depleted. Entity theorists believe that individual and group characteristics are stable and unchangeable. Because they view expectancy-violating information as uninformative and aversive, they tend to avoid this kind of information. Obversely, incremental theorists view individual and group characteristics as situationally determined and changeable. They view expectancy-violating information as informative, and process it carefully when it is available. Thus, stereotypes are flexible cognitive tools that may be adapted to the current needs of the perceiver, whatever they may be. As efficient tools, they are particularly likely to be recruited for these purposes when capacity is diminished.

REFERENCES

Allport, G. W. (1954). *The nature of prejudice*. Cambridge, MA: Addison-Wesley.

Blaxton, T. A. (1989). Investigating dissociations among memory measures: Support for a transfer-appropriate processing framework. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 15*, 657-668.

Bodenhausen, G. V. (1988). Stereotypic biases in social decision making and memory: Testing process models of stereotype use. *Journal of Personality and Social Psychology*, *55*, 726-737.

Bodenhausen, G. V. (1990). Stereotypes as judgmental heuristics: Evidence of circadian variations in discrimination. *Psychological Science, 1*, 319-322.

Bodenhausen, G. V., & Lichtenstein, M. (1987). Social stereotypes and information processing strategies: The impact of task complexity. *Journal of Personality and Social Psychology, 52*, 871-880.

Bodenhausen, G. V., Macrae, C. N., & Garst, J. (1997). Stereotypes in thought and deed: Social-cognitive origins of intergroup discrimination. In C. Sedikides, J. Schopler, & C. A. Insko (Eds.), *Intergroup cognition and intergroup behavior* (pp. 311-335). Mahwah, NJ: Erlbaum.

Bodenhausen, G. V., Macrae, C. N., & Sherman, J. W. (1999). On the dialectics of discrimination: Dual processes in social stereotyping. In S. Chaiken & Y. Trope (Eds.), *Dual-process theories in social psychology* (pp. 271-292). New York: Guilford.

Bodenhausen, G. V., & Wyer, R. S. (1985). Effects of stereotypes on decision making and information-processing strategies. *Journal of Personality and Social Psychology*, *48*, 267-282.

Bradley, B. P., Mogg, K., White, J., Groom, C., & de Bono, J. (1999). Attentional bias for emotional faces in generalized anxiety disorder. *British Journal of Clinical Psychology, 38*, 267-278.

Brewer, M. B. (1988). A dual process model of impression formation. In T. K. Srull & R. S. Wyer, Jr. (Eds.), *Advances in social cognition* (Vol. 1, pp. 1-36). Hillsdale, NJ: Erlbaum.

Challis, B. H., Velichkovsky, B. M., & Craik, F. I. M. (1996). Levels-of-processing effects on a variety of memory tasks: New findings and theoretical implications. *Consciousness & Cognition: An International Journal, 5*, 142-164.

Fiske, S. T. (1998). Stereotyping, prejudice, and discrimination. In D. T. Gilbert, S. T. Fiske, & G. Lindzey (Eds.), *Handbook of social psychology* (4th ed., Vol. 2, pp. 357-411). Boston: McGraw-Hill.

Fiske, S. T., & Neuberg, S. L. (1990). A continuum of impression formation, from category-based to individuating processes: Influences of information and motivation on attention and interpretation. *Advances in Experimental Social Psychology, 23*, 1-74.

Frey, D. (1986). Recent research on selective exposure to information. *Advances in Experimental Social Psychology*, *19*, 41-80.

Gilbert, D. T., & Hixon, J. G. (1991). The trouble of thinking: Activation and application of stereotypic beliefs. *Journal of Personality and Social Psychology, 60*, 509-517.

Green, D. M., & Swets, J. A. (1966). *Signal detection theory and psychophysics*. New York: Wiley.

Hamilton, D. L., & Sherman, J. W. (1994). Stereotypes. In R. S. Wyer, Jr., & T. K. Srull (Eds.), *Handbook of social cognition* (2nd ed., Vol. 2, pp. 1-68). Hillsdale, NJ: Erlbaum.

Hastie, R., & Kumar, P. A. (1979). Person memory: Personality traits as organizing principles in memory for behaviors. *Journal of Personality and Social Psychology, 37*, 25-38.

Hilton, J. L., & von Hippel, W. (1996). Stereotypes. *Annual Review of Psychology, 47,* 237-271.

Jacoby, L. L., Toth, J. P., & Yonelinas, A. P. (1993). Separating conscious and unconscious influences of memory: Measuring recollection. *Journal of Experimental Psychology: General, 122*, 139-154.

Johnston, W. A., & Hawley, K. J. (1994). Perceptual inhibition of expected inputs: The key that opens closed minds. *Psychonomic Bulletin and Review, 1*, 56-72.

Kruglanski, A. W., & Freund, T. (1983). The freezing and unfreezing of lay inferences: Effects on impressional primacy, ethnic stereotyping, and numerical anchoring. *Journal of Experimental Social Psychology, 19*, 448-468.

Macrae, C. N., Hewstone, M., & Griffiths, R. J. (1993). Processing load and memory for stereotype-based information. *European Journal of Social Psychology, 23*, 77-87.

Macrae, C. N., Milne, A. B., & Bodenhausen, G. V. (1994). Stereotypes as energy-saving devices: A peek inside the cognitive toolbox. *Journal of Personality and Social Psychology*, *66*, 37-47.

McClelland, J. L., McNaughton, B. L., & O'Reilly, R. C. (1995). Why there are complementary learning systems in the hippocampus and neocortex: Insights from the successes and failures of connectionist models of learning and memory. *Psychological Review, 102*, 419-457.

Mulligan, N. W. (1998). The role of attention during encoding in implicit and explicit memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 24*, 27-47.

Mulligan, N. W., & Hartman, M. (1996). Divided attention and indirect memory tests. *Memory and Cognition, 24*, 453-465.

Nelson, T. E., Acker, M., & Manis, M. (1996). Irrepressible stereotypes. *Journal of Experimental Social Psychology, 32,* 13-38.

Pendry, L. F., & Macrae, C. N. (1994). Stereotypes and mental life: The case of the motivated but thwarted tactician. *Journal of Experimental Social Psychology, 30*, 303-325.

Plaks, J. E., Stroessner, S. J., Dweck, C. S., & Sherman, J. W. (2001). Person theories and attention allocation: Preferences for stereotypic versus counterstereotypic information. *Journal of Personality and Social Psychology, 80*, 876-893.

Pratto, F., & Bargh, J. A. (1991). Stereotyping based on apparently individuating information: Trait and global components of sex stereotypes under attention overload. *Journal of Experimental Social Psychology, 27*, 26-47.

Richardson-Klavehn, A., & Bjork, R. A. (1988). Measures of memory. *Annual Review of Psychology, 39*, 475-543.

Roediger, H. L., III. (1990). Implicit memory. *American Psychologist, 45*, 1043-1056.

Sherman, J. W. (2001). The dynamic relationship between stereotype efficiency and mental representation. In G. Moskowitz (Ed.), *Cognitive social psychology: The Princeton Symposium on the legacy and future of social cognition* (pp. 177-190). Hillsdale, NJ: Erlbaum.

Sherman, J. W., & Frost, L. A. (2000). On the encoding of stereotype-relevant information under cognitive load. *Personality and Social Psychology Bulletin, 26*, 26-34.

Sherman, J. W., Lee, A. Y., Bessenoff, G. R., & Frost, L. A. (1998). Stereotype efficiency reconsidered: Encoding flexibility under cognitive load. *Journal of Personality and Social Psychology, 75*, 589-606.

Sherman, J. W., Macrae, C. N., & Bodenhausen, G. V. (2000). Attention and stereotyping: Cognitive constraints on the construction of meaningful social impressions. *European Review of Social Psychology, 11*, 145-175.

Sherry, D. F., & Schacter, D. L. (1987). The evolution of multiple memory systems. *Psychological Review, 94*, 439-454.

Srull, T. K., & Wyer, R. S. (1989). Person memory and judgment. *Psychological Review, 96*, 58-83.

Stangor, C., & Duan, C. (1991). Effects of multiple task demands upon memory for information about social groups. *Journal of Experimental Social Psychology, 27*, 357-378.

Stangor, C., & McMillan, D. (1992). Memory for expectancy-congruent and expectancy-incongruent information: A review of the social and social developmental literatures. *Psychological Bulletin, 111*, 42-61.

Taylor, S. E., & Crocker, J. (1981). Schematic bases of social information processing. In E. T. Higgins, C. P. Herman, & M. P. Zanna (Eds.), *Social cognition: The Ontario Symposium* (Vol. 1, pp. 89-134). Hillsdale, NJ: Erlbaum.

Tulving, E., Markowitsch, H. J., Kapur, S., Habib, R., & Houle, S. (1994). Novelty encoding networks in the human brain: Positron emission tomography data. *Neuroreport*, *5*, 2525-2528.

von Hippel, W., Jonides, J., Hilton, J. L., & Narayan, S. (1993). Inhibitory effect of schematic processing on perceptual encoding. *Journal of Personality and Social Psychology*, *64*, 921-935.

Wigboldus, D., Sherman, J. W., Franzese, H., & van Knippenberg, A. (in press). Capacity and comprehension: Spontaneous stereotyping under cognitive load. *Social Cognition*.