Effects of Reporting Beliefs in Syllogistically Related Propositions on the Recognition of Unmentioned Propositions

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Subjects completed a belief questionnaire that contained propositions of the form "X implies Y." In some cases, the questionnaire items included both premises and the conclusion of a syllogism of the form "A implies B, B implies C, A implies C" (e.g., "Taking vitamin C will increase resistance to infection," "Increasing resistance to infection will prevent colds," and "Taking vitamin C will prevent colds"). In other cases, one or more of these propositions was omitted. Later on, subjects were asked whether each of several propositions had or had not appeared in the form they completed earlier. Correct recognition of a statement that had actually been contained in the questionnaire was not appreciably affected by other statements in which beliefs were reported. However, false recognition of a statement that had not been contained in the questionnaire was substantially increased by reporting beliefs in other statements that were syllogistically related to it. These effects occurred over and above the effect of simply having been previously exposed to the concepts specified in the propositions being recognized and occurred regardless of whether the proposition to be recognized was the conclusion or a premise of the syllogism set. Results were interpreted both in terms of the role of syllogistic reasoning in belief processes and in terms of a conceptualization based on Abelson and Reich's implicational molecule theory.

People typically comprehend and organize information with reference to their previously acquired knowledge about the world (e.g., Bransford & Johnson, 1972, 1973; Graesser, 1981; Rumelhart & Ortony, 1977; Schank & Abelson, 1977; Smith, Adams, & Schorr, 1978). This knowledge may be in the form of complex schemata (Rumelhart & Ortony, 1977), scripts (Abelson, 1976, 1981; Schank & Abelson, 1977), generalizations about different types of persons or events (e.g., "people with similar values like one another"), or abstract principles that are not specific to a particular situation or content domain (McGuire, 1960; Potts, 1972). This article is concerned with the effects of one of these latter principles, namely, a syllogistic rule, on the organization of and subsequent memory for belief propositions.

The hypothesis that people organize beliefs about their social environment according to syllogistic principles is not new. A syllogistic model of belief organization was proposed by McGuire (1960, 1981), and an extension of it has been developed and applied successfully by Wyer and his colleagues (Wyer & Goldberg, 1970; for reviews see Wyer, 1975b; Wyer & Carlston, 1979). The latter formulation generates accurate quantitative predictions of (a) judgments of the consistency of interrelated beliefs (Henninger & Wyer, 1976) and (b) the effect of beliefs in the premises of a syllogism on beliefs in its conclusion (Wyer, 1970, 1975a). Despite this evidence, however, questions remain as to whether syllogistic principles actually describe the way in which beliefs are spontaneously organized in memory (Henninger & Wyer, 1976; Wyer & Hartwick, 1980). Moreover, Wyer's model, which is restricted to a particular type of syllogism (i.e., one of the form "A; if A, then..."
RECOGNITION OF BELIEF PROPOSITIONS

B; B"), may not actually be tapping the processes of belief organization originally pos-
tulated by McGuire. Instead, it may be de-
scribing a situationally induced conditional inference process that is not syllogistic in na-
ture (Wyer & Hartwick, 1980).

A Constructive Memory Approach to Understanding Belief Organization

The present article describes a quite dif-
ferent approach to understanding the role of syllogistic principles in belief organization. This approach, which is applicable to other types of syllogistic rules than the one inves-
tigated by Wyer, is based in part on theory and research on constructive processes in memory (cf. Bransford & Franks, 1971). That is, people who receive new information are likely to interpret it in light of prior knowledge about the types of persons or events to which it refers. In the process, they may infer the existence of features that were not mentioned in the information presented. (For example, people who are told that some-
one stopped at a restaurant and ordered beef stroganoff may infer that the person looked at the menu before doing so, based on real-
world knowledge that people typically look at a menu before ordering a meal.) These inferred features may then become part of the cognitive representation of the person or event described and may be stored in mem-
ory along with those that were explicitly men-
tioned in the information. Later on, the in-
ferred features may not be distinguishable from those that were actually presented and therefore may be remembered as having been seen. (For examples of this phenomenon in a variety of situations, see Bransford & Franks, 1971; Jenkins, Wald, & Pittenger, 1978; Picek, Sherman, & Shiffrin, 1975; Spiro, 1977; Woll & Yopp, 1978.)

Similar constructive processes may occur in the course of reporting beliefs about both new and familiar events. That is, a person who reports a belief in a particular proposition may, in the course of forming this belief, spontaneously generate other propositions that are either implied by or have implications for the one being evaluated. These latter propositions may then become part of a cog-
nitive representation of the issue or event to

which the reported belief pertains and may be stored in memory as "information." Later on, these generated propositions may be re-
trieved and used as information about the issue and event in much the same way as other information that is obtained from ex-
ternal sources.

Socially learned principles of syllogistic in-
ference may be among those that govern the processes described above. However, there are two different ways in which syllogistic prin-
ciples may affect memory for the beliefs one reports and the propositions to which they pertain. These alternative possibilities are outlined below.

The Role of Syllogistic Inference Processes

Suppose subjects are asked to report their beliefs in two propositions of the form "A implies B" and "B implies C" (e.g., "smoking cigarettes at an early age leads to depending on cigarettes," and "dependency on cigarettes leads to bad health"). These propositions in combination comprise the premises of a syl-
logism of the form "A implies B; B implies C; therefore A implies C." It is conceivable that in the course of reporting beliefs in these propositions, subjects will spontaneously rec-
ognize their syllogistic relatedness and will use the syllogistic principle described above to generate the conclusion "A implies C" ("smoking cigarettes at an early age leads to bad health"). This generated proposition, along with a belief in its validity, may then be stored in memory. If this occurs, subjects may subsequently report incorrectly that this generated proposition had actually been mentioned, as well as those propositions that they were explicitly asked to consider.

The Role of Implicational Molecules

A somewhat different conceptualization has other implications for belief organization. This conceptualization is based on the notion that the propositions of a syllogism comprise an implicational molecule of the sort postu-
lated by Abelson and Reich (1969; for elabor-
ations and extensions, see Wyer & Carls-
ton, 1979; Wyer & Gordon, in press). Implic-
cational molecule theory was originally de-
developed to describe the cognitive represen-
tation of real-world knowledge about particular types of persons and situations (e.g., generalizations such as "persons with similar values like one another") and the use of this knowledge in comprehending and making inferences about new experiences. However, the theory can potentially be extended to apply to the representation and use of more abstract cognitive rules that, although acquired through social learning, are not restricted to a given content domain (Wyer & Gordon, in press). Some of these rules may be syllogistic in nature.

Specifically, an implicational molecule is conceptualized as a set of propositions that are "bound together by psychological implication" (Abelson & Reich, 1969). To this extent, the general propositions contained in the type of syllogism noted above may comprise a "syllogism molecule" of the form "A implies B, B implies C, therefore A implies C", where A, B, and C refer to general or specific concepts about one's social world (e.g., "smoking cigarettes at an early age," "dependency on cigarettes," and "bad health," respectively, in the example given previously). According to implicational molecule theory, specific statements that exemplify two of the propositions comprising such a molecule may lead the molecule to be activated. When this occurs, an instantiation of the third proposition may be generated according to a completion principle. This process, which is similar to that postulated in other formulations of complex information processing (Rumelhart & Ortony, 1977; Schank & Abelson, 1977), may occur spontaneously at the time the original statements are comprehended. The inferred proposition, along with the two given propositions, may then be stored together in memory as a conceptual unit.

Although the two conceptualizations outlined above are similar, their implications differ in two important respects. First, the syllogistic inference process outlined above does not necessarily imply that the given propositions (premises) and the generated proposition (conclusion) are organized and stored in memory in relation to one another. That is, once the conclusion is generated according to a syllogistic inference rule and a belief in it has been formed, it may be stored in memory independently of the two premises that led to its construction. In contrast, implicational molecule theory implies that once syllogistically related propositions (or the beliefs associated with them) are organized according to a syllogism molecule, the set of propositions is stored in memory as a single unit.

Second, the syllogistic inference process as we have described it is unidirectional. That is, although a conclusion of a syllogism may be inferred from its premises, a premise (e.g., "A implies B") cannot easily be inferred from the conclusion ("A implies C") and the other premise ("B implies C"). This implies that, although subjects may tend to report incorrectly that conclusions of a syllogism have been presented if they have previously reported beliefs in the two premises, they may not report that a premise was presented after having considered a conclusion and the other premise. In contrast, an implicational molecule conceptualization implies that an instantiation of any one of the three propositions comprising the syllogism molecule may be inferred from the other two. For example, the notion that smoking cigarettes at an early age leads to bad health ("A implies C") may be generated as a result of considering the propositions that smoking at an early age leads to dependency on cigarettes ("A implies B") and that dependency on cigarettes leads to bad health ("B implies C"). In addition, the proposition that dependency on cigarettes leads to bad health ("B implies C") may be generated as a result of considering the possibilities that smoking cigarettes at an early age leads both to dependency on cigarettes ("A implies B") and to bad health ("A implies C"). Consequently, this conceptualization implies that a premise of a syllogism as well as its conclusion may often be reported as having previously been stated when it was not.

In applying implicational molecule theory under these conditions, it is sometimes difficult to know on a priori grounds which specific propositions are considered to instantiate the components of a syllogism molecule. For example, the proposition "smoking cigarettes at an early age leads to dependency on cigarettes" and "smoking at an early age leads to bad health" could in principle be encoded as instances of "A implies C" and "A implies B," respectively, rather than encoded as instances of "A
These possibilities were explored in the research reported here. In brief, subjects first reported their beliefs in a series of statements about social issues and events. Each statement was semantically equivalent to a proposition of the general form “X implies Y” (e.g., “taking large doses of Vitamin C will help prevent colds”). The belief questionnaire was constructed so that in some cases the statements contained in it exemplified all three general propositions in the type of syllogism noted above. In other cases, however, one or more of these statements was not presented. Later on, subjects were given a surprise recognition task containing both statements that were contained in the original belief questionnaire and those that were not. Subjects were expected to make more false recognition errors in responding to unmentioned conclusions (statements of the form “A implies C”) when they had previously reported beliefs in both premises (“A implies B” and “B implies C”) than when one or both premises had not previously been considered. Based on implicational molecule theory, it was also predicted that false recognition errors in responding to an unmentioned premise would be greater if the other premise and the conclusion had both previously been considered than if they had not. However, if the false recognition responses to conclusions reflect the application of a simple syllogistic inference rule rather than an implicational molecule, premises should not be inferred from the conclusion and the other premise, and thus false recognition responses to premises should not vary over conditions.

Correct Recognition of Belief Propositions

The preceding discussion focused on the tendency to report syllogistically related propositions as having been presented when they actually were not. Recognition responses to a previously unmentioned item may be determined primarily by whether or not a sufficiently similar memory trace has been constructed in the course of responding to other items that were in fact presented. The considerations that underlie the correct recognition of propositions that have in fact been presented are somewhat different. Memory traces of presented items are typically formed at the time they are first considered, independently of their context. Therefore, these traces may be accessed directly and used as a basis for recognition responses, and constructive processes may play a less influential role. This implies that contextual factors will have less effect on correct recognition of presented items than on false recognition of unmentioned items. This is particularly true when recognition responses are made only a short time after exposure to the original material. (For evidence in other paradigms that recognition responses to items that were presented are often minimally affected by the type and amount of schema-related information that accompanies these items, see Graesser, Gordon & Sawyer, 1979; Hartwick, 1979; Srull, 1981.) Thus, the effects of concern in this study were expected to be concentrated primarily in recognition responses to unmentioned belief propositions rather than in correct recognition of presented ones.

Methodological Considerations

In investigating the hypotheses outlined above, two additional considerations were taken into account. First, the implicational molecule conceptualization assumes that subjects who consider instantiations of two of the three propositions in a syllogism molecule will activate the molecule spontaneously and therefore will generate an instantiation of the third proposition without any external demand to do so. To increase the likelihood that results would be due to this spontaneous cognitive processing rather than to compliance with experiment-induced expectancies, subjects were asked to report their beliefs in propositions without being explicitly asked to learn them or to think about them in relation to one another. Moreover, the beliefs pertaining to any given syl-
logism were separated in the belief questionnaire being administered. Thus, there was no obvious demand to construct and consider beliefs in unmentioned prepositions.

A second consideration arises from the fact that a false recognition response to an item that was not previously considered could result simply from having been recently exposed to the individual concepts to which it refers. For example, reporting beliefs in propositions of the form "A implies B" and "B implies C" may activate the concepts A and C. The increased accessibility of these two individual concepts in memory may then lead a single proposition containing them ("A implies C") to appear familiar and therefore may lead subjects to guess incorrectly that it was among those propositions they had considered previously. This could occur independently of the syllogistic relatedness of the propositions that led the two concepts to be activated. To examine these possibilities, the number of propositions presented from each syllogistically related set was systematically varied. Moreover, control conditions were constructed that would allow us to compare false recognition responses to a proposition (e.g., "A implies C") when syllogistically related items were presented ("A implies B" and "B implies C") to false recognition responses to this proposition when unrelated propositions were presented that referred to the same concepts (e.g., "A implies D" and "B implies C"). Presumably, false recognitions should be more frequent in the first condition than in the second.

Method

Overview

Subjects completed a questionnaire consisting of 28 belief statements. Each statement was of the form X implies Y, where X and Y refer to general concepts about familiar events or consequences. Some of the 28 belief statements comprised all or part of 16 different syllogisms of the form "A implies B, B implies C, therefore, A implies C," whereas others referred to similar concepts but were syllogistically unrelated. These stimulus materials are discussed later in more detail.

Following completion of the belief questionnaire and an interpolated anagrams task, subjects received a second questionnaire containing all 48 statements comprising the 16 syllogisms and 32 additional, syllogistically unrelated statements. Subjects were instructed to indicate whether or not each statement was among those contained in the initial questionnaire. These data allowed us to determine both correct recognition of presented items and false recognition of nonpresented items as a function of the type of belief statements that subjects had considered previously.

Subjects were 160 male and female introductory psychology students who participated in the experiment in partial fulfillment of a course requirement. (An additional 12 subjects were randomly discarded prior to analysis to equalize the number of subjects in each of 16 stimulus conditions described below.)

Construction of Stimulus Materials

Sixteen sets of five statements each were constructed. Each set pertained to a different issue or aspect of a person's general social experience. Three statements in each set were logically related. These were of the form "A implies B" (referred to hereafter as AB), "B implies C" (BC), and "A implies C" (AC), where A, B, and C refer to different concepts about general life events or consequences (e.g., taking Vitamin C, increasing resistance to infection, and preventing colds). Two other statements, of the forms "A implies D" (AD) and "E implies C" (EC), each contained an element of the conclusion of the logically related statements (i.e., A or C) but were not logically related to this conclusion. Three of the 16 sets of items selected are shown in Table 1.

Sixteen different belief questionnaires, each containing 28 propositions, were constructed from these 80 (16 x 5) statements. Each questionnaire contained propositions from each of the 16 item sets shown in Table 2. Note that in eight cases, the conclusion (AC) was presented, whereas in the other eight cases, it was not. Furthermore, the number and logical relatedness of the other propositions containing the concepts A and C were varied to permit a variety of effects on recognition responses to be investigated.

The particular item set representing each of the 16 conditions shown in Table 2 was varied over the 16 questionnaires so that pooled over questionnaires, each specific set of five items was represented once in each of the 16 presentation conditions. Moreover, the order of presenting the 28 items in each questionnaire was varied systematically so that half of the subjects exposed to each questionnaire received all eight conclusions (denoted AC) first, whereas the remaining subjects received these statements last. The other statements were always presented in a constant order, such that all six AB statements were followed in order by the four AD statements, the six BC statements, and the four EC statements.

Procedure

Subjects were given the belief questionnaire with instructions that its purpose was to obtain students' opinions about social issues and events. Beliefs were reported along scales from 0 (not at all likely) to 10 (extremely likely). After completing this questionnaire, which took about 10 minutes, subjects were administered a 40-item
Table 1

Three Example Sets of Stimulus Propositions

Set 1
- A implies B: Taking large doses of Vitamin C will increase my resistance to infection.
- B implies C: Increasing my resistance to infections will help prevent colds.
- A implies C: Taking large doses of Vitamin C will help prevent colds.
- A implies D: Taking large doses of Vitamin C will show others my interest in nutrition.
- E implies C: Keeping out of the rain will help prevent colds.

Set 2
- A implies B: Being a TV addict will give a person a narrow view of the world.
- B implies C: Having a narrow view of the world will tend to give a person harmful stereotypes of others.
- A implies C: Being a TV addict will tend to give a person harmful stereotypes of others.
- A implies D: Being a TV addict will elicit greater passivity in a person.
- E implies C: Living in a small community all of one's life will tend to give a person harmful stereotypes of others.

Set 3
- A implies B: Taking Excedrin will relieve painful headaches.
- B implies C: Medication that relieves painful headaches may cause heart failure.
- A implies C: Taking Excedrin may cause heart failure.
- A implies D: Taking Excedrin will help one to fall asleep at night.
- E implies C: Too much exercise may cause heart failure.

Note. A, B, C, D, and E refer to general or specific concepts about a person's social world.

anagram task. This task was introduced with the information that its purpose was to determine how rapidly people can solve verbal problems and to determine the relation between "people's problem-solving abilities" and "other factors in social psychology." This task was selected because it was sufficiently complex to decrease rehearsal and short-term memory effects on subjects' subsequent recognition responses.

After working on the anagrams task for 5 minutes, subjects were interrupted, told that we were interested in "how well you can remember the items that appeared earlier in the opinion questionnaires," and administered a surprise recognition questionnaire. Subjects were told that only some of the statements appeared in the earlier questionnaire. This questionnaire contained the entire set of 80 items from which belief questionnaires were constructed. There were four forms of the questionnaire. The 16 conclusions (AC statements) were presented first in each form. This was done to decrease the possibility that subjects would logically infer the presence of a conclusion on the basis of their recognition responses to previous items (premises). However, the order of presenting the other four types of items (the 16 AB statements, the 16 AD statements, the 16 BC statements, and the 16 EC statements) was systematically varied so that each set occurred in each serial position the same number of times.

In responding to each item, subjects first indicated whether the statement was or was not included in the belief questionnaire they had completed previously. Then they indicated how confident they were of this judgment by placing a check along a category scale ranging from 0 (not at all confident) to 10 (extremely confident).

Scoring and Analyses

Recognition data were scored in two ways. First, the proportion of affirmative responses to each item (i.e., the proportion of subjects who reported that the item had been included in the belief questionnaire) was computed for each syllogistically related proposition. Second, each subject's dichotomous response to a recognition item was scored as either 1, if the subject indicated having seen the item before, or -1, if the subject indicated not having seen it. This response was then multiplied by the subject's confidence rating for that item. This procedure permitted recognition scores to be transformed to a continuous scale ranging from -10 (indicating extreme confidence that the item had not been included in the original belief questionnaire) to 10 (indicating extreme confidence that the item had been included).

Data pertaining to both recognition measures, which were similarly affected by experimental variables, are presented below. However, only statistical analyses of the second, continuous measure is reported, because this measure is more amenable to analysis of variance procedures and the assumptions underlying them. (In fact, analyses of both measures yielded virtually identical statistical conclusions.)

Results

The type of beliefs reported in the original questionnaire was expected to have more influence on the false recognition of propositions that were not contained in the ques-
Table 2
Types of Propositions Presented in Initial Belief Questionnaire

<table>
<thead>
<tr>
<th>Item set</th>
<th>Propositions presented</th>
<th>Item set</th>
<th>Propositions presented</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A implies B (AB)</td>
<td>9</td>
<td>A implies B (AB)</td>
</tr>
<tr>
<td></td>
<td>B implies C (BC)</td>
<td></td>
<td>B implies C (BC)</td>
</tr>
<tr>
<td></td>
<td>A implies C (AC)</td>
<td>10</td>
<td>A implies B (AB)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>E implies C (EC)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A implies C (AC)</td>
</tr>
<tr>
<td>2</td>
<td>A implies B (AB)</td>
<td>11</td>
<td>A implies D (AD)</td>
</tr>
<tr>
<td></td>
<td>E implies C (EC)</td>
<td></td>
<td>B implies C (BC)</td>
</tr>
<tr>
<td></td>
<td>A implies C (AC)</td>
<td></td>
<td>A implies C (AC)</td>
</tr>
<tr>
<td>3</td>
<td>A implies D (AD)</td>
<td>12</td>
<td>A implies B (AB)</td>
</tr>
<tr>
<td></td>
<td>B implies C (BC)</td>
<td></td>
<td>E implies C (EC)</td>
</tr>
<tr>
<td></td>
<td>A implies C (AC)</td>
<td></td>
<td>A implies C (AC)</td>
</tr>
<tr>
<td>4</td>
<td>A implies B (AB)</td>
<td>13</td>
<td>A implies D (AD)</td>
</tr>
<tr>
<td></td>
<td>A implies C (AC)</td>
<td></td>
<td>A implies C (AC)</td>
</tr>
<tr>
<td>5</td>
<td>A implies D (AD)</td>
<td>14</td>
<td>B implies C (BC)</td>
</tr>
<tr>
<td></td>
<td>A implies C (AC)</td>
<td></td>
<td>A implies C (AC)</td>
</tr>
<tr>
<td>6</td>
<td>B implies C (BC)</td>
<td>15</td>
<td>E implies C (EC)</td>
</tr>
<tr>
<td></td>
<td>A implies C (AC)</td>
<td></td>
<td>A implies C (AC)</td>
</tr>
<tr>
<td>7</td>
<td>E implies C (EC)</td>
<td>16</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>A implies C (AC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>A implies C (AC)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: A, B, C, D, and E refer to general or specific concepts about a person’s social world.

Recall that response bias (β) and sensitivity (d') are the parameters of the signal detection theory. The former is a function of the hit rate (correct recognition of items that were correctly recognized) and false alarm rate (incorrect recognition of items that were not presented). In this study, the effects of experimental variables on hit rate were small and nonsignificant, and thus variation in both signal-detection parameters would be almost entirely due to variation in false alarms. For both of these reasons, it seemed clearer to analyze false alarm rate directly.

Recognition of Conclusions (AC)

The recognition of conclusions was expected to be greater when two premises that were syllogistically related to them had both been previously considered in the belief questionnaire than when one or both had not been considered. A general indication of the validity of this prediction can be seen from the data summarized in Table 3. This table shows both the proportion of affirmatively recognized responses (i.e., judgments that the

2 Recognition data are often best analyzed in terms of signal-detection parameters (Green & Swets, 1966), which theoretically separate effects of sensitivity (d') and response bias (β). However, there were not enough stimulus replications in this study to obtain meaningful estimates of these parameters for each subject in each of the 16 experimental conditions (see Table 2). In addition, note that both parameters are a function of “hit rate” (correct recognition of items that were actually presented) and “false alarm rate” (incorrect recognition responses to items that were not presented). In this study, the effects of experimental variables on hit rate were small and nonsignificant, and thus variation in both signal-detection parameters would be almost entirely due to variation in false alarms. For both of these reasons, it seemed clearer to analyze false alarm rate directly.
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Table 3

Recognition of Conclusion as a Function of the Type of Propositions Actually Presented

<table>
<thead>
<tr>
<th>Other proposition presented containing A</th>
<th>B implies C (BC)</th>
<th>E implies C (EC)</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>A implies B (AB)</td>
<td>7.69 (.92)</td>
<td>8.45 (.97)</td>
<td>7.14 (.89)</td>
</tr>
<tr>
<td>A implies D (AD)</td>
<td>8.22 (.93)</td>
<td>—</td>
<td>8.24 (.94)</td>
</tr>
<tr>
<td>No conclusion</td>
<td>7.70 (.91)</td>
<td>9.00 (.98)</td>
<td>7.87 (.91)</td>
</tr>
<tr>
<td>Conclusion not presented</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>A implies B (AB)</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>A implies D (AD)</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>No conclusion</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

Note. The proportion of correct recognition responses (upper portion of Table 3) and the proportion of false recognition responses (lower portion of Table 3) are given in parentheses. A, B, C, D, and E refer to general or specific concepts about a person's social world.

item had been presented in the questionnaire) and the continuous response measure as a function of experimental conditions. As indicated, the eight conditions in which the conclusion (AC) was actually presented and the eight conditions in which the conclusion was not presented each comprise all but one of a 3 X 3 design pertaining to (a) other propositions in the questionnaire with the same subject as the conclusion (AB, AD, or none) and (b) other propositions in the questionnaire with the same predicate (BC, EC, or none). The correct recognition of conclusions, tabulated in the upper portion of Table 3, was minimally affected by the type of statements accompanying them in the belief questionnaire. However, false recognitions of conclusions that were not presented (lower portion of Table 3) were strongly influenced by the type of statements that had actually been responded to in the original questionnaire. These interpretations, which apply to both recognition measures, are confirmed by the series of planned comparisons described below.

Correct recognition of conclusions that had actually been presented. The first analysis determined if recognition of a conclusion (AC) depended on whether the belief statements accompanying it in the questionnaire were syllogistically related. This was done by partitioning the eight conditions shown in the upper half of Table 3 into two sets of orthogonal contrasts. First, we considered only the three conditions in which A and C had both been mentioned in another belief state-
Table 4

<table>
<thead>
<tr>
<th>Conclusion and other proposition containing C</th>
<th>Presented</th>
<th>Not presented</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conclusion presented</td>
<td>8.12 (.94)</td>
<td>7.69 (.92)</td>
</tr>
<tr>
<td>Other proposition containing A presented</td>
<td>8.35 (.94)</td>
<td>7.87 (.91)</td>
</tr>
<tr>
<td>Other proposition containing A not presented</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conclusion not presented</td>
<td>-4.41 (.26)</td>
<td>-8.91 (.03)</td>
</tr>
<tr>
<td>Other proposition containing A presented</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other proposition containing A not presented</td>
<td>-8.57 (.04)</td>
<td>-9.48 (0)</td>
</tr>
</tbody>
</table>

Note. The proportion of correct recognition responses (upper portion of Table 4) and the proportion of false recognition responses (lower portion of Table 4) are given in parentheses. A and C refer to general or specific concepts about a person's social world.

Data pertaining to the second set of contrasts are shown in the bottom half of Table 4. Subjects' tendency to report that the conclusion AC had been contained in the belief questionnaire increased when they had reported beliefs in a different proposition containing either A, $F(1, 159) = 112.89, p < .001$, or C, $F(1, 159) = 177.16, p < .001$. However, the interaction of these variables was significant, $F(1, 159) = 73.30, p < .001$, and indicated that false recognition of AC was substantially greater when both A and C had been mentioned in belief statements that subjects had actually considered ($M = -4.41$) than when only one or neither concept had previously been mentioned ($M = -8.98$).

To summarize, the correct recognition of previously presented conclusions was not enhanced (and may even have been decreased) by reporting beliefs in syllogistically related premises. However, the false recognition of unmentioned conclusions was increased by reporting beliefs in premises that syllogistically implied their validity. Moreover, this effect occurred over and above the effect of simply having recently considered the individual concepts to which the conclusions referred.

Recognition of Premises (AB and BC)

The extent to which false recognition of premises depended on the type of statements actually presented in the belief questionnaire was expected to bear on two alternative conceptualizations of how syllogistic principles might affect belief memory. First, subjects who report beliefs in the premises of a syllogism may spontaneously generate and consider its conclusion by applying a syllogistic inference rule. If this is the case, they should not spontaneously generate a premise in the process of reporting beliefs in a conclusion and the other premise. This hypothesis implies that the recognition of premises should not be appreciably affected by their syllogistic relatedness to other belief statements in the questionnaire. In contrast, the conceptualization of belief organization in terms of implicational molecule theory implies that these reciprocal, nonlogical effects may in fact occur.

Although analyses of premises could not completely parallel analyses of conclusions, the effects of similar variables could be eval-
uated. Again, separate analyses were performed on recognition responses to premises in which beliefs had actually been reported in the belief questionnaire and responses to premises that had not previously been mentioned.

Correct recognition of premises that had actually been presented. Each premise was presented in six different contexts (see Table 2). These conditions comprise a $2 \times 3$ design involving (a) whether the conclusion (AC) was or was not also contained in the belief questionnaire, and (b) the nature of the other proposition (if any) presented from the same set. In the case of the premise AB, for example, this other proposition was either the second premise (BC), a different proposition containing C (EC), or no proposition containing C. Thus, it was possible to determine whether correct recognition of a premise was facilitated by considering it along with other statements (the conclusion or the other premise) to which it was syllogistically related.

Recognition of premises is shown in Table 5 as a function of these variables. These data indicate that AB was generally less well recognized when AC was also contained in the belief questionnaire ($M = 6.95$) than when it was not ($M = 8.11$), $F(1, 159) = 13.86, p < .001$. However, this interference effect of presenting the conclusion, which is also reflected by the proportion of correct responses made in each condition (.88 vs. .93), did not depend on whether or not the other premise was also presented ($F < 1$). Analyses of recognition responses to BC (Table 5) yielded no significant effects whatsoever. Thus, reporting beliefs in AC appears to have inhibited the subsequent recognition of a statement with the same subject (i.e., AB) but not a statement with the same predicate (i.e., BC).

On the other hand, there is no evidence that correct recognition of either AB or BC is enhanced by reporting beliefs in other propositions that in combination form a valid syllogism. In fact, correct recognition of each premise was lower when beliefs in both the conclusion and the other premise had been reported than it was in almost every other condition (see Table 5).

False recognition of unmentioned premises. There were 10 conditions in which each premise was not presented in the original questionnaire (see Table 2). Eight of the 10 conditions in which AB was not presented comprise a $2 \times 2 \times 2$ design involving (a) the presence or absence of the conclusion (AC), (b) the presence or absence of the other syllogistically related premise (BC), and (c) the presence or absence of an additional, unrelated proposition containing A (AD). Similarly, 8 of the 10 conditions in which BC was not presented comprise a design involving the presence or absence of the conclusion (AC), the presence or absence of the other syllogistically related premise (AB), and the presence or absence of an unrelated proposition containing C (EC). Thus, each design permitted us to evaluate both the separate and the combined effects of reporting beliefs in the conclusion and one premise of a syllogistically related set (e.g., AC and AB) on false recognition responses to the other premise (BC). It also allowed us to determine the effect of considering an unrelated proposition containing one of the same elements.

False recognition data for each premise are shown in Table 6 as a function of these variables. The pattern of effects is similar in each case. Two questions may be evaluated on the bases of these data. First, does simply the mention of a concept described in the proposition to be recognized increase false recognition of this proposition? The answer to this question, which can be inferred from the effect of presenting each proposition considered independently of other propositions, is affirmative. Specifically, false recognition of
Table 6
Recognition of Premises That Were Not Presented as a Function of the Presence or Absence of Other Propositions in the Belief Questionnaire

<table>
<thead>
<tr>
<th>BC presented</th>
<th>False recognition of AB</th>
<th>BC not presented</th>
<th>False recognition of AB</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD presented</td>
<td>AC presented: -4.38 (.26)</td>
<td>AC not presented: -6.43 (.15)</td>
<td>AC presented: -5.52 (.19)</td>
</tr>
<tr>
<td>AD not presented</td>
<td>BC presented: -8.11 (.07)</td>
<td>BC not presented: -9.01 (.02)</td>
<td>BC presented: -8.36 (.06)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EC presented</th>
<th>False recognition of BC</th>
<th>EC not presented</th>
<th>False recognition of BC</th>
</tr>
</thead>
<tbody>
<tr>
<td>AB presented</td>
<td>AC presented: -5.31 (.20)</td>
<td>AC not presented: -7.00 (.11)</td>
<td>AC presented: -4.21 (.26)</td>
</tr>
<tr>
<td>AB not presented</td>
<td>BC presented: -7.70 (.09)</td>
<td>BC not presented: -8.68 (.04)</td>
<td>BC presented: -8.13 (.06)</td>
</tr>
</tbody>
</table>

Note. The proportion of false recognition (false alarms) under each condition is given in parentheses. A, B, C, D, and E refer to general or specific concepts about a person's social world.

AB was greater when beliefs in BC had previously been reported than when they had not (-5.99 vs. -8.60), $F(1, 159) = 76.57, p < .001$, greater when beliefs in AC had been reported (-6.57 vs. -7.99), $F(1, 159) = 29.16, p < .001$, and greater when beliefs in AD had been reported (-6.98 vs. -7.60), $F(1, 159) = 3.80, p < .06$. Similarly, false recognition of BC was greater when beliefs in AB had been reported when they had not (-6.08 vs. -8.23), $F(1, 159) = 52.08, p < .01$, and greater when beliefs in AC had been reported (-6.34 vs. -7.97), $F(1, 159) = 45.26, p < .001$, although it was no greater when beliefs in EC had been reported than when they had not (-7.17 vs. -7.14). Thus, false recognition of a proposition appears to have been increased by reporting beliefs in a second proposition that refers to the same concept, even if its syllogistic relatedness to the first proposition is not apparent.

The main question of concern, however, is whether false recognition of a premise is affected by previously reporting beliefs in two other propositions that are syllogistically related to it and whether this increase is over and above the effect of simply making salient the concepts contained in it. If this is the case, false recognition responses to a premise when beliefs in both the conclusion and other premise had previously been reported should be greater than expected from the additive effects of previously reporting beliefs in each related proposition considered independently. This was clearly the case. Pooled over conditions pertaining to the presence of AD, subjects' false recognition of AB was greater when they had previously reported beliefs in both AC and BC ($M = -4.95$) than when they had reported beliefs in only one or neither of these propositions ($M = -8.07$). Similarly, their false recognition of BC was greater when they had reported beliefs in both AB and AC ($M = -4.76$) than when they had reported beliefs in only one or neither ($M = -7.95$). Similar conclusions may be drawn from a comparison of the proportion of false recognitions under the two sets of conditions (.23 vs. .07 in both cases). This conclusion is confirmed statistically by an interaction of the presence of AC and the presence of BC in the first case, $F(1, 159) = 5.37, p < .05$, and by an interaction of the presence of AC and the presence of AB in the second case, $F(1, 159) = 12.70, p < .01$. Thus, although reporting beliefs in the conclusion and one premise of a syllogism each affected recognition responses to the unmentioned premise, a prior consideration of both syllogistically related propositions had an influence over and above the additive effects of considering each proposition separately. Further support for this interpretation is reported below.

Comparison of Premise Recognition and Conclusion Recognition
The evidence that the false recognition of premises is affected by previously reporting
beliefs in propositions that are syllogistically related to them is consistent with the hypothesis that these propositions are organized with reference to an implicational molecule. Some indication of whether these effects are similar to the corresponding effects on conclusion recognition may be obtained by comparing the difference between (a) false recognition responses to each unmentioned proposition when beliefs in both other syllogistically related propositions were previously reported and (b) false recognition responses to these same propositions when beliefs in two unrelated propositions containing the same elements were reported. An interpretation of these comparisons is somewhat compromised by the fact that different propositions occupy the positions of premises and conclusions. Consequently, differences in the effects of manipulated variables on the recognition of these propositions could be partly an artifact of idiosyncratic differences in the memorability of the issues to which they refer. However, the comparisons were nevertheless considered to be of sufficient heuristic interest to warrant reporting despite this interpretative ambiguity.

The recognition of each proposition was therefore compared under conditions in which (a) beliefs had been reported in the two propositions that were syllogistically related to it and (b) beliefs had been reported in two unrelated propositions containing the same elements.\(^3\) (Specifically, recognition of AB when beliefs in both BC and AC had been reported was compared to its recognition when beliefs in AD and BC had been reported; recognition of BC when both AB and AC had previously been considered was compared to its recognition when AB and EC had been considered; finally, recognition of AC when both AB and BC had previously been considered was compared to the mean of [a] its recognition when both AD and BC had been considered and [b] its recognition when both AB and EC had been considered.) Each comparison controlled for the number of prior exposures to both the subject and the predicate of the statement to be recognized. These comparisons are summarized in Table 7. As expected, false recognition of each proposition was generally greater when the propositions actually presented in the belief questionnaire were syllogistically related

\[F(1, 159) = 27.56, p < .001.\]

However, this difference was greater in the case of conclusions (AC) than in the case of premises and was greater in the case of the second premise (BC) than in the case of the first premise (AB). These contingencies are confirmed by an interaction of the syllogistic relatedness of the propositions presented and the type of proposition being recognized, \(F(2, 318) = 4.57, p < .01.\) Although these differences in the magnitude of the effects obtained on premises and conclusions may be due to the idiosyncratic content differences noted above, they could also have implications for certain assumptions underlying the formulation we have proposed. The nature of these implications is discussed more fully below.

**Discussion**

This study was based on the following assumptions: (a) Belief propositions are organized syllogistically in memory. (b) This organization occurs spontaneously as a result of reporting beliefs in logically related propositions in reasonably close temporal contiguity. (c) In the course of reporting these beliefs, unmentioned propositions that are syllogistically related to the ones being considered are spontaneously constructed. As a result, these propositions are often reported later on as actually having been mentioned along with the propositions to which they refer. The experimental design did not permit comparable comparisons to be made for correct recognition responses (see Table 2).

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\(^3\) The experimental design did not permit comparable comparisons to be made for correct recognition responses (see Table 2).
reported beliefs actually pertained. The results of this study are generally consistent with these assumptions and therefore with a conceptualization of belief organization in terms of implicational molecule theory. In evaluating the support for this conclusion, however, several aspects of the data reported are worth noting.

**Magnitude Differences in Effects on Premises and Conclusions**

The effects of reporting beliefs in syllogistically related propositions on the false recognition of premises were not as great as its effects on the false recognition of conclusions. As we have noted, there may be artifactual reasons for this difference. For example, it might be partially a result of idiosyncratic content differences between premises and conclusions. Note also that conclusions always preceded premises in the recognition questionnaire. Conceivably, the prior consideration of these conclusions had interference effects on memory for whether or not premises had previously been presented, thereby attenuating the effects of experimental manipulations on the recognition of these premises. Therefore, pending further research, the reliability of these magnitude differences in effects on premises and conclusions should be treated with some caution. Nevertheless, the more general implications of these differences are worth considering, because if they are indeed reliable, they may require modification of an important assumption underlying the conceptualization we have proposed.

First, it may be incorrect to assume that the likelihood of activating an implicational molecule in memory is independent of which propositions contained in it are instantiated. In the present case, for example, instances of both "A implies B" and "A implies C" in combination may be more likely to activate a syllogism molecule than do instances of both "A implies B" and "A implies C." Moreover, the latter propositions may be more likely to activate the molecule than do instances of both "B implies C" and "A implies C." Although this assumption is not implausible, it suggests a general consideration that may ultimately need to be incorporated into a refinement of implicational molecule theory as originally proposed (Abelson & Reich, 1969).

A second possible interpretation of these different effects on premises and conclusions points out an inherent difficulty in applying implicational molecule theory under the conditions we have investigated (although not in the theory itself). Specifically, subjects who report their beliefs in propositions that instantiate components of a syllogism molecule may not actually interpret them as occupying the positions in the molecule that we have assumed (see Footnote 1). That is, subjects who consider the propositions that "smoking at an early age leads to a dependency on cigarettes" and "smoking at an early age leads to bad health" could in principle interpret these statements either as (a) instantiations of "A implies B" and "A implies C," respectively, or as (b) instantiations of "A implies C" and "A implies B," respectively. Whereas in the first case they should spontaneously generate the proposition "dependency on cigarettes leads to bad health" (an instantiation of "B implies C"), in the second case they should generate the proposition "bad health leads to a dependency on cigarettes." We had assumed (see Footnote 1) that the generation of a proposition would be unlikely if it was inconsistent with real-world knowledge about the direction of the causal relationship (if any) that is likely to exist between the events to which it refers. However, if this assumption is invalid, and if subjects in fact varied in the interpretations they made of the propositions presented, the overall likelihood of false recognition responses to the particular premises presented in the recognition task would be less than the likelihood of false recognition responses to conclusions, as results suggest. (In the latter case, the interpretation of belief statements in terms of the syllogism molecule is unambiguous.) To this extent, an implicational molecule formulation of belief organization may be valid, but an a priori application of it may sometimes be difficult.

**Magnitude Differences Between Correct and False Recognition**

Although the probability of reporting unmentioned propositions as having been pre-
RECOGNITION OF BELIEF PROPOSITIONS

sentenced was increased by previously reporting beliefs in propositions that were syllogistically related to them, it obviously did not approximate the probability of correctly recognizing these propositions when they had in fact been presented. This could create problems for the assumptions that these unmentioned propositions are inferred and added to a single representation of the entire set of syllogistically related statements (based on the syllogism molecule). (If this were so, they should not be clearly distinguishable from propositions that had actually been presented.) However, the recognition task was administered only a few minutes after subjects had completed the original belief questionnaire. Therefore, an episodic representation of responses to individual belief items was still salient to subjects at the time they made recognition responses. They may therefore have based these responses in part on their ability to recall actually having reported a belief in the test propositions. If this is the case, the effects of the syllogistic relatedness of propositions on recognition errors should increase over time, as the episodic components of the actual experience of reporting beliefs become less accessible in memory. This possibility may be worth exploring.

The Role of "Guessing"

We have assumed that the process of reporting beliefs in two of the propositions contained in a syllogism molecule stimulates subjects to think about the remaining proposition at the time these beliefs are first reported. One might argue instead that the results obtained are attributable to a guessing bias that occurs at the time of recognition. That is, subjects who can remember thinking about two of three syllogistically related propositions may simply guess that the remaining one was presented as well. Moreover, the likelihood of making such guesses may depend on how obvious it is that the propositions one can remember are part of a syllogism. The pattern of results reported in Table 7, if considered in isolation, would be consistent with this interpretation.

In evaluating this possibility, however, two factors should be considered. First, a guessing bias should normally affect responses to items that were presented as well as responses to items that were not. However, there was no indication that this was the case; correct recognition responses to presented items were typically not a function of the items accompanying them in the original questionnaire. (If anything, considering propositions in the context of others that were syllogistically related to them decreased subsequent recognition of them.)

Second, even if a guessing bias is assumed to account for part of the effect of reporting beliefs in syllogistically related propositions on false recognition of nonpresented ones, it seems unlikely to account for all of it. A signal-detection analysis of the data collected in this study would theoretically permit the effects of a guessing bias ($\beta$) and the effects of discriminability ($d'$) to be isolated. This analysis was not performed for reasons noted earlier (see Footnote 2). However, the fact that the effects of experimental variables were restricted to false alarm implies that both signal-detection parameters would be influenced by these variables. (That is, the ability to discriminate between mentioned and unmentioned propositions would be less when beliefs in other syllogistically related ones have been previously reported, and the tendency to guess that an unmentioned proposition was presented would be greater under this condition.) Inasmuch as implicative molecules theoretically govern both the comprehension of information and the inferences made after the information is presented, both effects would be consistent with the formulation proposed. In any event, at least some proportion of the effect of reporting beliefs in syllogistically related propositions on false recognition of unmentioned propositions appears to be attributable to cognitive-processing differences at the time these beliefs are reported rather than at the time of recognition.

Interference Effects on Correct Recognition

The recognition of conclusions that had actually been presented slightly decreased when beliefs in the two propositions that syllogistically implied them were reported. Although this tendency was not significant, it is noteworthy in light of previous findings,
reported by Sentis and Burnstein (1979), that also suggested that subjects have greater difficulty in recognizing individual pieces of information once they are organized configurally. Because the organizational principle investigated in this earlier research (cognitive balance) can also be considered an implicational molecule (Wyer & Gordon, in press), the parallel between the two sets of findings is of heuristic interest.

Effect of Familiarity and Prior Beliefs

Theoretically, the effects reported in this article and the processes underlying them should be independent of the type of issues to which the belief propositions refer and independent of subjects' a priori beliefs in their validity. Certain differences are nevertheless worth noting. For example, compare the proposition sets “Cigarette smoking places impurities in the lungs. Impurities in the lungs cause cancer. Cigarette smoking causes cancer” and “Eskimos drink bourbon. Bourbon strengthens fingernails. Eskimos have strong fingernails.” The concepts mentioned in the first set of propositions are familiar, and a priori beliefs in the propositions are likely to be strong. Moreover, these propositions or their conceptual equivalents may already have been organized in memory in relation to one another before subjects are asked to consider them in a belief questionnaire. To this extent, subjects may access the entire set of propositions in the course of reporting their belief in any one, and so subsequent errors in remembering which of these propositions were actually presented may occur for this reason.

In contrast, beliefs in the propositions contained in the second set described above are unlikely to have been thought about in the absence of an explicit demand to report beliefs in them. Moreover, the concepts to which they refer are less common. For both reasons, subjects may engage in more extensive processing of the propositions at the time they are asked to report beliefs in them than they would in the case of more familiar propositions. On the one hand, this processing could lead to relatively better memory for the former propositions. On the other hand, subjects in the course of this more extensive cognitive activity may also be more likely to generate a third, unmentioned proposition through the processes postulated by implicational molecule theory. Thus, there is some reason to expect that a consideration of syllogistically related propositions would lead to false recognition responses, regardless of whether they are familiar or unfamiliar. Unfortunately, the sets of propositions used in this study were not sufficiently diverse to investigate this possibility.

Implications for Social Influence

In addition to their consistency with implicational molecule theory, the results of this study provide indirect support for McGuire's (1960, 1981) conceptualization of the role of syllogistic principles in belief organization and change. Our results unfortunately do not bear directly on the organization of beliefs themselves but rather concern the way in which propositions to which these beliefs refer are organized in memory. In this respect, the focus of the present study differs somewhat from that of earlier research (McGuire, 1960, 1981; Wyer & Carlston, 1979).

However, it seems reasonable that to the extent a proposition is stored in memory along with others that are syllogistically related to it, beliefs in this proposition will be affected by the implications of beliefs in the statements accompanying it. For example, associating a statement (i.e., “drinking coffee is bad for the health”) in a set of logically related propositions that are unlikely to be true (e.g., “drinking coffee leads to sleeping sickness” and “sleeping sickness is bad for the health”) should decrease beliefs in this statement, whereas embedding the statement in a set of propositions believed to be true (e.g., “drinking coffee leads to frequent insomnia” and “frequent insomnia is bad for the health”) should increase beliefs in the statement. This possibility, which is consistent with the “Socratic effect” postulated by McGuire (1960) and empirically demonstrated by Rosen and Wyer (1972; but see Henninger & Wyer, 1976), is worth investigating.

Finally, the role of syllogistic principles in the organization of beliefs in memory has
more practical implications. For example, people's construction of inferences may produce errors in eyewitness testimony (Loftus, 1975). That is, a witness to a crime may "remember" an event as having occurred when, in fact, it is only a logical inference based on other (valid or invalid) premises. Similar phenomena may underlie the impact of advertising on consumers' decision making (cf. Preston, 1967). For example, suppose an advertisement that states that a certain brand of mouthwash kills germs is received by a person who already believes that "killing germs prevents illness." This person may not only conclude that the mouthwash described in the advertisement prevents illness but at a later point may believe that the advertisement actually stated that this was the case. Such findings, if they occurred, could have implications for deception in advertising and the manner in which it occurs. These implications suggest avenues for future research.

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