Reasoning, Integration, Inference Alteration, and Text Comprehension

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Abstract This paper reports how the study of formal logical reasoning provides insight into more everyday types of reasoning, such as that involved in language comprehension. Both of these types of cognition are thought to involve the use of mental models, and so it is reasonable to think that the cognitive operations needed for formal logical reasoning would be involved in everyday reasoning as well. We focused on three aspects of formal reasoning: (a) the integration of information into a common mental model, (b) the drawing of inferences, and (c) the coordination of alternative possibilities. We were able to show that the integration and inference components were related to narrative comprehension processes, but the coordination of alternative models was not. Thus, there is evidence for some overlap in the mental processes used in formal and everyday reasoning. This further justifies the study of formal logical reasoning as a window into certain types of everyday reasoning.

This paper focuses on the relation between formal and everyday reasoning tasks. Both of these are thought to involve mental models (Johnson-Laird, 1983; van Dijk & Kintsch, 1983; Zwaan & Radvansky, 1998). Formal logical reasoning often involves presenting people with information in an artificial format, and putting constraints on people's thinking that are not typically presented explicitly in the real world. In contrast, everyday reasoning allows for a wide variety of mental operations, some of which may extend beyond what is observed in more controlled settings. So, one of the issues that this work addresses is the value of studying formal logical reasoning as a window into how people engage in more everyday sorts of reasoning.

While the domain of formal reasoning is relatively constrained, there are many types of everyday reasoning. We focus on everyday reasoning in language comprehension. In particular, we look at the integration of information during comprehension and the alteration of a person's understanding when led to believe one situation is true, but then finds that a different situation is operating. In addition to this primary goal, we look at how formal reasoning compares with measures of working memory span and situation memory as a predictor of everyday reasoning.

In this study, we are interested in looking at naïve reasoners for two reasons. First, experienced reasoners in formal logic are more likely to use domain-specific strategies that are based on mathematics or heuristics. Second, the psychological theories of human formal reasoning are oriented around the naïve reasoner.

The reasoning processes in formal logic require a person to not just store information, but to actively manipulate it. According to Mental Model Theory (e.g., Johnson-Laird, 1983), three processing components are (a) the integration of information, (b) the drawing of inferences, and (c) the consideration of alternative states. For formal logic problems, like categorical syllogisms, the integration process involves taking information from each premise, and integrating them into a single mental model. The success of this integration influences if a person is able to derive a correct conclusion. This is because after integrating the information, a person can draw an inference that should be true based on that representation. Even though this representation is a possible state of affairs, a person needs to assess whether it is the correct (valid) interpretation and to search for alternative possibilities (states-of-affairs) that also satisfy those premises, but that might lead to different conclusions than those derivable from the original model(s).

We look at the everyday reasoning that occurs during language comprehension. If the processes observed in formal reasoning involve general mental operations that are used in day-to-day living, then there should be some overlap for formal and everyday tasks. Moreover, this overlap should be confined to conditions where the two types of reasoning rely on similar mental processes. Observing such an overlap would provide support for the idea that the cognitive

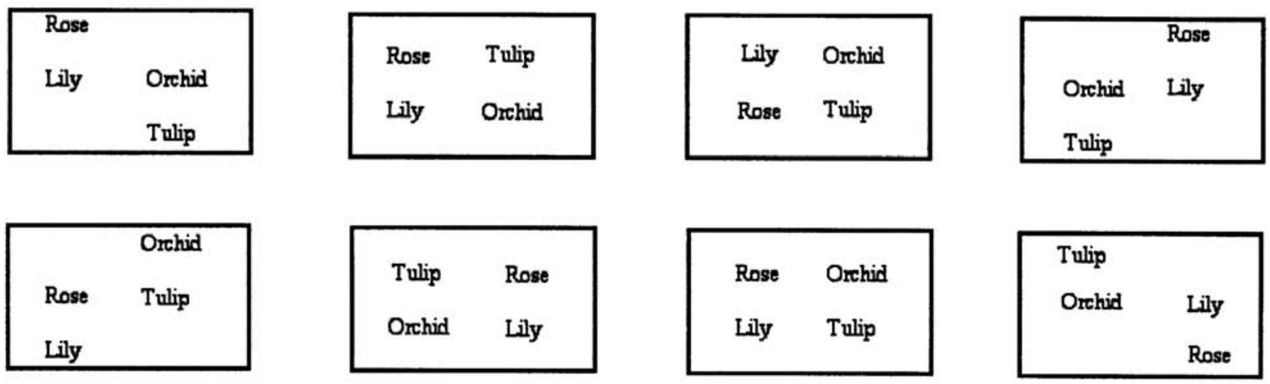

Figure 1. Sample response set for integration task.

processes involved in everyday reasoning is similar to the processes used in formal reasoning.

Experimental Tasks

Everyday reasoning. We had two comprehension and memory tasks. The first is a *spatial integration* task (Ehrlich & Johnson-Laird, 1982) in which people are presented with spatial descriptions. The task should draw on similar cognitive operations as the integration component of logical reasoning. What is interesting about this task is that in some cases the information is presented continuously so that the content of a description always contains elements from a previous description, whereas in other cases the information is presented discontinuously so that people need to retain the separate idea units before it is clear how they can be integrated. Sentences 1 to 3 correspond to a *Continuous* description. This is because each sentence refers to an object that is also in the sentence immediately preceding it.

The lily is in front of the rose. (1)
The rose is to the left of the tulip. (2)
The tulip is in front of the orchid. (3)

In contrast, Sentences 4 to 6 correspond to a *Discontinuous* description. This is because Sentence 5 refers to two new objects. Only after Sentence 6 is read can this information can be integrated.

The lily is in front of the rose. (4)
The tulip is in front of the orchid. (5)
The rose is to the left of the tulip. (6)

In this study, the task was to select one diagram, from a set of eight (See Figure 1), which fit the description. The difference between the Continuous and Discontinuous conditions provides an index of the facility with which a person can mentally integrate information.

TABLE 1
Sample Passages Used for the Situation Alteration Task

Expected Version:
Carol was not feeling well and decided to find out what was wrong. Carol went into town and entered the large building hoping to find some books relevant to her problem. She walked through the doors and took an elevator to the third floor.
She found a book that seemed relevant to her problem. Carol then went to the main desk and checked out the book for two weeks so that she could read it carefully at home. When she left the building she saw that it had started snowing hard and she hailed a taxi to take her home.

Unexpected Version:
Carol was not feeling well and decided to find out what was wrong. She called her friend who was a nurse to ask her for some advice. The friend told Carol what to do. Carol went into town and apprehensively entered the large building hoping to find an answer. She walked through the doors and took an elevator to the third floor.
She found a book that seemed relevant to her problem. Carol then went to the main desk and checked out the book for two weeks so that she could read it at home. When she left the building she saw that it had started snowing hard and she hailed a taxi to take her home.

Inference Question:
In what kind of building did Carol use the elevator?

Target Inference: Library

Competing Inference: Hospital

This task should draw on similar cognitive operations as the integration component of logical reasoning. Specifically, to be able to perform well, a person needs to integrate the information into a single mental model, which is then compared with the diagrams during the testing phase. This does not involve the inference component because all of the information is present in the pieces of information given. Similarly, it does not involve the alternative models component because it is known that these descriptions apply to one, and only one, situation.

The second everyday reasoning task is an *altered inference* task. This is a task where people are sometimes initially misled about the nature of the described situation (Hamm & Hasher, 1992). Examples of misleading and nonmisleading versions of a text are presented in Table 1. In one version of the text, the *Expected* version, readers are presented with information in such a way that they are likely to make the appropriate inference initially. In this case, the text invites the inference that Carol is going to go to a library to find out about her condition.

In the *Unexpected* version, people are initially led to believe that Carol is going to a hospital. Later in this story version, it is revealed that another situation is operating. Specifically, that Carol is going to a library, not a hospital. At that point, people need to alter the inferences that were drawn from the passage. Comprehension in this task is assessed with memory probes (e.g., "hospital" or "library") during reading and responses to questions (e.g., "In what kind of building did Carol use the elevator?") that were posed after reading is complete.

This task relates to the second and third component of formal reasoning. It relates to the inference-drawing component in that a person is required to use information that is not explicitly provided. In this case, making decisions about information relevant to the story that was never explicitly presented. In the example, the information about the type of building Carol went to was never provided. Furthermore, this task relates to the alternative state-of-affairs component in that one needs to reject the original interpretation of the situation in terms of a new interpretation. That is, people need to coordinate their use of an old, incorrect mental model and a new, correct mental model, in order to perform well on the task.

Logical reasoning. For our formal reasoning task, we chose categorical syllogisms: "All A are B," "All B are C," therefore, "All A are C." This task was selected because it is a simple task in that there are relatively few components involved in reasoning (i.e., two premises and a conclusion) and there is a very limited and well-known pattern of responses (Johnson-Laird & Bara, 1984). The three components of formal reasoning of interest to us here, namely, integration, inference drawing, and alternative consideration, can be neatly mapped onto this task. Integration corresponds to integrating the information in the two premises into a common mental model. Inference drawing involves deriving a conclusion from the model that is not stated by the premises. Finally, alternative consideration corresponds to cases where a person needs to consider multiple states-of-affairs in the world in order to derive the appropriate conclusion.

Performance on the logical reasoning task might be related to the spatial integration task because both require the integration of multiple pieces of information. In formal reasoning, a person is presented with two premises. The person needs to integrate the information from these separate premises into a single mental model. So, the logical reasoning task could account for performance in the spatial integration task in terms of the general integration effect. Moreover, because the Discontinuous condition places a heavier burden on the comprehender for mentally integrating information, logical reasoning should be more related to performance in this condition as compared to the Continuous condition.

Performance on logical reasoning may also be related to the altered inference task. In the logical reasoning task, to reach the appropriate conclusion, people need to switch from one model to another to assess the various states-of-affairs consistent with the premises. This is because a valid conclusion needs to be true for all possible circumstances that fit those premises. This coordination of mental models allows an appropriate inference to be derived. Similarly, in the altered inference task, people need to remove one mental model, and shift to another. This coordination of mental models also allows an appropriate inference to be derived.

Because both tasks require drawing inferences and coordinating multiple models, some relation is expected. With regard to drawing inferences, the relation between logical reasoning and language comprehension should be similar across all conditions. In addition, for model coordination, both tasks require a consideration of various states-of-affairs in the world. For the logical reasoning task, these are the different possible states that correspond to the premises. For the altered inference task, these are the two interpretations of the situations in which the protagonist is involved.

Other measures. In addition, there were two other tasks given. These were working memory span and situation memory tasks. The memory span task was the operation span test (Turner & Engle, 1989), which has become a standard measure (Daneman & Merikle, 1996). There are a number of claims that language comprehension is related to working memory span (e.g., Daneman & Merikle, 1996). If so, then it would be expected that performance on this measure would also be related to our language comprehension measures as well. For example, it would be reasonable to expect it to be related to performance on the spatial integration task because there is a greater working memory demand in the Discontinuous condition because a person needs to hold those items in working memory before they can be integrated. The greater one's capacity, the more efficiently this would be done. Also, working memory span may be related to performance in the altered inference task. Greater capacity would allow a person to coordinate a larger set of information during the re-interpretation process.

However, it is possible that memory span is not related to our comprehension tasks. Radvansky and Copeland (in press) have shown that while memory span is a good measure of language comprehension performance at lower levels of comprehension, such as the textbase level, it does a poorer job capturing ability at higher levels of comprehension, such as the mental model level. Because our language comprehension measures are focused on the mental model level, there may be no observed relation between working memory span and performance.

The other task was a *situation memory* test (Radvansky & Copeland, 2001). This involves presenting descriptions of situations and then having people select which set of alternatives most closely describes the same situation. This is a general measure of a person's ability to make judgments about previously encountered situation descriptions. It is also reasonable to expect that this might be related to performance on the language comprehension tasks because they all involve the mental model level of comprehension. Moreover, this relation might be expected to be greater in those specific tasks that involve memory for previously read descriptions.

Method

Subjects

Two hundred people were tested at Notre Dame and Indiana University South Bend. An additional 15 people were replaced for having excessive errors on many tasks.

Materials and Procedure

There were five tasks used in this study. These were the operation span test (Turner & Engle, 1989), a situation memory test (Radvansky & Copeland, 2001), a categorical syllogism task, a spatial integration task (Ehrlich & Johnson-Laird, 1982), and an altered inference task (Hamm & Hasher, 1992).

The operation span task (Turner & Engle, 1989) involved people reading aloud a series of 2 to 6 two-step math problems (e.g., (2 x 7) + 3 = 16). After reading the problem, the person indicated whether the answer was correct. Then a single word was read. At the end of a set, the task was to recall the words in the order that they had been read. Responses were said aloud and an experimenter typed them into a computer. For every set of words correctly recalled, as many points were given as there were words in the set. This is a standard measure of working memory capacity.

The situation memory task (Radvansky & Copeland, 2001) involved people rating 30 sentences, one at a time, for pleasantness on a 1 to 7 scale, with 1 for "very unpleasant" and 7 for "very pleasant." These ratings were not recorded. Afterward, a surprise memory test was given. On each trial, people were given six sentences that were alterations of the original. The task was to identify the one that was consistent with the situation described in the original. The six choices were given in a random order on each trial, for each person. People were told that the original sentences would never appear, and to type their responses into the computer. No feedback was provided. The six alternatives were (a) altered prepositional phrase, (b) altered direct object, (c) altered verb, (d) altered prepositional phrase and direct object, (e) altered prepositional phrase and verb, and (f) altered direct object and verb. Choices for the original sentence, "The man lost a hand of poker at the card shark's," are presented below (Sentence 8 is correct).

The man lost a hand of poker like the card shark. (7)
The man lost some money at the card shark's. (8)
The man won a hand of poker at the card shark's. (9)
The man lost some money like the card shark. (10)
The man won a hand of poker like the card shark. (11)
The man won some money at the card shark's. (12)

Performance was scored as the number of correct responses.

The logical reasoning task used standard categorical syllogisms. People were given 12 syllogisms (see Appendix), such as "All A are B," "Some B are C," along with a list of nine possible responses, including "no valid conclusion." The letters A, B, and C were replaced with occupations or hobbies, such as "artist," "jogger," or "mechanic." Half of the syllogisms had a valid response and half did not. They also varied in terms of the number of possible mental models that could be created. Performance on this task was measured in terms of the number of correct responses. This was a straight-forward way of assessing formal logical reasoning ability.

The spatial integration task was based on a study by Ehrlich and Johnson-Laird (1982). In this task, people

TABLE 2
Normative Measures for the Experiment

Test	Low	High	Mean score	SD	Maximum possible
Working Memory	0	49	14.17	9.03	60
Situation Memory	4	29	19.77	4.41	30
Logical Reasoning	0	12	5.73	2.05	12

were given a series of 16 (8 in each condition) three sentence descriptions, each followed by a set of diagrams. Sentences were presented one at a time and reading times were collected. The task was to select the one diagram that corresponded to the description. There were two conditions for this task: (a) Continuous and (b) Discontinuous descriptions. For Continuous descriptions, the second sentence always referred to an entity in the first. For the Discontinuous descriptions, the second sentence referred to two new entities. The information needed to integrate the information was not presented until the third sentence. As such, this is a more demanding condition. Examples are provided in the introduction to the manuscript.

Finally, for the altered inference task (Hamm & Hasher, 1992) people were given 12 paragraphs that describe situations in which there may be some ambiguity. Sample paragraphs are presented in Table 1. Paragraphs were presented one sentence at a time. For the Expected condition, people were given a sentence that made a critical aspect of the situation an expected outcome. In contrast, for the Unexpected condition, the situation was presented in such a way that people were likely to be misled and infer that some other sort of situation is operating. Later, people encounter information that makes clear that the original inference is incorrect, and that another type of situation is operating. At this point, people need to alter their inferences.

We tested people's ability to alter inferences in two ways. First we presented probe words that were consistent with either the incorrect or the correct interpretation. These were given after the disambiguating information, but before the end of the passage. The task was to indicate whether the probe word was consistent with the passage. The positive experimental probes were consistent with the appropriate final inference. In comparison, the negative experimental probes were consistent with the inappropriate inference that was invited in the Unexpected versions of the passages. Second, after reading each story, we explicitly asked people a question that directly probed the critical aspect of the passage and compared performance in the two conditions. People typed in the answers to these questions.

TABLE 3
Correlations Among the Normative Measures for the Experiment

	Working Memory	Situation Memory	Logical Reasoning
Working Memory	1.00		
Situation Memory	.125	1.00	
Logical Reasoning	.347*	.227*	1.00

* $p < .05$.
Note. Working memory span is the calculated span score. Situation memory is the total number of descriptions accurately identified. Finally, logical reasoning is the number of syllogisms correctly solved.

TABLE 4
Accuracy (in Proportions), Response Times (in s), and Reading Times (in s) for the Spatial Integration Task (Standard Deviations in Parentheses)

	Continuous		Discontinuous	
Arrangement selection accuracy	.61	(.28)	.48	(.26)
Arrangement selection response time	11.5	(6.9)	13.5	(7.7)
Sentence reading times				
First Sentence	6.9	(3.4)	6.9	(3.8)
Second Sentence	7.1	(4.1)	7.9	(5.4)
Third Sentence	5.3	(2.5)	8.4	(4.3)

Results

We first present general results for each measure followed by a comparison of measures of interest. These comparisons look at performance on the ability measures (working memory span, situation memory, and logical reasoning) and the comprehension measures.

General Performance

The means and ranges of the various ability measures are presented in Table 2, which are consistent with similar research. The correlations among these are presented in Table 3.

Spatial integration. The data for this task are presented in Table 4. People were more accurate, $t(199) = 8.73$, $p < .001$, and faster, $t(199) = 4.92$, $p < .001$, at identifying the correct arrangement in the Continuous

TABLE 5
Accuracy (in Proportions) for Responses to Memory Probes and Comprehension Questions During the Altered Inference Reading Task (Standard Deviations in Parentheses)

Memory Probes	Story Type	
Probe type	Expected	Unexpected
Positive	.91 (.16)	.88 (.19)
Negative	.87 (.21)	.80 (.26)

Comprehension Questions	Story Type	
Probe type	Expected	Unexpected
Positive	.92 (.19)	.90 (.20)
Negative	.95 (.14)	.87 (.24)

TABLE 6
Regression Beta Weights for the Various Probe and Question Types for the Altered Inference Task

Memory Probes	Measure		
Probe type	Working Memory	Situation Memory	Logical Reasoning
Expected			
Positive	.03	.06	.13**
Negative	.05	.09	.15*
Unexpected			
Positive	-.12	.22*	.16*
Negative	.06	.20*	.12**

Critical Questions	Measure		
Probe type	Working Memory	Situation Memory	Logical Reasoning
Expected			
Positive	-.02	.15*	.16*
Negative	-.01	.18*	.15*
Unexpected			
Positive	-.07	.17*	.15*
Negative	-.02	.24*	.13**

* $p < .05$; ** $.05 < p < .10$.

condition. This replicates Ehrlich and Johnson-Laird's (1982) study. Of less interest are the sentence reading times. Reading times for the first sentence did not differ between the two versions because they did not differ in content at this point. However, people were faster in the Continuous condition for both the second, $t(199) = 4.49$, $p < .001$, and third sentences, $t(199) = 16.17$, $p < .001$.

Altered inferences. The data for this task are presented in Table 5. These data were submitted to a 2 (Story condition: Expected vs. Unexpected) x 2 (Probe condition: Positive vs. Negative) repeated measure ANOVA. There was a main effect of Story, $F(1,199) = 17.65$, $MSE = .03$, $p < .001$, with greater accuracy in the Expected condition. Thus, there was more difficulty when there was an inference switch. In addition, there was a main effect of Probe type, $F(1,199) = 18.57$, $MSE = .04$, $p < .001$, with people being more accurate to correct than incorrect probes. Finally, the interaction was marginally significant, $F(1,199) = 3.74$, $MSE = .03$, $p = .06$. Simple effects tests showed that the Expected-Unexpected difference was significant for incorrect probes, $F(1,199) = 14.89$, $MSE = .04$, $p < .001$, but only marginally so for correct probes $F(1,199) = 2.94$, $MSE = .02$, $p = .09$. This is consistent with the idea that altering inferences was difficult and that there were residual effects from initial, but incorrect, inferences.

The question data were also submitted to a 2 (Story condition: Expected vs. Unexpected) x 2 (Question type: Positive vs. Negative) repeated measure ANOVA. There was main effect of Story, $F(1,199) = 22.66$, $MSE = .02$, $p < .001$, with people making fewer errors in the Expected than the Unexpected condition. Again, people had difficulty identifying story elements when inferences needed to be altered. While the main effect of Question type was not significant, $F < 1$, the interaction was, $F(1,199) = 7.61$, $MSE = .03$, $p = .006$. Simple effects tests showed that the difference between the Expected and Unexpected conditions was significant for the incorrect probes, $F(1,199) = 25.14$, $MSE = .03$, $p < .001$, but not the correct probes $F(1,199) = 1.54$, $MSE = .02$, $p = .22$. Again, this fits the idea that people had difficulty altering their inferences.

Comparisons

Spatial integration. For this measure, we used the difference between the Continuous and Discontinuous conditions as a measure of the ability to integrate information rather than just the ability to remember the pieces of information originally given. Presumably, people with a greater difference between the two conditions are less able to successfully integrate the information than people with a smaller difference. The data were then entered into a regression analysis using this difference score as the dependent variable, and performance on the working memory, situation memory, and logical reasoning tasks as the independent variables. This analysis revealed that logical reasoning was significantly related to performance ($b = -.15$, $p = .04$), but working memory span ($b = .07$, $p = .37$) and situation memory were not ($b = -.01$, $p = .90$).

Our interpretation is that the relation between the integration and logical reasoning tasks reflects the component of logical reasoning involved in integrating information from different premises, rather than simply maintaining multiple pieces of information. This is supported by separate analyses of the Continuous and

Discontinuous conditions. For the Continuous condition, logical reasoning was not related to performance (b = .10, p = .18), although working memory span (b = .21, p = .004) and situation memory were (b = .19, p = .008). In contrast, for the Discontinuous condition, logical reasoning was related to performance (b = .23, p = .001), in addition to working memory span (b = .16, p = .02) and situation memory (b = .21, p = .002). Note that some of the differences between the effect score analyses in the previous paragraph and the ones of the conditions in this paragraph reflect variation between a differences measure and a measure of general performance level.

Altered inferences. For this aspect of the data, we performed regression analyses on each of the conditions with the idea that, if inference alteration were related to multiple model coordination during formal reasoning, then there would be a stronger relation between them for the Unexpected story than the Expected story probes. These results are presented in Table 6.

For the memory probe data, logical reasoning was related to performance. Moreover, it was similarly related to responses in all of the conditions. Thus, there is a component of formal reasoning that is similar in these conditions. This is probably the inference generation process because there is no difference as a function of whether there was an inference alteration or not.

The coordination of multiple models does not seem to be a major factor in the relation between the altered inference and reasoning tasks because of the similar performance in the two conditions. However, there is something about inference alteration that is related to performance on the situation memory task. It seems that people who are better able at remembering a described situation are better at coordinating a re-evaluation of what the described situation was. Thus, these measures both seem to be tapping into some common facility in the coordination of information in the world to identify what is the most accurate representation that corresponds to a previously or currently described situation. Working memory span was not related to performance.

For the critical question, logical reasoning was again similarly related to performance in all of the conditions, consistent with the above interpretation. However, situation identification was also similarly related across the three conditions. This consistency may reflect general situation memory, which is similar in the question answering and situation memory tasks. The reason for the lack of difference on this task compared to the memory probe task is because the question task taps into the most highly available information, whereas the memory probe assesses whether information is at a higher level of availability, regardless of whether it is the most available. Again, working memory span was not related to performance.

Discussion

This study demonstrates that everyday reasoning, such as language comprehension, does share some processes with formal reasoning. Specifically, the integration of information and the inference-making process were similar. This supports the idea that there is value in studying formal reasoning because similar cognitive operations are operating in everyday reasoning.

However, we did not find that considering multiple alternatives was related to the ability to alter inferences. This lack of a relation could reflect either task differences or deeper issues. This difference could be due to the fact that the altered inference task required a person to disregard a previous interpretation whereas formal reasoning required people to maintain multiple alternative situations. The deeper issue is that the consideration of alternative possibilities in formal reasoning does not always involve a consideration of alternative inferences (see Copeland & Radvansky, in press; Newstead, Handley, & Buck, 1999; Polk & Newell, 1995; Thompson, Striemer, Reikoff, Gunter, & Campbell, 2003). It is possible that people rely on other processes, such as evaluating probabilities based on the terms in the premises (Chater & Oaksford, 1999).

Overall, this pattern of results is consistent with the idea that everyday reasoning involves mental processes that are shared with more formal types of reasoning, in this case, categorical logic. This is in line with the general claim that both language comprehension and formal reasoning involve mental models (Johnson-Laird, 1983). This is encouraging because it is a more parsimonious account of cognition. Rather than assuming that formal reasoning operates using one class of processes (e.g., probabilistic estimation) and language comprehension another (e.g., situation models), it can be more confidently asserted that the two types of thought share a common mental apparatus.

In addition to the results of primary interest, there are some additional conclusions that can be drawn with respect to our working memory span and situation memory measures. The most notable information regarding the operation span task (Turner & Engle, 1989) is that while it was related to memory retention over the short term (i.e., when the individual conditions are considered for the integration task), it was not related to performance on any of the mental model level factors except logical reasoning. This is inconsistent with the idea that working memory span is related to general language comprehension, but is more consistent with the idea that memory span taps more into the textbase level (Radvansky & Copeland, in press).

Finally, for the situation memory test (Radvansky & Copeland, 2001), as expected, performance on this measure was related to dependent variables that involved the retention of situation information over time. This is expected because the situation memory task is itself a relatively simple memory task. Of more interest here was the fact that the situation memory task was differentially related to performance in the different conditions of the altered inference task. Specifically, situation memory was more related to performance when there was a need to alter the inferences drawn during comprehension than when there was not such a strong need.

The situation memory task requires a person to identify a description that is different from the original, but that is consistent with the described situation. As such, people must put aside some of the inferences that were made based on the original sentence to best match their mental model with the set of six sentences they are currently presented with. The better that this can be done, the better one's performance will be. Similarly, when responding to memory probes in the altered inference task, in the altered inference condition, a person needs to put aside his/her original inferences in order to more effectively perform in the current circumstances of the task.

Conclusions

The study of formal logic has been of interest to cognitive psychologists because it can provide insights into the degree to which people's thinking conforms or deviates from more abstract forms of logic. That is, studies of formal logic provide insight into how people actually try to reason logically, even if they do not follow the formal rules of logic. It is relatively rare that people are presented with situations where they must bring their powers of reasoning to bear where the format of the information is as clear as it is with formal syllogisms. So, to what degree are the mental representations and processes observed and theorized in these formal settings able to be applied to more everyday sorts of reasoning? The results of the current study show that there can be substantial overlap in these two cases, and that the study of performance in formal logic situations can be transferred to our understanding of how people reason every day.

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Appendix

Syllogisms used in the logical reasoning task. Using standard notation A = "All," "E" = No, "I" = Some, and "O" = "Some… Not," 1 = Figure 1 (A-B B-C), 2 = Figure 2 (B-A B-C), 3 = Figure 3 (A-B C-B), and 4 = Figure 4 (B-A B-C). (Note that Figure here refers to the syllogistic figure.)

Syllogism	Conclusion(s)
AA1	All A are C
AA4	Some A are C or Some C are A
AO4	Some A are not C
AI2	Some A are C or Some C are A
EA4	Some C are not A
EI3	Some C are not A
AI1	No Valid Conclusion
EO3	No Valid Conclusion
IA2	No Valid Conclusion
II3	No Valid Conclusion
IO1	No Valid Conclusion
OO2	No Valid Conclusion

Sommaire

Le présent article traite de la mise en lumière de types de raisonnement courants, par exemple celui qui concerne la compréhension du langage, par l'étude du raisonnement logique formel. Ce dernier s'entend, pour la circonstance, de la résolution de syllogismes catégoriques. Il s'agit bien souvent de présenter à des gens de l'information dans une forme artificielle et d'imposer des contraintes à leur pensée. En revanche, le raisonnement quotidien autorise un large éventail d'opérations mentales, dont certaines sont susceptibles de s'étendre au-delà de ce qui peut être observé dans des contextes contrôlés. Les processus de raisonnement en logique formelle exigent d'une personne non seulement qu'elle enregistre de l'information mais aussi qu'elle la manie activement. Trois composantes du traitement cognitif que comporte le raisonnement sont (a) l'intégration d'information, (b) la formulation d'inférences, (c) la prise en considération d'états autres.

À titre comparatif, aux fins du raisonnement courant, les auteurs ont considéré l'intégration spatiale de l'information au cours de la compréhension et la modification de celle-ci lorsqu'une personne est persuadée de la véracité d'une situation puis découvre qu'une situation autre est en cours. On estime tant du raisonnement formel que du raisonnement courant qu'ils font appel à des modèles mentaux, et il est donc raisonnable de penser que les opérations cognitives nécessaires au raisonnement logique formel interviennent également dans le raisonnement courant. Les tâches de raisonnement courant choisies par les auteurs partagent, en outre, les éléments cognitifs critiques de types de raisonnement formel.

Ils ont pu démontrer que les éléments d'intégration et d'inférence étaient liés aux processus de compréhension de récits, ce qui n'était pas le cas de la coordination de modèles de substitution. Ainsi, l'étude révèle que le raisonnement courant, par exemple la compréhension du langage, partage certains processus avec le raisonnement formel. Cela justifie à nouveau l'étude du raisonnement logique formel comme moyen de comprendre certains types de raisonnement courant. Toutefois, les auteurs n'ont pas constaté de rapport entre la prise en considération de multiples possibilités et la capacité d'infléchir les inférences. L'absence de rapport témoignerait éventuellement du fait que la tâche de modification des inférences oblige une personne à ne pas tenir compte d'une interprétation antérieure ou de l'obligation imposée par le raisonnement formel d'envisager de multiples situations susceptibles d'être substituées les unes aux autres.