

The Emergence of Coherence Over the Course of Decision Making

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Previous research has indicated that decision making is accompanied by an increase in the coherence of assessments of the factors related to the decision alternatives. In the present study, the authors investigated whether this coherence shift is obtained before people commit to a decision, and whether it is obtained in the course of a number of other processing tasks. College students were presented with a complex legal case involving multiple conflicting arguments. Participants rated agreement with the individual arguments in isolation before seeing the case and after processing it under various initial sets, including playing the role of a judge assigned to decide the case. Coherence shifts were observed when participants were instructed to delay making the decision (Experiment 1), to memorize the case (Experiment 2), and to comprehend the case (Experiment 3). The findings support the hypothesis that a coherence-generating mechanism operates in a variety of processing tasks, including decision making.

Many decisions people are faced with require the integration of multiple inferences. Tasks such as deciding which job offer to accept, or what candidate to support in an election, involve sets of inferences that tend to be ambiguous, contradictory, and complex. Holyoak and Simon (1999) examined such inference-based decision making in a laboratory analog of judicial decision making, in which college students were asked to render a verdict in a complex legal case. The principal finding was that the decision-making process was accompanied by a systematic change in the evaluation of the inferences toward a pattern of coherence with the emerging decision. Assessments of inferences spread apart increasingly, with those supporting the chosen decision growing stronger as those supporting the rejected alternative waned. This shifting of inferences suggests that the participants' reasoning processes operated bidirectionally: The decisions seemed to be based on the inferences made from the provided information, and at the same time, the emerging decisions worked backwards to alter the strength of the inferences, yielding even stronger support for the decision. Evidence of this bidirectional influence was provided by a manipulation of the favorability of 1 of the 12 inferences in-

involved in the decision. The differential information resulted in a larger number of decisions made in favor of the corresponding side. More important, it generated a coherence shift in all of the other inferences, even though they were barely related to the manipulated inference or not related to it at all. Holyoak and Simon interpreted their findings in terms of a decision-making model in which options and inferences are represented in a connectionist network that operates by parallel constraint satisfaction (Kunda & Thagard, 1996; Ranney & Thagard, 1988; Read & Miller, 1994, 1998; Read, Vanman, & Miller, 1997; Spellman, Ullman, & Holyoak, 1993; Thagard, 1989, 2000; Thagard & Millgram, 1995).

Three additional findings from Holyoak and Simon's (1999) study are of note. First, despite the difficulty and ambiguity involved in the case, participants reported high levels of confidence that they had reached the best possible decision. High confidence in decisions despite entering ambiguity is a natural consequence of constraint-satisfaction mechanisms. Second, once a decision was made, participants had difficulty recalling the assessments that they had made prior to making their decision, suggesting that the final state of the decision network tended to render earlier states inaccessible. Third, the shifting of the evaluations appeared to occur both prior to overt commitment to the decision and after it, with the bulk of the change happening in the earlier stage. Holyoak and Simon therefore suggested that the spreading apart of inferences was not merely an *ex post facto* justification of the decision but rather was inherent to the actual mechanisms operative in the making of the decision.

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A preliminary report of the findings was presented at the 40th Annual Meeting of the Psychonomic Society, Los Angeles, November 1999. This research was supported by National Science Foundation Grants SES-0080424 and SES-0080375.

This article benefited from the comments of Tom Lyon, Steve Read, David Boninger, and Jay Russo. We thank Andre Der-Avakian, Mercedes Barajas, Vera Cha, Humberto Iglesias, Mimi Lin, Diana Lucero, Annahita Palar, Suzette Viernes, and Kristine Vuong for assisting in running the experiments and Sean McAuliffe for preparing figures.

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Characterizing the Mental Processes Involved in Decision Making

In this article, we extend the examination of the mental processes involved in the making of a decision. We critically revisit the question of when, and under what conditions, coherence shifts take place. In particular, do such shifts actually precede the making of a decision? This is the view advocated by Holyoak and Simon

(1999). Alternatively, it is possible that coherence shifts are made only after the point of commitment to a decision. According to the latter view, the process that precedes the commitment to a decision is a rational one, which does not involve any systematic, biasing reevaluation of alternatives. This characterization captures a central feature of *homo economicus*, the conception of rational choice that typically underlies economic analyses of human behavior (e.g., Becker, 1976) and rational choice models in decision theory (e.g., Savage, 1954; Von Neumann & Morgenstern, 1947). This view is consistent also with the position of Festinger (1957, 1964), who argued that cognitive dissonance does not arise until the person has already taken an action inconsistent with his or her prior beliefs or attitudes and thus becomes committed to the decision (Festinger, 1964, p. 42). Commitment implies binding oneself to a course of action, thus making the decision resistant to change (see Kiesler, 1971; Wicklund & Brehm, 1976). It should be noted that the empirical support for Festinger's position has been subjected to strong criticism (see Janis & Mann, 1977; Jones & Gerard, 1967; Zajonc, 1968).

Support for predecision changes has been offered by a number of decision theorists. In the context of consumer decision making, Russo and colleagues (Russo, Medvec, & Meloy, 1996; Russo, Meloy, & Medvec, 1998) have shown that when participants are presented with information about attributes of competing consumer products, the evaluation of information shifts toward supporting the preferred product. Montgomery's (1983; Montgomery & Willen, 1999) theory of "search for dominance structure" describes the decision-making process as a search for dominance, in the course of which the decision alternatives are restructured so that one comes to dominate its competitors. Svenson's (1992, 1996, 1999) theory of "differentiation and consolidation" proposes a shifting of evaluations at both the pre- and postdecision phases of the process. Prior to making the decision, the decision maker differentiates the hypothetically chosen alternative from its competitors so as to enable a confident choice, and after the decision is made the respective alternatives are spread even further apart so as to consolidate the decision and ward off dissonance and regret. Similarly, Mills (1968, 1999; Mills & Ford, 1995) proposed "choice certainty theory," according to which people spread the decision alternatives apart before committing to a decision.

Overall, the rational characterization of the predecision process has prevailed in economic perspectives, decision theory, and social psychology. The dissonance phenomenon associated with decision making is generally viewed as synonymous with "postdecision dissonance" (e.g., Abelson & Levi, 1985; Ajzen, 1996; Allison, Mackie, & Messick, 1996; Aronson, 1999; Baron, 1994; Berkowitz & Devine, 1989; Gerard & White, 1983; Shultz & Lepper, 1996; Wicklund & Brehm, 1976). This postdecision conception has carried over into other fields in which cognitive dissonance has been applied, including economic theory (e.g., Akerlof & Dickens, 1982; Hosseini, 1997), political psychology (Milburn, 1991), and advertising and consumer behavior (e.g., Cummings & Venkatesan, 1976; Korgaonkar & Moschis, 1982).

If coherence shifts can precede the point of commitment to a decision, a related issue concerns the minimal conditions under which changes in inferences might occur. Uleman, Newman, and Moskowitz (1996) have investigated this issue in the context of social inferences on the basis of the reading of texts. The bulk of their research has dealt with trait inferences, though similar find-

ings have been made with respect to inferring the gist of events (Uleman & Moskowitz, 1994) and inferring situational features (for a review, see Uleman et al., 1996). The central finding is that these inferences are made in the absence of any strategic goal and are thus performed without any apparent conscious intention. For example, inferences were made when participants were asked only to memorize the text (Winter & Uleman, 1984), merely to familiarize themselves with it (Carlston & Skowronski, 1994), and even when the text was presented as a distractor for some other ostensible processing task (Winter, Uleman, & Cunniff, 1985).

These experiments have led Uleman (1999; Uleman et al., 1996) to suggest a distinction between spontaneous and intentional mental processes. This classification focuses on the characteristic of intentionality—namely, on the goals, or lack thereof, that are associated with the mental process in question (see Gollwitzer, 1990). Spontaneous processes are initiated in the absence of strategic proximal goals; they are understood to be driven by chronic goals, or to be performed incidentally to some other goal, such as in the comprehension of the text or the event (Graesser, Singer, & Trabasso, 1994; Uleman, 1999). It is possible that the coherence effects observed by Holyoak and Simon (1999) are the result of such spontaneous processes as comprehension and evaluation of situations.

Objectives of the Present Study

The present study had two basic objectives. One objective was to resolve the question of whether the reevaluation of decision alternatives is exclusively a postcommitment phenomenon, or whether it can also occur before the decision-making process has been completed. The second objective was to investigate the minimal conditions for the occurrence of coherence effects. In particular, we examined the possibility that coherence effects are obtained under a variety of incidental processing goals and, in the extreme, when participants are not asked to make a decision at all.

Experiment 1

In each of the following experiments, we compared evaluations at three points in time. First, a baseline test was completed before participants were told anything about a legal case. The crucial measurement was at the second (interim) phase, when participants had been exposed to information about the case, but the instructions were manipulated so as to delay (Experiment 1) or avoid altogether (Experiments 2–3) the making of an explicit decision. At a third and final phase, participants were asked to simulate a judge and to decide the legal case.

The main purpose of Experiment 1 was to examine whether the interim shifts observed by Holyoak and Simon (1999, Experiment 1, three-phase condition) did, in fact, precede the commitment to the decision. At the interim phase of that Experiment 1, participants had been informed that their role was to simulate a judge, but they were instructed to withhold the making of the decision for a while. Participants were asked whether they had a "preliminary leaning" toward one of the two possible decision outcomes, and they were then asked to rate their evaluations of the arguments that favored or opposed each outcome. The results indicated a strong coherence shift in the evaluations (i.e., relative to a prior baseline measurement, participants' assessments of the

arguments were significantly correlated with each other and with the preliminary leaning, and also with the ultimate decision subsequently rendered).

It might be argued, however, that the request for a preliminary leaning initiated the decision process and that the participants felt somewhat committed to those decisions (see Cialdini, Cacioppo, Bassett, & Miller, 1978). If that were the case, then the reported interim evaluations were more akin to postdecision evaluations. Experiment 1 replicated the basic design used by Holyoak and Simon (1999) but explicitly varied whether participants assessed the arguments before or after they were asked to report their preliminary leaning.

Method

Participants

Fifty undergraduates at the University of California, Los Angeles (UCLA), took part in the study in order to satisfy a course requirement. The participants were randomly assigned in equal numbers to the leaning-first and leaning-second conditions. Participants were run in groups of two to four. Each session took from 30 to 50 min to complete.

Materials

The materials were identical to those used by Holyoak and Simon (1999; see their Appendix B), consisting of a legal case and sets of opposing arguments offered by the plaintiff and the defendant. The case was called "Caught in the Net," and involved a civil action triggered by a statement that was broadcast over the Internet. The case is based on a lawsuit launched by Quest, a software company, against Jack Smith, an investor in the company. The undisputed facts are that Quest's financial situation had deteriorated and its management was having difficulty in coping with the problems facing the company. Smith, a dissatisfied shareholder, posted a negative message about Quest's prospects on an electronic bulletin board directed at investors. Shortly thereafter, Quest's stock price plummeted and the company went bankrupt. It was later revealed that (unbeknownst to Smith) Quest had been secretly developing a new product that might have saved the company. Quest is now suing Smith for libel, claiming that his message caused the collapse of the company.

Each side made six arguments in favor of its position. The arguments formed opposing pairs, or points of dispute. The first three points of dispute involved matters of fact, and the second three involved matters of law or social policy:

- (1) *Truth*: Quest argued that Smith's negative message was unfounded, whereas Smith claimed it was well founded.
- (2) *Cause*: Quest asserted that the message caused the company's downfall, whereas Smith claimed that mismanagement was the cause.
- (3) *Motive*: Quest claimed that Smith's action was motivated by vindictiveness, whereas Smith claimed he only aimed to protect other innocent investors.
- (4) *Regulation*: Quest claimed that in posting his message, Smith had violated a company regulation requiring prior notification of management; Smith maintained that he had complied with the regulation.
- (5) *Speech*: Quest argued that it is in society's interest to regulate speech over the Internet, whereas Smith argued that society benefits from free speech over the Internet.
- (6) *Analogy*: Quest likened the Internet to a newspaper, which was subject to libel law, whereas Smith drew an analogy to a telephone system, which is immune from libel law.

Two instruments were used to assess participants' opinions about each point of dispute (see Holyoak & Simon, 1999, Appendix B). The first

instrument was a baseline test that was presented before participants were told about the Quest case. A total of eight questions were included, each presented with a brief context that was intended to correspond to the part of the Quest case relevant to that particular question. Each question was introduced as an independent query about "factual situations, public policy, business situations, and legal affairs." Participants were told they were not expected to have any expert knowledge but were simply to use common sense in making their ratings. Each question's context introduced a distinct company or individual, or else a general policy issue. For two of the points of dispute (speech and analogy), the opposing inferences were sufficiently independent that a separate question was used for each inference. For example, separate questions probed participants' assessment of the degree to which the Internet resembled a newspaper, and to which it resembled a telephone system. For two other points (cause and motive), the opposing inferences were more closely related; these were probed by two-part questions. For example, after describing the events leading up to an investor spreading a negative message, participants were asked to assess (a) whether he was motivated by vindictiveness and also (b) whether he was motivated by a desire to protect other innocent investors. Finally, for two points (truth and regulation), the opposing inferences appeared to logically contradict one another. In these cases only one question was asked. For example, after a company regulation and an investor's action were described, participants were asked to assess whether the investor had violated the regulation. All assessments were made by giving a rating on an 11-point scale, ranging from -5 (*definitely disagree*) to 5 (*definitely agree*), with a rating of 0 indicating neutrality.

The second instrument elicited participants' assessments of the parallel arguments in the context of the Quest case. These questions had the same form and wording as those used in the pretest, except that they were now embedded in the Quest case and formulated as arguments made by the two opposing parties. This instrument was administered twice (in the interim phase and the postdecision phase), with the order of questions varied.

Design and Procedure

The two conditions differed solely in the point at which a "preliminary leaning" was elicited in the interim phase. All participants in these conditions completed the experiment in three phases. Phase 1 involved completion of the baseline test. After this booklet was collected, participants spent 3-5 min completing an unrelated reasoning task. In Phase 2, they received a booklet that provided the factual summary and arguments for the Quest case and informed them that they would eventually have to render a verdict (role-playing the judge in the case). Participants were then given delay instructions. They were told that a very similar case was expected to be decided by the prominent Judge Brown, and that if the two decisions would turn out to be inconsistent, that would create a significant confusion in the state of the law and would also be an embarrassment for the young judge, simulated by the participants. Thus, they were advised to study the materials carefully but to suspend making the decision until they were able to evaluate their position in light of Judge Brown's verdict. All participants were given 10 min to read the facts and arguments of the case.

Participants in the leaning-first condition (a replication of the three-phase condition tested by Holyoak & Simon, 1999, Experiment 1) were then asked to state their preliminary leaning toward either Quest or Smith. They were also asked to rate on a 5-point scale their confidence that their leaning coincides with the best possible decision. The second assessment instrument was then administered. Participants in the leaning-second condition completed these tasks in the reverse order, first assessing the arguments, and only later (on a different page) being asked to provide a preliminary leaning and to rate their confidence.

After the response forms for Phase 2 were collected, all participants were told that the other judge was not going to deliver a verdict after all and that they should proceed to reach a final verdict independently, based on the facts and arguments they had read. They were allowed to look back at the

case as they went on to indicate a verdict and to provide a rating on a scale from 1 (*low*) to 5 (*high*) of their confidence that they had made the best possible verdict. Participants then completed the final postdecision evaluation of the arguments (the second assessment instrument, with a different random order of questions).

Within both the leaning-first and leaning-second conditions, the order of the two sets of arguments (for Quest and for Smith) was counterbalanced across participants. Three different versions of each assessment instrument were created by forming different random orders of the eight questions (while always keeping the parts of each two-part question together in a fixed order). The orderings were arranged so that for any participant, the corresponding questions appeared in a different ordering on each assessment.

Results and Discussion

Three participants gave a final verdict in Phase 3 that differed from their preliminary leaning in Phase 2. As the coherence shifts for these "switchers" were likely to be based on different factors than for those who maintained their initial leaning (see Holyoak & Simon, 1999), all data analyses we report are based on the remaining 47 participants. The distribution of final verdicts was 49% in favor of Quest and 51% in favor of Smith, replicating the even division obtained by Holyoak and Simon (1999). Although the case was clearly highly ambiguous, 93% of participants rated their final confidence in their verdict as at least moderate (ratings of 3–5 on the 5-point scale). This combination of ambiguity and relatively high individual confidence in decisions is consistent with constraint-satisfaction models of decision making, which tend to resolve ambiguous situations by allowing one coherent set of beliefs to become highly activated while inhibiting the rival set. This increase in support for the chosen decision increases confidence in the final stated verdict.

The main question was whether the process of reaching a verdict was accompanied by shifts in participants' assessments of the six points of dispute. Constraint-satisfaction models of decision making predict that an emerging decision will be accompanied by a general shift toward a coherent position across all the points of dispute. In particular, we wished to determine whether coherence shifts would be obtained in the interim phase (Phase 2), especially for the leaning-second condition. If the evaluations provided by participants in the leaning-second condition did not shift from baseline levels (and the shifts observed for leaning-first participants were reliably above the baseline), or if the leaning-second shifts were significantly weaker than those obtained in the leaning-first condition, it could be concluded that the elicitation of the preliminary verdict and confidence rating had contributed to the change of inferences. In other words, such a result would suggest that the coherence shifts were more akin to a postdecision phenomenon. If, however, no significant difference is found between the shifts obtained in the two conditions, then we would conclude that the cognitive change is not simply the consequence of eliciting a decision.

In order to measure participants' positions on each disputed point, the ratings obtained at each phase (baseline, interim, and postdecision) were converted to values termed *Q-scores*—a measure designed as an index of agreement with the position of the plaintiff, Quest. The Q-score for each point of dispute was computed by taking a weighted average of the ratings for questions that assessed that point, reversing the scale for those questions for

which positive values indicated support for Smith's position (see Holyoak & Simon, 1999). All Q-scores range from -5 (*minimal support for Quest's position*) to 5 (*maximal support for Quest's position*), with 0 indicating neutrality. Mean Q-scores were calculated by averaging the Q-scores for the individual points of dispute.

Figure 1 presents the mean Q-score on each assessment for the leaning-first and leaning-second conditions, plotted separately for participants who decided in favor of Quest versus those who decided in favor of Smith. The same basic pattern was observed for both the leaning-first and leaning-second conditions. Q-scores diverged across the three assessments as a function of the eventual verdict that was reached. The shift in the Q-scores across tests, in opposite directions for the Quest versus Smith participants, yielded a significant interaction, $F(2, 86) = 35.3$, $MSE = 27.9$, $p < .0001$. Tests of simple main effects revealed that Q-scores already differed on the baseline test between participants who would eventually decide in favor of Quest versus Smith (mean Q-score of .39 for Quest supporters versus $-.41$ for Smith supporters, a mean difference of .80), $F(1, 43) = 6.70$, $MSE = 3.05$, $p = .01$. This difference increased dramatically to 2.23 on the interim test and to 2.55 on the postdecision test ($p < .001$ for both comparisons). Newman-Keuls tests indicated that the shift in Q-scores from the baseline to the interim test was significant both for those who decided for Quest and for those who decided for Smith ($p < .001$) but that the further shift from the interim to the postdecision test was not significant for either group ($p > .30$). The shift in Q-scores as a function of verdict varied somewhat in magnitude across the six points of dispute, $F(10, 430) = 2.77$, $MSE = 2.49$, $p < .01$; however, Q-scores for each of the six individual points shifted in the direction that cohered with the verdict. Most important, the pattern of the coherence shift did not differ as a function of whether the preliminary leaning was elicited before or after the assessment of arguments, $F(2, 86) < 1$. The results thus indicate that the interim shift in coherence does not depend on participants being asked to express their preliminary leaning.

Although the above analyses revealed a clear shift in participants' assessments of the six points of dispute in the direction of

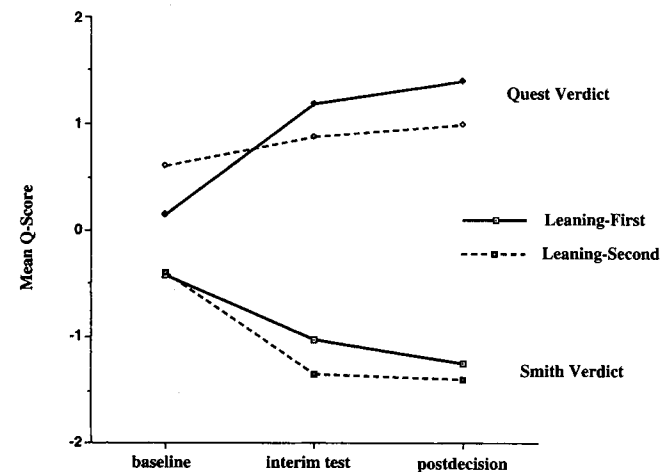


Figure 1. Shifts in Q-scores (favorability to Quest's position) across tests as a function of eventual verdict for Quest versus Smith, for leaning-first and leaning-second conditions (Experiment 1).

their verdict, they do not suffice to establish that individual participants reached a broadly coherent position across the disputed points. It remains possible, for example, that each participant was eventually persuaded by some single argument for one side in the case, with the particular critical argument varying from one person to the next. However, if a constraint-satisfaction process was used to reach a decision, then individual participants would be expected to shift their assessments of most or all of the disputed points in the direction of their eventual verdict. Such a general increase in coherence can be revealed by a correlational analysis and measured by Cronbach's alpha. On the baseline test, participants' assessments of the six positions would not constrain one another, and hence would tend to be uncorrelated, yielding a Cronbach's alpha near zero. Once the points are presented in the context of the case, however, a constraint network would be created, the effect of which would be to generate positive correlations among the disputed points, and between each point and the verdict, yielding a Cronbach's alpha approaching the maximum possible value of 1.

Such a correlational analysis was performed separately for the baseline, interim, and postdecision Q-scores for the combined data from the leaning-first and leaning-second conditions (as the patterns for the two conditions did not differ in any major way). The verdict was treated as a binary variable (1 for a Quest verdict, 0 for a Smith verdict). (Extremely similar results were obtained when the verdict was treated as a continuous variable based on verdict confidence.) The increase in coherence was striking. On the baseline test, only 2 of the 21 correlations among the disputed points and verdict were significantly positive, and several were negative, yielding a Cronbach's alpha of $-.25$. In contrast, on the interim test all but five of the correlations were significantly positive, including five of the six correlations between disputed points and the verdict, and all correlations were positive (Cronbach's alpha = $.74$). By the postdecision test, all but three correlations were significantly positive, including all six correlations between disputed points and the verdict (Cronbach's alpha = $.80$). Thus the major increase in correlations, like the shift in Q-scores, occurred from the baseline to the interim test, with only small additional increases in the correlations between the interim test and the postdecision test.¹ The correlational analyses thus provide further evidence that coherence had emerged by the interim phase.

Experiment 2

The results of Experiment 1 indicate that coherence shifts observed in the interim phase are not attributable to the elicitation of a preliminary leaning toward a particular verdict. These results, however, do not entirely rule out the possibility that participants made up their minds by the time the interim evaluations were reported. It might be argued that even in the absence of an elicitation of a decision or a preliminary leaning, the participants' evaluations were affected by their knowledge that they were playing the role of a judge who would eventually have to make the decision. Experiments 2 and 3 were designed to explore this possibility and to test, more generally, how participants process the same information in contexts that do not require the making of a decision. The notices used to enlist participants and the materials used in the relevant conditions of Experiments 2 and 3 avoided any mention of making a decision or of playing the role of a judge. *When a person does not anticipate having to making a decision, it*

seems implausible to hold that a formation of a preference could form a commitment to a decision.

A basic finding in literature on text comprehension and memory is that people actively impose organization on texts (e.g., Bartlett, 1932; Bransford & Johnson, 1973). We hypothesized that coherence would emerge in the course of processing the case for the sake of comprehending or memorizing it, in the absence of any requirement to ever reach a decision. Accordingly, in Experiment 2 we examined whether a memorization task is sufficient to create coherence shift. A secondary objective of this study was to test the possibility that the coherence shifts were influenced by participants' preconceptions of the judicial role. It is theoretically possible that our participants believed that judges are expected to generate coherent decisions and that this belief influenced the generation of coherence within the arguments.

Method

Participants

One hundred twenty-five UCLA undergraduates took part in the experiment as part of a course requirement.

Materials, Design, and Procedure

The same case and the same three-phase design were used as in Experiment 1. After completing the baseline test, participants were presented with the interim test, though rather than immediately presenting the task as one of a judge assigned to decide a legal case, we presented it as a memory task. Participants were told that the experiment concerned people's ability to memorize legal arguments and that they should try to remember the arguments to the best of their ability. They were told they did not have to remember the exact wording of the arguments, but were to try to remember the major ideas. The case was then presented, without any indication that a decision was required or that role playing of a judge would be expected. After having read the case (ostensibly for memorization purposes), the interim test was administered, in which participants were requested to evaluate the arguments and to report whether they had formed a preliminary leaning toward the case of either side (as in the leaning-second condition of Experiment 1). After the interim test was collected, participants were informed that for the last part of the experiment, they were to play the role of a judge and to decide the outcome of the dispute on the basis of the information already given. The same instructions as in Experiment 1 were then given. Participants were also informed that because this was the last phase of the experiment, they would not be asked to complete a memory test. After stating their verdict and confidence rating, the postdecision assessment of the arguments was administered. Throughout both the interim and the final postdecision tests, participants were allowed to look back at the case as they indicated their responses. All participants were then fully debriefed.

¹ An additional 25 participants were tested in a control condition, simply completing the baseline measure twice (with the questions in a different order each time), with an unrelated reasoning task administered in between. This group never received the legal case and made no decisions. The purpose of this control group was to check for the remote possibility that the increase in coherence across tests observed in the experimental conditions could have arisen simply due to repeating the argument evaluations rather than as the result of exposure to the case in which they were embedded. No coherence shift was observed for this control condition.

Results and Discussion

Of the 125 participants, 5 switched their decision from their preliminary leaning to their final verdict. All analyses were performed for the remaining 120 participants. As in Experiment 1, the distribution of verdicts was about even, with 44% of participants favoring Smith and 56% favoring Quest. Confidence in the final verdict was again high, with 88% of participants rating their confidence as moderate or higher (3–5 on the 5-point scale), and over half (57%) giving ratings of 4–5.

Figure 2 presents the mean Q-score on each assessment, plotted separately for participants who decided in favor of Quest versus those who decided in favor of Smith. As in Experiment 1, Q-scores diverged across the three assessments as a function of the eventual verdict that was reached. The shift in the Q-scores across tests, in opposite directions for the participants favoring Quest versus Smith, yielded a significant interaction, $F(2, 236) = 59.1$, $MSE = 2.92$, $p < .0001$. Tests of simple main effects revealed that the difference in Q-scores already differed on the baseline test between participants who would eventually decide in favor of Quest versus Smith (mean Q-score of .40 for Quest supporters versus $-.37$ for Smith supporters, a mean difference of .77), $F(1, 118) = 15.0$, $MSE = 4.23$, $p < .001$. This difference increased dramatically to 2.18 on the interim test and to 2.67 on the postdecision test ($p < .001$ for both comparisons). Newman-Keuls tests revealed that the shift in Q-scores from the baseline to the interim test was significant both for those who decided for Quest and those who decided for Smith ($p < .001$); the further shift from the interim to the postdecision test was significant for participants who favored Smith ($p = .02$) but not for those who favored Quest ($p = .16$). The shift in Q-scores as a function of verdict varied somewhat in magnitude across the six points of dispute, $F(10, 1180) = 4.36$, $MSE = 2.23$, $p < .001$; however, Q-scores for each of the six individual points shifted in the direction that cohered with the verdict, with one minor reversal (the cause factor for participants favoring Quest). These results thus reveal a major shift in participants' assessments of arguments in response to instructions to memorize the case, in the absence of any mention of decision making.

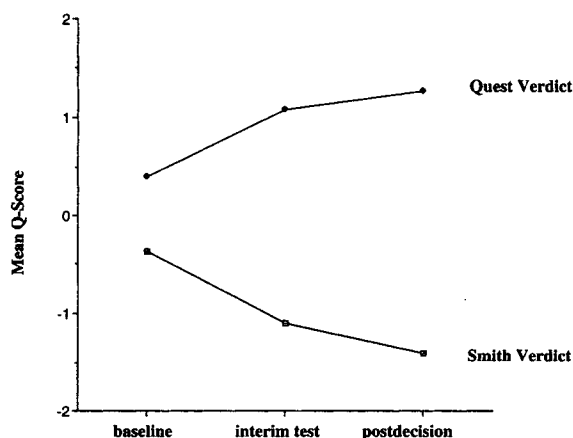


Figure 2. Shifts in Q-scores (favorability to Quest's position) across tests as a function of eventual verdict for Quest versus Smith (Experiment 2).

As in Experiment 1, a correlational analysis was performed to detect shifts in coherence of the argument assessments across the three tests. A strong coherence shift was apparent. On the baseline test only 2 of the 21 correlations among the disputed points and verdict were significantly positive, and several were negative (Cronbach's alpha = .08). In contrast, on the interim test all but 3 of the correlations were significantly positive, including all of the 6 correlations between disputed points and the verdict, and all correlations were positive (Cronbach's alpha = .70). By the postdecision test, all correlations were significantly positive (Cronbach's alpha = .80). Overall, the major increase in correlations, like the shift in Q-scores, occurred from the baseline to the interim test, with small additional increases in the correlations between the interim test and the postdecision test. The correlational analyses thus provide further evidence that the emergence of a coherent position on the disputed points was produced by the set to memorize the cases.

Experiment 3

The primary objective of Experiment 3 was to investigate other nondisciplinary sets that might yield coherence shifts. Given that people spread apart inferences as a side effect of memorizing complex materials, as shown in Experiment 2, it is possible that other mental tasks produce similar coherence effects. In Experiment 3 we introduced two additional processing sets: (a) preliminary processing under the expectation that more information would be received later (reception condition) and (b) processing under the expectation that the participants would later have to communicate the information to someone else (communication condition). These two tasks were modeled after the *receiver* and *transmitter* sets used by Zajonc (1960). In Zajonc's study, increases in coherence were found for both conditions, though the transmitter set yielded higher levels of coherence than did the receiver set. Accordingly, we anticipated that the communication condition would yield a larger coherence shift than the reception condition. For comparison, the standard decision task (role-playing a judge) was also included in the design of Experiment 3.

Method

Participants

One hundred sixty-six UCLA undergraduates took part in the study as part of a course requirement.

Materials, Design, and Procedure

The same basic set of materials was used as in the previous experiments. Participants were randomly assigned in approximately equal numbers to three conditions. Participants in the decision condition underwent the same procedures as in the leaning-second condition of Experiment 1. They were informed (before reading the legal case) that they would play the role of a judge and would eventually be asked to decide the outcome of the legal case. Delay instructions were provided to hinder the making of decisions prior to receiving information about the verdict of the other judge in a related case.

Participants in the reception condition were initially informed that the experiment concerned the gradual process of receiving information about legal arguments. They were told that they would be presented with incomplete information about the arguments of a case, and that at a later stage,

another student who had complete information about the arguments of the case would describe the entire case to them. Meanwhile, they were to simply read over the materials carefully. No mention was made of role-playing a judge or of ever having to reach a decision.

Participants in the communication condition were initially informed that the experiment concerned the communication of legal arguments. They were told that at a later stage they would be asked to communicate the arguments of the case to another student who had already read the facts of this case but had not seen the arguments. They would be expected to describe the arguments in a way that would make them comprehensible to the other student. Participants were told that it would not be necessary to communicate the exact wording of the arguments but rather the major ideas. As in the reception condition, no mention was made about playing the role of a judge or about having to reach a decision at any stage.

Following the baseline test, the interim test was administered in the same manner as in Experiment 2. After the interim test was collected, participants in all conditions were informed that they were to role-play a judge and reach a decision. Those participants in the decision condition and in the reception condition were informed that no more information would be given, and those in the communication condition were informed that they would not have to convey the arguments to someone else. The postdecision test was then administered in a manner identical to that used in Experiments 1 and 2. All participants were then fully debriefed.

Results and Discussion

Of the 166 participants, 9 switched their decision from their preliminary leaning to their final verdict. All analyses were performed for the remaining 157 participants. The distribution of verdicts was again roughly even, with 42% of participants favoring Smith and 58% favoring Quest. Confidence in the final verdict was again high, with 91% of participants rating their confidence as moderate or higher (3–5 on the 5-point scale) and 63% giving ratings of 4–5.

Figure 3 presents the mean Q-scores on each assessment, plotted separately for participants who decided in favor of Quest versus those who decided in favor of Smith, for each of the three conditions. As in the previous experiments, Q-scores diverged across the three assessments as a function of the eventual verdict that was reached. The shift in the Q-score across tests, in opposite direc-

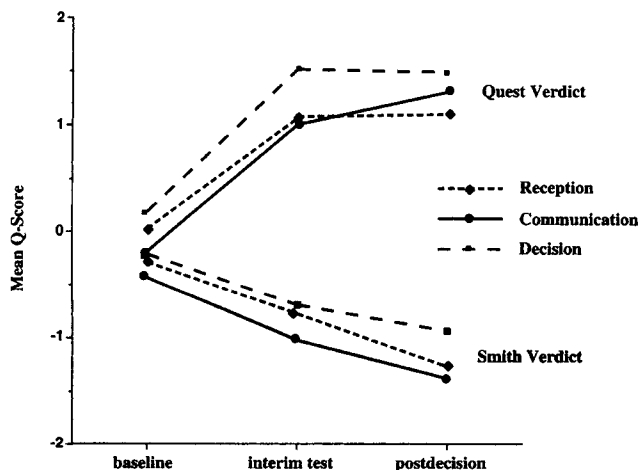


Figure 3. Shifts in Q-scores (favorability to Quest's position) across tests as a function of eventual verdict for Quest versus Smith, for decision, reception, and communication conditions (Experiment 3).

tions for the participants favoring Quest versus Smith, yielded a significant interaction, $F(2, 302) = 78.6$, $MSE = 2.92$, $p < .0001$. This interaction did not vary across the three conditions, $F(4, 302) < 1$, and indeed neither the main effect nor any interactions involving condition approached significance. Thus, the shift in Q-scores across tests was statistically identical for both the decision group, in which participants expected from the start to eventually have to make a decision, and in the reception and communication groups, where the interim test was completed without any instructions about an eventual decision or role-playing a judge.

Collapsing across the three conditions, tests of simple main effects revealed that the difference in Q-scores on the baseline test between participants who would eventually decide in favor of Quest versus Smith (.32) was not reliable, $F(1, 151) < 1$. However, this difference increased dramatically to 2.03 on the interim test and to 2.50 on the postdecision test ($p < .001$ for both comparisons). Thus, although in Experiment 3 there was very little, if any, initial difference in the argument assessments of participants who would decide for Smith versus Quest, a strong difference emerged by the interim test, after processing the legal case. Newman-Keuls tests revealed that the shift in Q-scores from the baseline to the interim test was significant both for those who decided for Quest and those who decided for Smith ($p < .001$); the further shift from the interim to the postdecision test was significant for participants who favored Smith ($p < .01$) but not for those who favored Quest ($p = .44$). The shift in Q-scores as a function of verdict varied somewhat in magnitude across the six points of dispute, $F(10, 1510) = 4.42$, $MSE = 2.25$, $p < .001$; however, Q-scores for each of the six individual points shifted in the direction that cohered with the verdict, with one reversal (the truth factor for participants favoring Smith) and one no-change (the speech factor for participants favoring Smith).

As in the previous experiments, a correlational analysis was performed to detect shifts in coherence of the argument assessments across the three tests. As preliminary analyses revealed no systematic differences in correlations across the three instruction conditions, we report an analysis collapsing across all three conditions. As in the previous experiments, a strong coherence shift was apparent. On the baseline test only 1 of the 21 correlations among the disputed points and verdict were significantly positive, and several were negative (Cronbach's alpha = .12). In contrast, on the interim test all but two of the correlations were significantly positive, including all of the six correlations between disputed points and the verdict, and all correlations were positive (Cronbach's alpha = .77). By the postdecision test, all but one of the correlations were significantly positive (Cronbach's alpha = .80). Overall, the major increase in correlations, like the shift in Q-scores, occurred from the baseline to the interim test. The correlational analyses thus provide further evidence that a coherent position on the disputed points emerged in all instructional conditions, including the reception and communication conditions in which no decision had yet been requested.

The finding of similar degrees of coherence in the reception and communication conditions was unanticipated. Zajonc (1960) found higher coherence effects for transmitters than for receivers, and similar differences have been observed in subsequent research (Boninger, Brock, Cook, Gruder, & Romer, 1990; Harkins, Harvey, Keithly, & Rich, 1977; O'Neal & Mills, 1969). One explanation for this discrepancy might have to do with the intensity of

engagement demanded by the materials. For example, the Zajonc (1960) experiment involved reading a description of a person in a period of 2 min; the Boninger et al. (1990) experiments involved reading a brief essay or an advertisement; and the Harkins et al. (1977) experiment involved watching an 8.5-min video clip. In comparison, the legal case we used was complex and ambiguous, it was laid out in three single-spaced pages, and it required grappling with 12 rather complicated arguments. On average, our participants spent 20–30 min on the case. Relative to the tasks used in previous studies, our materials required more elaboration, causing participants in all conditions to process them intensively, and that might have resulted in substantial and comparable levels of coherence.² More research is needed in order to sort out this issue.

General Discussion

The present experiments are concerned with how people process complex decision tasks that are based on a multitude of complex inferences. Our results replicated and extended the basic findings of Holyoak and Simon (1999) in showing that the processing of such tasks is accompanied by a change in inferences that increases coherence with the decision made. That is, relative to a baseline evaluation, the inferences that supported the chosen decision became stronger, and the inferences that supported the rejected decision decreased in their level of acceptance. Participants also reported remarkably high levels of confidence in their decisions.

The current experiments were designed to provide a more detailed understanding of the coherence-generating process, in particular with regard to the variety of the conditions under which coherence develops. Coherence shifts were observed not only following the making of a decision (Phase 3 in all three experiments), but, crucially, also when participants were induced to delay their decisions (Experiment 1, Experiment 3 decision condition), when they simply memorized the legal case (Experiment 2), and when they processed the case in preparation either to receive additional information (Experiment 3 reception condition) or to communicate it to someone else (Experiment 3 communication condition). The common feature of these conditions is that they all encouraged participants to process the materials for some purpose or another, which most likely entailed an attempt on their behalf to comprehend the case. Our findings were that every one of these processing sets was accompanied by coherence shifts. We propose that these changes in the strength of the decision variables play an important role in the decision-making process. When faced with tasks of high ambiguity, conflict, and complexity—conditions that might otherwise be experienced as insurmountable—the increase of coherence in support for one of the decision alternatives enables and facilitates the making of confident decisions. More broadly, these findings support the view that the processing and comprehension of complex situations entails changes in the evaluation of the variables, leading to a coherent representation of the situation.

Coherence Shifts Preceding Commitment to Decisions

The findings of coherence shifts under these various instruction sets is of special significance for research on the processes of decision making, particularly in light of cognitive dissonance

theory's assertion that reevaluation does not begin before the formation of a commitment to the decision (Festinger, 1957, 1964). Commitment is influenced by the explicitness of the act, the difficulty of revoking it, and the extent to which the act has been expressed publicly (see Kiesler, 1971; Wicklund & Brehm, 1976). In each of the present experiments coherence shifts occurred between the baseline and interim phase. The results of Experiment 1 showed coherence shifts at the interim phase, regardless of whether the evaluations were reported before or after participants indicated their preliminary leanings. This finding ruled out the possibility that the elicitation of a preliminary leaning initiated the making of a decision. It seems highly unlikely that at the interim phase of Experiment 1, participants had committed themselves to any decision. If, by any chance, participants had formed their opinions, these could not be said to be explicit acts, as there was nothing to hinder participants from changing their minds. More important, there was no public expression involved. Participants were given good reasons to withhold making decisions and were advised not to make their minds up at that stage. Thus, the finding of coherence shifts before the crucial information was provided offers strong support for the conclusion that our participants spread the inferences apart prior to having committed to a decision.

This conclusion is all the stronger in light of the coherence shifts that were observed in the subsequent experiments, in which the instruction sets were unrelated to the making of a decision. At the interim phases of Experiments 2 and 3, participants were not told anything about role-playing a judge or about having to make a decision at any stage. They were instructed to read the materials for the ostensible tasks of memorizing the arguments, communicating them, or receiving more information about them. It is an important finding that the processing of the materials under these goals engendered the spontaneous creation of coherent inferences. This finding contradicts the view that such changes in the evaluation of the task occur only after the decision has been made and the person has committed himself or herself to the decision (e.g., Festinger, 1957, 1964).

The present findings are consistent with those of Russo and his colleagues (Russo et al., 1996, 1998). In their experiments, participants were instructed to make a choice between two competing consumer products. They were gradually exposed to information about features of the two products and were asked to evaluate the favorability of each feature. In a control condition, the features were presented as isolated attributes unrelated to any specific product. The principal finding was that relative to the neutral evaluations of the features in the control condition, the evaluations in the critical condition were affected by the preference for the product. That is, participants consistently gave more positive evaluations of the features presented as belonging to the preferred product and poorer evaluations of the attributes of the rejected one. Most notably, changes in the evaluations of the attributes were also observed in a condition in which two products were presented but

² It should be noted that Carlston and Skowronski (1994) observed comparable degrees of trait inferences made by participants who were explicitly instructed to make trait inferences as by participants who were asked merely to familiarize themselves with the materials. Their result cannot be attributed to the intensity of elaboration because, in that experiment, the stimuli were exposed for only 8 s.

no choice between them was asked for (Russo et al., 1998, Study 1, constant-brand condition). These experiments also showed that changes in evaluations of the alternatives continued after the decision was made. The latter changes were more moderate than those that occurred prior to the completion of the decision.

The current research complements Russo et al.'s (1998) work and extends it in a number of ways. First, Russo et al.'s experiments tested people's preferences for attributes of consumer products, such as the type of zippers found in a backpack or attributes of running shoes, whereas our stimuli entailed complex reasoning processes about more abstract concepts. Second, Russo et al.'s experiments traced participants' evaluations sequentially as they were exposed to individual pieces of information. Their findings thus provide important observations about how information is evaluated on-line as the decision-making process progresses. In the present experiments, participants' inferences were tested after the entire set of information was provided. Thus, we presumably observed the mental representation of the materials after the entire network was processed and the constraints had been naturally settled. Third, Russo et al. used a between-subjects design, comparing evaluations made when the attributes were presented in isolation with those made when the attributes were described as features of competing products, whereas we compared the inferences made at various points of the process with the same participants' baseline inferences. The fact that these two bodies of research have yielded very similar observations testifies to the robustness of the findings.

Our findings shed light on a number of decision-making theories. The observed changes in the strength of the arguments between the baseline and the interim measurements can be viewed as a demonstration of the restructuring of the decision task in the search for dominance (Montgomery, 1983; Montgomery & Willen, 1999) and as the differentiation of the alternatives within the context of differentiation-consolidation theory (Svenson, 1992, 1996, 1999). The shifts between the interim and postdecision measurements, albeit weak changes, are consistent with Svenson's (1992) theory of the consolidation of the chosen decision. Our findings of high levels of confidence also provide support for Mills's (Mills, 1968, 1999; Mills & Ford, 1995) claim that a central feature of the decision-making process is to develop a high degree of certainty in the superiority of the chosen alternative. Our findings are partly consistent with Beach's image theory (Beach, 1990, 1998), which emphasizes the centrality of constructing elaborate mental models of the decision task and thus entails comprehension and deep processing of the situation. Image theory, however, does not account for the observed changes in the strength of the decision variables.

Our findings are closely related to Busemeyer and colleagues' (Busemeyer & Townsend, 1993; Roe, Busemeyer, & Townsend, 2001) decision field theory. Grounded in Gestaltian sources, both his approach and ours use dynamic networks as the basis for cognitive processing. Both approaches predict changes in preferences over the course of the decision-making process. Decision field theory explains preference changes based on a number of cognitive features, including predecisional switching of choice strategies. However, as currently formulated, it does not account for changes in the evaluations of the variables, as observed in the present experiments.

The current findings imply that the conventional distinction between the pre- and postdecision phases of the process is exaggerated, as argued by Brehm and Cohen (1962):

Suppose we assume for the moment that any prechoice change in the relative or absolute magnitude of a gradient is actually a kind of decision. If we could take "snapshots" of an individual in conflict, we would have a series of views, in no two of which the disposition of the gradients would be exactly the same. If the period immediately before a "snapshot" is taken is assumed to have involved a decision, then the disposition of the gradients in the "snapshot" should be predictable from the principles governing postdecisional behavior. According to this point of view there would be no need to arbitrarily dichotomize the decision process into pre- and post-decisional phases. One of the "snapshots" taken of the process might follow a decision that is more irrevocable or consummatory than the others, but to label this "THE decision" may be to misrepresent the actual process and emphasize the inadequacy of the psychologist's observations. (pp. 236-237, footnote omitted)

It is important to caution that the conclusions from the present experiments are confined to the kind of decision task examined here. While some important real-life decisions are of this complex, ambiguous, and conflicting nature, others are not. We do not claim that our conclusions would hold for substantially different decision tasks, such as simple preference-based choices or situations where the factors are clearly stacked in favor of one decision alternative.

The Role of Goals in Coherence Shifts

The findings of coherence effects incidental to tasks of memorization and communication support the possibility of generalizing the role of coherence-driven processing beyond tasks of decision making. One related body of research is that of spontaneous trait inferences. Uleman et al. (1996) showed that comprehension of social situations is performed spontaneously, that is, in the absence of strategic proximal goals. Similarly, the reading of narrative texts is deemed to be driven by the "search after meaning" (Graesser et al., 1994, p. 371). Text comprehension involves constructing representations of meaning that are coherent at both the global and local levels. Comprehension thus entails the imposition of order on the texts and carries the benefits of being able to draw correct inferences about the narrative, to fill in gaps and solve ambiguities, and to gain useful information about the described events. The coherence shifts observed in our experiments, particularly in Experiments 2 and 3, seem to serve similar purposes. Participants processed a large set of ambiguous and contradictory inferences in a way that yielded a small and strongly supported subset of coherent inferences. This state of coherence probably made it easier for participants to retain and retrieve the inferences, and when they had to make a decision, they felt comfortable in doing so and felt confident about their choice.

Our finding of coherence shifts provides further evidence for the blurring of the distinction between "cold" inferential mental processing and "hot" motivational processing (e.g., Higgins & Sorrentino, 1990; Kruglanski, 1990; Kunda, 1990). Research on "motivated" reasoning has demonstrated that when people have desired conclusions, or "directional goals" (Kunda, 1990, p. 482), their reasoning processes seem to be biased in a variety of ways that ultimately lead to the confirmation of those conclusions. Goals are typically considered to be motivated, or directed, when either one

of the decision alternatives is related to the person's self-concept (Baumeister & Newman, 1994; Kunda, 1990; Pyszczynski & Greenberg, 1987) or when they pertain to one's hedonic interests (e.g., Sherman & Kunda, 1989, as cited in Kunda, 1990). In contrast, when a person's goal is to be accurate, the reasoning processes are taken to be rational and overall accurate (Baumeister & Newman, 1994; Kunda, 1990).

Our finding of coherence shifts are of interest because the participants in our experiments did not appear to have been driven by directional goals, and can thus be considered to have been driven primarily by accuracy goals. Nonetheless, we found changes in the evaluations that cannot be explained as serving any accuracy goal. Indeed, the shifting of inferences toward coherence with the verdicts bears a distinct resemblance to the way in which motivated reasoning processes are biased toward supporting the desired goal. It follows, then, that reasoning processes can be motivated not only by ostensible goals such as self-maintenance and hedonic interests, but also to some degree by the tendency to create coherent mental representations. The attainment of coherence can be viewed as a cognitively driven goal that guides reasoning processes ostensibly intended to achieve accuracy goals.

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Received May 30, 2000

Revision received February 27, 2001

Accepted February 27, 2001 ■