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Dogmatism and Belief Formation: Output Interference in the Processing of Supporting and Contradictory Cognitions

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The role of reason generation in dogmatic thinking was examined by means of cognitive response analysis. In Experiment 1, dogmatism was associated with greater confidence in judgments as a result of postjudgment generation of more supporting and less contradictory evidence. Experiment 2 produced similar results for confidence judgments with prejudgment reason generation, except that no difference in supporting evidence was found as a function of dogmatism. Experiment 3 showed that dogmatism was associated with greater output interference in reason generation, leading to greater primacy effects in likelihood judgments. A delay between generation of reasons reduced output interference effects, but only for those low in dogmatism who showed a recency effect. The results were interpreted in terms of cognitive mechanisms in dogmatic thinking after artifactual and motivation explanations had been ruled out.

A central feature of Rokeach's (1954) analysis of dogmatism is that an individual's cognitive system is organized into belief–disbelief systems. This structural aspect of dogmatism is characterized by the relatively closed cognitive organization of beliefs and disbeliefs about reality. A large amount of research on dogmatism has focused on these information-processing tendencies and abilities (for a review, see Goldstein & Blackman, 1978). The closed nature of the belief systems of individuals high in dogmatism can be observed in their tendency to compartmentalize and isolate their beliefs and disbeliefs, whereas the more open belief systems of individuals low in dogmatism can be observed in their readiness to make connections between disparate beliefs (e.g., Franklin & Carr, 1971; Zagona & Zurcher, 1965). Individuals high in dogmatism strive to avoid inconsistency in their attitude and belief systems, and they react to inconsistent information by minimizing or ignoring it (e.g., Durand & Lambert, 1975; Hunt & Miller, 1968; Kleck & Wheaton, 1967; Leone, 1989; Palmer & Kalin, 1985).

Perhaps because of the early emphasis on the cognitive *structures* associated with dogmatism, little research has been carried out on the underlying cognitive *processes* involved in dogmatic judgment and decision making apart from that of Rokeach himself, who used the "Denny Doodlebug" problem to investigate the process of incorporating new beliefs into existing belief systems (e.g., Rokeach, McGovney, & Denny, 1955; recent additions to this process approach are DeBono & Klein, 1993, and Leone, 1989). By contrast, research in mainstream social cognition has led to a detailed understanding of how most people typically process information about everyday social events. However, relatively little research has been carried out on individual differences in such social information processing. Yet, studies of individual differences can add much to an understanding of cognitive processes. Such studies can provide a valuable test of normative theories by investigating the effects of naturally occurring variations in postulated mediating processes (Underwood, 1975). In the case of judgment heuristics and biases, for example, one would expect individuals to show a great amount of variation in their information processing. Unlike many cognitive psychology paradigms dealing with abstract stimulus material (e.g., Evans, 1989; Wason & Johnson-Laird, 1972), studies of everyday biases and heuristics focus on concrete, easily understood exemplars to examine human foibles in information processing (e.g., Nisbett & Ross, 1980; Plous, 1993). One would therefore expect such research to have investigated individual differences in the way that people process information and make judgments. However, there have been very few studies of individual differences in such everyday information processing (for exceptions, see Campbell & Tesser, 1983; Cochran & Davis, 1987; Davies, 1985, 1992, 1993b).

Research on social cognition has highlighted the importance of explanation and reason generation in both predictive and postdictive judgments (e.g., C. A. Anderson, New, & Speer, 1985; Davies, 1997; Hirt & Markman, 1995; Hoch, 1984, 1985; Koehler, 1991; Koriat, Lichtenstein, & Fischhoff, 1980; Levi & Pryor, 1987; Ross, Lepper, Strack, & Steinmetz, 1977; Sherman, Zehner, Johnson, & Hirt, 1983). This research has shown that the more reasons supporting rather than contradicting a given outcome, the greater the perceived likelihood of that outcome. One explanation for this is that people assess the likelihood of the outcomes of events according to how easily such outcomes come to mind, the *availability* effect (Tversky & Kahneman, 1973). The more supporting than contradictory evidence generated for an event outcome, the more available the outcome is perceived to be, because such differential reason generation increases the ease of imagining the outcome from the event scenario. A variant of this availability explanation is the *generation*

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effect (Slamecka & Graf, 1978), which explicitly involves memory processes. Self-generated items have a recall advantage over equivalent experimenter-presented items because there is greater processing of features shared by the stimulus (event scenario) and response (event outcome) in self-generation (Burns, 1990). Generating an explanation forces people to process more links between the scenario and its outcome so that the connection between antecedents and consequents is strengthened. The more supporting (than contradictory) information that can be retrieved, the more easily recalled the event outcome relative to nonexplained outcomes. A third, more perceptual explanation is in terms of *conditional reference frames* (Koehler, 1991). While explaining or imagining an event outcome, people temporarily assume the outcome to be true. When they then assess how well the hypothesized outcome accounts for the relevant evidence, people find that the evidence fits the outcome because the evidence has been selected and interpreted in favor of the hypothesized outcome rather than alternative outcomes. The greater the perceived fit between the hypothesized outcome and the evidence, the greater the perceived likelihood of the explained outcome.

In a recent article, Davies (1993a) investigated the role of dogmatism in the persistence of beliefs after evidential discrediting. When people form a belief on the basis of apparently bona fide evidence and this evidence is subsequently revealed to be false, it is found that they persist with their original but erroneous beliefs (for a review, see Ross & Lepper, 1980). During the formation of the initial belief, the original evidence is embellished and bolstered by processes such as explanation and selective recall so that indirect collateral evidence is generated that not only buttresses the belief but can also sustain it, even when the original evidence is discredited. Davies predicted that highly dogmatic individuals would show greater belief persistence because the revision of their initial belief is insufficient in the light of discrediting information, whereas individuals low in dogmatism would show less belief persistence because their more open belief system allows them to reconcile their initial belief with the discrediting information. In two experiments, Davies found support for these expectations. Moreover, it was found that individuals high in dogmatism generated fewer reasons contradicting their belief than individuals low in dogmatism, but there was no difference in the generation of supporting reasons as a function of dogmatism.

An important issue that precedes these findings is the role that dogmatism plays in belief *formation* rather than belief *revision*. In the Davies studies, participants made judgments after their beliefs had already been well established, and it is well known that individuals high in dogmatism have difficulty revising their existing belief systems to accommodate new evidence (e.g., Ehrlich & Lee, 1969; Rokeach, 1960). Much less is known, however, about the role of dogmatism in the formation of beliefs. In the studies described here, I examined both the cognitive processes involved in dogmatic thinking and the role of reason generation in belief formation. Through a process of "bootstrapping" (Snyder & Ickes, 1985), I hoped to gain insights (a) into the processes of dogmatic thinking by investigating how the differential generation of supporting and contradictory reasons affects judgments and beliefs and (b) into the operation of reason generation in belief formation by considering individual differences in dogmatism.

In Studies 1 and 2, I investigated differences between individuals high and low in dogmatism in their generation of supporting and contradictory reasons before and after formation of beliefs. A well-established finding is that dogmatic people tend to adopt and hold more extreme attitudes than people low in dogmatism (for a review, see Goldstein & Blackman, 1978). One explanation for this could be that individuals high and low in dogmatism generate differential amounts of consistent and inconsistent reasons for their attitudes and beliefs; dogmatic individuals tend to generate more supporting reasons and fewer contradictory reasons for their beliefs. After individuals high in dogmatism have formed a tentative belief, this belief subsequently becomes more extreme because more supporting reasons are generated for it, possibly as a consequence of thought-induced attitude change (e.g., Leone, 1989). Individuals low in dogmatism, however, are just as likely to generate contradictory reasons as supporting reasons, so their tentatively held beliefs are less likely to become polarized.

In Study 3, I examined how the order of generating reasons affects belief strength in people high and low in dogmatism. A primacy effect is typically revealed in judgments of attitude and belief such that the side of the issue considered first is found to have a greater influence on the final judgment than the side of the issue considered second (e.g., Asch, 1946; Lund, 1925). In the formation of a belief, initial evidence and reasons that come to mind will tend to support rather than contradict the belief (e.g., Dellarosa & Bourne, 1984; Koriat et al., 1980). Once people have generated reasons supporting the belief, they find it difficult to generate contradictory reasons, and this differential availability of reasons has been found to be an important factor in primacy effects (e.g., Hoch, 1984). It could be that differential reason generation produces primacy effects in this manner only to the extent that people compartmentalize their beliefs and disbeliefs. Because individuals high in dogmatism tend to keep belief and disbelief systems separate, they should show greater primacy effects in their reason generation and in their judgments than individuals low in dogmatism, who do not compartmentalize their belief–disbelief systems and who readily see connections between disparate beliefs.

Experiment 1: Dogmatism and the Generation of Reasons After Belief Formation

In Experiment 1, I examined the role of dogmatism in the generation of supporting and contradictory reasons after predictive judgments of the outcomes of events. In this judgment situation, one possible scenario is that individuals high in dogmatism are biased in their evaluations, so they selectively report evidence that favors their chosen belief. Once these individuals have endorsed a particular belief, they justify the belief by reporting confirming reasons and evidence and ignoring contradictory reasons and evidence. This leads to the prediction that individuals high in dogmatism will generate more supporting reasons and fewer contradictory reasons after making their judgments than individuals low in dogmatism.

Method

Overview. Participants who scored low and high on dogmatism read descriptions of hypothetical psychology experiments, along with two possible outcomes for each experiment.[1] Participants chose the outcome they judged more likely and rated their confidence in their decision. They then listed reasons for each possible outcome.

Participants. A short form of the Rokeach dogmatism scale (Troldahl & Powell, 1965) was administered to 104 college students in mass-testing sessions. The Troldahl–Powell scale consists of the 20 Rokeach items that have the highest item–total correlations. Troldahl and Powell reported a split-half reliability coefficient of .79 for the 20-item scale, as compared with .84 for the original 40-item scale. From this sample, 32 students (21 women and 11 men) were selected for the high dogmatism group from those scoring in the top third of the distribution of scores. The mean age of this group was 20.72 years (SD = 3.43, range = 18 to 31). For the low dogmatism group, 31 students (19 women and 12 men) were selected from those scoring in the bottom third of the distribution. The mean age of this group was 20.45 years (SD = 3.22, range = 18 to 28). (Gender of participant did not have any significant effect on the pattern of results and is not mentioned further.)

Materials. The stimulus materials were short case studies (approximately 350 words) describing four simple psychology experiments (for details, see Davies, 1987). The case studies were prototypical psychology experiments constructed so that (a) alternative outcomes of the experiments were similar in likelihood and (b) participants could generate a number of reasons for the possible outcomes. The studies were *forbidden toy* (children's preferences for toys were investigated as a function of a prohibition on play; based on Aronson & Carlsmith, 1963), (b) *observer effects* (performance on a spatial coordination task was investigated as a function of being observed by others; based on Manstead & Semin, 1980), (c) *emergency helping* (help from passersby was investigated as a function of the presence of blood on the victim; based on Piliavin & Piliavin, 1972), and (d) *eyewitness testimony* (jurors' judgments of a defendant's guilt were investigated as a function of eyewitness testimony; based on Hatvany & Strack, 1980). The descriptions covered methods used (participants, procedure, and settings), and, for each study, two possible outcomes were described: condition X > condition Y or condition X < condition Y. For example, in the emergency helping experiment, the presence of blood on a victim (condition X) could be more likely or less likely to elicit help from passersby than a no-blood condition (condition Y).

Procedure. Participants were tested in small groups. They were given booklets containing the instructions and the four case studies. Order of case studies was counterbalanced across participants. The experiment was described as one concerning people's judgments about psychological research. After reading the descriptions of possible psychology experiments, participants judged how they thought the experiments would turn out by checking one of the two outcomes. They then rated their confidence that their judgments were correct (1 = *not at all confident,* 10 = *completely confident*). A reason-generation task (cf. Cacioppo & Petty, 1981; Hoch, 1984) followed the judgment task. Participants listed reasons why each experiment could turn out one way or the other, writing each reason on a different line. In listing reasons, participants were advised that they could draw on any knowledge they had of psychology, their intuitions about human nature, personal experience in situations similar to those involved in the experiments, and their knowledge of other people's experiences in such situations. The reasons were scored by judges according to whether they supported the chosen outcome ("pro") or supported the opposite outcome ("con"). Two judges unaware of the purpose of the experiment coded approximately half of the thoughts. As a check on reliability, 20% of the thought-listing protocols were coded by both judges. The judges showed 85% agreement.[2]

Table 1
Confidence Ratings and Reasons Generated for Case Study Outcomes as a Function of Dogmatism: Experiment 1

	Case study			
Dogmatism	Forbidden toy	Observer effects	Emergency helping	Eyewitness testimony
Low				
Confidence	6.32	6.06	6.26	6.10
Pro reasons	2.39	2.48	2.68	2.68
Con reasons	2.35	2.39	2.45	2.29
High				
Confidence	7.41	7.38	7.47	7.22
Pro reasons	2.88	2.75	2.94	3.09
Con reasons	2.06	2.28	2.25	2.06
Overall				
Confidence	6.87	6.73	6.87	6.67
Pro reasons	2.63	2.62	2.81	2.89
Con reasons	2.21	2.33	2.35	2.17

Results

Confidence ratings and reasons generated for the chosen outcome of each case study are shown in Table 1.[3] As can be seen, individuals high in dogmatism were much more confident in their judgments (M = 7.37) than individuals low in dogmatism (M = 6.19), $F(1, 61) = 7.46$, $p < .01$.

Significantly more pro reasons (M = 2.74) than con reasons (M = 2.33) were generated for the chosen outcomes, $F(1, 61) = 13.97$, $p < .001$. However, there was a significant interaction of dogmatism with type of reason generated, $F(1, 61) = 10.33$, $p < .01$. As can be seen in Figure 1, individuals high in dogmatism produced more pro reasons (M = 2.91) than individuals low in dogmatism (M = 2.56), simple effect $F(1, 61) = 3.47$, $p < .07$; also, they produced fewer con reasons (M = 2.16) than individuals low in dogmatism (M = 2.50), simple effect $F(1, 61) = 3.07$, $p < .08$. Another way of interpreting the interaction is to note that the main effect of reasons applied only to individuals high in dogmatism; those low in dogmatism did not generate significantly more pro than con reasons.

The role of reason generation in participants' judgments was investigated further via covariance analyses. Such analyses can provide an indication of the causal role of reason generation in accounting for judgments (C. A. Anderson et al., 1985; Hoch,

[1] In keeping with previous research, dogmatism was investigated by comparing high and low scorers in a between-groups analysis of variance design rather than including all participants in a multiple regression design. It is acknowledged that such an extreme-groups analysis effectively has less power than a regression analysis because of the wastage of midrange scorers. However, it sometimes seems that the inclusion of midrange scorers makes findings less clear because of the lower validity of moderate scores (see Sorrentino & Short, 1977).

[2] Interjudge agreement was similar across the different case studies, with kappa values ranging from .63 to .78 (overall κ = .71). Comparable reliability ratings were obtained in the following studies as well.

[3] Case study was not found to be a significant variable either as a main effect or in interactions in any of the experiments, and so the data analyses are presented summing across case studies.

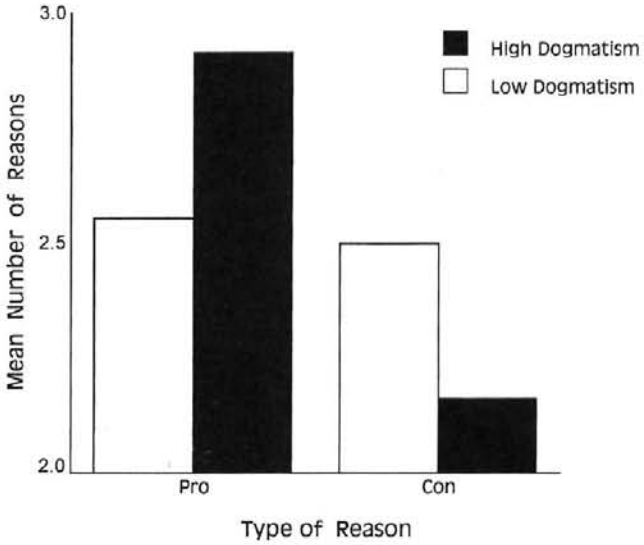

Figure 1. Experiment 1: Type of reason generated as a function of dogmatism.

1984). In the present experiment, net reasons (pro minus con) correlated significantly ($r = .65$, $p < .001$) with confidence ratings.[4] When net reasons were used as the covariate in analyses of confidence ratings, it was found that the covariate was highly significant, $F(1, 60) = 33.25$, $p < .001$. The presence of the covariate was found to reduce the effect of dogmatism on confidence ratings to insignificance, $F(1, 60) = 0.86$, $p < .40$. These findings therefore suggest that participants based their confidence ratings strongly on the availability of confirmatory evidence.

Discussion

The results of Experiment 1 show that individuals high in dogmatism are more likely to generate cognitions supporting their newly created beliefs and are less likely to generate cognitions contradicting them. This is somewhat different from the results of Davies (1993a) using an evidential-discrediting paradigm, who found that individuals high in dogmatism were not more likely to generate cognitions that supported a reported outcome (although they were less likely to generate contradictory cognitions). This difference may be due to belief formation versus belief revision. That is, once an outcome has been firmly established (as in belief persistence studies), there is no incentive to add extra support to that outcome. But when the outcome has yet to be firmly established (as in Experiment 1), there is an incentive to provide justification for it. This seems to imply a motivational explanation for differential reason generation in belief formation as a function of dogmatism: individuals high in dogmatism justify their new beliefs by providing more supporting cognitions and fewer contradictory cognitions.

However, a cognitive explanation is favored for the findings of Experiment 1. When people are thinking about a question, initial evidence that comes to mind will tend to support one alternative outcome over another. This alternative becomes the tentatively preferred answer, and subsequent search and retrieval of evidence are biased in its favor (Dellarosa & Bourne, 1984), thus making it difficult to access contradictory evidence. This seems to be the basis of the typical overconfidence effect found in predictive judgments (Koriat et al., 1980; Lichtenstein, Fischhoff, & Phillips, 1977). Individuals high in dogmatism might be more prone to such a process of differential memory search and retrieval. To test this cognitive explanation, I required participants in Experiment 2 to generate reasons before making their judgments (in contrast to Experiment 1, in which they listed their reasons after making their judgments). If this cognitive explanation is applicable, then individuals high in dogmatism would not be motivated to produce more supporting evidence (because the belief that needs justifying has not yet been established), but their inability to consider evidence discrepant with their tentatively held belief would lead them to generate fewer contradictory reasons.

Experiment 2: Dogmatism and the Generation of Reasons Before Belief Formation

Method

The method was similar to that of Experiment 1, with two exceptions. First, participants listed their reasons for possible outcomes before rather than after choosing the outcome they thought most likely. Second, participants were given only one case study rather than all four.[5] The point of this was that after participants had performed the procedure once, they might be primed to list their reasons in the subsequent case studies so as to be consistent with their upcoming choice of outcome. Individuals high in dogmatism might be more motivated by these concerns than individuals low in dogmatism, and so significant differences might occur simply because of a greater need to be consistent.

Of 112 students administered the dogmatism scale in mass-testing sessions, 37 (25 women and 12 men) who scored in the top third of the distribution of dogmatism scores were selected as the high dogmatism group. The mean age of this group was 20.87 years ($SD = 3.29$; ages ranged from 18 to 32 years). Thirty-six students (26 women and 10 men) who scored in the bottom third of the distribution of dogmatism scores were selected for the low dogmatism group. The mean age of this group was 21.23 years ($SD = 3.41$; ages ranged from 18 to 36 years).

Results

As found previously, individuals high in dogmatism were significantly more confident in their judgments ($M = 7.30$) than individuals low in dogmatism ($M = 6.14$), $F(1, 71) = 6.16$, $p < .02$. Participants generated significantly more pro reasons ($M = 2.62$) than con reasons ($M = 2.21$) for the chosen outcomes, $F(1, 71) = 9.40$, $p < .005$, and there was a significant interaction of dogmatism with type of reason generated, $F(1, 71) =$

[4] Correlations between confidence ratings and other indexes, such as number of pro reasons or proportion of pro reasons, were also significantly positive but smaller in magnitude ($r = .42$ and $r = .64$, respectively).

[5] Case study was a between-subjects variable in this experiment and also in Experiment 3, unlike Experiment 1, in which it was a within-subject variable; as was the case in Experiment 1, however, it was not found to be significant either as a main effect or in interactions.

4.97, $p < .05$. As can be seen in Figure 2, individuals high in dogmatism produced fewer con reasons ($M = 1.95$) than individuals low in dogmatism ($M = 2.47$), simple effect $F(1, 71) = 5.37$, $p < .05$, but this time they did not produce significantly more pro reasons ($M = 2.65$) than individuals low in dogmatism ($M = 2.58$), simple effect $F < 1$.

Number of net reasons (pro minus con) again correlated significantly ($r = .57$, $p < .001$) with confidence ratings, and, when net thoughts was used as the covariate in analyses of the confidence ratings, it was found that the covariate was highly significant, $F(1, 70) = 27.95$, $p < .001$. The presence of the covariate was found to reduce the effect of dogmatism on confidence ratings to insignificance, $F(1, 70) = 2.15$, $p < .15$.

Discussion

As in Experiment 1, the findings of this experiment showed that individuals high in dogmatism generated fewer contradictory cognitions, but, unlike in Experiment 1, it was not found that they generated significantly more supporting cognitions. It could be argued that this difference with Experiment 1 was due to predecisional versus postdecisional processes. When participants have committed themselves to a decision, postdecisional processing involves gathering evidence to support the decision. Individuals high in dogmatism are more motivated to justify their decision than individuals low in dogmatism and so they produce more supporting and fewer contradictory reasons. When participants have not (yet) committed themselves to a decision, there is less motivation to engage in such justification processes.[6] However, the cognitive processes involved in the search and retrieval of evidence (such as positive test strategies; Klayman & Ha, 1987) still tend to favor the generation of supporting cognitions, but this time individuals high in dogmatism are not likely to come up with more supporting evidence than individuals low in dogmatism. The difference is that individuals high in dogmatism are less likely to generate contradictory reasons because of their inability to consider evidence contrary to their tentatively held beliefs.

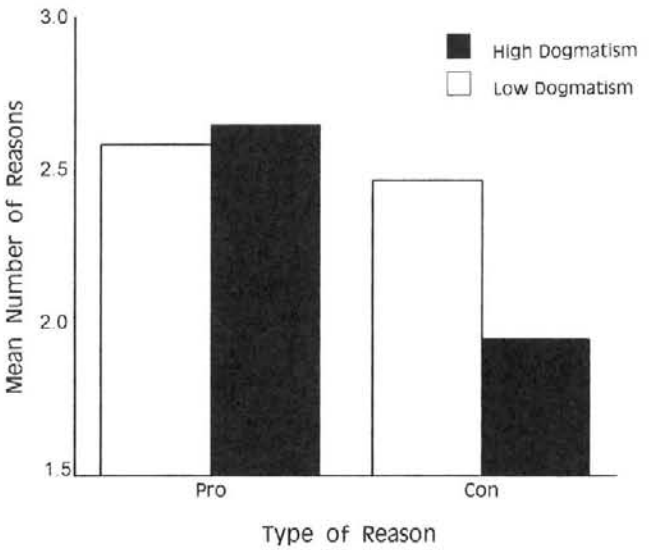

Figure 2. Experiment 2: Type of reason generated as a function of dogmatism.

If the tendency of individuals high in dogmatism to compartmentalize and isolate their beliefs and disbeliefs stems from an inability to consider contradictory evidence, they may be particularly prone to the phenomenon of output interference. Output interference was first observed in memory paradigms. In recall of items from memory, it has been found that the very act of recall produces interference (Roediger, 1978). For example, Rundus (1973) found that previously recalled list items interfered with the recall of new, unrecalled list items. According to Rundus, output interference is due to the strengthening of associations between retrieval cues and the recalled items produced by the act of recall. This strengthening of associations increases the likelihood of retrieving the previously recalled items but at the expense of the new, unrecalled items. By analogy with these verbal memory findings, Hoch (1984) argued that generating a particular reason for an outcome will reduce the availability of other reasons for the outcome through this process of output interference. In particular, generating a supporting reason should interfere with the ability to generate a contradictory reason, and vice versa. In three experiments on predictive judgment, Hoch (1984) provided confirmation of output interference effects by manipulating the order in which pro and con reasons were generated for outcomes. He found that pro–con generation produced not only more pro than con reasons but also higher likelihood judgments for a given outcome than con–pro generation. Output interference may well be an explanation for the relative inability of individuals high in dogmatism to generate contradictory reasons in the preceding experiments: The generation of initial evidence supporting a tentatively held belief interferes with the generation of contradictory reasons.

Experiment 3: Dogmatism and Output Interference in the Generation of Supporting Versus Contradictory Cognitions

In Experiment 3, I tested this output interference explanation by having participants generate reasons for one outcome and then generate reasons for the opposite outcome before making their judgments of outcome likelihood. I expected that more reasons would be generated for the first outcome than for the second outcome and that this differential reason generation would be associated with greater likelihood judgments for the first outcome. More important, I expected that individuals high in dogmatism would show this output interference effect to a greater extent than individuals low in dogmatism in terms of both differential reason generation and increased likelihood of the first outcome. As a more stringent test of the output interference effect, I used Experiment 3 to replicate Hoch's (1984) third experiment. This included a condition in which a time delay was inserted between the generation of the first and second

[6] Although plausible, this reasoning needs to be qualified by the fact that the interaction of dogmatism and type of reasons generated was not found to be significantly different between Experiment 1 and Experiment 2.

set of reasons. I expected that the associative strength between judgment outcome and the first set of reasons would decline during the delay period (when rehearsal is prevented) so that interference would be reduced or eliminated. Hoch found that such a delay eliminated the difference in number of reasons generated for the first and second set of reasons and, moreover, not only eliminated the effects of order of reason generation on likelihood judgments but actually reversed the primacy effect (greater likelihood of judgments in the direction of the first generated reasons) to produce a recency effect (greater likelihood of judgments in the direction of the second generated reasons). I therefore expected that the introduction of a delay in Experiment 3 would eliminate both the differential generation of first and second reasons and the difference in outcome likelihood.

Method

The method was similar to that of Experiment 2 except that participants generated reasons in a designated order. Half of the participants first generated reasons why Outcome 1 might occur and then generated reasons why Outcome 2 might occur, whereas the other half first generated reasons for Outcome 2 and then generated reasons for Outcome 1. In addition, for half of the participants there was no delay between generating the two sets of reasons, whereas for the other half of the participants, a delay with rehearsal prevention was inserted between the generation of the first set and the second set of reasons. In this delay condition, participants completed a task that involved spending 3 min crossing out all of the *es* detected in a passage of technical prose. After the reason-generation tasks, participants rated the likelihood of occurrence of Outcome 1 versus Outcome 2 on a 10-point scale (1 = *definitely Outcome 2*, 10 = *definitely Outcome 1*).

Sixty-seven students (41 women and 26 men) who scored in the top third of the distribution of dogmatism scores were selected for the high dogmatism group. The mean age of this group was 20.54 years (SD = 3.03; ages ranged from 18 to 30 years). Sixty-seven students (46 women and 21 men) who scored in the bottom third of the distribution of dogmatism scores were selected for the low dogmatism group. The mean age of this group was 20.78 years (SD = 3.11; ages ranged from 18 to 32 years).

Results

The likelihood ratings and reasons generated for outcomes are shown in Table 2 as a function of dogmatism, order of generation, and delay.

Reasons generated. More reasons were generated for the first outcome (M = 2.94) than for the second outcome (M = 2.51), as shown by a significant interaction of order of generating reasons and outcome, $F(1, 126) = 17.61$, $p < .001$. This is in line with the prediction of an output interference effect. However, the effect of order was qualified by a significant interaction with delay–no delay, $F(1, 126) = 5.31$, $p < .05$. As can be seen in Table 2, when there was no delay, more reasons were generated for Outcome 1 than Outcome 2 in the 1–2 order (net reasons = +0.66), and more reasons were generated for Outcome 2 than Outcome 1 in the 2–1 order (net reasons = −0.69), simple effect $F(1, 126) = 21.17$, $p < .001$; when there was a delay, however, this differential reason generation declined to nonsignificance, $F(1, 126) = 1.79$, $p < .20$. This confirms Hoch's finding that output interference is reduced or eliminated when there is a delay between the generation of first and second reasons.

In addition, there was a significant interaction of order with dogmatism, $F(1, 126) = 5.26$, $p < .05$. As can be seen in Figure 3, individuals high in dogmatism generated significantly more reasons for Outcome 1 than Outcome 2 in the 1–2 order (net reasons = +0.69) and more reasons for Outcome 2 than Outcome 1 in the 2–1 order (net reasons = −0.65), simple effect $F(1, 126) = 21.11$, $p < .001$, but this effect was much

Table 2
Likelihood Ratings and Reasons Generated for Outcomes as a Function of Dogmatism, Order of Generation, and Delay

	Order of generation of reasons			
	Outcome 1–Outcome 2		Outcome 2–Outcome 1	
Dogmatism	No delay	Delay	No delay	Delay
Low				
Reasons for Outcome 1	2.94	2.80	2.44	2.79
Reasons for Outcome 2	2.47	2.73	3.00	2.47
Net reasons	0.47	0.07	−0.56	0.32
Likelihood rating[a]	5.53	4.00	4.44	5.79
High				
Reasons for Outcome 1	3.17	3.00	2.34	2.44
Reasons for Outcome 2	2.33	2.47	3.16	2.94
Net reasons	0.83	0.53	−0.81	−0.50
Likelihood rating[a]	6.44	5.53	3.75	4.31
Overall				
Reasons for Outcome 1	3.06	2.91	2.39	2.63
Reasons for Outcome 2	2.40	2.59	3.08	2.69
Net reasons	0.66	0.31	−0.69	−0.06
Likelihood rating[a]	6.00	4.81	4.09	5.11

[a] On a scale ranging from 1 (*definitely Outcome 2*) to 10 (*definitely Outcome 1*).

less for individuals low in dogmatism, simple effect $F(1, 126) = 1.80$, $p < .20$. Thus, individuals high in dogmatism showed much more output interference in their generation of reasons than did individuals low in dogmatism.

Likelihood ratings. Order of generating reasons had a significant effect on likelihood ratings, $F(1, 126) = 6.39$, $p < .02$, such that the first outcome was judged more likely ($M = 5.43$) than the second outcome ($M = 4.63$). However, the effect of order was qualified by the delay–no delay manipulation, $F(1, 126) = 11.75$, $p < .001$. As can be seen in Table 2, the first outcome was judged significantly more likely ($M = 6.00$) than the second outcome ($M = 4.09$) in the no delay condition, simple effect $F(1, 126) = 17.78$, $p < .001$, whereas in the delay condition, the first outcome ($M = 4.81$) was judged slightly less likely than the second outcome ($M = 5.11$), simple effect $F < 1$. That is, likelihood judgments were in the direction of output interference effects in the no delay condition but slightly in the opposite direction in the delay condition.

Order effects on likelihood judgments were also influenced by dogmatism, $F(1, 126) = 13.14$, $p < .001$. As can be seen in Figure 4, the first outcome was judged significantly more likely ($M = 6.00$) than the second outcome ($M = 4.03$) for individuals high in dogmatism, simple effect $F(1, 126) = 18.97$, $p < .001$; for individuals low in dogmatism, the first outcome ($M = 4.81$) was judged slightly less likely than the second outcome ($M = 5.17$), simple effect $F < 1$. That is, the judgments of individuals high in dogmatism followed an output interference effect, but the judgments of individuals low in dogmatism did not. In fact, the judgments of individuals low in dogmatism in the delay condition were significantly different from their judgments in the no delay condition. As can be seen in Table 2, for individuals low in dogmatism, the first outcome was judged more likely ($M = 5.53$) than the second outcome ($M = 4.44$) in the no delay condition, but in the delay condition, the first outcome was judged less likely ($M = 4.00$) than the second outcome ($M = 5.79$), simple interaction $F(1, 126) = 9.73$, $p < .01$. For individuals high in dogmatism, however, the first outcome was judged more likely than the second outcome in both the no delay and delay conditions.

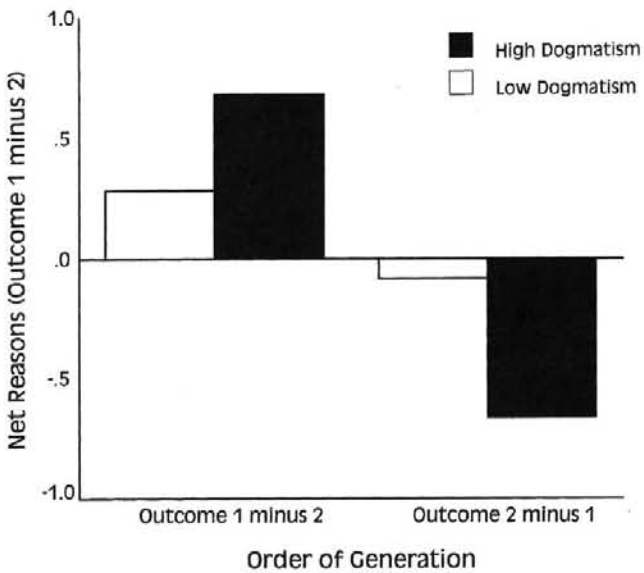

Figure 3. Net reasons generated as a function of order of generation, by dogmatism.

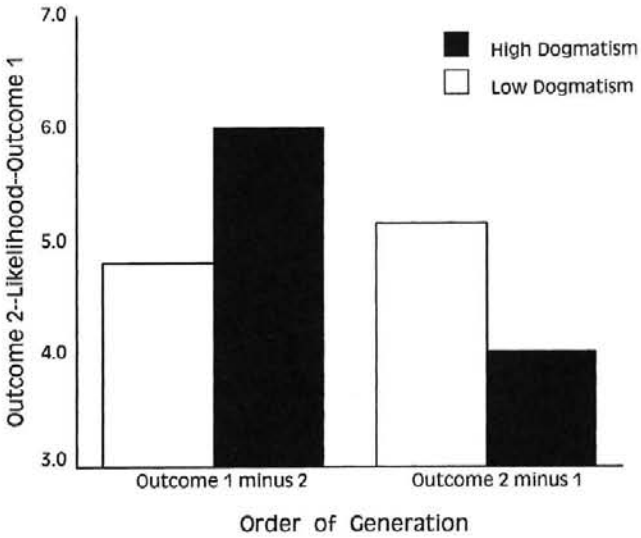

Figure 4. Likelihood judgments as a function of order of generation, by dogmatism.

Analysis of covariance. Net reasons again correlated significantly with likelihood judgments ($r = .50$, $p < .001$). Analysis of covariance showed that net reasons was a significant covariate, $F(1, 125) = 24.18$, $p < .001$, and, as a result, the effect of order of generation on likelihood was reduced to nonsignificance, $F < 1$. However, the interaction of order and delay remained significant, $F(1, 125) = 7.11$, $p < .01$, as did the interaction of order and dogmatism, $F(1, 125) = 8.29$, $p < .01$. Further analyses showed that the interaction of order and delay remained significant for individuals low in dogmatism, $F(1, 62) = 5.95$, $p < .02$, but not for individuals high in dogmatism, $F(1, 62) = 1.71$, $p < .20$; also, the interaction of order and dogmatism remained significant in the delay condition, $F(1, 62) = 6.15$, $p < .02$, but not in the no delay condition, $F(1, 62) = 2.26$, $p < .15$. These findings suggest that factors other than differential reason generation accounted for likelihood judgments in the delay condition for individuals low in dogmatism, as discussed subsequently.

Discussion

The results of Experiment 3 showed significant output interference in the generation of reasons; more reasons were generated for the outcome considered first than for the outcome considered second. However, such output interference was confined to the no delay condition; in the delay condition, output interference was negligible. Individuals high in dogmatism showed output interference much more strongly than individuals low in dogmatism. These findings for reason generation were nearly but not quite mirrored in the likelihood judgments. The delay condition showed a slight reversal of output interference effects in that the first outcome was judged slightly less likely than the

second outcome, and individuals low in dogmatism showed a similar slight reversal of the output interference effect in their likelihood judgments. In fact, individuals low in dogmatism in the delay condition showed a significant reversal of the output interference effect.

Hoch (1984) found that a delay in generating the second set of reasons, rather than simply reducing the likelihood of the first outcome relative to the second outcome, produced greater likelihood judgments for the second than the first outcome, a recency effect. Thus, differential reason generation could not account completely for likelihood judgments, just as in the present experiment the effects of differential reason generation could not completely account for the interaction of order and delay. In terms of N. H. Anderson's (1981) "attention decrement" hypothesis, he argued that, unlike the no delay condition, a delay could operate to increase the amount of attention paid to the second set of reasons without the interference of the first set of reasons. He also suggested an anchoring and adjustment explanation (Tversky & Kahneman, 1974) for findings in delay and no delay conditions. In the no delay condition, participants anchor their likelihood judgments on the first set of reasons and then adjust these judgments to take account of the second set of reasons. As a result of insufficient adjustment, likelihood estimates are biased in the direction of the first set of reasons (the primacy effect). In the delay condition, participants anchor their judgments on the second set of reasons and adjust for the first set of reasons so that the likelihood estimates are biased in the direction of the second set of reasons (the recency effect).

This anchoring and adjustment explanation can explain the findings for individuals low in dogmatism but does not seem able to explain the findings for individuals high in dogmatism. In both the no delay and delay conditions, the likelihood judgments of individuals high in dogmatism were biased toward the first outcome, whereas the judgments of individuals low in dogmatism were biased toward the first outcome in the no delay condition but toward the second outcome in the delay condition. It seems that once individuals high in dogmatism have formed a belief based on one set of reasons or evidence, they are unlikely to revise those beliefs in light of new reasons or evidence, and they show a primacy effect in both no delay and delay conditions.

General Discussion

The closed nature of cognitive systems characterized by highly dogmatic individuals leads to the processing of information in a way that ignores, minimizes, or avoids inconsistencies in beliefs and attitudes. By contrast, individuals low in dogmatism do not keep inconsistent attitudes and beliefs isolated or compartmentalized to the same extent, and the open nature of their cognitive systems allows them to make connections between disparate beliefs and disbeliefs. The findings provided in the experiments reported here have shown that individuals high in dogmatism have greater difficulty than individuals low in dogmatism in generating evidence and reasons contradicting their beliefs. In addition, differential reason generation was found to be closely associated with the greater confidence in judgments exhibited by individuals high as compared with low in dogmatism. Finally, primacy effects in reason generation and confidence judgments were found to be greater for the former than for the latter.

Before considering substantive explanations for the present findings, it is worth considering possible artifactual explanations. Dogmatism has often been found to be associated with an acquiescent response set (Couch & Keniston, 1960), and the Troldahl–Powell measure is not an acquiescence-free measure of dogmatism. The present findings could therefore be explained in terms of acquiescence. One reaction to this is simply to acknowledge that acquiescence is, in fact, part and parcel of the dogmatic personality. More than this, however, an explanation in terms of acquiescence actually serves to reinforce the message of this article, which is that dogmatic people are more prone to confirmatory bias. One recent account of acquiescence (see Zuckerman, Knee, Hodgins, & Miyake, 1995) explains that it is the result of a search for evidence that confirms a given proposition or hypothesis through the use of a positive test strategy (Klayman & Ha, 1987). Dogmatic people seem to favor such a positive test strategy; they look for evidence that supports their tentatively held belief. However, it could be argued from the results of the present experiments that dogmatic people go further in that they actively reject a negative test strategy, overlooking or ignoring evidence that contradicts their beliefs. The present analysis differs somewhat from an acquiescence explanation on the issue of whether the tendency toward confirmatory bias is due to motivational or cognitive factors. An acquiescence explanation suggests that yea-saying is the result of a cooperative or deferential motivation (Lenski & Leggett, 1960), and so individuals high in dogmatism show more confirmatory bias because of their greater deference to authority. However, this explanation does not adequately account for the present findings, because the hypothesis that is being confirmed is not someone else's (such as the experimenter's) but the person's own hypothesis, and it has not been suggested that dogmatic people are more deferent to their own authority. Conceivably, deference to authority is manifested in more general terms such as confirming the experimental hypothesis or conforming to experimental demands. However, it is difficult to see how such a demand explanation could account for the observed effects of either order or delay of generating reasons as a function of dogmatism, because it is not clear to participants what sort of response would be deemed desirable or expected (cf. Koehler, 1991).

According to current thinking in cognitive psychology (e.g., Dellarosa & Bourne, 1984; Klayman & Ha, 1987), in the belief formation process, the initial evidence that comes to mind is used to create a tentative belief. Subsequent cognitive processing tends to favor this belief through search and retrieval of supporting information at the expense of contradictory information. It seems that highly dogmatic individuals are more biased in their information processing toward supporting evidence and against contradictory evidence. One possible explanation for this biased processing is output interference: Generating reasons in support of a belief reduces the availability of alternative, contradictory reasons so that the strength of the belief increases. Highly dogmatic individuals showed such differential reason generation much more than individuals low in dogmatism. However, differences between the beliefs of individuals low and high in dogmatism could not be completely explained by output interference of reasons. The introduction of a delay between the generation

of different sets of reasons should have reduced the output interference effect on beliefs, but, in fact, for individuals low in dogmatism, the reduction became a reversal in belief. For these individuals, it appears that the effects of output interference of reasons are counteracted by the operation of a recency effect on judgments when there is a delay between the first set of reasons and the second set of reasons (Hoch, 1984).

Although this output interference explanation may seem plausible, Koehler (1991) recently cast doubt on the viability of associative memory explanations in accounting for the effects of explanation or imagination on confidence judgments. He argued that the parallels between the rather simple memory tasks involved in the generation effect (Slamecka & Graf, 1978) or output interference (Roediger, 1978) and more complex explanation tasks (e.g., Ross et al., 1977; Sherman et al., 1983) are rather speculative. Generating explanations or a list of reasons is an act of construction rather than a simple pouring out of retrieved information. In addition, he argued that mere correlation between recall and judgment is obviously not sufficient evidence for the proposition that recall causes judgment; indeed, studies show that recall can be independent of judgment (e.g., Dreben, Fiske, & Hastie, 1979; Hirt & Markman, 1995).

These arguments have some force and sound a cautionary note for researchers (including the author) to ensure that adequate measures of hypothesized memory mechanisms are taken. Koehler's own account of the relation between reason generation and judgment was in terms of a perceptual mechanism, the "conditional reference frame." Explaining or imagining an event outcome focuses attention onto one particular hypothesis: the *focal hypothesis.* This focal hypothesis leads people to adopt a conditional reference frame in which the hypothesis is temporarily assumed to be true; they then evaluate how plausibly the hypothesis can account for the relevant evidence. Adopting a conditional reference frame leads to systematic biases, because the evidence is interpreted in the direction of the focal hypothesis; a good fit is perceived between the evidence and the hypothesis, and so the hypothesis is judged to be true. In terms of dogmatism and belief formation, this account would suggest that once dogmatic individuals have adopted a conditional reference frame, they are either unable or unwilling to relinquish it. At present, however, the advantage of perceptual over memory models for explanation–judgment phenomena has not, in my opinion, been adequately established. Koehler suggested that a perceptual effect would lead to alterations in the perception of the issue; aspects of the issue that are consistent with the hypothesis or belief are given more prominence than aspects that are inconsistent. But this could just as easily be a memory-based account. Indeed, it could be argued that Koehler's explanation is actually a redescription rather than a subsuming explanation. One obvious way of testing such speculation in terms of dogmatic thinking would be to determine whether individuals high in dogmatism show more output interference in recall than individuals low in dogmatism on a straightforward memory task (e.g., Rundus, 1973).

A different issue is whether the results of the present studies can best be explained in terms of cognitive or motivational mechanisms. The results of Experiment 1 seem best explained in motivational terms: Individuals high in dogmatism are biased in their evaluations through their selective reporting of evidence that favors their chosen belief. This seems to be a clear case of motivated reasoning (Kunda, 1990). The results of Experiment 2 and 3, at first glance, do not appear to be interpretable in terms of such motivated reasoning. Because the generation of evidence occurred before the beliefs were formed (or at least written down), the evidence cannot have been selectively reported so as to justify the belief. It could, however, be argued that the belief was chosen to be consistent with the evidence generated; rather than a justificatory motive linking prior beliefs with subsequent evidence, there was a consistency motive linking prior evidence with subsequent beliefs. Although a cognitive explanation is preferred for the findings of Experiments 2 and 3, recent research at the intersection of cognition and motivation (e.g., Higgins & Sorrentino, 1990; Hilton & Darley, 1991; Kunda, 1990; Sorrentino & Higgins, 1986) suggests that purely motivational accounts of attitudes, beliefs, and inferences can be just as viable and coherent as purely cognitive ones (Thagard, 1989). In this respect, the traditional designation of dogmatism as a "cognitive style" may need to be reconsidered.

However, research on judgment biases and heuristics does not provide much evidence in support of motivational explanations. In reviewing the literature, both Fischhoff (1982) and Arkes (1991) found little evidence that accuracy incentives improve judgmental accuracy. It seems that some sort of cognitive restructuring is required to alter people's judgments and beliefs. One consistent finding here is that counterexplanation or counterfactual reasoning improves accuracy (e.g., C. A. Anderson, 1982; C. A. Anderson & Sechler, 1986; Davies, 1992; Hirt & Markman, 1995; Hoch, 1985; Koriat et al., 1980; Lord, Lepper, & Preston, 1984; Slovic & Fischhoff, 1977). From the findings presented in this article (especially those of Experiment 3), however, it might well be that dogmatic individuals would not show much benefit from such cognitive restructuring manipulations. Indeed, it may be that motivational inductions would have more influence on dogmatic thinking. Kruglanski's (1989) analysis of epistemic needs seems particularly relevant here. For example, motivational manipulations such as fear of invalidity might temper the closed-minded tendency of individuals high in dogmatism by reducing their need for closure (cf. Kruglanski & Freund, 1983; Kruglanski & Mayseless, 1988).

Research on personality variables (including cognitive styles) may be particularly useful in investigating some of the issues involved in motivated reasoning. Personality variables that reflect natural variations in mediating processes can be usefully applied in testing the operation of mechanisms proposed by general theories and models (Underwood, 1975). The present research underscores this point and emphasizes the utility of applying different theoretical approaches—one involving a general process model (output interference), the other an individual-differences variable (dogmatism)—to generate new findings that would not be produced with either approach alone. Thus, dogmatic individuals adopt more extreme attitudes and beliefs because they generate fewer contradictory reasons as a result of greater output interference, and differential reason generation produces greater primacy effects in the judgments of people who tend to compartmentalize beliefs and disbeliefs.

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