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Behavioral evidence for framing effects in the resolution of the doctrinal paradox

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Abstract The aggregation of individual sets of judgments over interconnected propositions can yield inconsistent collective sets of judgments, even when the individual sets of judgments are themselves consistent. A doctrinal paradox occurs when majority voting on a compound proposition (such as a conjunction or disjunction) yields a different result than majority voting on each of the elements of the proposition. For example, when most individuals accept proposition X; most individuals accept proposition Y; but only a minority of individuals accept the compound proposition 'X and Y'. Conducting two elemental votes would lead to accept X and Y, but conducting one compound vote would lead to reject X and Y. In such a situation, do people manifest a stable preference as to which voting procedure should be applied? This research reports the results of two behavioral experiments using a within-participant design, which show that procedural preferences can be upturned by framing either positively or negatively the set of judgments to be aggregated. This shift in procedural preference leads to large swings in the final collective judgment endorsed by participants.

1 Introduction

Whereas the science of individual judgment and decision making fully integrates behavioral and normative approaches, only preliminary steps have been taken yet to complement formal theories of social choice and collective judgment with behavioral data (Regenwetter et al. 2007). This article offers a behavioral investigation of the *doctrinal paradox* in judgment aggregation. The normative aspects of the doctrinal paradox have been extensively investigated in the domains of law, economics, political

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Table 1 A conjunctive doctrinal paradox

	Competent?	Motivated?
Evaluator 1	Yes	No
Evaluator 2	Yes	Yes
Evaluator 3	No	Yes
Evaluator 4	No	No
Evaluator 5	No	Yes
Evaluator 6	Yes	No
Evaluator 7	Yes	Yes

science, philosophy, and computer science (Brennan 2001; Bovens and Rabinowicz 2006; Cariani et al. 2008; Dietrich 2006; Dietrich and List 2008; List 2003, 2005; List and Pettit 2002, 2004; Pigozzi 2006); but its behavioral aspects are still largely unexplored.

Imagine that a committee of seven evaluators is assessing the employees of a firm. The task of the committee is to express a collective judgment as to whether each employee is competent and motivated. To do so, each evaluator individually assesses the employee, then answers 'Yes' or 'No' to the question of whether the employee is competent, and answers 'Yes' or 'No' again to the question of whether the employee is motivated. Once all individual judgments are collected, the committee must apply an aggregation procedure to reach a collective judgment.

Suppose that the evaluators gave the judgments displayed in Table 1. It appears that the employee is competent for a majority of evaluators (4 out of 7), and that the employee is motivated, again, for a majority of evaluators (4 out of 7). However, only a minority of two evaluators see the employee as being competent and motivated. Now, either the committee proceeds to a majority vote on each element of the evaluation, separately, and concludes that the employee is competent and motivated; or the committee proceeds to a single majority vote on the compound evaluation, and reaches the opposite conclusion. In other terms, in this situation, the aggregation procedure itself determines the collective judgment of the committee. How to proceed then?[1]

There is no easy way out of this dilemma. If we leave aside normative considerations and focus instead on the behavioral aspects of the situation, we may suggest that elemental aggregation leads to a more positive overall experience than compound aggregation. For example, Hastie et al. (1983) contrasted *evidence-driven juries,* who follow a procedure akin to elemental aggregation (they deliberate about the facts of the case, and reach a verdict when they have found a consensus about these facts) with *verdict-driven juries,* who follow a procedure akin to compound aggregation (they primarily deliberate about their overall verdict preferences, rather than about the facts of the case). Hastie et al. (1983) reported that evidence-driven juries did a more thorough and careful work, and were more satisfied with their deliberation. These empirical observations were consolidated by Kameda (1991), who experimentally elicited an elemental or a compound deliberation style, by manipulating the timing of

[1] The doctrinal paradox in judgment aggregation is reminiscent of but distinct from the Ostrogorski paradox studied in traditional social choice theory. On the relation between the two paradoxes, see Pigozzi (2005).

the aggregation (before or after participants had individually committed to a verdict). Kameda (1991) found that participants whose judgment was not the aggregated judgment, showed more agreement with this final judgment, and more opinion change, when they had engaged in elemental deliberation.

However suggestive these results, we are still largely ignorant of whether people spontaneously prefer elemental or compound aggregation when facing a doctrinal paradox; and whether this spontaneous preference is stable or not. In the first empirical study to directly address these questions, Bonnefon (2007) reported that people manifested a slight spontaneous preference for compound aggregation, apparently for reasons of simplicity (compound aggregation requires a single judgment from each judge, whereas elemental aggregation requires an entire vector of judgments). However, this baseline preference for compound aggregation was attenuated in some situations. One finding in particular suggested that aggregation preferences in presence of a doctrinal paradox might be prone to a framing effect.

In the study of Bonnefon (2007), two groups of participants aggregated the same set of judgments about whether an individual was young and trilingual. This set of judgments exhibited a doctrinal paradox: elemental aggregation yielded the conclusion that the individual was young and trilingual, whereas compound aggregation yielded the opposite conclusion. The experiment manipulated the ultimate consequences of deciding that the individual was young and trilingual. In the first experimental group, this conclusion gave the individual a position that nobody wanted to fill; in the second experimental group, this conclusion gave the individual a much coveted position. The first group of participants showed a clear preference for compound aggregation, but this preference was largely attenuated in the second group.

This result suggests that preferences for aggregation procedures may shift depending on the framing of the collective judgment they allow to reach. Faced with the same set of judgments about an individual, participants preferred compound aggregation when it had positive consequences for the individual, but not when it had negative consequences for the individual. All happened as if participants did not have a strong opinion on which aggregation procedure was better, and that they let the framing of the problem guide their preference. This demonstration is not quite as strong as one may want, though. To begin with, the shift in preference was not a complete swing: the second group did not demonstrate a clear preference for elemental aggregation, but was rather indifferent between the two aggregation procedures. Moreover, the between-group design did not allow to claim that a given participant would change his or her preferences from one case to the next, if presented with both.

The present research aims at a triple generalization of the initial result of Bonnefon (2007). First, it seeks to completely upturn the aggregation preference as a function of the framing of the paradox. To do so, it strengthens the framing manipulation: Instead of manipulating the ultimate consequence of the collective judgment, it directly frames the judgments to be aggregated as positive or negative. Second, and critically, it seeks to establish that this shift in aggregation preference can be obtained in a within-participant design; that is, that individuals do change their personal procedural preference when aggregating two structurally equivalent sets of judgments, as a function of their framing. Finally, it seeks to generalize these results to a disjunctive variant of the paradox, in addition to its conjunctive version.

2 Experiment 1: framing the conjunctive paradox

2.1 Method

Participants were recruited by third-year psychology students as a course requirement. Each student made a list of several men and women who were older than 18, not studying psychology, and willing to take part in a series of unrelated experiments (no other restriction applied, e.g., family members were permitted). Each student then randomly selected one male and one female participant from this list. It was expected that this recruitment procedure would promote variety in age, occupation, and education, while ensuring equal proportions of male and female participants. No incentive was offered to participants. In the rare cases when a randomly selected participant did not consent to take part in the survey, the student made a second random selection from his or her list.[2]

Of the 260 participants who returned a fully completed questionnaire (49% women, mean age = 31, SD = 13), 15% had completed graduate school or an equivalent school form, 41% had the equivalent of an undergraduate education, 26% graduated from high school only, and the educational level of 18% was lower than high school. The sample included a large proportion of students (38%), but the remaining 62% came from a large variety of professional perspectives.

Participants were presented first with the *positive framing* questionnaire.[3] They read the following introduction to the task:

> Seven experts have evaluated the employees of a firm, and each expert has judged for each employee whether he was 'competent' (that is, he knows his job well), and whether he was 'motivated' (that is, he is interested in his job). Their evaluations regarding one of the employees are summarized in the following table.

At this point, participants were given the set of judgments depicted in Table 1.

> From these evaluations, your task is to answer the following question: Is it true that this employee is *competent and motivated?* There are two ways to look at the evaluations in order to answer this question.

The elemental and compound voting procedures were then introduced side by side.

> Four experts out of seven think that the employee is competent: They are the majority. Likewise, Four experts out of seven think that the employee is motivated: They are the majority. Therefore, the employee is 'competent and motivated.'

[2] This recruitment procedure was introduced in Bonnefon and Villejoubert (2006), and has been applied since to a rich variety of behavioral issues, including deductive reasoning (Bonnefon et al. 2008), life regrets (Bonnefon and Zhang 2008), and comparative happiness (Vautier and Bonnefon 2008).

[3] In both experiments, participants always completed the positive framing questionnaire first. Because this order of presentation was not manipulated, we cannot rule out the unlikely possibility that it would affect the main results reported in the paper.

Table 2 Experiment 1: procedural agreement and final decision as a function of framing condition

	Compound aggregation	Elemental aggregation	Decision (%)
Positive framing	−0.04 (1.3)	+0.30 (1.3)	61
Negative framing	+0.15 (1.3)	+0.13 (1.3)	45

Agreement is rated on a 5-point scale, coded from −2 (total disagreement) to +2 (total agreement). The 'decision' column records the percentage of participants deciding that the employee is 'incompetent and unmotivated' (elemental voting result) in the negative framing condition, or 'competent and motivated' (elemental voting result) in the positive framing condition

> Only two experts think that the employee is both competent and motivated. The five other experts think differently: They are the majority. Therefore the employee is not 'competent and motivated.'

Participants rated their agreement with each argument on two 5-point scales anchored at *Not at all* and *Absolutely.* Finally, they gave their final decision by choosing between the two options *The employee is 'competent and motivated'* and *The employee is not 'competent and motivated.'*

The whole questionnaire was one page in length. When they were finished, participants completed two short tasks (a personality test and a Bayesian updating problem), and were then presented with the *negative framing* version of questionnaire. The negative framing questionnaire was exactly the same as the positive framing questionnaire, except that all occurrences of 'competent' and 'motivated' were replaced by 'incompetent' and 'unmotivated,' respectively.

2.2 Results and discussion

Descriptive statistics are reported in Table 2. As expected, the framing of the questionnaire reliably influenced both elemental and compound agreement ratings, in opposite directions. Agreement with the compound aggregation procedure was greater in the negative framing questionnaire than in the positive framing questionnaire, $t(259) = -2.3$, $p = 0.02$ (all p values are two-tailed). In contrast, agreement with the elemental aggregation procedure was greater in the positive framing questionnaire than in the negative framing questionnaire, $t(259) = 2.2$, $p = 0.03$.The individual procedural preference index (elemental agreement minus compound agreement) tilted slightly toward compound voting (−0.02) in the negative framing version, but this preference was upturned in the positive framing version (+0.34).

Do these arguably small effects translate into observable differences in terms of the final decision made by participants? Note first the percentage of participants who eventually made the decision dictated by elemental voting (last column in Table 2). This proportion is reliably higher in the positive framing condition (Sign Test, $Z = 4.3$, $p < 0.001$), showing a remarkable increase of 16 percentage points, and crossing the 50% line. This is an illustration of how a small individual effect can snowball into a readily observable phenomenon: Here, a small change in individual procedural preferences translates into a clear reversal of collective judgment.

However, this conclusion assumes that the effect of framing on the final decision made by participants is indeed due to the difference in individual procedural preference, and not to another unknown mediator. To check this assumption, a within-participant mediation analysis was conducted, following the statistical recommendations of Judd et al. (2001).

The goal of a within-participant mediation analysis is to check whether the effect of a within-participant experimental manipulation (here, the framing manipulation) on a dependent variable (here, the final decision) is due to a variation in a concomitent variable (here, the procedural preference), whose value is measured in both experimental conditions. This concomitent variable is the mediator variable. For the purpose of this analysis, there are four data points of interest for each participant: the values of the dependent variable in each experimental condition, Y_1 and Y_2; and the values of the concomitent variable in each experimental condition, X_1 and X_2. The analysis then amounts to regress the difference variable $Y_2 - Y_1$ on two predictors: the difference variable $X_2 - X_1$, and the centered sum variable $X_2 + X_1 - \text{mean}(X_2 + X_1)$. If the first regression coefficient is significantly positive, one can conclude to mediation: the experimental manipulation affects the dependent variable through its effect on the mediating, concomitent variable. For the sake of simplicity, we will not discuss here the meaning of the second coefficient, which is an indicator of statistical moderation.

The final decision was coded 0 if it followed compound aggregation (1 if it followed elemental aggregation). Then, the difference between the decision made in the positive framing and the decision made in the negative framing was regressed on two predictors: (a) the change in individual procedural preference (elemental agreement minus compound agreement in the positive version, *minus* elemental agreement minus compound agreement in the negative version) and (b) the centered sum of all four elemental and procedural agreement ratings. In line with the mediation assumption, the first coefficient (standardized $\beta = 0.54$) was significantly higher than zero ($t = 10.3$, $p < 0.001$). The second coefficient was essentially zero ($\beta = 0.001$, $t = 0.02$, $p = 0.99$).

In sum, the results of Experiment 1 indicate that the framing of the propositions being aggregated (e.g., 'competent' vs. 'incompetent') influences the aggregation procedure that individuals are ready to apply in a situation of conjunctive doctrinal paradox; and that this preference change can translate into a reversal in collective judgment. Experiment 2 attempts to generalize these findings to a disjunctive variant of the paradox.

3 Experiment 2: framing the disjunctive paradox

Experiment 1 investigated the conjunctive version of the doctrinal paradox, which features a group level inconsistency between the agreement with two propositions, on the one hand, and the agreement with their conjunction, on the other hand. The paradox, however, also exists in a disjunctive version, which features a group level inconsistency between the agreement with two propositions, on the one hand, and the agreement with their disjunction, on the other hand. Consider the set of judgments summarized in Table 3. It appears that the employee is competent for a minority of

Table 3 A disjunctive doctrinal paradox

	Competent?	Motivated?
Evaluator 1	No	Yes
Evaluator 2	No	No
Evaluator 3	Yes	No
Evaluator 4	Yes	Yes
Evaluator 5	Yes	No
Evaluator 6	No	Yes
Evaluator 7	No	No

evaluators (3 out of 7), and that the employee is motivated, again, for a minority of evaluators (3 out of 7). However, a majority (5 out of 7 evaluators) see the employee as being either competent, or motivated, or both. Is the employee 'competent or motivated'?

Just as in the conjunctive version of the paradox, the final decision depends on which aggregation procedure is adopted. If elemental aggregation is applied, the evaluators must come to the conclusion that the employee is not 'competent or motivated.' However, if compound aggregation is applied, they must reach the opposite conclusion. Will aggregation preferences in that situation be sensitive to the same framing effect as in the conjunctive situation, with the same ultimate effect on the aggregated judgment?

3.1 Method

Experiment 2 used the same recruitment procedure as Experiment 1, with the additional requirement that participants to Experiment 1 could not take part to Experiment 2. Of the 244 participants who returned a fully completed questionnaire (48% women, mean age = 31, SD = 13), 23% had completed graduate school or an equivalent school form, 36% had the equivalent of an undergraduate education, 25% graduated from high school only, and the educational level of 16% was lower than high school. The sample included a large proportion of students (37%), but the remaining 63% came from a large variety of professional perspectives.

Participants were presented first with the positive framing version of the questionnaire. They read the same introduction as in Study 1, and were given the set of judgments depicted in Table 3. They then read about their task:

> From these evaluations, your task is to answer the following question: Is it true that this employee is *competent or motivated?* There are two ways to look at the evaluations in order to answer this question.

The elemental and compound aggregation procedures were then introduced side by side.

> Only three experts think that the employee is competent. The four other experts think differently: They are the majority. Likewise, Only three experts think that

Table 4 Experiment 2: procedural agreement and final decision as a function of framing condition

	Compound aggregation	Elemental aggregation	Decision (%)
Positive framing	+0.39 (1.3)	+0.23 (1.4)	57
Negative framing	+0.03 (1.3)	+0.50 (1.2)	44

Agreement is rated on a 5-point scale, coded from −2 (total disagreement) to +2 (total agreement). The 'decision' column records the percentage of participants deciding that the employee is 'incompetent or unmotivated' (compound aggregation result) in the negative framing condition, or 'competent or motivated' (compound aggregation result) in the positive framing condition

> the employee is motivated. The four other evaluators think differently: They are the majority. Therefore the employee is not 'competent or motivated.'
>
> Five experts out of seven think either that the employee is competent, or that he is motivated, or both: They are the majority. Therefore, the employee is 'competent or motivated.'

Participants rated their agreement with each argument on two 5-point scales anchored at *Not at all* and *Absolutely.* Finally, they gave their final decision by choosing between the two options *The employee is 'competent or motivated'* and *The employee is not 'competent or motivated.'*

The whole questionnaire was one page in length. When they were finished, participants completed the same two short tasks as in Experiment 1. They were then presented with the *negative framing* version of questionnaire. The negative framing questionnaire was exactly the same as the positive framing questionnaire, except that all occurrences of 'competent' and 'motivated' were replaced by 'incompetent' and 'unmotivated,' respectively.

3.2 Results and discussion

Descriptive statistics are reported in Table 4. As expected, the framing of the questionnaire reliably influenced both elemental and compound agreement ratings, in opposite directions. Agreement with the compound aggregation procedure was greater in the positive framing questionnaire than in the negative framing questionnaire, $t(243) = 4.5$, $p < 0.001$. In contrast, agreement with the elemental aggregation procedure was greater in the negative framing questionnaire than in the positive framing questionnaire, $t(243) = -3.5$, $p < 0.001$. The individual procedural preference index (elemental agreement minus compound agreement) tilted toward compound voting (−0.16) in the positive framing version, but this preference was reversed in the negative framing version (+0.47).

The framing of the questionnaire also had an effect on the final decision made by participants. The percentage of participants who eventually made the decision dictated by compound aggregation was 13 percentage points higher in the positive framing condition (Sign test, $z = 3.3$, $p < 0.001$), crossing again the 50% line. Finally, the within-participant mediation analysis showed that the effect of framing on the final decision was mediated by the change in procedural preference ($\beta = -0.36$,

$t = -6.1$, $p < 0.001$). In addition, the regression coefficient indicating moderation was significantly different from zero ($\beta = -0.16$, $t = -2.7$, $p < 0.01$), suggesting that larger inconsistencies in individual procedural preferences delivered increasingly larger effects on the final decision made by participants.

4 Conclusion

Behavioral investigations now form a core aspect of individual judgment and decision making research, alongside with formal, normative analyses. In contrast, research on collective judgment and decision making is still dominated by formal analyses. While we know a lot about the way individuals make their own judgments and decisions, we know comparatively much less about the way they aggregate different opinions and preferences into a collective judgment or a social choice.

In this article, I have shown that preferences for aggregation procedures in a situation of doctrinal paradox can be influenced by framing the compound proposition as a positive or a negative judgment. When the compound proposition was whether an individual was 'competent and motivated' (Experiment 1), or 'competent or motivated' (Experiment 2), participants tended to prefer the aggregation procedure that led to accept the proposition. In contrast, when the compound proposition was 'incompetent and unmotivated' (Experiment 1), or 'incompetent or unmotivated' (Experiment 2), participants tended to prefer the aggregation procedure that led to reject the proposition. The changes in procedural preference were small (albeit reliable), but they largely mediated a clear-cut swing in the collective judgment that was eventually endorsed by the participants.

Remarkably, these findings were obtained in a design where participants served as their own control. One might expect that after they spent time pondering the first set of judgments, participants would realize that the second set of judgments was structurally identical, and that the argument that supported their first procedural choice applied equally to the second situation. Nonetheless, it appears that the appeal of structurally identical arguments was partly determined by the framing of the collective judgment they led to.

One intriguing question is whether this sensibility to framing could be amplified or attenuated by some personal characteristics of the participants. For example, comparatively more compassionate participants may be more inclined to apply the procedure yielding the most lenient collective judgment, whereas participants with comparatively stronger concerns for equity might be more inclined to treat all cases equally, rather than changing their procedural preference from one case to the next. In addition, participants with a comparatively stronger inclination to engage in effortful cognitive processing might be more likely to realize that the procedural rationale is independent of the framing of the judgments to be aggregated, and thus more likely to resist the framing manipulation.

These speculations, however reasonable, found little support in the current datasets. Personality measures were available for all participants to the two studies, who answered to the Kindness, Equity, and Need for Cognition scales available from the International Personality Item Pool website Goldberg et al. (2006, http://ipip.ori.org/).

Table 5 Appropriate aggregation procedure as a function of goal (avoid false positive vs. avoid false negative) and version of the paradox (AND vs. OR)

	Avoid false positive	Avoid false negative
AND	Compound	Elemental
OR	Elemental	Compound

The correlation between each of these scores and the magnitude of the individual framing effect was essentially zero.

These null results suggest to look elsewhere than personality traits to find the psychological locus of unstable preferences for aggregation procedures. One promising possibility, suggested by a reviewer, is to consider the current results in terms of signal detection. As discussed in List (2006), the two aggregation procedures (compound and elemental) have different probabilities of delivering false positives and false negatives, as a function of whether the paradox under consideration is conjunctive of disjunctive. As summarized in Table 5, the compound procedure yields fewer false positives for the conjunctive paradox, whereas the elemental procedure yields fewer false negatives. This pattern is reversed for the disjunctive paradox: now the elemental procedure yields fewer false positives, and the compound procedure yields fewer false negatives.

As a consequence, if one's goal is to avoid false positives, one would be warranted to opt for the compound procedure to solve the conjunctive paradox, and to opt for the elemental procedure to solve the disjunctive paradox. Conversely, if one's goal is to avoid false negatives, one would be warranted to opt for the elemental procedure to solve the conjunctive paradox, and to opt for the compound procedure to solve the disjunctive paradox.

Let us assume now that a positively framed paradox promotes the goal of avoiding false negatives, whereas a negatively framed paradox promotes the goal of avoiding false positives. This seems intuitively plausible: when the task is to decide whether people are competent and/or motivated, excluding someone by mistake seems to be more of a concern than including someone by mistake. Conversely, when the task is to decide whether people are incompetent and/or unmotivated, including someone by mistake seems to be more of a concern than excluding someone by mistake.

If this assumption is correct, then the pattern of empirical results makes sense as a whole: The framing of the paradox affects the type of mistakes people feel concerned about, and people then adopt the procedure that is the most likely to allay this specific concern, taking into account the conjunctive or disjunctive version of the paradox.

In support of this account, we do know from prior experimental results (Hilton et al. 2005) that the goal of avoiding false positives or false negatives can play an important role in everyday reasoning. What is not clear, though, is whether participants' behavior in the current experiments reflects an *intentional* strategy aimed at avoiding false positives and false negatives. Certainly, all happens as if participants were selecting the aggregation procedure that would best serve the goal promoted by the framing; but it remains to be shown whether they consciously endorse this goal, and deliberately make the selection that serves this goal best. It is quite possible indeed

that participants had no explicit knowledge about the properties of the aggregation procedures they were selecting, and adopted them as an automatic response to the framing manipulation, rather than as a deliberate means to achieve a self-chosen goal.

This is an important issue for future research, because it has large consequences for the manipulability of collective judgements. The current experiments showed that framing manipulations could increase or decrease the acceptability of a given aggregation procedure; thus, any party with the ability to engage in such framing manipulations may have the power to push the adoption of the aggregation procedure that promotes its own agenda. If people's response to framing is deliberate, they may be able to resist these manipulations and stick to the procedure that best serves the goal they deem important, however the problem is framed. But if people's response to framing is automatic, they will not be in this capacity, and will fall prey to the manipulative party. Behavioral science can help prevent such an untoward outcome.

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