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# Secret ballots and costly information gathering: The jury size problem revisited

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ABSTRACT

Suppose paying attention during jury trials is costly, but that jurors do not pool information (as in contemporary Brazil, or ancient Athens). If inattentive jurors are as likely to be wrong as right, I find that small jury panels work better as long as identical jurors behave symmetrically. If not paying attention makes error more likely than not, jurors may coordinate on two different symmetric outcomes: a "high attention" one or a "low attention" one. If social norms stigmatize shirking, jurors coordinate on the high attention equilibrium, and a smaller jury yields better outcomes. However, increasing the jury up to a finite bound works better if norms are tolerant of shirking, in which case coordination on the low attention outcome results. If jurors always act as if they are pivotal, a larger jury may work better. Allowing deliberations is efficient if the jury panel is relatively large, and if the police and prosecution are effective. However, barring deliberations is better at smaller jury sizes, specially if the police and prosecution are not too efficient.



## 1. Introduction

Condorcet's jury theorem showed that if each juror were more likely to be right than wrong, the probability of arriving at a correct judgment increases in the number of jurors.[1] This theorem, however, relied on two key assumptions – independence and sincerity. It assumed that jurors make their decisions independently, and that each juror acts as if he is the only juror on the panel (that is, he acts as if his vote is pivotal). Much of the economics literature on Condorcet's theorem centers on violations of one or both of these assumptions.

One strand of the literature looks at how the incentives of individual jurors change when they have the option of incurring an informational or effort cost to arrive at a better decision. This literature – which also encompasses voters and committees in general – emphasizes violations of Condorcet's independence assumption, pointing out that jurors may free ride on other jurors' information flows, rather than incur this cost. They can do this either if decisions are made through group deliberations, so that they can vote after listening to the opinions of more informed jurors, or if the costly information collected by the other jurors is hard, and is visible to the uninformed.

However, what if individual members on a committee *do* need to incur an effort cost to receive the right information, but *do not* have the option to free ride on the information of others? This is the primary question that this paper addresses. I also look at the effect of biases resulting from inattention, contrasting a model where inattentive jurors are more likely than not to make a mistake – but are unaware of their biases – with a benchmark bias-free model where inattentive jurors are equally likely to be correct and incorrect. Finally, I perform a number of robustness checks, and discuss implications for jury size and for when it is beneficial to allow jurors to deliberate.

Free riding on informational flows is not possible if individual votes are secret, and deliberations do not occur. This is the informational environment I consider. This is, for instance, the case in Brazil, where jurors are instructed to vote privately without deliberations, and votes are aggregated using a simple majority rule[2] (Leib, 2007). It was also the practice in jury trials in classical Athens (Hansen, 1991; Guha, 2011). There, each juror was given a hollow disc and a solid one. Votes were cast by inserting one of these discs

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[1] McLean and Hewitt (1994).

[2] A panel consists of seven jurors.

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into a bronze urn, in such a manner that no one could observe which disc had been inserted (the other disc was discarded in a wooden urn so that other jurors could not infer one's vote by examining the remaining disc). The judgment was made through counting the number of solid versus hollow discs in the bronze urn after all votes had been cast, and using a simple majority rule (in later jury trials, the number of jurors was odd to avoid a hung jury).[3] The trial was settled in the course of one working day (nine and a half hours) during which jurors did not communicate or leave the courtroom. Thus, there was no opportunity to share information.

While proponents of secret ballot mostly cite the argument that secrecy ensures freedom from intimidation and undue influence, I focus on another advantage of secret voting without group deliberations – freedom from the worry that others would free ride on one's costly information. Thus, the independence assumption is satisfied in the environment that I consider.

Focusing on symmetric mixed strategy equilibria, I find that if uninformed jurors are as likely to be correct as incorrect, then if the cost of information is not too large, small panels work best. The probability of arriving at the correct verdict falls in jury size.

I then find that if inattentive jurors are more likely than not to make mistakes, the repercussions are nuanced.[4] In particular, multiple mixed strategy equilibria coexist – a "high attention" one in which all jurors have a high probability of paying attention, and a "low attention" one. Moreover, while the outcomes in the "low attention" equilibrium improve with increasing jury size, exactly the opposite is true of the "high attention" equilibrium. Social norms that dictate attitudes towards slacking on the job can then affect the implications for jury size by determining which of these symmetric equilibria jurors coordinate on. Thus, larger jury panels work better if norms are tolerant of slacking, while smaller jury panels would yield better outcomes if lack of effort were associated with social stigma.

I also investigate the effects of (i) endogenizing the cost of paying attention, (ii) allowing deliberations, (iii) allowing jurors to have different utility functions, and (iv) considering unequal priors for guilt and innocence. While the result that small panels work better carries through for most of these cases, an exception is the case where jurors do not care about the ultimate verdict, but only about their own probability of voting correctly (equivalently, they always act as if they are pivotal). In this case, their intensity of effort is independent of jury size, and a larger jury results in a more accurate verdict.

I also find that barring deliberations works better than allowing deliberations if the jury panel is relatively small and if the police and the prosecution are not too efficient (so that being up for trial does not convey very strong evidence of guilt). Intuitively, the free rider problem is severe in these conditions, and barring deliberations does not allow jurors to free ride on the costly efforts of others while casting their votes.

## 2. Related literature

Mukhopadhyaya (2003) considers a model where identical jurors have to exert costly effort to pay attention, and can free ride on the efforts of other jurors through the deliberation process. Thus, in his model, it is sufficient for just one juror to pay attention (with a perfectly informative signal) to ensure the correct outcome, and the pure strategy equilibrium in his model is independent of jury size. He also finds a symmetric mixed strategy equilibrium where outcomes improve when the jury size is small. He argues that though there might be benefits from multiple jurors if each juror receives an imperfect signal, and jurors can pool information, smaller panels work best on average. In contrast, in my model, deliberations or free riding are not possible, but jurors take their probability of being pivotal into account.

Other papers that consider costly participation include Martinelli (2006), Koriyama and Szentes (2009), Cai (2009), and Triossi (2013). In Martinelli (2006), homogeneous voters simultaneously invest in information of potentially differing quality. He shows that as the number of voters becomes infinitely large, the probability of a correct decision converges to one, with each voter investing only a small amount. Koriyama and Szentes (2009) show that when committee members decide whether to invest in an imperfect signal, the only equilibrium in small committees is a pure strategy one where everyone invests with probability one. In larger committees, mixed strategy outcomes prevail with some members randomizing between investing and not investing, though the number of committee members randomizing can differ. They show that though large committees may be inefficient, the welfare losses associated with them are small. In their paper, uninformed members can free ride on information acquired by others. Cai (2009) considers committee members with heterogeneous preferences who have to collect information at a cost and pass it on to a principal, and shows that optimal committee size increases in the heterogeneity of preferences. Triossi (2013) considers voters with heterogeneous skill levels whose cost of information is skill-dependent, and finds a justification, in terms of electoral outcomes, in restricting suffrage to more skilled voters.

Another strand of the literature deals with the fact that voters may not vote sincerely. Austen-Smith and Banks, 1996 showed that voters will generally not automatically act as if they are pivotal, and that sincere voting may not in fact constitute an equilibrium. Fedderson and Pesendorfer (1998) showed that, given that jurors behave differently when they are pivotal, the unanimity rule is worse than a simple majority and other non-unanimous rules, in that it can simultaneously increase the probability of convicting an innocent defendant, as well as acquitting a guilty one. Persico (2004) shows that supermajority rules are only optimal when the signals that the individual jurors receive are very accurate.

McCannon (2011) applies the Condorcet jury theorem to ancient Athenian trials, though, unlike me, he does not focus on the secret ballot aspect, or on the fact that jurors may have to exert a cost to pay attention. Instead, he focuses on deriving optimal jury size when it is costly to assemble jurors, and explains the sizes of the jury panels used in different types of classical Athenian trials. McCannon and Walker (2016) derive the optimal jury size when jurors can invest in "competence" – a stage that encourages free riding. Hummel (2012) and Helland and Raviv (2008) model the effect of jury deliberation on jury size. The former shows that the Condorcet theorem continues to hold if jurors have diverse preferences, provided each juror shares preferences with a small fraction of other jurors. The latter show that if jury deliberation follows a random walk, jurors receive independent signals, and truthfully reveal their signals in a vote prior to deliberation, then the number of jurors has no effect on the correctness of the decision.[5] Unlike these papers, I focus on a setup where there is neither jury deliberation nor free riding on other jurors' competence.

The rest of the paper is organized as follows. Section 3 sets up and solves our benchmark model, where inattentive jurors are as likely to vote correctly as not. Section 4 solves the model under the assumption that inattentive jurors are more likely to make a mistake than not, and are unaware of their biases. Section 5 contains

[3] This number was also often very large, 201 or 501.

[4] These biased jurors are unaware of their biases. Otherwise, they would simply make a guess and do no worse than inattentive jurors in the bias-free model.

[5] They argue that if the opportunity costs of jury service are considered, the optimal jury size is one.

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