Betting and Presuming: From God's Existence to Morality and Law

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Abstract: Pascal famously argued that since God transcends the rational domain of demonstration, we must *bet* on his existence. Less famously, Leibniz claimed that in the absence of a full-fledged demonstration of God's existence, we at least have to *presume*, that is to say, to assume, that he exists until the contrary is proved. Aside from marking a significant contrast between these two leading figures of modern philosophy (Leibniz would later reproach Pascal for having "paid attention only to moral arguments"), these two stances are at the origin of two independent developments: decision theory and presumptive reasoning, respectively. In this paper we will provide a critical account of Pascal's and Leibniz's lines of thought by first presenting the original arguments and then reconstructing them in light of the developments they gave rise to. Finally, we will advance some remarks about the interplay of presumption and probability in Leibniz's approach to morality and law.

1. *Introduction*

In the "Pascal's Wager" entry in the *Stanford Encyclopedia of Philosophy*, we find it remarked that "it is important to contrast Pascal's argument with various putative 'proofs' of the existence of God that had come before it" (Hájek 2018). In our opinion it is even more important to contrast Pascal's argument with a later argument advanced by his younger contemporary Gottfried Wilhelm Leibniz. At first sight, the two arguments originate from the common acknowledgment that none of the available "proofs" was able to conclude to God's existence. Pascal thought that he could nonetheless provide compelling reasons for acting as if one believed in God's existence. In an apparently similar vein, Leibniz proposed that in the absence of a valid deductive demonstration of God's existence we at least have to presume, that is to say, to assume, that he exists until the contrary is proved. In reality the two arguments are very different. For one thing, Leibniz thought, in contrast to Pascal, that the ontological argument could be "completed" so to satisfy the canons of demonstrative validity. In the second place, Pascal's argument has an explicit decision-theoretic character: it ap-

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peals to considerations of probability and utility to sketch a clear formulation of what was much later to become the theory of rational choice under uncertainty. Leibniz's argument instead traces to the traditional legal procedure of accepting something as true as long as there is no proof to the contrary. But by proposing such a procedure as a perfectly reasonable alternative to the classical deductive ways of establishing God's existence, Leibniz anticipated those reasoning patterns which are now captured by various logics of defeasible inference.[1] So, in the last analysis, it could be said that Pascal and Leibniz made the two first decisive contributions to the development of a theory of practical rationality. Our aim in this paper is to account for those contributions by first presenting the original arguments and then reconstructing them in light of the developments they gave rise to. Finally, we advance some remarks about the interplay between presumption and probability in Leibniz's account of morality and law.

2. *Betting on God*

In an imaginary exchange with St. Anselm, trying to convince the *insipiens* by proving to him that God exists, Pascal would have objected that "the metaphysical proofs of God are so far removed from man's reasoning, and so complicated, that they have little force" (Pascal 1670/1999: 63).[2] However, he could have continued, we can convince a rational *insipiens* that acting as if God existed is the absolutely best thing to do. This is exactly what Pascal set out to do in his celebrated fragment *Infini*, *rien* ("Infinite, nothing"). Let us read the relevant passages from this text. (In what follows we have confined ourselves to making explicit its intrinsically dialectical structure by giving it the form of a dialogue between a proponent *P* and an opponent *O* who must be convinced of the inevitability and rationality of choosing to live as if God existed).

P: Let us now speak according to natural lights.

If there is a God, he is infinitely beyond our comprehension, since, having neither parts nor limits, he bears no relation to ourselves. We are therefore incapable of knowing either what he is, or if he is. That being so, who will dare to undertake a resolution of this question? It cannot be us, who bear no relationship to him.

[1] This is something Leibnizian scholars have generally neglected. At best, Leibniz's presumptive argument for God's existence has been viewed as an inferior alternative to proof to which Leibniz submitted unwillingly never giving up thinking that "he could *prove* the existence of God in one way or other" (Adam 1994: 194).

[2] The text continues: "When they do help some people it is only at the moment when they see the demonstration. An hour later they are afraid of having made a mistake". On Pascal's rejection of the metaphysical proofs of God's existence, see Carraud (1991).

Who will then blame the Christians for being unable to provide a rational basis for their belief, they who profess a religion for which they cannot provide a rational basis? They declare that it is a folly, *stultitiam* (*I Cor.* I, I8) in laying it before the world: and then you complain that they do not prove it! If they did prove it, they would not be keeping their word. It is by the lack of proof that they do not lack sense.

O: Yes, but although that excuses those who offer their religion as it is, and that takes away the blame from them of producing it without a rational basis, it does not excuse those who accept it.

P: Let us therefore examine this point, and say: God is, or is not. But towards which side will we lean? Reason cannot decide anything. There is an infinite chaos separating us. At the far end of this infinite distance a game is being played and the coin will come down heads or tails. How will you wager? Reason cannot make you choose one way or the other, reason cannot make you defend either of the two choices. So do not accuse those who have made a choice of being wrong, for you know nothing about it!

O: No, but I will blame them not for having made this choice, but for having made any choice. For, though the one who chooses heads and the other one are equally wrong, they are both wrong. The right thing is not to wager at all.

P: Yes, but you have to wager. It is not up to you, you are already committed. Which then will you choose? Let us see. [1] Since you have to choose, let us see which interests you the least. You have two things to lose: the truth and the good, and two things to stake: your reason and will, your knowledge and beatitude; and your nature has two things to avoid: error and wretchedness. Your reason is not hurt more by choosing one rather than the other, since you do have to make the choice. That is one point disposed of. But your beatitude? Let us weigh up the gain and the loss by calling heads that God exists. Let us assess the two cases: if you win, you win everything; if you lose, you lose nothing. Wager that he exists then, without hesitating!

O: This is wonderful. Yes, I must wager. But perhaps I am betting too much.

P: Let us see. [2] Since there is an equal chance of gain and loss, if you won only two lives instead of one, you could still put on a bet. But if there were three lives to win, you would have to play (since you must necessarily play), and you would be unwise, once forced to play, not to chance your life to win three in a game where there is an equal chance of losing and winning. But there is an eternity of life and happiness. [3] And that being so, even though there were an infinite number of chances of which only one were in your favour, you would still be right to wager one in order to win two, and you would be acting wrongly, since you are obliged to play, by refusing to stake one life against three in a game where out of an infinite number of chances there is one in your favour, if there were an infinitely happy infinity of life to be won. But here there is an infinitely happy infinity of life to be won, one chance of winning against a finite number of chances of losing, and what you are staking is finite. That removes all choice: wherever there is infinity and where there is no infinity of chances of losing against one

of winning, there is no scope for wavering, you have to chance everything. […] That is conclusive, and, if human beings are capable of understanding any truth at all, this is the one (Pascal 1670/1999: 153-5).

As to items [1]-[3], they have been interpolated in the text to mark the sequence of the three different logical arguments of increasing strength which constitute the overall argument.[3] These arguments are looked at in the next section.

3. *The logic of the game*

In this section we provide a simple game-theoretic account of Pascal's arguments tracking the original text as closely as possible. Argument [1] arises from *O*'s objection to *P*'s invitation to consider the situation as a game of heads and tails (notice that *O* here objects not, as Voltaire would have done in his time, that "this idea […] ill benefits the seriousness of the subject",[4] but that the right thing to do is not to bet at all). In response to such an objection *P*, having emphasized that *O* cannot avoid betting ("you are committed"), presents him with the following game. There are two possibilities (or "states of the world", in the usual game-theoretic terminology), s_1 = God exists and s_2 = God does not exist, and two possible courses of action (or "strategies"): a_1 = betting that God exists and a_2 = betting that God does not exist. Let u_{ij} ($i, j \in \{1,2\}$) be the payoff ("utility") resulting from the choice of strategy a_i if it is the case that the "true" state of the world is s_j. The game can be summarized in the following matrix:

	s_1	s_2
a_1	u_{11}	u_{12}
a_2	u_{21}	u_{22}

Let $u_{11} = 1$ (you win everything) and $u_{12} = u_{22} = 0$ (you lose nothing; note that at this point *P* neglects what has just been said regarding the possible losses of choosing a_1 and the true state of the world turning out to be s_2). Given that the matrix also contemplates the case in which you choose a_2 and the true state of the world turns out to be s_1, let $u_{21} = -1$ (you lose everything). Thus we have

	s_1	s_2
a_1	1	0
a_2	–1	0

[3] As has been conclusively demonstrated by Hacking (1972).

[4] *On Mr. Pascal's Pensées*, remark V (Voltaire 1733-34/2007: 104).

which, of course, rationally mandates choosing a_1. In fact, in the case in which the true state of the world is s_1, the payoff resulting from choosing a_1 is strictly better, whereas in the case in which the true state of the world is s_2, it is not worse than the payoff resulting from choosing a_2. In game-theoretic terms, a_1 is said to be dominant. Thus, *O* must bet on God's existence because this is the dominant strategy in the game.

Argument [2] arises from another objection of *O*: I could have something to lose, and perhaps much to lose, if I choose a_1 and the true state of the world is s_2. In reply to this objection *P* proposes another game. *O* must choose between a_1 = betting 1 in order to win 2 and a_2 = not betting. The payoffs are thus as in the following matrix (*W* and *L* stand for winning and losing, respectively):

	W	*L*
a_1	2	–1
a_2	0	0

In this game, strategy a_1 is patently not dominant (-1 is strictly worse than 0). However, *O* is told that there is an equal chance of winning and losing. This implies that *O* must "treat the problem as one of risk with the uniform *a priori* probability distribution over states, and to each act a_i assign its expected utility index, $u_{i1} + u_{i2} + \ldots + u_{in}/n$, and choose the act with the largest index" (Luce and Raiffa 1957: 282; adapted to our notation). By performing the calculation corresponding to the values in the matrix, a_1 turns out to have expected utility index $(2 + (-1))/2 = 0.5$ (a_2 obviously has expected utility index 0). Given this value, *O* "could still put on a bet". But suppose that the first row in the matrix is modified as follows:

	W	*L*
a_1	3	–1
a_2	0	0

In this case, the expected utility index associated with a_1 turns out to be $(3 + (-1))/2 = 1$, so that *O* would be "unwise" not to bet. But what, now, if the payoff is infinite ("there is an eternity of life and happiness")? This gives rise to argument [3]. This argument can be construed as a sort of *a fortiori* argument. *P* starts out by arguing that *O* "would still be right" to bet 1 in order to win 2 even in a game in which there is only one chance of winning against *infinite* chances of losing, and that he "would be acting wrongly" if he refused to bet 1 in order to win 3 in the same game. Thus, *P* concludes, *O* should, by even greater force of logic, bet in a game in which "there is an infinitely happy infinity of life to be won, one

chance of winning against a *finite* number of chances of losing, and what you are staking is finite". For, in this case, any positive and finite probability of winning, no matter how small, is sufficient for betting ("there is no scope for wavering, you have to chance everything"). Consider, in fact, the following matrix:

	*S*1	*S*2
a_1	∞	u_{12}
a_2	u_{21}	u_{22}

where u_{12}, u_{21}, and u_{22} are finite (this is implied by *O*'s suggestion that "what you are staking is finite"). Given that *O* now has an *a priori* probability distribution *p*, 1-*p*, with $p > 0$ for winning and losing, respectively, the expected utility index is to be calculated as the sum of the payoffs associated with a_1 and a_2 multiplied for the probability of winning and losing:

a_1: $\infty \cdot p + u_{12} \cdot (1-p) = \text{infinite}$
a_2: $u_{21} \cdot p + u_{22} \cdot (1-p) = \text{finite}$

which rationally mandates choosing the strategy associated with God's existence, so that the argument turns out to be really "conclusive". In fact, as Hacking (1975: 203) has argued, it is unquestionably valid in the logicians' sense that the conclusion follows from the premises. Whether it is also persuasive is a whole different story (see Section 6 below).

4. *From betting to presuming*

From a receipt for the purchase of a copy of the work (A I, 1, 436),[5] we know that Leibniz was acquainted with Pascal's *Pensées* as early as 1671, just one year after its first edition.[6] Thus, he had had all the time to meditate Pascal's argument when, in a letter to Veit Ludwig von Seckendorf dated 1/11 June 1683, he wrote:

> Pascal paid attention only to moral arguments, such as he excellently presented in his little posthumous book of *Thoughts*, but he did not put much value on the metaphysical arguments which Plato and St. Thomas, and other philosophers and theologians have used in proving the divine existence and immortality of the soul. In this I do not agree with him. I think that God speaks to us, not merely in sacred and civil history, or even

[5] The abbreviations used to refer to Leibniz's writings are listed in the bibliography at the end of the paper.

[6] See also Leibniz to Johann Georg Graevius, 7 June 1671, where Leibniz refers to Pascal's *Pensées* as "libellum aureolum": "a gold little book" (A I, 1, 155). For further evidence of Leibniz' early acquaintance with Pascal's *Pensées*, see Carraud (1986: 110-2).

in natural history, but also internally, within our mind, through truths which abstract from matter and are eternal. Even if I should confess that these arguments have not been carried to the full force of a complete demonstration, they already seem to have as much force as the moral arguments; and I believe that men will gradually perfect them and that sometime, perhaps, they can be reduced to a rigorous demonstration (L 275).

What Leibniz is referring to in this letter is the realization, to which he had come in the later 1670s, that the ontological argument was not so much wrong as it was incomplete.[7] In fact, the argument tacitly assumes the possibility of God (i.e., of a being whose essence implies its existence), a possibility which in turn needs to be proved. As Leibniz writes in a letter to Oldenburg on 28 December 1675:

Whatever the conclusions which the Scolastics, Valerianus Magnus, Descartes, and others derived from the concept of that being whose essence it is to exist, they remain weak as long as it is not established whether such a being is possible [...]. Assuming that such a being is possible [...] it certainly follows that such a being exists. But we believe that we are thinking of many things (though confusedly) which nevertheless imply a contradiction (L 165-6).

Bringing in concepts which might not be possible because of some hidden contradiction is one of the pitfalls of demonstration, for if something implies a contradiction, then, obviously, whatever we infer from it, we can also infer the opposite (L 231, 292-3, 386; GP VII, 294, 310). Let us assume, as Leibniz does, that from the concept of God it is possible to infer that God exists, i.e., that God, being the most real being (*ens realissimum*), has all (positive) predicates, including existence, and therefore necessarily exists. This does not ensure the existence of God, since the concept of God itself might be inconsistent, i.e., logically impossible. If this were the case, then the nonexistence of God could also be derived (since what is logically inconsistent cannot exist). But, in this case, we would have to reject the very concept of God as *ens realissimum* which provides the premise for the ontological proof.

Thus, the ontological proof of God's existence presupposes that it is established that the concept of God is consistent, i.e., that God is (logically) possible. Leibniz claimed to have provided such a proof,[8] but he does not seem to have

[7] For the development, and a critical discussion, of Leibniz' views on the ontological argument, see Adams (1994, chaps. 5, 6, 8). The references to Leibnizian texts in these chapters are so detailed that no further reference is needed here.

[8] See Leibniz's note of November 1676 (L 167) and his letter (probably) of 1678 to Countess Elisabeth (AG 240).

been much convinced of its success.[9] He came in time to realise that the only way out of the difficulty of carrying the ontological argument "to the full force of a complete demonstration" by proving the possibility of God with "geometrical" or "metaphysical" rigour was to *presume*, that it to say, to assume, God to be possible until it was shown to be impossible.

Leibniz's argument goes as follows. We know for certain that if God is possible, then God exists (this is what the "incomplete" ontological argument proves).[10] As far as our present knowledge is concerned, we cannot prove that God is possible. But, surely, neither can we prove that God is not possible. Since we cannot prove that God is not possible, we should presume that God is possible. But if God is possible, then God exists. Thus, we can conclude that God exists. This, of course, is not a valid deductive argument, for the conclusion that God exists does not follow logically from the conditional "If God is possible, then God exists": it is a conclusion that only holds on the assumption that God is possible, and that can be reversed by a contrary proof, even if we can expect that such a proof will never be provided. As Leibniz writes in a much later text,

> this Argument has the force to shift the burden of proof to the opponent, or to make the opponent responsible for the proof. And as that impossibility [i.e., the impossibility of God] will never be proved, the existence of God ought to be held for true (GP III, 443-4).

What Leibniz is saying in this passage is strictly related to the question about *cui incumbat onus probandi* (who the burden of proof lies with) in deriving a legal conclusion. As a rule, the burden of proof lies with the proponent (according to the old canon *affirmanti incumbit probatio*, A VI, 1, 76), but if in the course of a dispute one of the parties advances something having a presumption for it, then the burden of proof shifts to the other party. It is in this sense that Leibniz credits his presumptive argument with "the force to shift the burden of proof to the opponent". For the proponent arguing for God's existence bears the onus of proving the truth of the conditional at the core of the ontological argument, i.e., that "If God is possible, then God exists". However, she has no onus of proving that God is possible, since there is a presumption in favour of God's possibility. On the other hand, the opponent has not the onus of disproving the conditional "If God is possible, then God exists". But she has the onus of disproving that God is possible (i.e., of proving that God is impossible). And since, as Leibniz urges in the above-quoted passage, God's impossibility

[9] See Leibniz's circumspect assessment of his own contribution in NE 438.

[10] See, e.g., NE 438; L 231, 292-3. Somewhere Leibniz calls this "an identical or indemonstrable axiom" (GP VII, 490).

will never be proved, we must conclude for God's existence. At first, Leibniz maintained that this conclusion, though not demonstrative, "is sufficient for practical matters in life" (AG 238). Later on, he took a more decisive attitude, going so far as to claim that what the presumptive argument yields is, indeed, "a moral demonstrative conclusion", which implies that "in the present state of our knowledge we ought to judge that God exists" (NE 438). Pascal would rather have said that we ought to *bet* that God exists. But Leibniz could have replied that without presuming that God is possible, we not only cannot judge that he exists, but also cannot bet on his existence.

5. *Presumption as a default rule*

Summarizing, then, Leibniz accepted the ontological argument in the form of the following conditional (let us call it the "ontological conditional"):

If God is possible, then God exists

and the issue was to establish that God is possible. As hinted by the above quotation from the letter to Oldenburg of 28 December 1675, Leibniz held a proof-theoretic notion of possibility:

> I call possible that which does not imply a contradiction, and so in this sense it cannot be disproved (Grua 390)

which displays the close connection between possibility, consistency, and provability. For, obviously, if Q is consistent (free from contradiction), then it cannot be disproved, or, which is the same, not-Q cannot be proved. In the case at hand, to presume that God is possible is thus, in a crucial sense, to assume that it cannot be proved that God is impossible. This allows us to capture Leibniz's presumptive argument by relying on default logic. Following Reiter's (1980) original scheme, a default has the form

$$\frac{\text{Prerequisite: Justification}}{\text{Conclusion}}$$

meaning that if the prerequisite is true, and the justification can be consistently assumed (it is not in contradiction with what has already been accepted), then the conclusion is also to be accepted. According to the typical example

$$\frac{\text{Bird(Tweey): Fly(Tweety)}}{\text{Fly(Tweety)}}$$

which means that if Tweety is a bird (the prerequisite is established), and it cannot be inferred from the given knowledge that it does not fly (the justification is not contradicted by accepted beliefs), we can conclude that Tweety flies. Of course, this conclusion would have to be retracted if it were established that Tweety does not fly (if the justification were to be contradicted), on discovering, for example, that Tweety is a penguin. Let us use the convention of using a single line to separate the premises of a default inference from its conclusion and a double line to mark a conclusive inference based on propositional logic. Under this convention Leibniz's argument can be reconstructed as follows

{}: God is possible

God is possible — If God is possible, then God exists

God exists.

This diagram combines two inferential steps. The first step is the defeasible (presumptive) inference to the conclusion that God is possible as long as the justification that God is possible is not disproved (i.e., as long as it is not established that God is impossible). Note that this inference has an empty prerequisite: nothing has to be established to prove the possibility of God (the failure to establish God's impossibility is sufficient). The second step is the deductive inference from God's possibility and the ontological conditional to the conclusion that God exists. The whole inference is presumptive to the extent that if we had proof of the impossibility of God (a proof which someone smarter or better informed could provide), then we would have to retract our belief in God's possibility (as the justification for having this belief would be contradicted), and we would consequently be unable to apply the ontological conditional to infer God's existence. On the other hand, if we had conclusive proof that God is possible, we would not need any presumption. Similarly, if we had conclusive proof that God is impossible, the presumption would be useless since its justification would be conclusively disproved. So what, in the last analysis, justifies our making a presumption is that we have no conclusive proof either of God's possibility or of God's impossibility.

6. *Are Pascal's and Leibniz's arguments persuasive?*

It must be conceded that the two arguments, however much prima facie endowed with considerable rhetorical force, may fail to be persuasive. The critical point in Pascal's Wager[11] is that the crucial argument [3] only works on the

[11] Pascal's wager is one of the most contested arguments in Western philosophy. What follows is

assumption that there is a finite, nonzero probability of winning, i.e., that God exists. Indeed, assigning such a probability to God's existence would seem dictated by no other reason than *P*'s insistence that "you are obliged to play", for, obviously, a zero probability implies that there would be no reason to play. As the editors of the Port Royal edition of the *Pensées* already acknowledged, this being the case, one cannot say much more than that the argument "addresses only a certain kind of persons" (Thirouin 1991: 168), i.e., those rational agents who are willing to consider God's existence as having a nonzero probability.[12] Otherwise, it could be argued that "the peculiarity and strength of the argument is that it […] relies on the difficulty of proving beyond the shadow of any doubt that [God exists] is false and hence that [God does not exist] must be true" (Chimenti 1990: 325). But had this been Pascal's line of argument, Leibniz might have argued that it tacitly assumes that the very notion of God is consistent, for otherwise the probability that such a being exists would, "beyond the shadow of any doubt", be zero. Thus, a rational agent should assign a positive probability to God's existence only on the premise that God is possible. But a reasoner who accepts both this premise and the ontological conditional can conclude for the existence of God without having to bet.

Leibniz's presumptive argument also has faced objections. In his detailed analysis of the argument Richard M. Adams (1994: 206) has placed much emphasis on the "obvious objection" that the rule of presuming that something is possible until it is proved impossible fails to discriminate between conflicting presumptions. In fact, we could consistently assume both that God is possible and that God is not possible, thus inferring both that God exists and that God does not exist. The point, according to Adams, is that either conclusion can be justified by the corresponding presumption, although the two presumptions are mutually inconsistent. Obviously, for Leibniz's argument to succeed there should be a way of "prioritizing" the possibility presumption over its contradictory. But, according to Adams (1994: 206), Leibniz seems to have been unable to provide a satisfactory solution. And this – Pascal could have argued – brings the wager argument back into play.

only a taste of the huge critical literature it has spawned: Clifford (1877); Flew (1960); Cargile (1966); Flew (1976); Nicholl (1978); Mackie (1982); Martin (1983); Duff (1986); Martin (1990); Oppy (1991); Mougin and Sober (1994); Amico (1994); Holcomb (1995); Gustason (1998); Armour-Garb (1999); Carter (2000); Hájek (2000); Saka (2001); Hájek (2003); Wood (2008); Bostrom (2009); Hájek (2012); Ryan (2015). See also several essays in Jordan (1994).

[12] As Rescher (1985) has famously argued, for a committed atheist it would be perfectly rational to assign a zero probability to God's nonexistence.

7. *Did Leibniz have a solution?*

So the issue is: how are we justified in leaping from our inability to establish that God is impossible to the belief that he is possible? In this section we shall argue that Leibniz did indeed have an answer and that, despite Adam's insistence that he was unable to provide "a good reply to the obvious objection to his presumptive argument" (Adams 1994: 206), his was, in principle, a good reply. To flesh out this point we have to go back to Leibniz's early writings in the *Elements of Natural Law* (1671). Here we find Leibniz striving to prove that presumption lies always on the side of possibility.[13] This is how the argument runs:

(1) Nothing is required for *Q* to be possible but that it be supposed.
(2) For *Q* to be impossible it is required that *Q* be supposed together with not-*Q*.

Therefore

(3) It is easier for *Q* to be possible than for it to be impossible.

Steps (1) and (2) stem from Leibniz's conception of what constitutes a "requirement or supposition". In his writings Leibniz speaks very often of a "requirement" as both a necessary causal condition for a thing to exist and a logical or conceptual mark of its definition (C 50, 258, 471-2; Grua 267, 513), and defines as "easy" that which needs fewer requirements in order to come into existence (C 474) or is, by its own definition, more intelligible (A VI, 1, 472; A VI, 2, 567). On this view, in order to conceive of the possibility of *Q*, we need only consider the requirements for the existence of *Q*, whereas in order to conceive of the impossibility of *Q*, we need to consider the requirements of both *Q* and not-*Q* (not-Q being something whose existence is incompatible with the existence of Q). In this sense, "more" is required for *Q* to be impossible than for *Q* to be possible. This proves (3) for, according to Leibniz's usual definition, "that is easier in which less or fewer [things are required] than in the opposite" (A VI, 1, 472; Grua 513, 525, 540; C 474). If we accept Leibniz's notion of easiness (*facilitas*), then we can reformulate Leibniz's argument as follows:

[13] The question at hand concerns the presumption of an act's legitimacy. See Artosi and Sartor (2018), in particular the section "Deontic Logic and the Elements of Natural Law".

(1) It is easier for anything to be possible than for it to be impossible

(2) It is easier for God to be possible: God is possible

God is possible — If God is possible, then God exists

God exists.

Let us reconsider the Leibnitian inference. The first step is a deductive step. From the general principle according to which it is easier for anything to be possible than impossible, we can conclude, in particular, that it is easier for God to be possible (rather than impossible). The second, defeasible step, applies Leibniz's idea that "anything easier is presumed" (A VI, 2, 567), i.e., that what is easier can be inferred unless its negation is established.[14] In our specific context this means that God's possibility can be inferred unless its impossibility can be established. Rephrasing this idea in the context of default reasoning, we have it that the prerequisite that it is easier for God to be possible (which is obtained through the first inferential step) leads us to conclude that God is possible, so long the negation of the justification, i.e., the impossibility of God, is not established. Since, as argued by Leibniz, the impossibility of God has not yet been established (and indeed it is unlikely to ever be established), we should conclude

[14] As has been observed by Armgardt (2015), in some texts it seems that Leibniz considers easiness to be insufficient to ground presumption. In other texts, on the contrary, easiness appears to *support* presumption. This apparent conflict may possibly be reconciled by considering that, for Leibniz, concept (proposition) A is easier than concept (proposition) B if A has fewer requirements than B. Now, "having fewer requirements" can be understood in two ways, both of which are present in Leibniz's writings. To clarify the distinction, let us assume that concepts (propositions) A and B are incompatible, and that A has the set of prerequisites SA, while B has the set SB (where by "prerequisites" is meant the features that are all required for the concept to be instantiated, or for the corresponding proposition to be true). We can now say that A is easier than B if, and only if, A has fewer prerequires than B, i.e., if the cardinality of SA is inferior to the cardinality of SB. Alternatively, we can adopt the stronger notion that A is easier than B if, and only, is A's prerequisites are a strict subset of the prerequires of B (i.e., if SA is included in SB). Only under this second understanding does easiness ground a (defeasible) presumption: when all the prerequisites for the concept having a smaller set of prerequires are present, we may infer that the concept holds, but this presumption will fail if the additional prerequisites of the incompatible, more specific concept also hold. In other terms, let us assume that SA = {A1,…, An} and SB = {A1,…, An, B1,…, Bm}. Then, given A1,…, An, we can infer A, but this is a mere presumption, since, if B1,…, Bm were to also be established, then we should rather derive B (and exclude A). In particular, with regard to possibility, to presume that an entity is possible, it is sufficient that that the concept of the entity at issue has not been proven to suffer from any internal contradiction (this is the case of the perfect being), but this presumption fails if it is established that the internally consistent concept is incompatible with something which is necessary.

that God is possible. In the third, deductive step, this conclusion, in combination with the ontological conditional, leads us to the conclusion that God exists. It is important to note that this conclusion cannot be challenged by presuming that God is impossible. Indeed, such a line of reasoning is precluded by the fact that God's impossibility, like any impossibility, is less easy than God's possibility. Therefore, we cannot presume that God is impossible. Thus, reliance on the idea of easiness enables Leibniz to avoid Adam's criticism.

Obviously, Leibniz's proof of the existence of God can be subject to further criticisms, such as Kant's famous objection, addressed against the consequent of the ontological conditional, that existence is not a predicate, so that even from the possibility of the concept of God as *ens realissimum* we cannot infer God's existence (Kant 1787/1998: chap. 3, sec. 4, A592/B620). But this, again, is an entirely different story.

8. *Presumption and probability*

Leibniz's approach to reasoning is conveyed by his famous claim that controversies could be solved through calculations:

> if controversies were to arise, there would be no more need of disputation between two philosophers than between two calculators. For it would suffice for them to take their pencils in their hands and to sit down at the abacus, and say to each other (and if they so wish also to a friend called to help): Let us calculate! (GP VII, 200).

However, deduction and calculation are not the only cognitive methods supported by Leibniz. On the contrary, he argues for a broader set of cognitive tools, which also includes those instruments that are needed to approach domains where uncertain premises have to be taken into account. For Leibniz, not only mathematics but also law, a discipline that has to deal with partial proofs of uncertain facts, can provide useful reasoning tools. "[O]ne should admit as certain", he writes,

> that *just as the mathematicians have excelled above the other mortals in the logic, i.e., the art of reason, of the necessary, so too the jurists did in the logic of the contingent.* Hence, we can learn much from their precepts about complete and half-complete proofs, about presumptions, about conjecturing regarding the meanings of the laws, about contracts and wills, about criminal clues (indicia); and about the arguments directing investigations, cheating, intimidation, interrogation under torture, all of which in their lowest, intermediate and highest degrees; and finally about the legal commonplaces of arguments, which complete the Topics with the axioms of law, commonly called maxims. For ultimately, what is a judicial process if not the form of disputing

transferred from the Schools to life, purged of vacuousness and limited by public authority in such a way that it is illicit to wander about or to twist or to omit whatever can be shown to be relevant for the search of truth (Dascal 36).

According to Leibniz, topical patterns of reasoning (which we would now describe as non-deductive or, better yet, nonmonotonic or defeasible) are paramount in the law, being involved in any application of a system of legal rules:

> In such a system every law has a presumption, and applies in any given case, unless it is proved that some impediment or contradiction has emerged, which would generate an exception extracted from another law. But in that case the charge of proof is transferred to the person who adduces the exception (A VI, 4C, 2791).

Leibniz's approach to defeasible/presumptive reasoning is clearly grounded in his acquaintance with the law, which he had to practice extensively throughout his life, as a student, a legal counsellor, and a diplomat. However, he does not confine this method of reasoning to the law: he views it as playing a key role in other domains where uncertainty is pervasive, and disputations may emerge, such as morality (where "most inferences are indeed presumptive") and theology. Leibniz's analyses and exemplifications of defeasible reasoning indeed identify those nondeductive patterns that only in recent decades have been studied in philosophy (Rescher 2006) and formalized in logic and artificial intelligence (Pollock 1989) and, in particular, in the logical analysis of legal arguments (Prakken and Sartor 2015).

We know that Leibniz admired Pascal's work on the mathematics of probability and was in contact with other pioneers of probability calculus, such as Jakob Bernoulli (see Schneider 1984). So, we may wonder what view he had of the connection between the legal tradition of presumptive reasoning and the new probability calculus. Did he view the two as alternative and incompatible approaches – as we may be led to think if we contrast Pascal and Leibniz's theological proofs – or did he rather believe in the possibility of combining and integrating them? To be sure, though he was aware of the developments being undertaken, Leibniz never devoted himself to providing a formal model of probabilistic reasoning. The only attempt in this direction is found in his *De conditionibus*, published in 1665, when he only was nineteen. Here Leibniz discusses the attribution of different degrees of probability to propositions conditioning the conferral of legal rights. He observes that when a contract includes a conditional clause (e.g., if the ship arrives, I will pay you), three cases are possible, depending on whether (1) the condition in impossible, in which case the right is void (*jus nullum*); (2) the condition is necessary, in which case the right is pure (*jus purum*), and (3) the condition is contingent (uncertain), in

which case the right is conditional. Leibniz also uses the numbers 1 and 0 for necessity and impossibility, respectively, and argues that the uncertain cases could be captured by fractions between 1 and 0, these fractions expressing the right's "degree of proof" or "degree of probability" (Hacking 1975: 206-8).

As far as we know, the idea of assigning a probability measure to legal propositions was not further developed in Leibniz's writings; and, notably, his *Dissertation on the art of Combinations* (1666) contains no reference to the possible link between combinatorics and probability. In fact, the notion of probability that he would have conceptualized in his writings had different sources and motivations than the emerging mathematics of probability based on combinatorics. As Hacking (1975: chaps. 10 and 15; cf. Artosi 1988) has shown, Leibniz's aim was to formulate a concept of probability appropriate to his plan for a general theory of non-deductive inference – a "logic of the contingent", as he himself would have put it – comparable in rigour to the theory of demonstrative inference. It is by reference to *this* concept of probability that we should ask about the connection between presumption and probability. Unfortunately, Leibniz's meditations in the matter seem to have been rather sketchy and wavering. Sometimes, we find him speaking of presumption as strictly related to the doctrine of probability or, at least, as expressing some probabilistic notion (NE 446; see also A VI, 1, 426; G 742, 785). Other times, he strives to sharply distinguish presumption from probability (see, e.g., A VI, 1, 472). In the final analysis, we would like to argue that his mature view was expressed in a well-known passage of his 1696 letter to Gabriel Wagner, in which he presents presumption and probability as two distinct, but closely related, branches of the same logic. Having expounded his views about demonstrative logic, Leibniz writes:

> Thus the form of disputation has been shown to be necessary in necessary matters where eternal truths occur but not in contingent matters where the most probable must be chosen. In this case two further problems arise. The first concerns presumption, that is, when and how one has the right to shift the demonstration from one's self to someone else; the second concerns the degrees of probability, how to weight and evaluate considerations which do not constitute a perfect demonstration but run counter to each other (L 467).

9. *Conclusion*

To sum up, faced with the troubling question of God's existence, Pascal and Leibniz adopted two quite different attitudes: Pascal framed his argument in terms of *acting as if* God existed; Leibniz sought to substantiate the *belief that* God exists. This points once more to a significant contrast between the two

thinkers. To be sure, Leibniz was "a rationalist about belief" (Hacking 1972: 191) who sharply separated epistemic and practical reasoning. As he would write in a 1677 draft on the obligation to believe: "To believe is to be conscious of reasons that persuade us" (Dascal 44),[15] such that a belief cannot be rationally supported by a merely practical choice. As he will remark in a letter of the next year to the Duke Johann Friedrich, an argument relying on such a choice[16]

> only proves that even those who believe neither in God nor in the immortal soul, should act as if they did, while they cannot demonstrate that neither exist (A I, 2, 112).

Pascal would have agreed, but he would have argued that in the end living as a believer could – causally, even if not epistemically – lead "those who believe neither in God nor in the immortal soul" to believe.

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[15] From this Leibniz concludes that "There is no obligation to believe. For to be conscious of reasons is not in our power" (*ibid.*).

[16] Here Leibniz does not refer directly to Pascal's argument, but to the version of it appeared in Port Royal's *Logic* (1st ed. 1662).

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