

Subjectivity, Bayesianism, and causality[☆]

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ABSTRACT

Bayesian probability theory is one of the most successful frameworks to model reasoning under uncertainty. Its defining property is the interpretation of probabilities as degrees of belief in propositions about the state of the world relative to an inquiring subject. This essay examines the notion of subjectivity by drawing parallels between Lacanian theory and Bayesian probability theory, and concludes that the latter must be enriched with causal interventions to model agency. The central contribution of this work is an abstract model of the subject that accommodates causal interventions in a measure-theoretic formalisation. This formalisation is obtained through a game-theoretic *Ansatz* based on modelling the inside and outside of the subject as an extensive-form game with imperfect information between two players. Finally, I illustrate the expressiveness of this model with an example of causal induction.

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1. Introduction

Early modern thinkers of the Enlightenment—spurred by the developments of empirical science, modern political organisation, and the shift from collective religion to personal cults—found in the free, autonomous, and rational *subject* the *locus* on which to ground all of knowledge [30]. Most notably, Descartes, with his axiom *cogito ergo sum* ('I think, therefore I am'), put forward the idea that the thought process of the subject is an unquestionable fact from which all other realities derive—in particular of oneself, and in general of everything else [12].

This proposition initiated a long-lasting debate among philosophers such as Rousseau and Kant, and its discussion played a fundamental rôle in shaping modern Western thought. Indeed, the concept of the subject operates at the heart of our core institutions: the legal and political organisation rests on the assumption of the free and autonomous subject for matters of responsibility of action and legitimisation of ruling bodies; capitalism, the predominant economic system, depends on forming, through the tandem system of education and marketing, subjects that engage in work and consumerism [3]; natural sciences equate objective truth with inter-subjective experience [22]; and so forth.

Nowadays, questions about subjectivity are experiencing renewed interest from the scientific and technological communities. Recent technological advances, such as the availability of massive and ubiq-

uitous computational capacity, the internet, and improved robotic systems, have triggered the proliferation of autonomous systems that monitor, process and deploy information at a scale and extension that is unprecedented in history. Today we have social networks that track user preferences and deliver personalised mass media, algorithmic trading systems that account for a large proportion of the trades at stock exchanges, unmanned vehicles that navigate and map unexplored terrain. What are the "users" that a social network aims to model? What does an autonomous system know and what can it learn? Can an algorithm be held responsible for its actions? Furthermore, latest progress in neuroscience has both posed novel questions and revived old ones, ranging from investigating the neural bases of perception, learning, and decision making, to understanding the nature of free will [50]. Before these questions can be addressed in a way that is adequate for the mathematical disciplines, it is necessary to clarify what is meant by a subject in a way that enables a quantitative discussion.

The program of this essay is threefold. First, I will argue that Bayesian probability theory is a subjectivist theory, encoding many of our implicit cultural assumptions about subjectivity. To support this claim, I will show that some basic concepts in Bayesian probability theory have a counterpart in Lacanian theory, which is used in cultural studies as a conceptual framework to structure the discourse about subjectivity. In the second part, I will put forward the claim that Bayesian probability theory needs to be enriched with causal interventions to model agency. Finally, I will consolidate the ideas on subjectivity in an abstract mathematical synthesis. The main contribution of this formalisation is the measure-theoretic generalisation of causal interventions.

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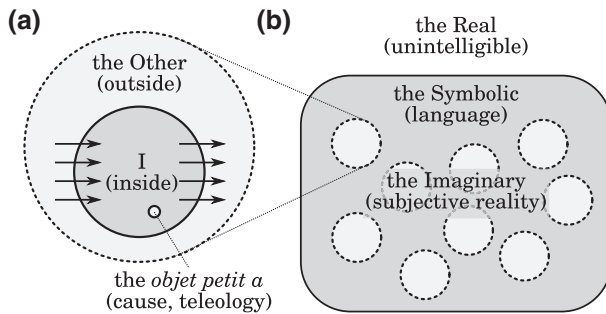


Fig. 1. The subject in Lacanian theory.

2. Subjectivity in Lacanian theory

To artificial intelligence, statistics, and economics, the questions about subjectivity are not novel at all: many can be traced back to the early discussions at the beginning of the twentieth century that eventually laid down the very foundations of these fields. Naturally, these ideas did not spring out of a vacuum, but followed the general trends and paradigms of the time. In particular, many of the fundamental concepts about subjectivity seem to have emerged from interdisciplinary cross-fertilisation.

For instance, in the humanities, several theories of subjectivity were proposed. These can be roughly subdivided into two dominant approaches [30]: the *subjectivist/psychoanalytic* theories, mainly associated with Freud and Lacan, which see the subject as a *thing* that can be conceptualised and studied (see e.g. [14,17]); and the *anti-subjectivist* theories, mainly associated with the works of Nietzsche and Foucault, which regard any attempt at defining the subject as a *tool* of social control, product of the culture and power of the time [15,34].

For our discussion, it is particularly useful to investigate the relation to Lacan¹, firstly because it is a subjectivist theory and secondly because its abstract nature facilitates establishing the relation to Bayesian probability theory. Some ideas that are especially relevant are the following.

The subject is a construct. There is a consensus among theorists (both subjectivist and anti-subjectivists) that the subject is not born into the world as a unified entity. Instead, her constitution as a unit is progressively built as she experiences the world [30]. The specifics of this unity vary across the different accounts, but roughly speaking, they all take on the form of an acquired sense of separation between a *self* (inside) and the rest of the world (outside). For instance, during the early stages of their lives, children have to learn that their limbs belong to them. In Lacan for instance, this distinction is embodied in the terms *I* and *the Other* (Fig. 1a). Crucially, Lacan stresses that the subject is precisely this “membrane” between inward and outward flow [14].

The subject is split. Structurally, the subject is divided into a part that holds beliefs about the world, and a part that governs the organisation and dynamics of those beliefs in an *automatic fashion*. The most well-known instantiation of this idea is the Freudian distinction between the *conscious* and the *unconscious*, where the latter constitutes psychological material that is repressed, but nevertheless accessible through dreams and involuntary manifestations such as a “slip of the tongue” [17]. Here however, the interpretation that is more pertinent to our analysis is Lacan’s. In his terminology, the two

aforementioned parts correspond to the *imaginary* and the *symbolic* registers, respectively (Fig. 1b). Simply put, the imaginary can be described as the collection of concepts or images that, when pieced together, make up the totality of the subject’s ontology: in particular, the world and the subject’s sense of self. In other words, the imaginary register is responsible for entertaining hypotheses about reality. In turn, these images are organised by the symbolic register into a network of meaning that is pre-given, static, and “structured like a language” [26].

Language is a system of signification. Many of the modern ideas about knowledge and subjectivity are centred around language. In this view, the subject is seen as a signifying entity that produces and consumes signs (linguistic material) in the form of spoken language, images, and general sensorimotor expression [48]. Language then can be thought of as a system of signs that operates by detecting signifiers (labels) and associating them to signifieds (meanings or ideas)—possibly in cascade, with the signifieds being the signifiers of later stages. Crucially, the associations between signifiers and signifieds are arbitrary and contingent, established by pure convention (think of ‘apple’, ‘manzana’, ‘mela’, ‘Apfel’, ‘pomme’, ‘תפוח’, etc.). The influence of these views is witnessed by the adoption of related ideas by thinkers from fields ranging from logic [44,62], philosophy of language [63], phenomenology [18], rhetoric [23], and linguistics/cognitivism [6] to computer science [56] and biology/cybernetics [31,32].

The real is the engine of the subject. The imaginary and the symbolic registers refer to the subject’s intellect, that is, to the organisation of the things that she can potentially comprehend or experience, and their structure is static. There is a third register in Lacan’s conceptualisation, namely the *real* (Fig. 1b), representing the unintelligible, random source of external perturbations that the subject picks up and integrates into her symbolic domain in the form of sense-data, thereby setting her knowledge in motion (compare e.g. to the “web of beliefs” of Quine [41]).

Teleology. Finally, there is the question of purposeful behaviour. In Lacan, teleology (see Fig. 1a) is related to what he calls the *objet petit a*: that is, an unexpected incoherence that interrupts the otherwise regular chain of signification [25,58]. Such an interruption has two consequences that are worth pointing out. First, the deviation from the regular chain of signification can be thought of as an expression of spontaneous desire, i.e. a sudden jerk that steers the chain into different, *preferred* consequences. Second, the interrupted signifying chain, by injecting randomness, introduces an independence of choice that entails a responsibility, a claim to ownership of cause, and a post-rationalisation of the subject’s decisions. In short: a detected irregularity signals *agency*. For instance, in the sequence

1, 2, 3, 4, 5, 6, 8, 9, 10,

the missing number 7 breaks the pattern and can give the impression that it was intentionally omitted.

3. Subjectivity in Bayesian probability theory

In the mathematical disciplines, one of the most prominent theories dealing with subjectivity is Bayesian probability theory. Its current formal incarnation came to be as a synthesis of many fields such as measure theory (see e.g. [24,29]), set theory [4], and logic [16,44,62]. After Bayes’ and Laplace’s initial epistemic usage of probabilities [1,27], founders of modern probability theory have *explicitly* started using probabilities as degrees of subjective belief. On one hand, they have postulated that subjective probabilities can be inferred by observing actions that reflect personal beliefs [11,42,49]; on the other hand, they regarded probabilities as extensions to logic under epistemic limitations [7,21]. Importantly, both accounts rely on

¹ It shall be noted however, that Lacan’s work is notoriously difficult to understand, partly due to the complexity and constant revisions of his ideas, but most importantly due to his dense, multi-layered, and obscure prose style. As a result, the interpretation presented here is based on my own reading of it, which was significantly influenced by Fink [14], Mansfield [30] and the work by Žižek [58,59].

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