PSYCHOANALYSIS AND PROBABILISTIC THINKING

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Psychoanalysis is largely overlooked in mathematics education, yet is relevant to many aspects of the field, such as the institution of the school, curriculum and instruction, and content. Specifically, one content area where psychoanalysis is both exceedingly relevant and absent is that of probability education. In this critical literature review, I resurface important literature on the topic of psychoanalysis and probabilistic thinking, providing a Lacanian synthesis of its relevance in the future of probability education research. Important concepts such as subjectivity, epistemology, and linguistics are explored, all of which hold massive implications for probability education researchers in their interpretations of students' probabilistic thinking. The purpose of the paper is to demonstrate the relevance of psychoanalytic theory to probability education research, and to introduce the idea of such an alignment to researchers.

Keywords: Research Methods, Probability

The purpose of this literature review is double. First, literature on the topic of psychoanalysis and probabilistic thinking is resurfaced and synthesized for the mathematics education research audience. Second, a synthesis of the literature and related psychoanalytic concepts are elaborated and discussed from a Lacanian point of view apropos probability education research.

Psychoanalysis is a theory—juxtaposed against positive psychology—that acknowledges the existence of the unconscious and thus understands itself through its own limits; it can be thought of as the "first psychiatry" that existed before modern psychoactive medicines. The work of early pioneers such as Sigmund Freud is well-known in popular discourse although it is widely misunderstood by those who do not study it professionally. Perhaps the second most well-known psychoanalyst coming out of the Freudian tradition was the French psychoanalyst Jacques Lacan whose work is notoriously difficult to understand. Much of his published work comes from the transcriptions of his yearly *Seminars*. Despite Lacan being trained in medical school as a Freudian, he built on or reinterpreted many of Freud's foundational ideas after he began his own practice. As a result, Lacanianism has largely become its own school of thought in psychoanalysis, although it is based in the Freudian tradition rather than in the other major school of psychoanalytic thought—the Jungian tradition (see Bailly, 2009). The word "Lacanian" has come to represent "courageous and radical commitment to understanding the depth and vastness of the human condition, with full acceptance of the impossibility and ineffability of that task" (Gerson, n.d.).

Psychoanalysis is different from other types of psychological theories because it is largely based on speculative analysis of the analysand and their speech, and the interaction between their conscious and unconscious desires. An analysand can be an individual person, a group of people, or an institution (e.g., the state). In the case of mathematics education, all three are relevant: for example, a student or teacher, a classroom, and the curriculum or school itself as situated within a particular political and cultural context. While the case of the unconscious in a single subject (e.g., a student) might be obvious, the unconscious is also present in groups of people and institutions: in the form of spirit (e.g., Hegel's notion of world spirit), through the economy of ideology (see, for example, Žižek, 1989/2008), and by that which conditions discourses (Lacan, 1993). Additionally, psychoanalysis is not concerned with mathematical concepts' existence *as*

such or what might be described as "out there" or as ontologically positive in-and-for themselves. Indeed, Lacan even used mathematics to develop a system of Lacanian Algebra that he used to describe concepts so that people would not fall prey to intuitive understandings of psychoanalytic concepts—a trap of the Imaginary (see next section; also see No Subject, 2019)—because there is no metalanguage that would guarantee the universality of mathematics through the conferral of meaning.[1] In other words, according to Lacan, the ingenuity of mathematical symbols *qua* signifiers is that you have "to explain what you are going to do with them" (Lacan, 1991, p. 2).

Background on Relevant Lacanian Concepts

Signifiers and Signifieds

The incorporation of Saussurean linguistics into psychoanalysis was one of Lacan's major contributions to psychoanalytic theory. Signifiers are, for Lacan, mental images of the sound of a sign. In other words, signifiers are the meaning(s) psychically assigned to a symbol, word, idea, or other sign by a subject, as interjected into an already-constituted network of meaning made up of other signifiers. Jöttkandt (2016) describes this relationship as:

> What one hears in speech is the signifier rather than the signified. The signified is not what we hear (in the auditory sense) but something that must be read. In order to signify, the signifier must undergo an act of signification. This process can be described as the signifier, *S*, becoming shot through or injected with signifieds, *s*, that have undergone a certain operation: a transfer occurs whereby a signified crosses over the bar [in Saussurean notion, *S/s*,] that separates signifier and signified to be a signifier, *S*. (p. 145)

A crucial property of signifiers is that they are meaningless and belong to a closed system of constantly re-conferred meaning, following the transference of meaning back to a signifier that signifies nothing:

> The signified is something quite different – it's the meaning [… that] always refers to meaning, that is, to another meaning. The system of language, at whatever point you take hold of it, never results in an index finger directly indicating a point of reality; it's the whole of reality that is covered by the entire network of language. (Lacan, 1993, p. 32)

However, this meaninglessness is what gives signifiers their power: "The more [a] signifier signifies nothing, the more indestructible it is" (Lacan, 1993, p 185). Moreover, the signifier is what constitutes[2] the subject: he[3] is merely a system of signifiers that, for himself, structure the ways in which he interprets the meaningfulness of signs in everyday life. Because signifiers *qua* signifiers are meaningless and closed, acting as a subject for another signifier to confer meaning onto, there is always one signifier missing at the beginning of the chain, thus rendering the whole chain meaningless. A string of signifiers only makes sense in retrospect by reaching the end by punctuating it, as evidenced by the necessity of having to hear an entire sentence before one can

1 Elaborating more on this point is outside the scope of this paper. Readers interested in more relevant discussion of philosophy of mathematics may find Jöttkandt (2016) to be of interest.

2 The field of the signifier is related to the field of l'Autre, which is the precarious Symbolic entity that—among other things—confers onto each person his subject position; it is only from this position that one begins to speak.

3 I acknowledge the failings of the English language apropos gendered pronouns. I use he/him/his in this paper in the admittedly archaic general sense to mean an individual Subject (one person), regardless of gender. I do not use they/them/their for that purpose because of the linguistic detraction that it makes from conceptualizing the Subject in their subjectivity, viz. situating the identifying voice in the radically-subjective first-person view (of the Subject). The distinction between he/him/his and they/them/there is purely linguistic.

retroactively assign/understand the meaning of the entire sentence, beginning back with the first word and the string of all words comprising the sentence.

The Structure of the Ego

In Freudian and Lacanian theory, the ego consists of three parts: the ideal ego, the ego-ideal, and the superego. The ideal-ego "stands for the idealized self-image of the subject (the way I would like to be; how I would like others to see me)" (Žižek, 2007, p. 80). The ego-ideal is "the agency whose gaze I try to impress with my ego image, the big Other who watches over me and propels me to give my best, the ideal I try to follow and actualize" (Žižek, 2007, p. 80). The Superego is

> the same agency (*l'Autre*) as the ego-ideal, but in its revengeful, sadistic, punishing aspect. It is what pushes us towards the expectation of certainty, even if certainty is absent—which it always is in actuality. Nothing forces anyone to enjoy except the superego. (Žižek, 2007, p. 80)

Further, the superego makes enjoyment an imperative. *Jouissance* qua enjoyment—in reality—brings as much pain as it does pleasure, so the superego is also responsible for things like the drive to do things that bring us pain. In late capitalism, Lacanian psychoanalysis elucidates that enjoyment is not only an imperative but has also become a "kind of weird and twisted ethical duty" (Žižek, 2007, p. 80).

The Psychic Registers: Imaginary, Symbolic, and Real

Lacanian theory is largely based on the structure of three psychic registers or realms of Lacan's theory of psychic reality: the Imaginary, the Symbolic, and the Real.

The *Imaginary* is the register of images ("picture thinking" or *Vorstellung*) and their relation to the ego. The *Symbolic* is the register of logic, meaning, and symbols as they determine the subject; for example, the Symbolic contains language and law, since they are always-already constituting the people who raise children into the same ordering structures. The *Real* is the register that resists representation, what cannot be symbolized, logically represented, or represented through pictures or *Vorstellung*, where words fail, "gut" feelings, anxiety, that residue that cannot be reduced, the foreclosed element that can be "approached but never grasped: the umbilical cord of the symbolic" (Lacan, 1979/1998, p. 280). In short, the Real is that which does not rely on my conception of it. Lacan describes it algebraically using Lacanian algebra because it is simultaneously already here and continuously emerging, and thus "cannot be conceived" (u/wokeupabug, 2015).

A newborn baby enters the Imaginary through not knowing that she is a separate person from the mother or primary caregiver; "as it gains a visual image of the world and itself"—for example, the first time she recognizes herself in a mirror—she "starts to understand that [she] is a distinct object" (u/wokeupabug, 2015).

The Symbolic can be described by the interactions experienced with other subjects: "Those we come in contact with use language to communicate and tell us how to see the world (how to Symbolize it). Eventually all experiences are filtered through language" (u/wokeupabug, 2015). This starts when the baby enters into language.

The Real cannot be defined but can be described through examples and metaphors. For example, the Real is evidenced in "[A]n experience or thought occurs that creates a response so sudden or inexplicable and that language we have does not have time or sufficiency to explain it and we experience something primal—it cannot be Symbolized" (u/wokeupabug, date).

Reddit user u/wokeupabug described the three registers as follows, using lay terminology and metaphor to craft a useful triad of examples:

> The *Imaginary* is like this: Suppose you think you're working late at the office and you think you're alone, and you start absently picking your nose while you work, then in the middle of it you realize your co-worker hasn't left yet and has totally caught you in the act. You suddenly feel very different about yourself, right? That's the Imaginary.
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> The *Symbolic* is like this: Suppose you're at a party and you're meeting people for the first time, and after some basic introductions when you settle into the conversation, they ask what you do. Unfortunately, you've been depressed for the past year, you were doing school, but you failed a couple courses and didn't go this year, and you haven't been able to find a job in the meantime. You're kind of embarrassed and don't really know what to tell them. A couple years later you're at another party and the same thing happens, only now your situation has changed, and you report that you just finished your degree and are working a help desk job in an IT department with some good opportunities for advancement. You feel differently about yourself after giving this report about what you do, right? That's the Symbolic.
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> The *Real* is like this: You're getting ready for work in the morning, running late, but you've got to iron your shirt. Ok, you iron it, get ready to head out, as you're putting your jacket on you remember you may not have turned off the iron. So you go check; actually, ok it's off. You head out the door but think you were actually a bit hasty, you barely glanced at the iron when you checked, and you're not really confident you saw it right. It'll only take a minute, you jump back in to check the iron; yup, it's off. So you head out, the whole time down the street you're thinking gee you probably should have unplugged it to make sure, you start imagining it catching something on fire and think about what an asshole you'd feel like if your house burnt down over something simple like this, and it drives you a bit nuts all morning. That's the Real. (u/wokeupabug, 2015)

Lacanian Synthesis of the Literature Results

Signifiers and Vindication, and the "Types" of Probability

Psychoanalysis first reveals that the misrecognition of signifiers—e.g., "probability" and "chance"—in probabilistic thinking is an important topic of study. This is not a novel focus of probability education research; quite the contrary, as probabilistic thinking is well-known to contain complicated disjunctions of meaning in the minds of students (e.g., Abrahamson, 2014; cf. Chassan, 1956; Jones et al., 2007). Chassan (1956) published one of the first papers on the matter. As with any writing, his claims must be considered within the historical context in which they were written. At the time, the emergence of quantum mechanics had created something of a philosophical crisis within the physics and mathematics communities, as the foundational tenets of determinism on which both fields had been built were up for question.[4] The development of probability theory had always been somewhat separate from the rest of the mathematics community. The philosophy that had guided the development of probability up until the middle of the 20th century had been mainly deterministic in nature before the advent of quantum mechanics created questions about determinism apropos mathematical philosophy. Chassan claimed that this existential crisis that the physics and mathematics communities were facing—the main contest of which was the philosophy of probability theory—could be solved through the use of psychoanalysis. "Probability theory is applicable when the initial state is so complicated that it is impossible in practice to ascertain it accurately enough to determine the final state uniquely…" (p. 56). This is precisely the same case as in the unconscious and thinking about

4 For example, the debate of Heisenberg's Uncertainty Principle.

probabilistic events such as causality and chance: that "nothing malfunctions more than human reality […] One is always being fooled" (Lacan, 1993, p. 82).

Chassan drew primarily on Freud's work describing the connection between determinism, chance, and superstitious beliefs,[5] in which he separates the commonly committed conflation of real chance with psychic accidents. For Chassan, the difference between "real" chance in the external world and the psychic reality of the person doing the thinking about it was not delineated in any mathematical literature. This naïve conflation was the cause of the philosophical conflicts developing over the (in)determinism of probability. Chassan, using Freud, sought instead to suss the external and psychic realities apart, one being a product of psychology and the other being a product of the conditions of the physical external reality. However, Chassan broke with Freud over his claims of causality, instead articulating a position that would later become more aligned with Lacan. Lacan's work was just becoming available in published form at this time; for example, Lacan's major break with the established Freudian psychoanalytic school had only occurred three years prior to this paper's release, in 1953, and at the time was only available as a French transcript of a talk he had given in Paris that year. That same year, in 1953, Chassan had written an analogous paper[6] to the 1956 paper, but focusing on the interrelation of *statistics* with psychoanalysis. Chassan stated that, "The acceptance of the usefulness of thinking in terms of probabilities in psychoanalysis confronts the research investigator who would seek to establish probability statements with considerations of observation and objectivity" (p. 58). The most relevant point he makes in both papers is that of intuition and *a priori* judgments—and how subjective experiences are the determining limits of them for an individual.

To shore up the relevance of signifiers to probabilistic thinking, I next discuss the concept of vindication—elucidated in the located literature— which implicates the importance of using psychoanalysis in research on students' probabilistic thinking. Moncayo and Romanowicz (2015) discuss the interesting psychological relationship between "certainty" of quantitative measurement in the soft sciences (such as education) against the—as they argue—more appropriate concept of probability. The chapter is a critique of the famous adage by Edward Deming: "In God we trust; all others bring data." The authors argue that within the quantitative paradigm, probability is the only appropriate numerical concept for measuring "the things that cannot be measured" in the soft sciences—as opposed to the "hard" causality. "Lacan distinguished between lawful regularity and causality and placed causality on the side of chance. On the side of chance, causality is the same as the absence of causality or causality in the form of a gap" (Moncayo & Romanowicz, 2015, p. 77). Here we begin to see the relationship between the unconscious and probability: the word "probability" was chosen when probability theory was developed out of the mathematical study of games as opposed to the rowdier term "chance," which connotes gambling and so forth. The signifier probability and the signifier chance ostensibly connote different things happening but in reality are the same. By my reading, the article shows that probability and the mirage of certainty are psychic products of the Real; thus, the normal distribution is a Symbolic distribution, representing regularities within the randomness.

A "personal" probabilistic understanding was further developed by van Fraassen (1983), who wrote about the difference between *personal probability* and *frequentist probability* in an edited volume that connected physics with psychoanalysis. At that time, with the advent of quantum

5 Viz. Freud (1938).
6 Viz. Chassan (1953).

mechanics becoming more salient, psychoanalysis was beginning to be seen as a useful tool in understanding the existential nature of the horizon towards which mathematics and physics were heading. In the chapter, van Fraassen (1983) attempted to establish connections between the frequentist approach to probability (counting frequencies of occurrences) and the personal approach to probability (subjectivist or Bayesian, dealing with degrees of belief in an event happening), stating that "the use of probabilistic language to express personal opinion about a single event can be understood in a way that avoids the major problems with which frequentists have struggled" (p. 295). He begins the chapter with a vignette:

> Yesterday I said, 'I promise to give you a horse.' But I did not give you anything, and today you accuse me of the heinous immorality of breaking a promise. No, I reply, I am not guilty of that at all, but only of the much lesser offense of lying. All that happened was that yesterday I stated falsely that I was promising to give you a horse. (p. 296)

Evaluating this vignette, van Fraassen argues that there are two ways to analyze attitudes: reasonableness and vindication. The former concerns the present, and the latter concerns the future. Further, reasonableness requires vindication: "Let the frequentist equate probabilistic expression of opinion with something else; and let him investigate the conditions under which such vindication is not *a priori* excluded" (van Fraassen, 1983, p. 297). Use of reasonable and vindication to analyze statements of personal or subjective probability address the failings of language apropos probabilistic concepts through what van Fraassen calls *calibration*. Calibration is a way of measuring or "frequentizing" one's subjective judgments apropos probabilistic statements "as indicators of actual frequencies" (van Fraassen, 1983, p. 300). It consists of evaluating one's personal probabilistic claims afterwards to see how well they fit the observed frequencies of events. Adjusting one's personal probability through calibration leads one towards what van Fraassen calls *coherence*. We can then assume that coherence is a frequentist's way of intentionally adjusting an individual's signifying chains apropos the language associated with the frequentist's claims and the subjectivist's claim. Through calibration, van Fraassen attempts to unify the divide between personal and frequentist probability, although the implications for psychoanalysis are not well sussed out in the chapter.

Joyce (2005) extended van Fraassen's arguments about the analytic potential of subjectivity, employing the notions of specificity, ambiguity, and sufficiency. In his paper, he focuses on evidence for probabilistic events, and claims that types, weight, and balance of evidence form a basis for subjective interpretation of probabilistic events. Consider a probability word problem that describes some conditions of an event, and perhaps an existing knowledge about how some of the events have already turned out. The problem is providing evidence in the form of those given statements. The individual subjectively interprets the statements of evidence, evaluating to what extent each piece of evidence exhibits specificity towards the probabilistic situation being considered, how much ambiguity there is around the conditions of the situation, and the extent to which the evidence given is sufficient for making a personal probabilistic statement (as informed by the non-personal evidence given) about the situation. It seems that Joyce's extensions of van Fraassen's arguments provide a finer grain of the subjectivist's reintegration to frequentism.

We can build on our understanding of Chassan through van Fraassen's intervention and Joyce's elaboration, in that psychoanalysis not only splits apart probability into what is "out there" and what is "inside us," but that psychoanalysis also allows us to reunify them through an interpretation of events *a posteriori*. In my interpretation the psychic registers of psychoanalysis reveal the following homology: Frequentist = Imaginary, Theoretical = Symbolic, Personal/Subjective = Real. Thus, psychoanalysis gives us a framework for understanding these

three forms of probability in relation to each other.

The Superego and Desire

Britton (2021) argues that the "should" of superegoic expectation is used heavily in probabilistic thinking. Britton develops the notion of Belief/Doubt as an ego function that is mediated by the superego's expectations of "should." Crucially, these are psychic constructs which are separate from the material, external reality. This leads to implications for the way we understand what people think "should" happen, including the relations of causality with belief and counter-belief. The author gives an example of a case study patient: "She could not derive any security from belief unless she regarded it as knowledge; probability did not exist for her, only certain doubt or certainty" (p. 72). Thus, probability leads to anxiety because its signification is at conflict with the psychic reality of certainty and doubt. In external reality, there is only probability, but we psychically insist on certainty in our interpretation of the world (e.g., the superego's assertions). Thus, the superego filters the way in which the signifiers of probabilistic concepts (e.g., likelihood, chance) are being chained together in the unconscious.

Connecting desire and the superego, Rohy (2019) elucidates the connection between probability, psychoanalysis, and sexuality:

> Comparing the detective's investigative task to the process of psychoanalytic interpretation, Slavoj Žižek argues that 'every final product of the dream work, every manifest dream content, contains at least one ingredient that functions as a stopgap, as a filler holding the place of what is necessarily lacking in it.' This is the crucial clue, the telling symptom (p. 50).

Like a detective in one of Poe's mystery stories, the psychoanalyst's task is to transform what "appears to be accidental or random into a narrative of motivated causality. The difference is to a large extent one of perception: an anomaly that weak thinkers dismiss as 'coincidence' may in fact be nothing of the sort" (Rohy, 2019, p. 46). An example of this is the gambler's fallacy. The gambler's fallacy confronts the Real and the Symbolic through the failure of notions such as the anticipation of "being owed" or "being due." For Lacan, the Real cannot be represented or assimilated, whereas the symbolic is precisely the register of representation and assimilation. The Real, which creates the tension of the gambler's fallacy, opposes meaning, including causality. Our difficulty in thinking probabilistically might be related to the fact that we are socialized as gendered and sexualitied[7] people from childhood, assuming heterosexual necessity instead of queer accidentality, vis-à-vis suppression of the Real (see Jöttkandt, 2016; Tomšič, 2016). If true, this engendered orientation towards heteronormativity would function as a technology for predisposing us to think about "what should be the case" (heterosexuality and cisgenderism as "normal" or "standard"; what "should" be the outcome of a probabilistic event) when really there is no such thing: there is only maximum probability—viz. that most people, for biological reasons, are indeed heterosexual and cisgender—underlaid by motivated causality. My argument for this homology comes from the irreducibility of sexuality, in psychoanalysis, to meaning.[8]

7 Elsewhere (Moore, 2021), I have used this term in parallel with the term gendered to denote categorical determinations of the process of sexual identification, such as the same process that occurs in human socialization apropos gender.

8 Due to space limitations, I will not elaborate on this further here, although interested readers may find Zupančič (2017) of interest. I have been exploring this connection in my work elsewhere (e.g., Moore, 2022).

Conclusion: Towards a Future of Psychoanalytic Probability Education Research

Psychoanalysis possesses the potential to enhance the study of the teaching and learning of probability. There are several key concepts from psychoanalysis that provide a useful and innovative reframing of issues in probability education research. The first is the logic of the signifier and the three registers of psychic reality; they are both related to vindication and the different "types" of probabilistic thinking. The second is the superego and its complexification of the signifiers in probabilistic concepts.

To briefly recapitulate and close with an imperative takeaway, probability learning leads to anxiety because its signification is at conflict with the psychic reality of certainty and doubt. The superego drives towards certainty when it is not there. Thus, psychoanalysis affords a unique yet crucial perspective on understanding probabilistic thinking. Future studies into students' probabilistic thinking should take up these psychoanalytic concepts in theoretical orientation and methodological considerations.

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