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REVIEW

Attachment as a Primary Mechanism in Physician Cognition and Bias During Complex Medical Cases: A Narrative Review

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Introduction: In recent decades, improvements in diagnostic accuracy in medical cases have been minimal despite rapid advancements in technology. Moreover, in complex cases, diagnostic accuracy remains a significant challenge, often reflecting practices from the 18th and 19th centuries. This comprehensive narrative review explores how cognitive bias may act as a critical, yet neglected, factor contributing to the persistent diagnostic error rate.

Methods: A narrative review of the literature was conducted through a search of the George Washington University library databases and Google Scholar to identify studies related to physician cognition, complex medical diagnosis, and cognitive error.

Results: This review synthesizes existing literature to propose a theoretical framework explaining how cognitive error, clinician cognition, tolerance of uncertainty, and attachment theory interact to influence the formation of cognitive bias at the cost of diagnostic accuracy and efficiency.

Discussion: It is not only necessary for clinicians to focus on a patient's words, symptoms, or data to improve diagnostic accuracy, but also for clinicians to relate to others' distress through their own attachment styles: technology's critical blind spot. Clinicians with insecure attachment styles may struggle with metacognition, exhibit lower cognitive flexibility, have reduced tolerance for uncertainty, experience lower thresholds for cognitive load, and rely more heavily on heuristics, leading to an increased likelihood of cognitive error during complex medical cases. This theory provides a foundation for further research into how attachment influences clinician decision-making and diagnostic performance while also highlighting how medical education may reinforce these patterns.

Keywords: diagnostics, unconscious bias, cognitive theory, attachment theory

Background

Prior to the 1800s, the essence of medical diagnostics was a patient's story.[1–4] And, while highly emphasized, this sole diagnostic approach also allowed for transparent vulnerabilities and disparities within the clinician–patient relationship. Historical accounts reveal that as clinicians began to treat all patients, rather than just those of the upper class, these rifts became apparent.[1,2] And, the greater the chasm between a doctor's social class and education background and that of their patient's, the greater the disparities were in communicating and understanding one's health history.[5–7] Unfortunately, these historic miscommunications have created tension between both parties, resulting in a relationship where clinicians have displaced or reinforced unconscious bias against specific groups of patients while influencing a relationship where certain groups of patients may have accepted or deepened a learned passivity inbreeding an unconscious feedback loop within the field of medicine.[2,6,7] And, without medical technology offering supportive evidence in conjunction with a patient's words and behaviors, other biases were permitted to fill the unavoidable gaps of uncertainty.

Forced reliance on one's medical history encompassed by ancient doctrines molded a weight of authority heavily vulnerable to confirmation bias: the unconscious tendency to selectively accept information that meets one's expectations while ignoring information that may contradict them.[8–15] Regrettably, during a time ignorant to the medical knowledge

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we currently have, these confirmations may have easily been assumed stereotypes, claims of hysteria and other unacknowledged biases – whether conscious or unconscious – as they were medical terms. The implications of such tendencies should be obvious.

The 19th century led us to the development of the physical exam, and, soon, doctors focused significantly less on a patient's story and more on the exam: the deep rooting of paternalistic medicine.[2–4] Yet, without standardized testing and protocols, and without objectively reflecting on a patient's words, measurement bias became the next major issue for the practice of medicine.[8,16] Similar to confirmation bias, measurement bias is the unconscious tendency to skew measurement results based on an expected outcome.[8] For example: if a male doctor in the 1800s assumed hysteria – due to an unconscious bias propagated by misguided cultural and sociological acceptance – in a lower class, female patient complaining of idiopathic pains, temperature dysregulation, and fatigue, that doctor may be less attentive to critical data and, therefore, may miss the possibility of an accurate diagnosis further perpetuating the labeling of, "hysteria". In other words, he will have seen nothing because he expected nothing. The more qualitative the observations, the more prone the observations are to measurement bias. Again, the implications of such tendencies should prove obvious.

With the turn of the 20th century came the eruption of modern medical technological advancements to facilitate the diagnostic process encouraging efficiency and accuracy.[3] We invented the X-ray, MRI, and CT Scan; we gained an understanding into germ theory, while infections and acute illnesses became much better diagnosed and treated; testing and protocols became much more standardized.[3,17–19] And, beginning in the 1970s, we found ourselves coming full circle acknowledging the patient's story as an indispensable party alongside numerical data with the creation and recognition of "patient-centered" medicine and shared decision-making.[2,20,21]

However, the rapid progress of medicine quickly led to learned dependency on technology.[3,22] Tragically, many complex chronic conditions either do not currently have known biomarkers or cannot, yet, be easily tested for in most doctor's offices due to a lack of standardized or recognized diagnostic process.[23] Although today we may have proper names and nomenclature for most of these complex medical conditions in contrast with earlier times, we can still assume that in the average clinician's office these complex conditions are viewed through a similar lens to that of the 18th and 19th centuries: with only a health history and/or qualitative or non-standardized measurement options on hand. Many complex patients, therefore, fall through parallel gaps of uncertainty vulnerable to the same biases as those of previous centuries. And, now, with the tremendous support of technology to lean on, there is the added risk of presumed infallibility amongst healthcare professionals in a rapidly evolving field still very much in its infancy.

Ironically, evidence does not actually support technology as the infallible entity in diagnostics that some purport it as. Autopsy research repeatedly demonstrates that up to 20% of patients are given a misdiagnosis.[3,11,24–28] In about half of these patients, treatment plans most likely would have changed had they been given the correct diagnosis.[24,28] Patient surveys, medical record reviews, and physician-focused research all continuously show a rate of misdiagnosis between 2% and 20% across diverse patient populations and physician domains.[3,24] We can imagine in complex medical cases, these estimates are far greater. Despite all of the technological advancements in the most recent 100 years, these statistics have remained relatively stable across decades. While there has been some progress, the overall outcomes have not significantly improved, underscoring the persistence of the issue and confirming that technology cannot compensate human error.[3,11,24,28] We must now circle back and explore the flawed processes of cognition that up until this point have consistently remained grossly neglected across medical research and education.

This exploratory literature review considers how cognitive bias may be uniquely present in complex medical cases – where uncertainty is ever present – to offer a starting point for further research. Additionally, a theoretical explanation is provided for why cognitive bias may present at overwhelming rates when confronted with medically complex patients. First, the definition of a complex medical case will be offered, followed by a discussion of the current literature on cognitive error, clinician cognition, tolerance for uncertainty, and attachment theory. These variables are integrated to illustrate their interplay in the formation of cognitive bias at the cost of accuracy and efficiency in diagnostics. For clarity, the term "clinician" is used inclusively throughout this paper to refer to physicians, physician assistants, nurse practitioners, and other advanced practice diagnosticians. Up until this point, minimal discussion has been published on such a crucial topic and, to our knowledge, no research has been conducted. Accordingly, this paper presents a theoretical

review proposing a new framework, with the hope that it will serve as a catalyst for initiating the necessary research in this area. As Dr William Osler once said: "Medicine is a science of uncertainty and an art of probability". But, first, we must understand the influence of uncertainty on misguided probability: a step that has been overlooked for far too long.

Search Methods

Sources for this narrative literature review were identified through a search of the George Washington University's electronic databases in the Gelman Library and the Himmelfarb Health Sciences Library, as well as through Google Scholar. Only articles published in English were used in the development of this review. A combination of key terms was used to conduct the literature search (eg, physician cognition, complex medical diagnosis, physician unconscious bias, cognitive error, tolerance with uncertainty, barriers to accurate diagnosis, physician attachment style, attachment style and cognitive bias). This initial list of resources was culled to remove articles of little relevance to the review, specifically those that did not directly address clinician cognition and the role of cognitive error in managing complex patient cases. The resulting resources were then filtered according to three criteria for this narrative review: (1) literature that specifically discussed clinician cognition as opposed to cognitive development generally. In other words, all the literature in this review was related to clinician decision making in complex medical cases; (2) Any literature that was referenced from informal sources (ie, not peer-reviewed journals) was required to come from credible and bipartisan news sources, non-governmental organizations, or think-tanks. And finally, (3) publications in this review had to have translational application to the diagnosis and care of patients with complex clinical conditions (eg, multiple conditions and rare diseases). Though this is not a comprehensive scoping review, a review flowchart inspired by the PRISMA guidelines is presented in Figure 1. This figure provides a general overview of the literature review process employed in this narrative

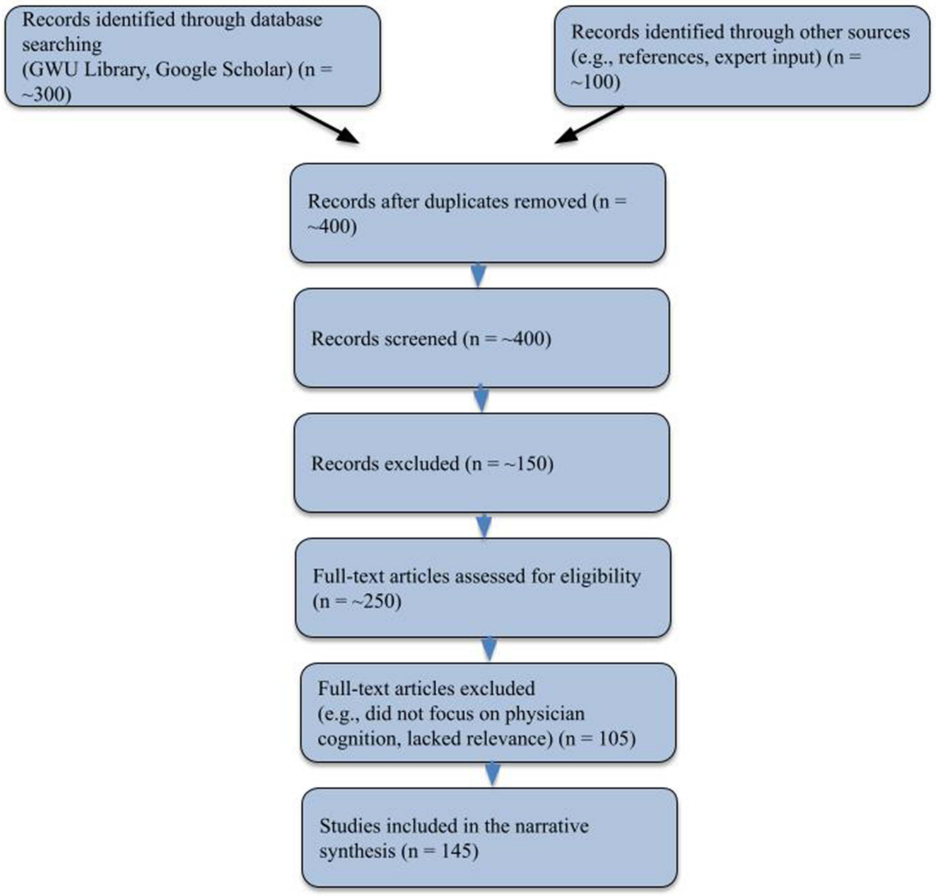

Figure 1 Narrative Review Flowchart.

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review. While not a scoping or systematic review, this diagram outlines the key steps taken in identifying, screening, and selecting relevant literature for synthesis. The process began with the identification of approximately 300 records through database searches described above (GWU Library and Google Scholar) and an additional 100 records from other sources such as reference lists and expert input. After removing duplicates, approximately 400 records remained for screening. During the screening phase, approximately 150 records were excluded due to irrelevance to the study's focus. The remaining 250 full-text articles were assessed for eligibility, with 105 articles excluded due to misalignment with the review criteria. Ultimately, 145 studies were included in the final narrative synthesis.

Complex Medical Cases

Complex chronic illness is a special subgroup of medical cases enveloped in levels of uncertainty, contributing to overwhelming estimates of delayed and wrongful diagnosis.[29–33] Often, amidst uncertainty that patients and clinicians experience, there are symptomatic complaints mimicking common conditions. This confusion further enables the complexity.[30,32] According to a recent narrative review, there is currently no universally accepted definition for "complex" within the medical literature.[34] For the purpose of this review, "complex medical cases" refer to those that include atypical presentations of disease, rare or genetic conditions, or conditions that are regularly misunderstood and/or underrecognized and which cause unique challenges in diagnostics. Unfortunately, it is not possible to provide statistics for all rare, genetic, atypical, and other complex conditions due to difficult parameters. But, we do know that rare diseases alone account for almost 10% of the US population[35] – the near equivalent of those in the US currently diagnosed with Type 2 Diabetes.[36] This underscores the fact that, while these conditions are individually rare, their collective burden on the population is substantial.

Research validates that the diagnostic interval for an individual living with a rare disease ranges from five to 30 years with an average of seven to eight years, while the initial diagnosis is incorrect 40% of the time.[31–33,37] Additionally, the average rare disease patient sees approximately eight physicians – though some may see anywhere from three to 20 specialists – and receives two to three misdiagnoses in total.[29,31,33,37] In one study conducted by the European Organization for Rare Diseases, 40% of patients received a wrongful medical intervention due to an erroneous diagnosis: 16% had unnecessary surgery, 33% did not receive appropriate care, and 10% were given psychological care on the assumption that the symptoms were psychosomatic.[31,37] Without an accurate diagnosis, patients may be denied social and economic opportunities, experience stigma within their personal lives, be vulnerable to extended hospital stays, receive extensive and unnecessary testing and/or procedures, and risk a worse prognosis: all factors that devastate lives as well as overburden our healthcare system and stress our economy.[29,31,32,37]

Current Literature on Cognitive Error

Heuristics are mental shortcuts we all use to support efficient decision making in everyday life.[3,9,11,38–46] They allow us to preserve resources for situations requiring much more complex thought.[40,41,43] And, when a situation consists of predictability, stability, or adequate feedback, heuristics are overwhelmingly effective.

Biases are cognitive errors occurring when unconscious emotions, judgements, or other sociological and psychological factors cause heuristic shortcuts to unknowingly misguide us.[9,10,12,15,24,41,42,47–49] Often, these biases emerge when heuristics are applied to situations that appear familiar but lack true relevance, potentially leading to negative health outcomes.[40,43,50]

Cognitive bias is typically viewed through the lens of cognitive-psychology, ecology, or evolution. For the purposes of this review, Korteling et al's[43] proposed neural framework for cognitive error is utilized due to the universal display of many of these heuristics and biases found across a wide-range of human conditions.[51,52] In this framework, the authors discuss the associative basis common to the function of all neural networks: the unconscious creation of patterns and relationships resulting from every observation. These neural networks embrace an innate preference for building on prior knowledge and experiences ordinarily seeking out compatibility while becoming blind to information that is contradictory. Once these associations are unconsciously formed, our neural networks seem to favor maintaining and focusing on the established familiarity, neglecting the possibility of irrelevancy and the unknown. Strictly speaking, the brain, in its most primal form, is uncertainty-avoidant.

Bias has been well explored in other fields with research showing that over 90% of air traffic control system errors,[53,54] 82% of production errors,[54,55] 80% of wrongful convictions in the criminal justice system,[56] and 50–70% of all electronic equipment failures are the direct consequence of cognitive errors.[53,54] In medicine, however, the discussions of heuristics, biases, and cognitive error seem almost taboo in a field that takes immense pride in analytical, rational, objective thought.

Schmidt et al[57] estimate that cognitive bias is present in nearly 75% of all diagnostic errors in internal medicine contributing greatly to the 98,000 medical error-related deaths in the U.S. each year. Medical errors cost the US about $19.5 billion annually with diagnostic errors as the most costly of all errors as well as the largest contributor to malpractice claims.[54] In one literature review, Saposnik et al,[54] found that cognitive bias contributed to diagnostic errors in 36.5–77% of case scenarios involving 6,810 physicians across 20 publications. These studies included routine procedures, such as the evaluation of a basic skin biopsy. If cognitive errors occur at this frequency in common scenarios, what happens when a case involves an atypical presentation, a rare condition, or a condition commonly misunderstood and/or underrecognized by healthcare practitioners? Aside from Saposnik's literature review and the 20 original publications cited in this work, very limited theory has been published and very little research conducted on such a pivotal concept in general and emergency medicine. Critically, there has been nearly no research focused on cognitive bias in complex chronic illnesses.[54]

Within the literature, there is some debate as to why cognitive biases occur across the diagnostic process. Some speculate that cognitive error typically occurs during times of uncertainty.[9] Others theorize that bias most often occurs when a clinician feels most certain of a diagnosis due to prior cases involving similar symptoms.[24] Ultimately, we need more research to understand both of these arguments. Given that complex medical cases tend to create feelings of uncertainty as well as mimic symptoms of more common conditions, it is clear that both of these postulations may have a direct impact on the lengthy diagnostic interval of complex chronic conditions. More than likely, both arguments will prove correct with other variables potentially mediating when bias presents – a topic further explored in the following sections.

Current Literature on Clinician Cognition

System 1 and System 2 Thinking

Cognitive psychology coined the dual-system theory to explain two systems of thought in decision making: system 1 and system 2.[38,39,41,44,45,52,58–61] System 1 thinking is thought to be our fast, unconscious, intuitive thinking that emphasizes pattern-recognition and heuristics.[3,11,14,38,41,44,45,52,56,62] This type of thinking seems to be favored when confronted with significant time-constraints, a lack or overload of relevant information, when no optimal solution is evident, or during times of assumed familiarity.[38,41,43,50,52] Though system 1 decision-making is not formally taught and is often discouraged in medical school, experienced clinicians frequently rely on it to recognize patterns in patients based on prior cases and illness scripts.[11,12,24,38,43,45,57,62] And, with our modern-day medical system that creates significant time constraints, this automatic form of decision-making allows for rapid hypothesis generation to save time, energy, and resources, which is highly beneficial in common cases with typical presentations.[3,14,24,38,63,64]

It is theorized that the more certain a clinician feels about a patient's presentation pattern, the more likely they are to default to system 1 for hypothesis generation.[3,43] Additionally, emotions, unconscious bias towards specific groups of people, prior beliefs, expectations, temperament, and personality traits may all affect system 1 thinking and, therefore, diagnostic accuracy.[3,9,11,12,21,24,48,56,57,65–74]

System 2 thinking is our slow, analytical thinking or our hypothetical-deductive thinking.[14,24,39,41,45,56,62] It is the type of thinking taught in medical schools and, ideally, practiced in clinical settings.[11] Often, we engage system 2 decision-making while encountering a complex or unfamiliar situation.[41,43,44,52,] Yet, due to systemic time constraints, this may prove challenging in actual medical practice.

Interplay Between System 1 and System 2

Many presume bias is only problematic when system 1 thinking takes precedence over system 2.[14,41,43,44,56,58,75] In reality, bias can just as likely occur in both decision-making processes.[14,44,58,62,75] And, some believe the consequences

of bias presenting during system 2 engagement may actually be more dire.[14,75] Whereas error emerges in system 1 due to unconscious processes, error emerges in system 2 as a result of the limitations in our working memory. These limitations may be compounded by a physician's fear of failure, overconfidence, ego, or perfectionism.[9,11,12,14,24,56,62]

Ironically, one successful solution to compensate for the limitations of our working memory is by using unconscious pattern recognition: a solution shown successful in typical, common cases.[39,40,42] Unfortunately, Mamede et al[76] found that in complex cases, the presence of salient-distracting features (SDF) – ie, unimportant symptoms that catch a physician's eye due to their importance in a different, more familiar, disease – is a common cause of error. This research shows that physicians demonstrate 58% fewer accurate diagnoses when confronted with a SDF early on in a complex case. Unexpectedly, the authors found that medical students actually spent more time on a case when confronted with an SDF early on, disproving their theory of rushing towards premature closure. This discovery may demonstrate a direct conflict between system 1 and system 2 processes: SDFs may trigger system 1 bias and heuristics that system 2 is not able to override, despite paying more time and attention.[38,76,77] A concerning consequence of this increased time and attention is a potential false sense of confidence, which may contribute to overconfidence, anchoring, confirmation bias, and search-satisficing bias, amongst others. This, then, creates a scenario that reduces a clinician's likelihood of using diagnostic aids as well as reduces the likelihood that other clinicians will challenge the original diagnosis.[38,77,78]

And, what happens in complex cases where we not only lack the appropriate knowledge in our working memory but we also lack the appropriate prior experiences in our long-term memory? Do we blame the failure of both systems? Or, do certain mediators determine which system we tend to lean on when confronted with a complex medical case predisposing us towards certain cognitive errors? The answer to these questions may, at least in part, explain the contradictory results in the literature regarding various cognitive-enhancing and debiasing strategies.[14,62,79–90]

Current Literaute on Tolerance for Uncertainty/Ambiguity

Research consistently shows that a clinician's ability – or inability – to tolerate uncertainty and ambiguity directly impacts patient care and diagnostic accuracy.[38,48,91–95] In their meta-analysis and proposed framework, Hillen et al[92] defines uncertainty as, "the conscious, metacognitive awareness of ignorance", constructed by "ambiguity, probability, and complexity".[96] The authors proceed to define ambiguity as information lacking in reliability, credibility, or adequacy and complexity as a phenomenon difficult to comprehend.[92]

Intolerance with uncertainty has consistently been demonstrated across numerous disciplines to provoke feelings of fear, worry, anxiety, uneasiness, perceptions of vulnerability, denial, and disinterest.[48,92,94,95] These feelings then likely influence that individual's decision-making abilities and contribute to cognitive error.

Some clinicians may respond to uncertainty with avoidance, putting patients at great risk of perceived medical gaslighting – the downplaying or total denial of suffering symptoms.[48,97] Other clinicians may tend towards anxious responses when confronted with uncertainty. This phenomenon has been long studied and identified as a concern for health care settings.[98–102] Estimates suggest 17% of excessive medical care costs (ie, extended hospital stays, ordering unnecessary tests, more referrals) are the result of clinicians with high anxiety due to uncertainty.[98,99,101]

It is emphasized that in order to experience uncertainty, one must be consciously aware that uncertainty exists. If a clinician lacks conscious awareness of uncertainty during a complex medical case, they are likely relying on system 1 thinking and are vulnerable to its associated biases. On the other hand, a fault in system 2 thinking may occur only when a clinician can consciously acknowledge the uncertainty and ambiguity present in a complex medical case. It is the degree of metacognition available to a clinician during a complex medical case that differentiates between which system of thinking is most likely to be adopted. And, when this metacognition is lacking in a complex case, a clinician's tolerance or intolerance with uncertainty or ambiguity may not be the most significant factor affecting diagnostic decision making as the literature suggests.[48,91,93,94,103,104] Consequently, strategies that solely address increasing one's tolerance to uncertainty or ambiguity may not be beneficial in improving overall clinician care with this subgroup of patients.

Current Literature on Attachment Theory

Definition

Attachment theory states that our relational patterns and interactions as adults are heavily influenced by our earliest attachments in childhood, particularly with primary caregivers.[105–108] Research on attachment theory highlights how early relational experiences shape genetic expression, influence the development of the neuronal cytoarchitecture in the neocortex, and create representative schemas that drive subconscious programming and unconscious mechanisms.[105–113] Attachment is also theorized to be related to one's stress response, conflict resolution skills, communication skills, level of emotional intelligence, locus of control, and metacognitive abilities.[106,107,110–121] Simply by being in a position either in need of care or expected to provide care is thought to be enough to activate one's internal model of attachment.[105,107,122] And, while attachment theory has primarily been studied in patients, it is equally relevant to clinicians. If attachment shapes how individuals process uncertainty and interpret social cues, then a clinician's attachment style may unconsciously influence clinician–patient interactions. This is particularly important in ambiguous cases where the potential for reinforcing cognitive patterns that sustain diagnostic errors is great.

Individuals may present with a secure attachment, dismissive attachment, preoccupied attachment, or fearful attachment style.[106,108,110,112] Those who display traits of a dismissive attachment organization seem to avoid negative emotion and vulnerability, often maintaining and projecting hyper independence, while those with a preoccupied attachment style tend to experience a hyperfixation of their own value and worth, sometimes clinging to the need for predictability.[106,108,110] With possible risk of over-simplification, those with a dismissive attachment style can be thought of as "other-focused", while those with a preoccupied attachment can be thought of as "self-focused". Individuals who fall into the "fearful" category are overwhelmingly representative of those diagnosed with significant psychiatric and personality disorders. Due to the multifaceted nature of fearful attachment and its strong association with psychiatric and personality disorders, this group is intentionally excluded from this discussion, as it falls outside the scope of this paper.[123]

Chronic Illness Patients

Different studies reveal that chronic illness patients display significantly higher rates of insecure attachment styles than the general population.[123,124] Particularly, pain-specific conditions seem to be associated with a dismissive attachment style, while preoccupied attachment seems to be associated with a much wider range of syndromes presenting with diffuse presentations.[123,125,126] Additionally, research consistently shows that perceived threats to one's safety and security can trigger attachment disorganization in individuals with a history of insecure attachment.[107,119,120,] Given the immense medical trauma – both physical and psychological – experienced by many complex chronic illness patients, it is not hard to imagine how this subgroup may become trapped in a chronic cycle of reactivation.

Tragically, research demonstrates that clinicians more commonly rate patients with insecure attachment styles as "difficult", while those with a secure attachment are typically viewed as "easy" or "compliant".[124] However, a review of the literature suggests that research on this topic has only examined attachment from the angle of the patient, potentially enabling significant rater bias.[124] What are the attachment styles of the clinicians who rate insecure patients as "difficult?" For example, in Maunder et al's[124] work on this topic, the Doctor–Patient Relationship Questionnaire (DDPRQ-10) was used to measure patient difficulty. One sample item from this questionnaire asked, "to what extent are you frustrated by this patient's vague complaints?" The answers to this questionnaire were then compared to a patient's attachment style to reveal such a relationship. Yet, research in other contexts suggests that individuals with insecure attachment styles tend to express lower levels of distress tolerance.[119]

Countertransference

Countertransference – a clinician's unconscious emotional reactions or responses towards a patient – may play a significant role triggering attachment-related mechanisms.[127] In one study, Hausmann et al[128] found a significant rate of negative physician–patient relations when African-American patients reported a history of experienced racial and class bias, despite a lack of implicit bias present during the observed encounter. These interactions contrasted with cases where

African-American patients did not report a history of experienced bias. The authors theorize that disconcerting encounters may prime patients for similar engagements shaping one's overall affect. Through countertransference, clinicians may unconsciously mirror a patient's negative affect leading to unfavorable interactions and a breakdown in communication for both parties. Considering the lengthy diagnostic interval many complex chronic illness patients endure as well as the significant rates of wrongful diagnosis and treatments, accusations of psychosomaticism, and heightened risk of perceived medical gaslighting, we can begin to understand how a similar relational pattern may be at play within this subgroup, especially when other gender, racial, class, educational, psychiatric or relevant unconscious stereotypes are added on top.[5,7,129,130] And, once again, if we examine a clinician's attachment style in these relationships, we may find that those with an insecure attachment are more likely to mirror or negatively react to a patient's understandable fear and trauma. In contrast, securely attached clinicians may be better equipped to separate a patient from their affect.[114,115,131]

In other relational contexts, significant associations have been found between insecure attachment organization and negative attribution bias, which is the tendency to misinterpret other's behavioral and social cues through the lens of negative cognitive distortions.[132] This may also contribute to spiraling relationships during times of countertransference in these unique medical cases.

Clinician Cognition

Limited research has been conducted on clinician attachment. Though, one study found that 44.4% of medical students possess an insecure attachment style – a statistic similar to that of the general population.[113,133] And, although one's attachment style may underlie an individual's (in)tolerance to uncertainty or ambiguity, it does not require the same cognitive awareness to become triggered affecting a clinician's decision-making abilities and subsequent behaviors.[104]

As mentioned earlier, our brain in its most primal form is "uncertainty-avoidant" creating neural circuits that reinforce an internal sense of safety and security, even at the cost of cognitive accuracy.[43] Attachment is theorized to act as an unconscious mechanism molded during one's formative years with the goal of establishing an internal sense of safety and security, while an insecure attachment acts as an exaggerated response compensating for poor establishment. Considering this, might it be possible that attachment significantly influences these primal neural mechanisms?

While clinician cognition has traditionally been examined through isolated cognitive traits (eg, metacognition, open-mindedness, critical thinking), insecure attachment may act as a first-order mechanism, shaping these traits at a fundamental level. Unlike discrete cognitive tendencies, attachment influences a clinician's baseline cognitive style, emotional regulation, and stress response, making it a cross-cutting factor that permeates multiple variables in Croskerry et al's framework.[134] In other words, attachment security – or insecurity – does not merely contribute to cognitive tendencies; rather, it may predispose clinicians to certain cognitive styles and biases before they even engage in explicit reasoning.

In one study, Mikulincer[104] found that a secure attachment style is associated with curiosity, openness, and positive feelings towards information processing during times of ambiguity. It appears that individuals with a secure attachment tend to demonstrate flexibility in schema formation and integration when presented with novel data: there is an ease in reevaluating the known with the unknown. In contrast, those with insecure attachment are more reluctant to open their schemata when presented with new information, often displaying a high need for cognitive closure: the ease comes from a sense of security and stability at the cost of cognitive accuracy.

Expanding on this research, Warren, et al[135] investigated the neural link between adult attachment and cognitive control. The authors coded participants' secure-base-script knowledge, a measure of their mental representation of attachment experiences. Participants then completed an emotion-word Stroop task while undergoing functional magnetic resonance imaging (fMRI). Overall, this study found that those with a lower secure-base-script showed significant evidence of compensatory mechanisms for cognitive control while simultaneously demonstrating significantly more errors for both unpleasant and pleasant stimuli during implicit processes. Specifically, these authors found that those with lower secure-base-scripts showed enhanced activity in the lateral and medial orbitofrontal cortex – areas that regulate emotion –, the superior frontal gyrus in the right hemisphere – an area responsible for inhibitory functions –, and left-frontal activity and dorsal anterior cingulate cortex during pleasant words – areas responsible for top-down attentional

control. Put simply, individuals with attachment insecurity not only used greater neural resources to maintain relevant attention to the task, but these compensatory mechanisms became less effective as task intensity increased. Further, this neurobiological evidence of compensatory cognitive control mechanisms may provide a foundation for future research exploring the System 1/System 2 conflict in complex medical cases involving SDFs.

Attachment and Bias in Clinical Decision-Making

In light of the above, it is possible that clinicians with insecure attachment styles express lower levels of metacognition concerning the presence of uncertainty during complex medical cases with SDFs. These clinicians may rely more frequently on system 1 decision-making and its associated biases. And, when the uncertainty is overwhelming and triggers a system 2 approach, one may predict that insecurely attached clinicians would display significantly higher rates of overconfidence, premature closure, anchoring bias, confirmation bias, and measurement bias in comparison to securely attached clinicians. Importantly, these are all biases that tend to close medical cases much quicker, but sacrifice diagnostic accuracy.[10,12,15,] On the other hand, secure clinicians may be more consciously aware of the uncertainty in a complex case, despite SDFs, demonstrating higher rates of effective system 2 decision-making and, overall, lower rates of cognitive error.

Of course, it is important to note that a secure attachment does not negate one's propensity for bias or errors in cognition as cognition is highly complex. Croskerry, et al[134] published an excellent framework with six clusters demonstrating how multivariable the challenge of diagnostics is, with each cluster emphasizing a component of the clinician's individual characteristics, challenges, or environmental factors, patient-related characteristics, or disease presentation. However, as discussed above, it is highly possible that an insecure attachment makes a clinician much more susceptible to, or influenced by, many of the variables described in Croskerry et al's[134] clusters. And, therefore, should be thought of as a first-order mechanism rather than merely one of several equally weighted factors.

For instance, Cluster B specifically discusses cognitive characteristics of the clinician. Some of the characteristics listed include metacognition, adaptiveness, active open-mindedness, reflection, perseverance, and critical thinking. Open-mindedness, cognitive flexibility, curiosity, persistence and perseverance, specifically, may be viewed as foundational precursors to critical thinking skills.[136–138] Mikulincer and Warren et al[104,135] suggest that insecure attachment acts as a priming mechanism influencing the expression of these cognitive traits. Given that these traits are critical for effective clinical reasoning, clinicians with insecure attachment styles may face inherent disadvantages when navigating complex, uncertain, high-intensity, or high-emotional scenarios – factors that define complex medical patients.

The authors also propose signal detection theory as a model for understanding pattern recognition accuracy during the diagnostic process.[134] This theory posits that diagnostic accuracy depends on the signal-to-noise ratio – the more noise, the higher the risk. In this context, noise may include heightened uncertainty, multisystemic symptoms, or even SDFs. Building on Warren et al's[135] findings, we can hypothesize that insecure attachment elevates the baseline level of unconscious noise in clinician cognition due to increased neural activation in implicit processing. This suggests that attachment insecurity does not just increase cognitive effort – it may actively reduce the cognitive resources available for accurate pattern recognition and diagnostic reasoning. If insecure attachment raises the baseline cognitive noise level, clinicians may experience a lower cognitive load threshold requiring greater attentional resources to maintain diagnostic accuracy. Over time, this may lead to cognitive fatigue, decision inertia, and an increased reliance on heuristics, ultimately heightening the risk of diagnostic errors. Future research should investigate whether this heightened baseline noise and increased cognitive control contributes to higher diagnostic error rates, particularly in complex cases.

Although direct studies linking clinician attachment style to diagnostic error rates are lacking, extensive research on attachment, cognitive control/flexibility, and decision-making biases provide a strong neurocognitive foundation for this theoretical framework. With growing recognition of metacognition and cognitive biases in medical error research, future studies should integrate attachment theory into this domain, bridging a critical yet unexplored gap in clinician cognition.

Attachment-Specific Bias Mitigation Strategies

In addition to attachment insecurity acting as a primal barrier to cognitive accuracy, those with a dismissive attachment compared to a preoccupied attachment may require different bias mitigation strategies. Doolan & Bryant's[139] research

supports that cognitive bias modification techniques targeting interpretations (CBM-I) training conducted on non-clinical adults with high attachment anxiety improves attachment-related biases to represent that of more secure attachment. However, CMB-I did not appear to significantly influence those with a dismissive attachment style, potentially illuminating the importance in understanding this differentiation.

Other studies emphasize significant differences in unconscious, preconscious, and conscious cognition during times of attachment-related threat. These differences are particularly evident in individuals with a preoccupied attachment style when required to prioritize self-transcendence values over self preservation, compared to those with a dismissive attachment style.[119,120,122] Notably, some evidence suggests that in dismissively attached individuals, attachment activation may never reach conscious awareness during an attachment-related threat. This is in stark contrast to those with a preoccupied attachment style who display significant levels of conscious attachment activation in both neutral and threatening contexts.[119,120] This brings into question the differing levels of metacognition available to clinicians dependant on attachment style and may offer at least one possible explanation for the mixed results in the literature that focuses on using debiasing techniques to improve clinician cognition.[14,62,140,141] Further, this encourages us to consider other strategies that may better support cognitive processes in clinicians who specifically display dismissive attachment disorganization.

Unconscious Feedback Loop in Medicine

Given the number of specialists a complex chronic illness patient consults during their diagnostic odyssey, it is likely that every patient in this subgroup has encountered at least one clinician that falls into the category of "insecure". According to the literature, such encounters may put them at great risk of unfavorable interactions. Often, out of desperation to feel seen and heard, these patients choose to not return back to the same clinician following such an encounter. This lack of care continuity poses a significant problem. Without clinicians receiving the adequate feedback necessary to trigger proper metacognition to override bias, the resulting neural connections underlying their cognitive errors strengthen putting future patients at risk. In fact, research shows that when a patient does not return to a practice, those clinicians are more likely to assume that either their original conclusions were correct or that the patient healed: clinicians rarely assume fault.[24,130] These scenarios also deny insecurely attached clinicians – particularly those susceptible to negative attribution bias or with higher rates of implicit bias – the opportunity to develop empathy for this subgroup of patients, further perpetuating the labeling of "difficult", potentially triggering a lower threshold for future countertransference to occur, all while these wrongful neural connections continue to strengthen.[63,68,72,129,]

In view of this, we can begin to conceptualize the unconscious feedback loop within the field of medicine – one that continues to withstand tremendous technological advancements, particularly in cases involving patients with undiagnosed complex chronic conditions. And, with this conceptualization, the hope is to offer a deeper understanding of why previous cognitive strategies may have failed, igniting further curiosity for research on such a neglected, yet necessary, topic: one that is essential if we truly want to improve overall clinician care and patient outcomes at their utmost core.

Discussion

Medicine is a science of the grey. It is filled with uncertainty, ambiguity, exceptions, relational transactions, and the entire complexity of the human experience. Complex chronic illness patients embody this "grey reality". They are the exceptions; the patients who fall outside of algorithms and probabilities while simultaneously filling clinician rooms with all of the nuances that separate us from computers and robots. As medical technology rapidly advances, we see ourselves moving towards a new generation of medicine in which artificial intelligence (AI) is expected to play an increasingly significant role in diagnostics to encourage efficiency and accuracy. Yet, decades of research show that the rate of wrongful diagnosis does not diminish in the face of technological advancements and that AI systems are just as prone to bias as the humans who develop them.[14,43,142] Given these limitations, the medical field must critically assess AI's blind spots and recognize that diagnostic inaccuracy is rarely a technological or knowledge-based problem – it is fundamentally a thinking and a relational one, particularly in the context of complex patients.

Some research has examined the use of type two processing, clinician reflection, feedback, debiasing strategies, cognitive forcing techniques, and tolerance for uncertainty as potential solutions to reduce diagnostic

errors.[12,14,24,56,57,62,75,78–90] However, these studies are often small, not necessarily generalizable, and tend to yield mixed results across clinicians and scenarios: most results do not seem particularly promising. Specifically, in the context of complex medical cases, some experimental studies have found that clinician reflection improves diagnostic accuracy.[57,62,76,80,82,83] Unfortunately, significant time constraints and other systemic barriers make it impractical for clinicians to reflect on every case. This raises a crucial question: why do many clinicians fail to recognize which cases require deeper reflection in the first place?

Additionally, diagnostic support tools, while valuable in theory, often fail in real-world scenarios due to the same metacognitive limitations. If a clinician does not recognize uncertainty, they are unlikely to seek assistance.[3,62,64,143,144] This suggests that improving diagnostic accuracy is not just a matter of refining AI or implementing debiasing strategies; it requires a deeper understanding of how the interplay between emotion and cognition shapes clinicians' thinking and decision-making. This review proposes that improving diagnostic accuracy is not merely about a clinician's focus on a patient's words, symptoms, or data, but rather the subtle effects of how clinicians relate to others' distress through their own attachment styles–technology's blindspot.

Beyond individual cognition, we must acknowledge that our current medical education may unintentionally reinforce attachment-related biases through a semi-rigid curriculum that ingrains a reliance on right and wrong answers, systems, and protocols.[94,145] The curriculum's overuse of multiple-choice tests, combined with heuristics such as, "When you hear hoofbeats, think horses not zebras", may foster an over-reliance on probability, algorithms, and pattern-recognition catered towards more common and typical presentations of illness while inadvertently offering a false sense of safety and security through an unrealistic, yet, predictable certainty.[94,145] This method of teaching may, regrettably, strengthen neural pathways that cause some to become more susceptible to cognitive error in an unconscious search for this false sense of safety and security. In practice, this may manifest as a gravitational pull toward SDFs, cognitive closure tendencies, improper reliance on system 1 thinking, or increased vulnerability to cognitive bias for unconscious "relief". Given that research demonstrates these neural patterns are highly resistant to change once established, we must ask if our medical school curriculum unintentionally sets some clinicians up for failure when confronted with complex patients.[43]

Future research should not only explore how attachment theory influences clinician cognition and decision-making abilities when presented with undiagnosed complex chronic illness patients, but it must also examine how medical education may be redesigned to mitigate these cognitive vulnerabilities. Understanding these mechanisms can pave the way for curricular reforms that foster cognitive flexibility, metacognitive awareness, and critical thinking skills so clinicians are better equipped to navigate such scenarios with confidence and security. For our healthcare system's success can only truly be possible through its success with our most difficult and vulnerable patients.

Conclusion

This review proposes a theoretical framework that serves as a starting point for researchers and academics to explore the severely neglected intersection of attachment style, emotion and clinician cognition. Variations in attachment style may directly or indirectly influence a clinician's metacognitive awareness of uncertainty, cognitive control and flexibility, tolerance for uncertainty, inappropriate use of system 1 thinking, susceptibility to cognitive and implicit biases, cognitive load threshold, and ability to recognize SDFs – all of which impact diagnostic accuracy in complex medical cases.

Advancing this research through rigorous, peer-reviewed studies will be essential to understanding the interplay of these nuanced cognitive and relational factors. Only by doing so can we develop practical recommendations for clinicians, educators, and policymakers to reduce diagnostic error and mitigate bias in medical decision-making. If we fail to address the unconscious forces shaping clinician cognition, diagnostic errors will persist – not due to lack of knowledge, but because of cognitive blind spots we refuse to confront.

Disclosure

The author reports no conflicts of interest in this work.

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