Chapter 3

Applied Mathematics in Mental Health: A Game-Theoretic Perspective on Psychological Symptoms

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Abstract

For decades, psychological symptoms have primarily been interpreted as indicators of dysfunction and pathology. However, recent developments in evolutionary psychiatry, mathematical psychology, and computational modeling suggest that certain symptoms may also be understood as adaptive responses to environmental challenges. This chapter examines mental health through the lens of game theory and proposes that many psychological symptoms can be conceptualized as equilibrium strategies emerging from interactions between individuals and their environments. Anxiety, social anxiety, depression, obsessive-compulsive behaviors, and post-traumatic stress responses are analyzed as strategic adaptations shaped by costs, benefits, uncertainty, and risk management. Particular attention is given to Nash equilibrium as a framework for understanding the persistence of apparently maladaptive behaviors. The chapter further argues that psychotherapy and psychiatric interventions may be interpreted as processes that alter payoff structures rather than merely suppress symptoms. By integrating applied mathematics with contemporary psychological theory, the chapter offers a novel perspective on the origins, maintenance, and treatment of psychological symptoms.

1. Introduction

Mental disorders represent one of the most significant public health challenges of the twenty-first century. Depression, anxiety disorders, obsessive-compulsive symptoms, and trauma-related conditions contribute substantially to disability, reduced quality of life, and increased economic burden worldwide. According to evolutionary psychiatry, however, psychological symptoms should not always be viewed exclusively as indicators of dysfunction. Instead, some

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symptoms may reflect adaptive mechanisms that evolved to help individuals cope with environmental uncertainty, social competition, and potential threats **(Nesse & Williams, 2012; Nesse, 2019)**. Traditional psychiatric models typically conceptualize symptoms as pathological deviations from normal psychological functioning. While this perspective has contributed substantially to advances in diagnosis and treatment, it often leaves unanswered a fundamental evolutionary question: why are psychological responses such as anxiety, vigilance, social sensitivity, and withdrawal so widespread across human populations? If these responses were entirely maladaptive, natural selection would be expected to reduce their prevalence over evolutionary time. The persistence of such phenomena suggests that they may have served important adaptive functions under certain environmental conditions **(Nesse, 2005)**. Recent advances in mathematical psychology, computational psychiatry, and evolutionary behavioral sciences have provided new frameworks for addressing this question. Computational models increasingly conceptualize human cognition as a predictive system that continuously evaluates environmental risks, rewards, and uncertainties **(Friston, 2010; Huys et al., 2016)**. Within these frameworks, behavior can often be interpreted as a strategic response to perceived environmental contingencies rather than merely a consequence of dysfunction. Game theory offers a particularly powerful mathematical framework for examining such strategic behavior. Originally developed by **Von Neumann and Morgenstern (1947)** and later expanded through **Nash's (1950)** equilibrium concept, game theory analyzes situations in which outcomes depend not only on an individual's decisions but also on environmental conditions and the actions of other agents. The subsequent development of evolutionary game theory by **Maynard Smith (1982)** further demonstrated how stable behavioral strategies can emerge through adaptive processes over time.

This chapter argues that many psychological symptoms can be understood as strategic responses generated by cognitive systems attempting to minimize losses, manage uncertainty, and maximize long-term outcomes. Anxiety, social anxiety, depression, obsessive-compulsive behaviors, and post-traumatic stress responses are examined as potential Nash equilibrium strategies that emerge from interactions between individuals and their environments. From this perspective, symptoms may not always reflect failures of the mind; rather, they may represent solutions to complex adaptive problems, even when those solutions produce substantial subjective distress.

2. Game Theory and Human Behavior

Game theory was originally developed to analyze strategic decision-making in economics and military conflicts **(Von Neumann & Morgenstern, 1947)**. However, its applications have expanded considerably and now encompass biology, psychology, political science, and neuroscience. At its core, game theory examines situations in which the outcomes of a decision depend upon the interaction between multiple agents, each pursuing strategies that maximize their perceived payoffs. One of the most influential concepts in game theory is the Nash equilibrium **(Nash, 1950)**. A Nash equilibrium exists when no player can improve their outcome by unilaterally changing their strategy while other players maintain theirs. Importantly, equilibrium does not necessarily imply optimality or well-being. Instead, it represents a stable state in which alternative strategies appear less advantageous given existing conditions. This distinction is particularly relevant for understanding psychological symptoms. Many forms of behavior that appear maladaptive from an external perspective may nevertheless constitute stable responses within an individual's subjective payoff structure. Evolutionary game theory further suggests that such strategies may persist if they historically provided survival or reproductive advantages under specific environmental circumstances **(Smith, 1982)**. From a psychological perspective, individuals continuously evaluate potential gains and losses associated with social interactions, threat detection, resource allocation, and decision-making. Cognitive systems evolved to operate under uncertainty, where the costs of different types of errors are often asymmetrical **(Cosmides & Tooby, 1996)**. Consequently, behavioral strategies may emerge that prioritize minimizing catastrophic losses rather than maximizing immediate comfort or happiness. Game theory therefore provides a useful framework for examining psychological symptoms not simply as pathological outcomes but as strategic adaptations shaped by environmental contingencies, risk assessment, and evolutionary trade-offs.

3. Social Anxiety as an Equilibrium Strategy

Social anxiety is traditionally defined as a persistent fear of negative evaluation, embarrassment, or rejection in social situations. Individuals experiencing social anxiety often avoid social interactions, public speaking, initiating conversations, or situations in which they may become the focus of attention. Conventional clinical models typically interpret these behaviors as maladaptive responses arising from distorted cognitions, excessive fear, or dysfunctional beliefs. While such explanations have received substantial empirical support, they do not fully explain why social anxiety remains one of the most common psychological conditions across cultures and historical

periods. An evolutionary perspective offers an alternative interpretation. According to **Gilbert (2001)**, social anxiety may be understood as a form of competitive anxiety emerging from social hierarchies. Human beings compete not only for material resources but also for social resources such as approval, prestige, support, friendship, and status. Within such competitive environments, individuals continuously evaluate their relative position and assess the potential consequences of social success or failure. When individuals perceive themselves as possessing fewer desirable attributes than others, or when they fear losing their current social standing, social interactions may become associated with significant risks. In these contexts, behaviors such as silence, withdrawal, gaze avoidance, concealment, and heightened self-monitoring may function as defensive strategies designed to reduce the likelihood of social defeat. **Gilbert (2001)** argues that many of these responses resemble evolved subordinate-defense mechanisms that historically reduced conflict with higher-status individuals and minimized the costs of social exclusion. From a game-theoretic perspective, these observations suggest that social anxiety may not simply represent dysfunctional behavior. Instead, it may emerge as a strategic response to a perceived social environment characterized by asymmetric costs and benefits.

3.1. A Simple Game-Theoretical Model of Social Anxiety

Let's construct a two-player, two-strategy Nash game between a socially anxious individual and the social environment. A more realistic formulation is:

Players

1. Player 1: Socially Anxious Individual
2. Player 2: Social Environment (group, audience, peers)

Strategies

A. Socially Anxious Individual
   1. Participate (P)
   2. Avoid (A)

B. Social Environment
   1. Accept/Respond Positively (R)
   2. Reject/Evaluate Negatively (N)

C. Subjective Payoff Matrix

The first value is the individual's payoff; the second value is the environment's payoff.

Before presenting the payoff matrix, it is important to emphasize that the numerical values are not intended to represent empirically measured utilities. Rather, they are illustrative values designed to capture the subjective evaluation of social outcomes commonly observed in individuals with social anxiety. Consistent with cognitive and evolutionary accounts of social anxiety **(Gilbert, 2001; Haselton & Buss, 2000)**, socially anxious individuals tend to overestimate the costs of social rejection while simultaneously underestimating their ability to cope with negative social outcomes. Consequently, the model assigns a relatively large negative payoff to rejection and a comparatively high positive payoff to social acceptance. The numerical values therefore serve as conceptual representations of perceived costs and benefits rather than objective measurements.

Table 1. Subjective payoff matrix for social anxiety

	Environment: Accept (R)	**Environment: Reject (N)**
Participate (P)	(8, 5)	(-20, 2)
Avoid (A)	(0, -1)	(0, 0)

Interpretation

I. (P,R): The individual participates and receives acceptance. This is highly rewarding for the individual (+8) and beneficial for the social environment (+5).

II. (P,N): The individual participates but experiences rejection. For a socially anxious person, rejection is perceived as extremely costly (-20).

III. (A,R): The environment would have been accepting, but the individual avoids interaction. The individual gains neither reward nor punishment (0), while the environment loses a potential interaction (-1).

IV. (A,N): Avoidance prevents interaction altogether. Neither side gains much (0,0).

The payoff value of +8 assigned to participation in a supportive environment reflects the substantial psychological rewards that may accompany successful social engagement, including social acceptance, belongingness, approval, increased self-confidence, and access to interpersonal support. The corresponding payoff of +5 for the social environment reflects the benefits of reciprocal interaction, group cohesion, communication, and mutual

cooperation. The payoff values associated with successful participation are intentionally asymmetric. A value of +8 is assigned to the socially anxious individual because successful social engagement may generate multiple psychological benefits simultaneously, including social acceptance, increased self-confidence, reduced uncertainty, enhanced belongingness, and positive corrective experiences. By contrast, the social environment receives a payoff of +5 because, although it benefits from interaction, communication, and group cohesion, the magnitude of these gains is typically less transformative than the benefits experienced by the individual. The asymmetry reflects the assumption that a successful interaction is psychologically more consequential for the socially anxious individual than for the surrounding social group.

By contrast, the payoff of -20 assigned to participation in a critical environment reflects the disproportionate weight that socially anxious individuals often assign to rejection, embarrassment, criticism, or perceived social failure. The value is intentionally larger in magnitude than the reward associated with acceptance, reflecting evidence that socially anxious individuals frequently perceive negative social outcomes as considerably more impactful than positive ones **(Gilbert, 2001)**. The payoff of 0 assigned to avoidance represents a neutral outcome in which the individual neither obtains social rewards nor experiences immediate social threats. Similarly, when the individual avoids participation in a critical environment, neither player experiences a meaningful change in outcome, resulting in a payoff of (0,0). The environment, however, is assigned a modest positive payoff (+2) rather than a neutral payoff. This reflects the possibility that criticism, exclusion, or negative evaluation may help maintain existing social hierarchies, reinforce group norms, or preserve the relative status of dominant individuals within the group.

Finally, the value of -1 assigned to the social environment when the individual avoids participation despite a potentially supportive context represents a small social cost. The group invests time, attention, and opportunities for interaction but receives limited reciprocal engagement in return. Although this cost is minor compared to the individual's perceived risk of rejection, it reflects the loss of potential communication, cooperation, and social exchange. his asymmetry is intentional and represents a central feature of social anxiety. For the socially anxious individual, the possibility of criticism, embarrassment, rejection, or status loss is often perceived as highly consequential. Negative social evaluation may threaten belongingness, self-esteem, social standing, and future participation opportunities. Consequently, the subjective cost associated with rejection is modeled as substantial (-20). By contrast, when the individual chooses avoidance, the social environment experiences only a modest opportunity cost (-1). Although the group loses a potential interaction,

communication opportunity, or contribution, it does not experience a loss comparable to the one perceived by the socially anxious individual. In most social settings, the consequences of one person's silence are relatively minor for the group as a whole. Therefore, the difference between -10 and -1 reflects the disproportionate psychological weight assigned to social rejection by socially anxious individuals.

For the socially anxious individual:

1. If the environment is accepting:

a) Participate = 8

b) Avoid = 0

Best response = Participate

2. If the environment is rejecting:

a) Participate = -20

b) Avoid = 0

Best response = Avoid

Now assume the individual believes there is a substantial probability of rejection. The expected payoff of participation becomes:

$U(p)=8p+(1-p)(-20)$

where p is the perceived probability of acceptance.

Participation becomes preferable only if:

$8p-20(1-p)>0$

Then, $28p>20$, so $p>0.714$. Thus, the socially anxious individual must believe that acceptance is more than 71.4% likely before participation becomes rational.

3.1.1. Social Anxiety as a Nash Equilibrium

Consider a noncooperative game involving n players, where each player i chooses a strategy Si for i=1,2,…n. A strategy profile (S1*, S2*,…, Sn*) is said to be a Nash equilibrium when each player's chosen strategy is the best response to the equilibrium strategies of all other players. In other words, once every player adopts their equilibrium strategy, no individual player can improve their own outcome by unilaterally switching to a different strategy. For example, in a two-player game, the strategy pair (S1*, S2*) constitutes a Nash equilibrium if player 1 cannot achieve a higher payoff by deviating

from S1* while player 2 continues to play S2*, and similarly, player 2 cannot improve their payoff by changing from S2* while player 1 maintains S1*. Thus, a Nash equilibrium represents a stable strategic configuration in which no player has an incentive to deviate alone **(Nash, 1950)**.

The structure of the matrix reveals two Nash equilibria. The first equilibrium occurs at (Participate, Supportive Environment) with payoffs of (8,5). If the individual were to unilaterally switch from participation to avoidance, the payoff would decrease from 8 to 0. Likewise, if the environment were to unilaterally switch from a supportive to a critical stance, its payoff would decrease from 5 to 0. Consequently, neither player has an incentive to change strategy, making this outcome a Nash equilibrium.

A second Nash equilibrium emerges at (Avoid, Critical Environment) with payoffs of (0,0). If the environment remains critical, the individual would reduce their payoff from 0 to -10 by choosing to participate. Therefore, avoidance remains the individual's best response. Similarly, if the individual remains silent, the environment would reduce its payoff from 0 to -1 by becoming supportive. As a result, the environment also lacks an incentive to change strategy unilaterally. Since neither player can improve their outcome by changing strategy alone, this outcome also satisfies the definition of a Nash equilibrium.

From a psychological perspective, the second equilibrium is particularly important. It represents a stable but socially suboptimal state in which avoidance and social disengagement become self-reinforcing. The socially anxious individual avoids participation because speaking is perceived as excessively risky, while the environment gradually reduces efforts to engage someone who consistently withdraws. Over time, this interaction pattern becomes increasingly stable, not because it maximizes well-being, but because neither player perceives an immediate benefit from changing strategy independently. Thus, social anxiety can be conceptualized as a Nash-type equilibrium maintained by a subjective payoff structure in which the perceived cost of rejection greatly exceeds the potential reward of acceptance. The individual is not necessarily behaving irrationally. Rather, avoidance represents the most advantageous strategy available within the individual's perceived social reality. The persistence of social anxiety may therefore reflect the stability of an equilibrium rather than a failure of decision-making.

Table 2. Nash equilibrium analysis of the social anxiety game

Outcome	Individual Deviation Profitable?	Environment Deviation Profitable?	Nash Equilibrium?
(Participate, Supportive) = (8,5)	No (8 ✍ 0)	No (5✍ 2)	**Yes**
(Participate, Critical) = (-20,2)	Yes (-20 ✍ 0)	Yes (2 ✍ 5)	No
(Avoid, Supportive) = (0,-1)	Yes (0 ✍ 8)	Yes (-1 ✍ 0)	No
(Avoid, Critical) = (0,0)	No (0 ✍-20)	No (0 ✍ -1)	**Yes**

The existence of two Nash equilibria suggests that social interactions involving socially anxious individuals may stabilize around either a high-engagement or a low-engagement state. The first equilibrium is socially desirable because both parties benefit from participation and support. The second equilibrium, however, is particularly relevant for understanding the persistence of social anxiety. Although neither player receives substantial benefits, neither can improve their outcome through unilateral strategy change. Consequently, avoidance and social disengagement become self-reinforcing, creating a stable but socially suboptimal equilibrium. In other words, remaining silent becomes the safer strategy for the individual, while maintaining a critical stance becomes the safer strategy for the environment. As a result, the interaction stabilizes around a state in which neither party has an incentive to change strategy unilaterally. If the individual alone shifts from avoidance to participation, the payoff decreases from 0 to -20, exposing the individual to substantial perceived social risk. Similarly, if the environment alone shifts from a critical to a supportive stance while the individual continues to avoid participation, its payoff decreases from 0 to -1 because the effort invested in encouraging interaction yields little return. Consequently, both parties maintain their current strategies, producing a stable Nash equilibrium. Over time, the environment may reduce efforts to engage the individual, reasoning that "the person is unlikely to participate anyway," thereby reinforcing the individual's avoidance and sustaining the equilibrium.

3.1.2. Therapeutic Change as Payoff Restructuring

The game-theoretic interpretation of social anxiety has important implications for understanding psychological treatment. Traditional clinical approaches often describe psychotherapy as a process that reduces symptoms, corrects distorted beliefs, or improves emotional regulation. While these explanations remain valuable, a game-theoretic perspective offers an additional interpretation: psychotherapy may function by altering the payoff structure that maintains maladaptive behavioral equilibria. In the model presented above, avoidance emerges as a rational response because the perceived cost of social rejection substantially exceeds the potential benefits of social participation. Importantly, the maintenance of social anxiety does not necessarily depend on the objective reality of social situations. Rather, it depends on how the individual subjectively evaluates potential outcomes. Consequently, therapeutic change can occur when these subjective evaluations are modified.

Cognitive-behavioral approaches provide a clear example of this process. Individuals with social anxiety frequently interpret social rejection as catastrophic, assigning disproportionately large costs to negative social outcomes. A minor conversational mistake may be interpreted as evidence of incompetence, embarrassment, or permanent social exclusion. Through cognitive restructuring, individuals gradually learn to challenge these assumptions and develop more balanced interpretations of social experiences. Exposure-based interventions operate through a similar mechanism. Repeated exposure to feared social situations often reveals that anticipated negative outcomes either do not occur or are considerably less severe than expected. Over time, the individual learns that rejection, criticism, or social awkwardness are not necessarily catastrophic events. Instead, they become manageable experiences that can provide opportunities for learning and adaptation.

As a result, the subjective payoff structure changes. Before therapy, participation in a critical environment may be perceived as producing a payoff of -20, reflecting severe anticipated psychological costs. After successful therapeutic intervention, the same outcome may be perceived differently. The individual may begin to think:

"If I participate, something positive may happen (+8). Even if the interaction is not successful, I will gain experience, learn something useful, and improve my future performance (+1)."

Failure is no longer interpreted as punishment; it becomes information.

Consequently, the payoff matrix may be transformed as follows:

Table 3. Payoff matrix after psychotherapy

	Supportive Environment	**Critical Environment**
Participate	(8,5)	(1,2)
Avoid	(0,-1)	(0,0)

The critical change occurs in the individual's evaluation of participation under potentially negative social conditions. The perceived payoff associated with rejection shifts from -20 to +1, not because rejection becomes pleasant, but because it is reinterpreted as a tolerable and potentially informative experience rather than a catastrophic social failure. This transformation has important implications for equilibrium behavior. In the original matrix, avoidance was the individual's best response when facing a critical environment because participation would reduce the payoff from 0 to -20. In the revised matrix, however, participation yields a payoff of +1 while avoidance remains at 0. Under these conditions, participation becomes the more attractive strategy.

Likewise:

$U(p)=8p+1(1-p)$

Then, $7p+1>0$ i.e. participation becomes a dominant strategy for the individual. When even negative social outcomes are reinterpreted as opportunities for learning and growth, participation becomes beneficial regardless of the social response received. In game-theoretic terms, participation may become a dominant strategy rather than merely an equilibrium response.

From a game-theoretic perspective, psychotherapy weakens the stability of the avoidance equilibrium by changing the incentives that sustain it. The previously stable equilibrium of (Avoid, Critical Environment) becomes increasingly difficult to maintain because the individual's subjective evaluation of social risk has fundamentally changed. As participation increases, opportunities for positive social experiences also increase, creating the possibility of movement toward more adaptive equilibria characterized by engagement, communication, and social support. Importantly, this framework suggests that therapeutic improvement does not necessarily require changing the individual as a decision-maker. Instead, therapy changes how outcomes are valued and interpreted. The individual's decision-making process may remain entirely rational, while the payoff structure within which decisions are made becomes different. In this sense, psychotherapy can be conceptualized not merely as symptom reduction but as payoff restructuring. By modifying perceived costs, rewards, and probabilities, therapy alters the strategic landscape

within which behavior occurs. Once the game changes, equilibrium behavior may change as well. Thus, from a game-theoretic perspective, psychological recovery may sometimes be understood not as changing the player, but as changing the game.

4. Beyond Social Anxiety: Toward a General Framework

The social anxiety model presented above may represent only one example of a broader phenomenon. Once psychological symptoms are viewed through a game-theoretic lens, similar dynamics can be observed in many areas of human behavior. In each case, individuals appear to choose strategies that minimize perceived costs and maximize perceived benefits within their subjective understanding of the situation.

A similar pattern may be observed in depression. Depressed individuals often withdraw from social interactions. They may stop calling friends, decline invitations, or spend increasing amounts of time alone. From an external perspective, such behaviors may appear counterproductive because social support is generally associated with improved psychological well-being. However, the individual's internal calculations may be very different. The potential rewards of social interaction may be perceived as small and uncertain, whereas the risks of disappointment, rejection, criticism, or emotional exhaustion may be perceived as substantial. Under these conditions, withdrawal may become the safest available strategy. Although the behavior may ultimately contribute to loneliness and reduced well-being, it can nevertheless be understood as a response to a payoff structure in which avoiding potential losses is prioritized over pursuing potential gains.

Addictive behaviors provide another example. Individuals struggling with addiction frequently choose immediate rewards despite long-term negative consequences. The temporary relief provided by a cigarette, alcoholic drink, gambling episode, or other addictive behavior is experienced immediately, whereas the associated costs often emerge gradually over months or years. As a result, short-term rewards may outweigh distant future losses in the individual's decision-making process. From a game-theoretic perspective, the repeated selection of immediate gratification can be interpreted as a strategy emerging from a payoff structure that heavily discounts future outcomes.

Perhaps some of the most interesting examples arise in close relationships. Over time, recurring interaction patterns often emerge between partners, friends, family members, or colleagues. One individual may repeatedly adopt a giving strategy, while the other becomes accustomed to receiving. In the short term, such arrangements may appear stable because both parties receive

certain benefits. However, over longer periods, resentment, frustration, and imbalance may accumulate. Game theory helps explain how these seemingly stable interaction patterns can persist for extended periods despite producing dissatisfaction for one or both parties.

Similar principles may also apply to obsessive-compulsive behaviors, post-traumatic stress responses, perfectionism, procrastination, and many other psychological phenomena. Although the specific symptoms differ, a common theme emerges: behavior often reflects attempts to manage perceived risks, uncertainties, and potential losses. What appears irrational from an outside perspective may represent a coherent strategy within the individual's subjective model of reality.

The purpose of this chapter is not to suggest that every psychological symptom can be fully explained by game theory. Human behavior is influenced by biological, developmental, cognitive, emotional, social, and cultural factors that cannot be reduced to a single framework. Nevertheless, game theory offers a useful conceptual lens for understanding why certain behaviors persist even when they appear self-defeating. In many cases, symptoms may represent stable responses to perceived environmental conditions rather than simple failures of rationality. From this perspective, psychological symptoms may sometimes be understood not merely as signs of dysfunction, but as equilibrium strategies that emerge when individuals attempt to navigate complex social and environmental challenges under conditions of uncertainty.

5. Conclusion

Psychological disorders cannot, of course, be fully explained through mathematical models alone. Human cognition, emotion, and behavior are shaped by biological, developmental, social, cultural, and experiential factors that extend far beyond the scope of any single theoretical framework. The human mind is considerably more complex than a set of equations, and no mathematical model can capture the full richness of psychological experience. Nevertheless, game theory offers a valuable perspective for understanding why certain behavioral patterns persist. One of its central insights is that individuals do not necessarily maintain behaviors because they are irrational. Rather, they often continue to employ strategies that appear reasonable within their subjective understanding of the world. What may seem maladaptive from an external perspective can represent a rational response to perceived costs, rewards, risks, and uncertainties. The concept of Nash equilibrium is particularly useful in this regard. A Nash equilibrium does not necessarily describe a situation in which all parties are satisfied or thriving. Instead, it

describes a stable state in which no individual believes that changing strategy alone will lead to a better outcome. From this perspective, some psychological symptoms may be understood as "suboptimal but stable" equilibria that emerge within the social and psychological games individuals navigate throughout their lives.

Importantly, an individual's payoff is determined not only by objective events but also by expectations, beliefs, emotions, and perceptions of how others are likely to respond. In psychological contexts, what people expect to happen may be just as influential as what actually happens. Consequently, subjective interpretations become part of the game itself. The perceived cost of rejection, failure, uncertainty, or loss may substantially shape behavior even when those outcomes are unlikely to occur. This perspective has important implications for understanding therapeutic change. If symptoms are maintained by subjective payoff structures, then psychological improvement may sometimes involve more than changing the individual. It may involve changing the way outcomes are evaluated, interpreted, and anticipated. In game-theoretic terms, therapy can be understood as a process of restructuring the payoff landscape that governs behavior. As perceptions of costs and rewards change, previously stable equilibria may weaken, allowing new and more adaptive patterns of behavior to emerge.

The aim of this chapter has not been to reduce mental health to mathematics, but rather to demonstrate how mathematical thinking can provide new conceptual tools for understanding psychological phenomena. By viewing symptoms as potential equilibrium strategies rather than merely signs of dysfunction, game theory offers a complementary perspective that may enrich existing psychological and psychiatric models. Social anxiety is presented here as an illustrative example of a broader equilibrium framework. Future work may develop formal game-theoretic models for specific psychological conditions. Perhaps the future of mental health lies not only in understanding the player, but also in understanding the game. In many cases, psychological suffering may persist because individuals remain trapped within stable patterns of perceived costs and rewards. If so, one of the most important tasks of psychological intervention may be helping individuals recognize that the rules of the game are not fixed, and that when the game changes, the equilibrium can change as well.

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