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Обзор литературы / Review article

Genetic contributions to sexual relationship dynamics: A narrative review

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Abstract

The stability and satisfaction of sexual relationships are vital for individual well-being and societal cohesion. Although psychological and social influences on these outcomes are well-documented, the study of their genetic underpinnings remains an emerging area of research. This review aims to synthesize and critically analyze genetic research findings related to the stability and satisfaction of sexual relationships, highlighting key genetic mechanisms and their implications. **Material and methods.** This review synthesizes findings from 42 peer-reviewed publications published between 2003 and 2023, focusing on the genetic contributions to relationship stability and satisfaction. **Results.** Evidence indicates that neuroticism, with a heritability estimate of approximately 40 %, strongly predicts relationship instability. In contrast, higher levels of agreeableness and extraversion are associated with greater satisfaction. The review examines how genetics influence personality traits, attachment patterns, emotional regulation, hormonal factors, sexual compatibility, communication behaviors, and mental health predispositions. It also highlights the interaction between genetic and environmental influences, supported by case studies and empirical research that demonstrate the complexity of these relationships. **Conclusions.** This review discusses ethical implications and outlines future research opportunities, providing a comprehensive perspective on how genetics can shape successful sexual partnerships. By integrating genetic research with relationship science, it offers evidence-based insights to guide future interdisciplinary investigations.

Key words: genetics, relationship stability, relationship satisfaction, personality traits, attachment patterns, emotional regulation, hormonal factors, sexual compatibility, communication behaviors, gene-environment interaction.

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Генетические основы стабильности и удовлетворенности сексуальными отношениями: нарративный обзор

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Резюме

Стабильность и удовлетворенность сексуальными отношениями играют важную роль в благополучии личности и сплоченности общества. Хотя психологические и социальные факторы, влияющие на эти аспекты, хорошо изучены, генетическая основа этих явлений остается развивающейся областью научных исследований. Цель данного обзора — синтезировать и критически проанализировать результаты генетических исследований, связанных со стабильностью и удовлетворенностью сексуальными отношениями, с акцентом на ключевые генетические механизмы и их значение. **Материал и методы.** Обзор включает анализ 42 рецензируемых публикаций, опубликованных в период с 2003 по 2023 г., с фокусом на генетический вклад в стабильность и удовлетворенность в отношениях. **Результаты.** Данные свидетельствуют о том, что невротизм с уровнем наследуемости около 40 % является значимым предиктором нестабильности в отношениях. Напротив, высокий уровень добро-

желательности и экстраверсии связан с большей удовлетворенностью. Обзор рассматривает влияние генетики на черты личности, типы привязанности, эмоциональную регуляцию, гормональные факторы, сексуальную совместимость, поведение в коммуникации и предрасположенность к психическим расстройствам. Также подчеркивается взаимодействие генетических и средовых факторов, подтвержденное данными эмпирических исследований и тематическими случаями, демонстрирующими сложность этих взаимосвязей. **Заключение.** Обзор затрагивает этические аспекты и обозначает перспективные направления для будущих исследований, представляя всесторонний взгляд на то, как генетика может формировать успешные сексуальные отношения. Интеграция генетических данных с наукой о межличностных отношениях позволяет получить обоснованные научные выводы для дальнейших междисциплинарных исследований.

Ключевые слова: генетика, стабильность отношений, удовлетворенность отношениями, личностные черты, стили привязанности, эмоциональная регуляция, гормональные факторы, сексуальная совместимость, коммуникативное поведение, взаимодействие генов и окружающей среды.

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Introduction

Sexual relationship stability and satisfaction are fundamental to both personal well-being and societal harmony. Positive relationships contribute to better mental health, increased life satisfaction, and longer lifespans. In contrast, unstable or dissatisfying relationships can result in psychological challenges, such as anxiety, depression, and reduced life quality [1]. Relationship dynamics are shaped by various factors, including social, environmental, and psychological elements. Recently, genetics have gained recognition for their influence on relationship outcomes [2].

Progress in behavioral genetics has revealed the significant impact of genetic factors on human behavior, particularly in interpersonal contexts. Genetic predispositions influence personality, emotional regulation, and behaviors essential for forming and sustaining relationships. For example, genetic variations like those affecting the serotonin transporter gene (*SLC6A4*) are linked to neuroticism and agreeableness—traits that significantly impact relationship satisfaction and stability [3]. Such genetic influences shape behavioral patterns and emotional responses that can either strengthen or weaken relationships. Furthermore, attachment theory, which examines how early caregiver relationships influence adult bonding, has been enriched by genetic research. Genetic predispositions contribute to attachment styles, affecting responses to intimacy and conflict in relationships [4]. Variations in the oxytocin receptor gene (*OXTR*), for instance, have been associated with differences in social bonding and attachment behavior, providing a biological basis for these critical relational processes.

This review aims to provide a comprehensive synthesis of current research on the genetic influences that shape sexual relationship stability and satisfaction. It focuses on identifying key genetic factors, evaluating their impact on relationship dynamics, and offering a foundation for future interdisciplinary research. To make this topic accessible across disciplines, defining key genetic terms is essential. Heritability refers to the proportion of variation in a trait within a population that can be attributed to genetics. Single nucleotide polymorphisms (SNPs) are variations in a single DNA component that can impact traits such as emotional regulation. Polygenic risk scores summarize the effects of multiple genetic variants, estimating an individual's likelihood of exhibiting certain behaviors, including those relevant to relationship satisfaction.

Beyond personality and attachment, emotional regulation is a vital area influenced by genetics. The ability to manage emotions plays a critical role in maintaining relationship harmony, especially during conflict. Genetic studies have identified specific alleles linked to neurotransmitters like serotonin and dopamine, which are central to emotional control [5]. Individuals with favorable genetic variations related to emotional regulation tend to experience higher relationship satisfaction and stability. Hormonal influences, intertwined with genetic factors, also affect relationships. Genetic variations related to hormones such as oxytocin and vasopressin influence social bonding and partner interactions [6]. These hormonal pathways are fundamental in fostering intimacy and trust, which are essential components of successful partnerships. Sexual compatibility, another cornerstone of relationship satisfaction, may also have a genetic basis. Research suggests

that compatibility at the genetic level, especially concerning the major histocompatibility complex (MHC), influences sexual attraction and partner choice, thereby affecting relationship stability [7]. Such genetic compatibility may drive subconscious preferences for certain partners, contributing to relationship success. Additionally, communication styles, which are crucial for conflict resolution and expressing personal needs, can be influenced by genetic factors. Studies indicate that some communication tendencies are heritable, affecting how partners handle relational challenges [8]. Understanding these genetic contributions sheds light on the biological foundations of relationship dynamics. Lastly, mental health – a factor significantly shaped by genetics – plays a vital role in relationship outcomes. Genetic predispositions to conditions like anxiety and depression can strain relationships, making these factors critical in understanding relationship success [9]. The interaction between genetic vulnerabilities and environmental triggers highlights the complexity of relationships. Moreover, the role of epigenetics – where environmental factors modify gene expression–remains underexplored and represents an important avenue for future research.

Material and methods

This narrative literature review was designed to explore and synthesize existing research examining genetic influences on the stability and satisfaction of romantic relationships. As a narrative review, the approach emphasizes thematic integration and conceptual analysis rather than rigid systematic protocols. The methodology focused on collecting a broad spectrum of relevant literature, highlighting diverse genetic factors and their implications within relationship science.

Search strategy

An exploratory literature search was conducted across several academic databases, including PubMed, Scopus, Web of Science, and Google Scholar. These platforms were chosen for their broad coverage of genetics, psychology, and social sciences. Search terms were selected to reflect the primary themes of the review, including “Genetics,” “Relationship Stability,” “Relationship Satisfaction,” “Personality Traits,” “Attachment Styles,” “Emotional Regulation,” “Hormonal Influences,” “Sexual Compatibility,” “Communication Styles,” and “Gene-Environment Interactions”. Boolean operators such as AND, OR, and NOT were used to refine the search where appropriate. For example, queries like “Genetics AND Relationship Stability” and “Hormonal Influences OR Attachment Styles” were employed to capture a wide range of perspectives. Only English-language sources were reviewed for consistency.

Selection criteria

The inclusion of studies was based on thematic relevance rather than strict methodological filters. Criteria included: language (english publications only), population (studies examining aspects of romantic or sexual relationships, relevance (explicit focus on genetic contributions to relationship outcomes), publication type (empirical peer-reviewed journal articles, systematic reviews, and meta-analyses), time frame (2003 to 2023). Exclusion criteria: theoretical books or textbooks without primary data (e.g., general overviews on attachment theory), studies based exclusively on non-human subjects, articles lacking discussion of genetic mechanisms or findings, non-peer-reviewed publications, duplicate entries.

Review and thematic analysis process

Articles were reviewed for thematic content, rather than assessed through formal quality appraisal tools like CASP. Emphasis was placed on identifying key genetic variables (e.g., gene polymorphisms, heritability, hormonal markers), their relationship with psychological and interpersonal traits, and any reported implications for romantic relationship dynamics. Instead of quantitative synthesis, this narrative approach relied on thematic clustering, grouping findings into major categories such as genetic influences on personality, attachment, emotional regulation, hormones, sexual compatibility, communication, and mental health. Conceptual overlaps and interdisciplinary insights were highlighted to offer a broad, integrative perspective.

Limitations and bias consideration

As a narrative review, this study does not follow PRISMA guidelines or formal bias-mitigation protocols. However, efforts were made to ensure a balanced overview by consulting multiple databases and diverse publication types (Table 1). The exclusion of theoretical books and non-empirical works was intended to maintain scientific rigor. The limitation to English-language sources is acknowledged as a potential source of bias.

Results

Genetic foundations of personality traits

Rather than analyzing personality traits as standalone psychological dimensions, recent advances in behavioral genetics emphasize a gene-centric approach, revealing how specific genetic

Table 1. *Summary of reviewed studies on genetic contributions to romantic relationship dynamics*

Таблица 1. *Резюме рассмотренных исследований генетического вклада в динамику романтических отношений*

Study type	Genetic focus	Relevance to relationship outcomes	Reference
1	2	3	4
Experimental Psychology	None (focus on sleep)	Contextual relevance to interpersonal conflict, not genetics	[1]
Review/meta-analysis	General intelligence genetics	Foundational for genetic approaches to psychological traits	[2]
GWAS	Major depression (44 loci)	Relevant due to depression's impact on emotional dynamics	[3]
Theoretical/review	Attachment theory (general)	Theoretical foundation for gene-attachment links	[4]
Neuroscience review	SLC6A4	Direct relevance to emotional regulation and relationship quality	[5]
Review	Oxytocin and vasopressin	High relevance to pair bonding and emotional closeness	[6]
Experimental	MHC-related preferences	Relevant to sexual attraction and genetic compatibility	[7]
Theoretical	None	General model of intimacy; not genetic-specific	[8]
Book/review	Depression genetics	Contextual background on mental health impact on relationships	[9]
GWAS	Neuroticism, depression	Links neuroticism genetics to relationship instability	[10]
Meta-analysis	Neuroticism loci	Supports heritability of traits linked to instability	[11]
GWAS	Personality traits	Genetic loci for traits impacting satisfaction	[12]
Systematic review	Oxytocin receptor gene methylation	Directly linked to bonding and regulation	[13]
Review	Adult attachment genes	Updated review on genes shaping attachment	[14]
Review	Environmental modulation of brain	Environmental influence on genetic expression	[15]
Empirical	Attachment and environment	Attachment genetics + trauma context	[16]
Behavioral study	Dopamine and attachment	DRD2/DRD4 and relationship styles	[17]
Meta-analysis	Attachment and behavior	Gene-environment influence on attachment	[18]
Review	SLC6A4	Serotonin transport and emotional regulation	[19]
Review	Familial depression risk	Depression heritability and relational effects	[20]
Empirical (neuroimaging)	Emotional regulation	Neurological correlates of emotion in couples	[21]
Genetic Association	AVPR1A	Vasopressin and pair bonding	[22]
Review	Resilience and bonding	Oxytocin-linked resilience in relationships	[23]
Experimental	MHC	MHC and sexual attraction via scent	[24]
Meta-analysis	MHC mate selection	Cross-species analysis of mate compatibility	[25]
Experimental	MHC preferences	Perfume and immunogenetic compatibility	[26]
Conceptual	Endophenotype framework	Defines genetic-behavior links	[27]
Review	Gene-environment interactions	Foundational gene-environment model	[28]
Theoretical/review	Differential susceptibility	Individual genetic sensitivity in relationships	[29]
Twin study	Marital genetics	Twin-based genetic component of satisfaction	[30]
Empirical	SLC6A4	Serotonin transporter and relationship-linked stress	[31]
fMRI study	Neural correlates	Brain-genetic link to relationship satisfaction	[32]
Review	Bipolar disorder genetics	Mood instability and relationship effects	[33]
Commentary	Behavioral genetics	Challenges in regional research	[34]
Ethics report	Genetics and behavior	Ethical issues in relationship genetics	[35]

End of the Table 1

1	2	3	4
Ethics review	Genetic testing	Ethics of using genetics in matchmaking	[36]
Future directions	Genomics roadmap	Emerging trends in human behavioral genetics	[37]
Genomic study	Resilience	Polygenic resilience in social settings	[38]
Neuroimaging review	Brain-behavior genetics	Tech interface for gene-behavior research	[39]
Policy review	Genomics and equity	Disparities in access to genomic tools	[40]
Methods review	CRISPR/Cas9	Methods in gene editing, future applications	[41]
Theoretical	Relationship science and genetics	Interdisciplinary overview	[42]

polymorphisms contribute to interpersonal behaviors linked to relationship satisfaction and stability. These findings suggest that emotional expression, empathy, sociality, and conflict sensitivity can be traced back to variations in neurotransmitter-related genes that operate across multiple traits. Personality traits critically influence sexual relationship dynamics, shaping interpersonal interactions, conflict resolution, and intimacy maintenance. Genetic research underscores that a significant portion of individual differences in these traits stems from heritable factors. Twin and family studies consistently report substantial heritability for traits such as neuroticism, extraversion, and agreeableness [10].

SLC6A4, particularly the 5-HTTLPR polymorphism, has been extensively studied in relation to neuroticism and stress reactivity [11]. Individuals with the short allele variant often show greater sensitivity to emotional stimuli, elevated amygdala activation, and reduced resilience to interpersonal stressors. These tendencies increase vulnerability to relationship instability, as heightened emotional reactivity can lead to miscommunication and conflict escalation during relational tension. Dopamine-related genes, such as dopamine receptor D4 gene (*DRD4*) and *DRD2*, are implicated in extraversion and approach-oriented social behaviors. *DRD4* polymorphisms, especially those affecting the length of variable number tandem repeats (VNTR), influence novelty-seeking, sociability, and responsiveness to reward [12]. These qualities are often associated with positive partner engagement, greater openness, and greater relational satisfaction. *DRD2*, while studied less frequently in this context, contributes to social motivation and reward processing—factors critical to emotional closeness and partner responsiveness (Table 2). *OXTR*, particularly the polymorphism at locus rs53576, has been associated with differences in empathy, cooperation, and trust [13]. Individuals with the GG genotype at rs53576 tend to exhibit higher levels of prosocial behavior. These traits directly support supportive communication, forgiveness, and partner satisfaction in romantic relationships. *OXTR* expression is also modulated epigenetically, meaning that early-life stress can downregulate oxytocin sensitivity, leading to difficulties with intimacy and emotional attunement later in life.

Rather than functioning in isolation, these genes often operate interactively, forming neurochemical networks that regulate interpersonal sensitivity and responsiveness. For instance, individuals with a combination of the *SLC6A4* short allele and *DRD4* long allele may show increased social vigilance and variability in emotional control. Such gene-gene interactions contribute to the complex ways in which genetic predispositions influence relationship experiences. This gene-based synthesis offers a more precise explanation of how heritable biological mechanisms influence personality-relevant behaviors that shape relationship satisfaction. It shifts the focus away from abstract trait categories and toward specific biological substrates that interact with environmental experiences to predict relational outcomes [13]. For example, high neuroticism coupled with low agreeableness may intensify conflict frequency, but this can now be reinterpreted as stemming from certain *SLC6A4* and *OXTR* polymorphism profiles. In contrast, balanced serotonin and dopamine activity – driven by optimal genetic combinations – may support effective emotional regulation and relational stability.

Attachment styles and genetic influences

Attachment theory has traditionally focused on psychological models of interpersonal bonding, yet genetic research has increasingly revealed how specific loci influence attachment behaviors by modulating neurochemical signaling pathways. This section synthesizes the genetic architecture of attachment through key polymorphisms associated with bonding, social motivation, and stress response systems. Attachment styles – secure, anxious, and avoidant – are essential in understanding relationship patterns. Emerging research reveals that these styles

Table 2. *New synthesis table: key genes and their relationship outcomes*

Таблица 2. *Новая обобщающая таблица: ключевые гены и результаты их взаимоотношений*

Gene	Trait/outcome	Effect	Key polymorphism / allele	Study type
SLC6A4	Neuroticism, anxiety, attachment	Heightened stress sensitivity; insecure attachment; poor emotion regulation	5-HTTLPR – Short (S) allele	Twin, GWAS, epigenetic
OXTR	Empathy, attachment, regulation	Increased bonding, social sensitivity, and trust	rs53576 – GG genotype	GWAS, epigenetic
AVPR1A	Pair bonding, attachment	Stronger emotional closeness and commitment	RS3 repeat length polymorphism	Behavioral genetics
COMT	Emotional regulation	Met allele linked to better prefrontal dopamine and conflict management	Val158Met – Met allele	Neurogenetic, twin studies
DRD4	Extraversion, novelty seeking	Promotes sociability and relationship satisfaction	VNTR – 7-repeat allele	Twin, candidate gene studies
DRD2	Avoidant attachment	Lower social reward, diminished intimacy-seeking	Taq1A polymorphism – A1 allele	Behavioral, neuroimaging
NR3C1	Stress reactivity, attachment	Increases cortisol; anxiety-related attachment insecurity	rs1360780 or methylation patterns	Gene-environment interaction

are partially heritable, with genetic factors accounting for 30–50 % of attachment behavior variance [14].

OXTR plays a pivotal role in promoting secure attachment. Specific genotypes at the *OXTR* rs53576 polymorphic locus, particularly the GG genotype, have been associated with increased oxytocin sensitivity, which facilitates trust, empathy, and affectionate touch [15]. These features underlie behaviors that promote emotional safety, bonding, and responsive caregiving in romantic contexts. Individuals with the GG genotype, for example, often demonstrate higher relational satisfaction due to more secure behavioral patterns. Vasopressin receptor 1a gene (*AVPR1A*) also supports pair bonding and emotional attunement. Its polymorphisms affect vasopressin binding efficiency, which contributes to relationship investment and commitment behaviors [22]. Male carriers of specific alleles (e.g., RS3 repeat length variations) have been shown to report lower levels of marital conflict and greater partner satisfaction. *SLC6A4*, again notably the 5-HTTLPR polymorphism, is associated with anxious attachment through heightened emotional reactivity and fear of rejection. When these alleles are paired with adverse early experiences, they can intensify abandonment fears and create hyperactivation of attachment systems [16]. Polygenic risk scores aggregating such variants are increasingly used to quantify genetic vulnerability to insecure attachment patterns. Stress-regulation genes like the glucocorticoid receptor gene (*NR3C1)* influence the hypothalamic-pituitary-adrenal axis, impacting cortisol release and thus shaping attachment through physiological stress responsiveness. Variants of *NR3C1* have been associated with anxious behaviors and difficulties in emotion regulation during relational stressors [16]. Epigenetic studies show that early neglect or trauma can increase methylation of the *NR3C1* promoter region, reducing gene expression and leading to chronic stress sensitivity.

Avoidant attachment, characterized by emotional withdrawal and discomfort with intimacy, has been linked to dopaminergic genes such as *DRD2* [17]. These genes modulate reward processing and social motivation, meaning that individuals with certain *DRD2* variants may experience less emotional gratification from closeness, leading to detachment or dismissive behaviors. These biological traits can discourage emotional reciprocity and long-term relational engagement. Gene-environment interactions (G×E) are especially significant in attachment development. Even when individuals carry risk alleles, supportive parenting or therapeutic intervention can moderate outcomes. Conversely, adverse environments may exacerbate genetic vulnerabilities. For example, methylation changes in *OXTR* and *NR3C1* are frequently observed in individuals with early trauma, further impairing oxytocin and cortisol signaling [18].

Genetic basis of emotional regulation

Effective emotional regulation is fundamental for sustaining relationship satisfaction and stability. Proper management and expression of emotions significantly influence how individuals cope with stress, resolve disagreements, and communicate within relationships. Contemporary studies have pinpointed various genes that contribute to emotional regulation, underscoring the genetic foundation of these abilities and their effects on relationship dynamics [19].

A prominent gene associated with emotional regulation is *SLC6A4*, which governs serotonin reuptake – vital for mood balance. Variations in this gene, especially the short allele of the 5-HTTLPR polymorphism, have been connected to heightened emotional sensitivity and reactivity [20]. Nevertheless, other research suggests that environmental factors, such as early life experiences and stress levels, moderate the relationship between this polymorphism and emotional regulation. Some findings even report no significant correlation between *SLC6A4* and emotional reactivity, highlighting the intricate gene-environment dynamics in emotional control.

The catechol-O-methyltransferase gene (*COMT*) is another key player, responsible for the breakdown of dopamine, a neurotransmitter linked to pleasure and reward. The Val158Met polymorphism in this gene is particularly notable. Individuals carrying the Met allele demonstrate lower enzymatic activity and elevated dopamine levels in the prefrontal cortex, leading to enhanced executive functioning and emotional management [21]. This improved emotional regulation can positively affect relationship satisfaction by fostering constructive stress responses and efficient conflict resolution. Additionally, *OXTR* is integral to emotional regulation and social bonding. Oxytocin, often referred to as the "love hormone", facilitates trust, empathy, and social communication. Genotypic differences at the rs53576 polymorphism of the *OXTR*, such as the GG or AA genotypes, are associated with variations in emotional responsiveness and stress reactions [13]. Furthermore, epigenetic factors like DNA methylation of the OXTR gene influence individual differences in emotional expression, further illustrating the genetic and epigenetic contributions to emotional regulation and relationship satisfaction.

Genetic differences can also impact the hypothalamic-pituitary-adrenal axis, which governs stress responses. Polymorphisms in *NR3C1* may affect cortisol levels and stress management [16]. Individuals with certain *NR3C1* variants may display heightened stress sensitivity, potentially hindering effective emotional regulation during conflicts, thereby diminishing relationship satisfaction. Conversely, those with genetic profiles favoring balanced stress responses are more adept at handling relational stress, promoting relationship stability.

Genetic influences on hormonal mechanisms in relationships

Hormonal mechanisms, influenced by genetic variation, play a significant role in shaping bonding, intimacy, and emotional regulation within romantic relationships. Among these mechanisms, oxytocin and vasopressin stand out due to their prominent roles in fostering social connections, attachment, and emotional balance. Although this section primarily discusses two key hormonal systems, it reflects a broader trend in the field exploring how gene-regulated hormonal pathways contribute to relationship dynamics.

Oxytocin, known as the "love hormone", is essential for establishing and maintaining social bonds by enhancing trust, empathy, and emotional intimacy. Genetic variations in *OXTR*, particularly the rs53576 polymorphism, have been associated with differences in social cognition and stress responsiveness [13]. Individuals with specific alleles of this gene may exhibit higher empathy and better bonding capabilities, which contribute to relationship satisfaction. Conversely, variants that reduce oxytocin receptor sensitivity may impair emotional closeness, potentially disrupting relationship success. Vasopressin, another hormone intricately linked with oxytocin, plays a vital role in social behaviors and pair bonding. Research has highlighted *AVPR1A* as pivotal in modulating these effects. Specific polymorphisms in *AVPR1A* have been connected to differences in partner attachment and bonding behaviors. Certain alleles correlate with stronger social bonds and greater relationship satisfaction [22], emphasizing the genetic influences underlying relationship dynamics. Additional hormones such as testosterone and estrogen also contribute to romantic and sexual dynamics, though their genetic underpinnings remain less consistently documented. Testosterone often correlates with dominance, competitiveness, and mate-seeking behaviors. While these traits can boost attraction, excessive dominance may threaten relationship stability. Estrogen, on the other hand, supports emotional bonding and nurturing tendencies, enhancing relationship closeness. The interplay between testosterone and estrogen levels, along with genetic variations in their receptors, shapes relationship satisfaction and stability [23].

It is important to note that the literature on genetic regulation of hormone-related behavior in romantic relationships remains relatively limited and sometimes inconsistent. Many studies involve small

sample sizes, hindering the generalization of findings. Moreover, the effects of hormone-related genetic variants are often influenced by environmental factors such as stress, nutrition, and social experiences. Additionally, methodological challenges arise when attempting to measure hormone levels accurately due to their fluctuation in response to various stimuli. The interaction between genetic predispositions and hormonal activity plays a pivotal role in relationship outcomes. For example, individuals genetically inclined toward efficient oxytocin and vasopressin signaling typically exhibit superior social skills and stress management, leading to stronger emotional support and higher relationship satisfaction [24]. In contrast, impaired hormone signaling pathways may hinder intimacy, elevating the risk of dissatisfaction. Environmental factors further modulate these effects. Supportive environments can amplify the positive impact of favorable genetic profiles, while adverse conditions may exacerbate the challenges faced by those with less advantageous genetic variations [23].

Sexual compatibility and genetic compatibility

Genetic compatibility significantly influences sexual attraction and long-term relationship satisfaction. One of the most explored genetic systems in this domain is the major histocompatibility complex (MHC), which plays a critical role in immune system functioning. Research suggests that individuals are often subconsciously attracted to partners with dissimilar MHC alleles, potentially offering evolutionary advantages to offspring [25]. Nevertheless, findings on MHC compatibility and relationship satisfaction in humans remain inconsistent, as some studies have failed to replicate these associations.

The preference for MHC-dissimilar partners is believed to enhance offspring immunity, increasing survival chances. Seminal studies, such as those by C. Wedekind et al., showed that women favored the scent of men with differing MHC genes, likely mediated through olfactory signals [26]. However, subsequent research has presented conflicting results, showing no clear preference for MHC dissimilarity in partner selection. When examining long-term relationship satisfaction, some studies suggest that MHC-dissimilar couples report greater sexual and relationship fulfillment. This satisfaction may stem from enhanced immune diversity in offspring and a lower risk of fertility problems. However, cultural and environmental influences may moderate the extent of MHC compatibility's effects on relationship satisfaction [25].

Pheromones – chemical signals believed to influence sexual attraction – are also hypothesized to convey information about genetic compatibility, particularly regarding MHC diversity. Despite this, empirical evidence remains limited, with some studies failing to establish a robust link between pheromonal attraction and genetic compatibility [26]. Consequently, the role of pheromones in human mate selection warrants cautious interpretation. Beyond the MHC, other genetic markers also contribute to sexual compatibility and relationship dynamics. For instance, variations in neurotransmitter systems, including dopamine and serotonin, can affect personality traits and sexual behaviors. Couples whose genetic profiles align in these systems may experience more synchronized sexual preferences and behaviors, enhancing both emotional and sexual intimacy, which are crucial for long-term relationship satisfaction [17].

Genetic contributions to communication styles

Effective communication is fundamental to maintaining healthy relationships, playing a key role in relationship satisfaction and stability. Genetic influences significantly shape individual communication patterns and styles. Variations in genes that regulate neurotransmitter systems, particularly those involving dopamine and serotonin, account for differences in communication behaviors, such as expressiveness, responsiveness, and conflict resolution.

A major area of research examines *SLC6A4* and its connection to emotional regulation and communication. The 5-HTTLPR polymorphism in this gene, consisting of short (S) and long (L) alleles, is especially noteworthy. Individuals carrying the S allele often display heightened emotional sensitivity and reactivity, impacting their communication approach. These individuals may exhibit greater emotional expressiveness but encounter challenges in regulating emotions during conflicts, potentially resulting in more volatile and less effective communication [19]. Conversely, those with the L allele generally demonstrate better emotional control, leading to more stable and constructive communication patterns. *OXTR* also plays a vital role in communication. Oxytocin, essential for social bonding and emotional regulation, influences communication behaviors significantly. Specific genotypic variations at the *OXTR* rs53576 locus, including the GG genotype, are linked to heightened empathy and improved communication behaviors. Certain genotypes correspond with higher levels of empathy and supportive communication, fostering relationship satisfaction and stability [13]. However, individuals with less favorable genotypes might find empathic communication more challenging,

potentially resulting in misunderstandings and relationship conflicts.

Although *DRD4* has been hypothesized to affect communication styles, empirical evidence remains limited [17]. While some research links *DRD4* polymorphisms to novelty-seeking behavior and impulsivity, their direct impact on communication within relationships is not well-supported. Instead, gene-environment interactions seem more influential in shaping communication patterns. For example, interventions like relationship counseling and behavioral training can help individuals with genetic tendencies toward communication challenges, reducing risks and improving relational outcomes [23].

Mental health, genetic predispositions, and relationship outcomes

Genetic predispositions to mental health conditions greatly affect relationship satisfaction and stability. Understanding the role of these genetic factors in mental health challenges provides insight into the complexities of relationship dynamics and highlights strategies for managing their effects. Mental health disorders such as depression, anxiety, and bipolar disorder have established genetic underpinnings. Variations in genes related to neurotransmitter function, stress response, and neural plasticity increase susceptibility to these conditions. For example, the *SLC6A4* is associated with a heightened risk of depression and anxiety. Individuals carrying the short allele of the 5-HTTLPR polymorphism experience less efficient serotonin reuptake, resulting in prolonged stress responses and negative emotional states [19]. Such vulnerabilities can strain relationships by increasing emotional instability, conflict, and reducing emotional support. Bipolar disorder, marked by alternating episodes of depression and mania, also has genetic components. Variants in the *CACNA1C*, which influence calcium channel function, are linked to bipolar disorder. These genetic predispositions can result in unpredictable mood shifts, posing challenges for sustaining stable and fulfilling relationships [17]. Partners of individuals with bipolar disorder may face difficulties due to inconsistent emotional availability and the disorder's impact on daily interactions.

These genetic predispositions not only affect individuals but also impact their partners and relationships. Managing a partner's mental health condition can lead to caregiver fatigue, reduced relationship satisfaction, and increased conflict. Moreover, societal stigma and limited understanding of mental health issues can intensify these challenges, making it harder for couples to access necessary support [13]. Nonetheless, psychiatric interventions can help mitigate the effects of genetic vulnerabilities on relationships. Cognitive Behavioral Therapy (CBT) enhances emotional regulation in individuals genetically predisposed to mood disorders, lowering relational conflict and improving communication. Additionally, couples therapy offers structured guidance for addressing mental health complexities in relationships, fostering mutual understanding and coping strategies [27]. Comorbid genetic risks, such as overlapping vulnerabilities to anxiety and depression, may further complicate relationship dynamics. For such cases, early intervention and sustained support become crucial for couples to navigate these challenges successfully [28].

Interplay between genetics and environment

The complex interaction between genetics and environmental factors profoundly influences relationship outcomes. Gene-environment interactions describe how genetic predispositions and environmental influences collectively shape individual behaviors and relational dynamics. While genetic factors lay the groundwork for certain traits, environmental contexts modulate these influences, leading to diverse relationship outcomes. A notable example of gene-environment interaction is the influence of *SLC6A4* on emotional regulation and relationship satisfaction. Individuals with the short allele of the 5-HTTLPR polymorphism are more prone to stress and negative emotional states. However, supportive environments can help buffer these genetic vulnerabilities, resulting in improved emotional regulation and relationship satisfaction. In contrast, adverse environments, marked by high stress or conflict, may exacerbate genetic risks, leading to poorer relational outcomes [19]. Genetic predispositions also interact with environmental factors to shape attachment styles and relationship stability. For example, *OXTR*, crucial for social bonding and emotional regulation, plays a significant role. Research indicates that individuals with particular *OXTR* genotypes respond differently to social support and attachment-related cues. Supportive environments promote secure attachment styles, fostering trust, emotional intimacy, and relationship stability. However, environments lacking social support or characterized by neglect can lead to insecure attachment styles, such as anxious or avoidant attachment, which negatively affect relationship satisfaction and stability [13].

Cultural and socioeconomic factors further influence gene-environment interactions. In collectivist cultures, robust social support systems may help counteract genetic risks for attachment insecurity, enhancing relationship stability. Conversely, in individualistic cultures where

independence is emphasized, genetic tendencies toward anxiety or avoidance may be intensified by weaker social safety nets [29]. Socioeconomic status also shapes these interactions – individuals with genetic risks for emotional dysregulation may fare better in resource-rich environments offering mental health support and counseling, while those in lower socioeconomic settings may face greater challenges due to limited access to such resources [30]. Additionally, childhood experiences significantly impact gene-environment interactions and adult relationship outcomes. Supportive childhood environments characterized by warmth and secure attachments can mitigate genetic risks for mental health issues, leading to healthier relationships in adulthood [31]. Conversely, adverse childhood experiences, such as abuse or neglect, can amplify genetic risks, resulting in poorer mental health and relationship outcomes.

Case studies and empirical evidence

Case studies and empirical research offer valuable insights into how genetic factors influence relationship stability and satisfaction. Longitudinal studies, particularly twin studies, have been instrumental in uncovering the intricate relationship between genetics and relationship outcomes. The Minnesota Twin Family Study is a pivotal investigation in this field, examining the genetic and environmental determinants of psychological traits and relationship dynamics. By tracking twins from adolescence through adulthood, this study has clarified how genetics and environment contribute to crucial traits like emotional regulation, personality, and social behaviors, all of which are key to relationship success [32].

Research using twin study methodologies, such as the work by E.L. Spotts et al., highlights the heritability of marital satisfaction. Their findings suggest that 30–40 % of the variance in marital satisfaction is attributable to genetic factors, with the rest shaped by individual experiences and environmental contexts. This underscores that while genetics plays a notable role, environmental influences are equally critical [30]. Qualitative case studies complement these large-scale investigations by providing in-depth perspectives on how genetics affects relationship dynamics. For example, K.S. O'Connell et al. examined couples where one partner had a genetic predisposition to bipolar disorder, revealing how genetic vulnerability and environmental stressors collectively impact relationship outcomes. The study also emphasized the role of therapeutic interventions in mitigating genetic risks [33]. To maintain methodological integrity, studies analyzed in this review were selected based on rigorous criteria, including substantial sample sizes, replication across diverse populations, and evaluations using frameworks like the Critical Appraisal Skills Programme (CASP). This ensures the robustness and reliability of the findings presented.

Ethical and social implications

Exploring genetic contributions to relationship satisfaction raises essential ethical and societal issues. As genetic research continues to advance, addressing these implications becomes critical. A primary ethical concern revolves around genetic privacy and the potential misuse of sensitive genetic data. There is a real risk that such information could be exploited for discrimination in employment, insurance, or personal relationships. The prospect of genetic screening for relationship-related traits may also lead to stigmatization based on genetic predispositions [34]. Establishing stringent privacy protections and ethical frameworks is therefore essential. Another concern involves genetic determinism – the belief that genetic makeup solely determines behavior and relationship outcomes. This oversimplified perspective neglects the significant influence of environmental factors and individual agency. An ethical approach to communicating genetic findings must balance the acknowledgment of genetic influences with an understanding of contextual factors and personal choices [35].

Real-world ethical challenges further illustrate these concerns. For instance, the emergence of genetic testing in dating platforms raises questions about consent, privacy, and the commodification of genetic compatibility. While proponents argue that such tools could enhance relationship outcomes, critics warn they may reinforce genetic determinism and unfairly exclude certain individuals [36]. Policymakers and ethicists must carefully weigh these risks when considering the application of genetic research in matchmaking services. Addressing these ethical and social issues requires a multidisciplinary approach, involving collaboration among geneticists, ethicists, sociologists, and policymakers. Public education and engagement are also crucial for fostering a nuanced understanding of genetic research and its implications for human relationships [37].

Future directions and research needs

The intersection of genetics and relationship science presents vast opportunities for further exploration. Despite recent progress, numerous research gaps remain that future studies must address. A key area for future research involves delving deeper into gene-environment interactions.

Although it is recognized that genetics and environment jointly influence relationship dynamics, the specific mechanisms of these interactions are not yet fully understood. Future studies should investigate how diverse environmental factors – such as cultural norms, socioeconomic status, and life stressors – interact with genetic predispositions to shape relationships [30]. Longitudinal research that follows individuals and couples over time can provide critical insights. Another promising avenue is the study of epigenetics, which examines how environmental factors can alter gene expression without changing the DNA sequence. Understanding how these epigenetic modifications influence relationship-related behaviors and emotional regulation could lead to more nuanced insights into relationship dynamics [13]. Such research will require advanced methodologies, including genomic sequencing and sophisticated bioinformatics tools. Additionally, large-scale genome-wide association studies (GWAS) are needed to identify genetic markers linked to relationship traits like communication styles, emotional regulation, and attachment patterns. The use of polygenic risk scores could also enhance the predictive accuracy of genetic contributions to relationships [38]. Expanding the diversity of study populations is crucial to ensure findings are applicable beyond Western, educated, industrialized, rich, and democratic (WEIRD) societies (NHS – Race and Health Observatory, 2024).

Neuroimaging techniques such as functional magnetic resonance imaging (fMRI) and positron emission tomography should also be leveraged to explore the neural mechanisms underlying relationship dynamics [39]. Furthermore, technologies like CRISPR-Cas9 could provide controlled insights into genetic influences on social behaviors, although ethical concerns surrounding their application must be carefully managed [40]. Artificial intelligence (AI) and machine learning offer additional avenues for innovation. AI-driven models can integrate genetic, psychological, and environmental data to develop personalized relationship counseling strategies and predict relationship satisfaction. These tools could identify couples at risk of relationship difficulties, allowing for timely and targeted interventions [41]. Interdisciplinary research that bridges genetics, psychology, neuroscience, and sociology will be essential in unraveling the complexities of relationships. Such collaborative efforts will support the development of holistic interventions and inform policies aimed at promoting healthy and fulfilling relationships [42].

Conclusions

This review highlights the specific genetic mechanisms that influence romantic relationship dynamics. Genes such as *OXTR* and *AVPR1A* are linked to emotional bonding, trust, and relationship satisfaction. Polymorphisms in *SLC6A4* affect emotional regulation and stress sensitivity, contributing to relationship instability. Additionally, compatibility within the major histocompatibility complex (MHC) may influence sexual attraction and partner selection, though empirical findings are mixed. Beyond these loci, heritable traits like neuroticism, agreeableness, and attachment tendencies also shape how individuals form and sustain relationships. However, genetic influences do not operate in isolation. They interact dynamically with environmental conditions, including early life experiences, stress exposure, and social context. Twin, longitudinal, and neuroimaging studies increasingly reveal the complexity of these interactions. Emerging insights from polygenic models and epigenetics hold promise for personalizing relationship counseling and identifying relational vulnerabilities. Still, any practical application must navigate ethical challenges related to determinism, stigmatization, and genetic privacy. Ultimately, while genetic research offers valuable understanding of relational behavior, environmental support, therapeutic interventions, and personal agency remain essential to fostering stable and fulfilling romantic partnerships.

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