THE NATURE OF GENDER

And why it is a distinct biological attribute

Abstract

Our understanding of behavioural biology and our understanding, identification and treatment of transgender individuals has advanced considerably over the past 100 years. However, a campaign has been run, over the past 10 years, by ideological extremists who have been claiming that only sex is biological, is binary and immutable and that being transgender is an ideology, that should receive no special treatment or rights but must be eradicated.

This article reviews the research, by study type, that has been conducted into gender and being transgender to determine what science and biology actually show us. It concludes that not only are these claims false but that gender identity and being transgender is a natural neurobiological, behavioural attribute, genetically determined, that cannot be influenced or changed by psychosocial events or ideology and that is not intrinsically tied to sex and sex biology. It also concludes that rather than trying to double down on our outdated and false beliefs about sex and gender, as used in our society, it is time these were adjusted to support the realities of nature.

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Version Information

Version no	Date	Details
1.0	October 2025	Initial draft
1.1	October 2025	Minor corrections/adjustments and added aromatase, evolutionary psychology and parthenogenesis references.

Introduction : Understanding what is being considered.

In these studies, we are looking at behavioural/functional output from the brain and asking what causes this behaviour/function? What are the mechanisms that produce this and are these pre-determined or the result of external influences? Its the branch of science known as behavioural biology.

Gender is a set of behaviours that are fundamental to our relationship with the world around us. Comprising gender identity and gender role behaviours, gender evolved because it advanced procreation and survival success, while enabling greater individual and social complexity. It is not purely human but can be seen across nature.

Our understanding of the brain and its biology has advanced considerably over the past couple of hundred years, though with over 100 billion neurons and trillions of synaptic connections our understanding still has a long way to go. However, the idea that we were born with our brains a blank sheet of canvas and that we learn everything (behaviourism), popular 100 or so years ago, has long since been displaced by the understanding that the vast majority of our behaviours are predetermined, hardwired into our brains and that environment and learning only shapes and adds the icing to these.

Gender, as a set of behaviours, has been acknowledged across societies throughout history. Western society, backed by religious/political ideology, has historically asserted it to be part of sexual dimorphism and intrinsically tied to physical sex, both of which it views as binary and immutable.

However, putting aside the true complexities and bi-modal nature of physical sex, the existence of those who are transgender challenges this assertion. There are individuals whose gender is clearly opposite to that assumed belongs to their sex, and can live more comfortably and be completely accepted as the opposite gender, especially after a small amount of medical treatment, in a way that is impossible for the majority.

This obviously goes against western religious/political ideology and the rules it imposes, and has led to challenges in societal understanding, acceptance and inclusion. A current campaign instigated and run by political and religious extremists is now trying to eradicate trans folks on the basis that 'being transgender is an ideology' with psychosocial rather biological causes and is false and dangerous because it goes against 'the real rules'.

However, there is converging evidence from multiple scientific sources (DSD cases, Twin studies, brain imaging, genetics) that biology is the primary contributor to gender identity and that this is immutable. It is, though, multifactorial, with complex biology, while to a minor degree psychosocial environment, culture, and individual psychological factors also play a role. This fits with our understanding of the nature behavioural biology – biologically determined but rounded off by environment.

The tables below give examples of this research, though the lists are not definitive (and additions always welcomed). They are all from leading science and medical journals and are peer reviewed Some require subscriptions to view in full. They are intended to show that there is considerable consistent research across multiple types of standard scientific study to support the claim of biological aetiology as opposed to psychosocial aetiology (i.e. gender ideology). They also demonstrate the complex multi-faceted nature of this biology. These papers contain numerous references to other research, which provides further supporting evidence. There are some caveats that need noting.

- While these studies give clear evidence for the biologic basis for transgender identity they do not yet explain how gender identity forms and works in the brain.
- Many of the studies have small sample sizes. Though hardly surprising, this is used by some to dismiss this research for ideological reasons. Ongoing research needs to continue to build and confirm understanding.
- For some topics there are limited numbers of studies. Of note here are those studying and supporting psychosocial (ideological) causes, for which there is very little evidence.
- We understand that gender identity is not binary but exists on a bimodal spectrum, while the extent of gender variance and gender dysphoria varies from individual to individual. The research must be viewed in that context though much of it is written in very binary terms.

Finally, to reiterate – this is about gender which is behaviour hardwired into the brain by biology and then 'shaped' by external factors. It gives you your personal identity, including, but not exclusively a sexual identity and a set of role behaviours. It is not the same as sex which is purely the physical attributes evolved for procreation nor sexuality, which is the behaviour of attraction. It is believed to be influenced by the biology of sexual differentiation but the biology and genetics suggest a distinct and complex nature rather than this being simply 'the sex of the brain'. In short, while our social conditioning means we view gender as part of sex, research points to these being distinct attributes with partial ties only, though many continue to confuse and conflate the two.

Meta Data studies

These studies are important because they review all the research across study types to draw an overarching picture of the nature of being transgender. This includes those that cover psychosocial (ideological) studies as well as biological studies.

What these invariably conclude is that :-

- There is no data to suggest that gender identity is manipulated by external forces, but has a biological aetiology with a strong genetic base. In short, being trans does not have psychosocial or ideological causes, but is biological and not influenced by environment/ideology
- There is no specific genetic locus or neuroanatomic region consistently identified as a cause of gender identity. The biology is deeply embedded and multifaceted so cannot be identified with a specific brain area or genetic sequence, making it impossible to test for or cure. This fits with gender's evolutionary history.
- That prenatal androgen exposure *may* influence gender identity and gender expression in some individuals. This means that while hormone exposure in the womb may have an influence this is not the sole or specific cause.

Essentially gender, comprising gender identity and gender role behaviours, is a natural complex and deep-rooted neurobiological attribute and being trans is a natural variance in this that cannot be caught, coerced into, chosen, cured of, or converted from. It is just how some people are.

General Meta Data Studies **Title**	**Published**	**Article**
Sex on the brain: Are gender-dependent structural and functional differences associated with behavior?	2016	Wiley
Is there a biological component in gender identity?	2025	Sciencedirect
Sexual differentiation of the human brain in relation to gender identity and sexual orientation	2010	Sciencedirect
The genetics and hormonal basis of human gender identity	2024	Pubmed
Evidence Supporting the Biologic Nature of Gender Identity	2015	Pubmed
Biological basis of gender identity	2020	Sciencedirect
Etiology of Gender Identity	2019	Sciencedirect

Brain differences, similarities and MRI

The advent of magnetic resonance imaging has enabled scientists to study brain structures in great detail non-invasively. This has been used to study trans folks brain structures and compare them with cis folks. These show that trans folks have significant brain structural features that resemble those of their experienced gender (or are "shifted" somewhat toward it), with other features remaining somewhere intermediate from cisgender male/female norms. However, this does not apply to all or always i.e. its not a perfect "swap". The regions involved in body perception / visual-spatial processing / self-representation (precuneus, posterior cingulate, angular gyrus, lateral occipital

cortex, insula and bed nucleus of the stria terminalis) are frequently implicated which aligns with the subjective mismatch of body identity. Additionally scans involving tests measuring brain activity during a gender-specific activity, have shown that trans brains respond in ways that are aligned with the gender they identify. Hormone treatment influences both structural and functional brain features based on duration, levels/type of hormones with changes after therapy bringing certain metrics closer to those typical of the target gender.

However, “correlations” do not imply causation. They merely support the biological underpinning to gender and its bi-modal nature while validating transgender identities. To what extent these differences are genetic vs external and what external factors are involved are the subject to different and additional studies.

MRI and Brain Differences **Title**	**Published**	**Article**
Sex Matters: A Multivariate Pattern Analysis of Sex- and Gender-Related Neuroanatomical Differences in Cis- and Transgender Individuals Using Structural Magnetic Resonance Imaging	2020	OUP
Sexual differentiation of the brain and behavior	2007	Sciencedirect
Transgender brains are more like their desired gender from an early age	2018	ESE and IFL
Structural, Functional, and Metabolic Brain Differences as a Function of Gender Identity or Sexual Orientation: A Systematic Review of the Human Neuroimaging Literature	2021	Pubmed
Neural Correlates of Gender Face Perception in Transgender People	2020	MDPI
Brain network interactions in transgender individuals with gender incongruence	2020	ClinicalKey
Cortical Gyrification in Transgender Individuals	2021	OUP
The Neuroanatomy of Transgender Identity: Mega-Analytic Findings From the ENIGMA Transgender Persons Working Group	2021	OUP
Gray matter volume differences between transgender men and cisgender women: A voxel-based morphometry study	2021	Sagepub
A Structural Magnetic Resonance Imaging Study in Transgender Persons on Cross-Sex Hormone Therapy	2016	Karger
Male-to-Female Transsexuals Have Female Neuron Numbers in a Limbic Nucleus	2000	JCEM
Grey and white matter volumes either in treatment-naïve or hormone-treated transgender women: a voxel-based morphometry study	2018	Nature
Sex Differences in Brain and Behavior: Hormones Versus Gene	2007	Sciencedirect
A sex difference in the hypothalamic uncinate nucleus: relationship to gender identity	2008	OUP

Sexual differentiation of the human hypothalamus: Relationship to gender identity and sexual orientation	2021	Sciencedirect
Brain Sex in Transgender Women Is Shifted towards Gender Identity	2022	Pubmed
The Complex Relationships between Sex and the Brain	2020	Sagepub
Neuroimaging gender dysphoria: a novel psychobiological model	2019	Link Springer
Gender Diversity and Brain Morphology Among Adolescents	2023	Pubmed
Structural Connectivity Networks of Transgender People	2014	OUP
Male-to-Female Transsexuals Show Sex-Atypical Hypothalamus Activation When Smelling Odorous Steroids	2008	OUP
Regional gray matter variation in male-to-female transsexualism	2009	Sciencedirect
Sex and gender affect the social brain: Beyond simplicity	2011	Wiley
The microstructure of white matter in male to female transsexuals before cross-sex hormonal treatment. A DTI study	2011	Sciencedirect
Regional volumes and spatial volumetric distribution of gray matter in the gender dysphoric brain	2015	Sciencedirect

Intersex studies

Roughly 2% of people are born intersex, that is with DSD (Differences of Sex Development). There are many different conditions – complete, mild and partial androgen insensitivity syndromes, congenital adrenal hyperplasia, Denys–Drash syndrome and the related Frasier syndrome, oestrogen insensitivity syndrome, Klinefelter syndrome, 5AR/17HS deficiency, Herlyn-Werner-Wunderlich syndrome, pseudovaginal perineoscrotal hypospadias, Turner syndrome, Mayer-Rokitansky-Küster-Hauser syndrome, and so on. Each has different biological causes and effects.

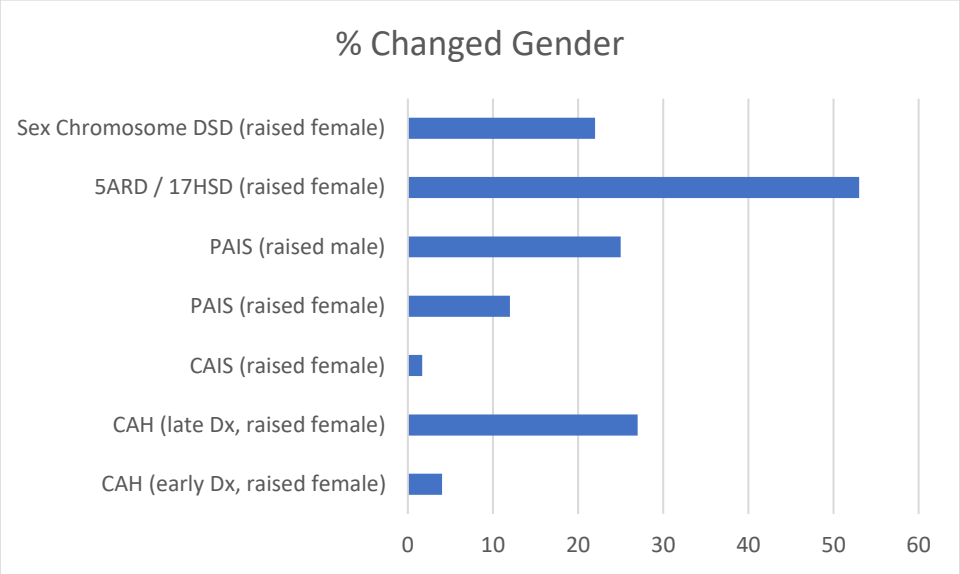
The varied nature of Intersex conditions means identification can arise at different stages of life – at birth, at puberty or in adult life. Some may not be diagnosed at all, which would mean >2% are born intersex. For those identified at birth some have non-consensual surgery and are bought up as a particular gender, while others do not, but are also bought up as particular gender.

This is, therefore, an excellent group for studying the nature of gender identity and specifically the degree to which sex biology is involved in the biology of this and to what extent social and environmental factors determine gender identity, both in formation and persistence.

What the research shows is that, firstly, intersex people have identities that cover the complete gender spectrum, though more than normal identify as non-binary (~30%-40%). There is also an above average number who express a gender identity differing from the gender they were initially assigned, which vary considerably by DSD (see chart). Hormones, and especially androgens, have

been shown to play a role, but to not be determinant. For example, most of those with CAIS and XY chromosomes are brought up female and this matches their gender identity in all but ~1.7%, but for those with 5ARD/17HSD and XY Chromosomes, who are initially sexed and reared as female, over 50% will subsequently identify as male. This indicates that sex biology plays a part in gender identity formation but is not the sole factor and that a range of other biological factors (genes, epigenetics etc.) are involved. It also supports the understanding that gender identities are not binary but exist across a spectrum.

Secondly the research shows that socialisation and upbringing doesn't significantly affect gender identity. Intersex children who are raised in a specific gender, even those who have non-consensual gender affirming treatment, often subsequently identify with a different gender and experience distress or gender dysphoria. The John/Joan case (David Reimer), where a boy was raised as a girl after a botched circumcision, is a well-known and extreme example. Despite intensive efforts to socialize him as female, he rejected that identity in adolescence and reverted to living as male. In essence this shows gender identity cannot be chosen or imposed and conversion/psychological therapies do not nor cannot change an individual's gender identity.



Intersex Studies **Title**	**Published**	**Article**
Gender identity and role in a pedigree of arabs with intersex due to 5 alpha reductase-2 deficiency	1996	Sciencedirect
Male pseudohermaphroditism due to primary 5 alpha-reductase deficiency: variation in gender identity reversal in seven Mexican patients from five different pedigrees	2014	Link Springer
A Systematic Review of the Health and Healthcare Inequalities for People with Intersex Variance	2020	Pubmed
Male Gender Identity in an XX Individual with Congenital Adrenal Hyperplasia	2007	Wiley

Gender Identity Outcome in Female-Raised 46,XY Persons with Penile Agenesis, Cloacal Exstrophy of the Bladder, or Penile Ablation	2005	Link Springer
Gender identity/role differentiation in adolescents affected by syndromes of abnormal sex differentiation	2002	PubMed
Effects of chromosomal sex and hormonal influences on shaping sex differences in brain and behavior: Lessons from cases of disorders of sex development	2015	Wiley
Discordant Sexual Identity in Some Genetic Males with Cloacal Exstrophy Assigned to Female Sex at Birth	2004	NEJM
46,XX Patients with Congenital Adrenal Hyperplasia: Initial Assignment as Male, Reassigned Female	2005	De Gruyter Brill
Gender Dysphoria and Gender Change in Chromosomal Females with Congenital Adrenal Hyperplasia	2005	Link Springer
Gender identity and recalled gender related childhood play-behaviour in adult individuals with different forms of intersexuality	2005	Pubmed
Androgen and psychosexual development: core gender identity, sexual orientation and recalled childhood gender role behavior in women and men with congenital adrenal hyperplasia (CAH)	2004	T&F
Androgens and the Evolution of Male-Gender Identity among Male Pseudohermaphrodites with 5α-Reductase Deficiency (Guavadoces)	1979	NEJM
Gender identity disorder (GID) in adolescents and adults with differences of sex development (DSD): A systematic review and meta-analysis	2020	JPUROL
Prenatal androgenization affects gender-related behavior but not gender identity in 5-12-year-old girls with congenital adrenal hyperplasia	2004	Pubmed
Gender Identity and Gender Role in DSD Patients Raised as Females: A Preliminary Outcome Study	2013	Pubmed
Pseudo-Hermaphroditism: A Multi-Faceted Pathosis	2016	Longdom

Hormone/Biochemical studies

Some years ago, it was hypothesised that too little or too much exposure to the sex hormones, testosterones and oestrogens, during the third trimester in utero, when significant brain development takes place, had major effects on gender identity and gender role behaviours.

It is of course a difficult subject to study and therefore proxy studies have tended to be used, especially those where hormones are known to have measurable effects (e.g. digit ratios) alongside mouse and rat studies (though you can't actually ask a mouse what its gender identity is, assuming it has one!). This research is placed alongside the studies of those with intersex conditions that affect hormone response and production.

What these studies show is that while abnormal exposure seems to have significant irreversible effects on gender behaviours and sexual behaviours, they have limited effect on gender identity and are certainly not determinant. How hormone exposure (prenatal, perinatal) interacts with brain development, gene regulation, epigenetics, and later social / environmental influences is still poorly understood, so exactly how and to what extent this works remains unclear.

What is clear is that cross sex hormone treatment of those who are with severe dysphoria has a significant benefit on body image and psychological well-being.

So in short, hormones can play a part in gender formation and transgender identity, but seemingly less than we might have believed some years ago and are certainly not the basis for these. However, hormone treatment for those who are transgender is effective and beneficial.

Hormone/Biochem Studies **Title**	**Published**	**Article**
Gender Development and the Human Brain	2011	Sagepub
Cross-sex hormonal treatment and body uneasiness in individuals with gender dysphoria	2014	OUP
Increased Cross-Gender Identification Independent of Gender Role Behavior in Girls with Congenital Adrenal Hyperplasia: Results from a Standardized Assessment of 4- to 11-Year-Old Children	2014	Link Springer
Serum concentrations of brain-derived neurotrophic factor in patients with gender identity disorder	2013	Sciencedirect
Evidence for Perinatal Steroid Influence on Human Sexual Orientation and Gendered Behavior	2022	Pubmed
Linking Prenatal Androgens to Gender-Related Attitudes, Identity, and Activities: Evidence From Girls With Congenital Adrenal Hyperplasia	2016	Link Springer
Early Female Transgender Identity after Prenatal Exposure to Diethylstilbestrol: Report from a French National Diethylstilbestrol (DES) Cohort	2024	MDPI
Low Perinatal Androgens Predict Recalled Childhood Gender Nonconformity in Men	2022	Sagepub
Prenatal testosterone and gender-related behaviour	2006	OUP
Cross-Sex Hormone Treatment and Psychobiological Changes in Transsexual Persons: Two-Year Follow-Up Data	2016	OUP
The Effects of Gender-Affirming Hormone Therapy on Body Satisfaction, Self-Esteem, Quality of Life, and Psychopathology in People with Female-to-Male Gender Dysphoria	2023	Pubmed
Early androgen exposure and human gender development	2015	Pubmed

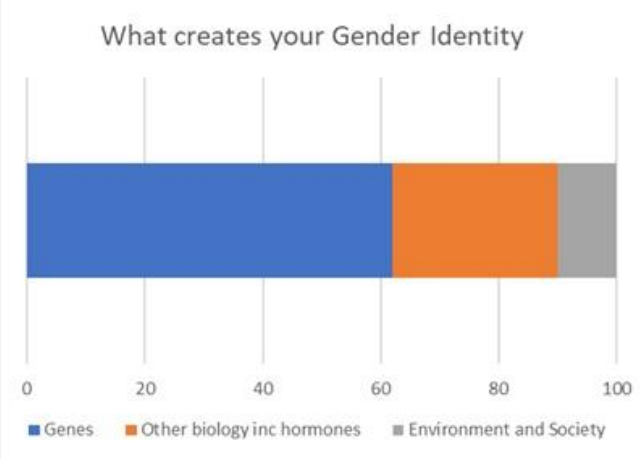
How early hormones shape gender development	2016	Sciencedirect
Comparing Postnatal Development of Gonadal Hormones and Associated Social Behaviors in Rats, Mice, and Human	2018	OUP
Estrogen masculinizes neural pathways and sex-specific behaviors	2009	Pubmed
Prenatal endocrine influences on sexual orientation and on sexually differentiated childhood behavior	2011	Sciencedirect

Twin studies and heritability

Heritability is the measure of how much a biological attribute is determined by genetics and how much by external influences. External influences always have some influence not least because they interact with the epigenetic control mechanisms that control gene expression. A high heritability factor suggests a largely genetic basis for an attribute. Studies of twins are commonly used to determine heritability scores due to their known genetics and measurable environments.

This is an evolving area in transgender biology, and many studies have limitations (sample size, measurement, etc.), but there is accumulating evidence that genetics plays a significant role. However, the trait is almost certainly polygenic (many genes each contributing small effects) with there being no evidence of there being a single "transgender gene," nor that genetics fully determine gender identity; rather, genetic predisposition plus developmental, hormonal, environmental, and possibly epigenetic influences combine in complex ways.

From the twin studies, heritability estimates (i.e. proportion of variance in gender identity / gender dysphoria traits attributed to genetic variation) tend to be moderate to high: ~62% in the child/adolescent twin study for GID symptomatology, while the pooled twin data study (Australia and others) finds much higher concordance in MZ vs DZ twins, suggesting strong genetic influence. There are also studies that show the trait runs through families also supporting strong genetic influence.



These estimates mean that genetic factors account for a major portion of the variation in who experiences transgender identity / gender dysphoria, but also that multiple nonspecific external factors play a role too.

Twin Studies and Heritability		
Title	**Published**	**Article**
Using twin data to examine heritable and intrauterine hormonal influences on transgender and gender diverse identities (Australia + pooled data)	2025	Pubmed

Genetic and Environmental Influences on Traits of Gender Identity Disorder: A Study of Japanese Twins Across Developmental Stages	2016	Pubmed
The heritability of gender identity disorder in a child and adolescent twin sample	2002	Pubmed
Concordance for Gender Dysphoria in Genetic Female Monozygotic (Identical) Triplets	2022	Link Springer
The Biological Contributions to Gender Identity and Gender Diversity: Bringing Data to the Table	2018	Link Springer
Genetic and Environmental Contributions To Gender Diversity: A Systematic Review of the Twin Literature	2025	Link Springer
Gender dysphoria in twins: a register-based population study	2022	Nature
Gender identity disorder in twins: a review of the case report literature	2012	OUP

Genetic/Epigenetic studies

While we know from twin studies that gender and transgender identity is fundamentally genetically determined, the question arises is there a 'gender/transgender gene'? These studies look at that question and also the trigger mechanisms for gene expression, the epigenetics, that may be involved. Every cell in our body contains the complete set of DNA and so can become any cell type. Epigenetics is the study of the mechanisms that control gene expression and conversion so that a particular cell becomes say a neuron rather than a liver cell. The currently known mechanisms are varied and exceedingly complex – DNA methylation, histone acetylation, mRNA, transcription factors, spandrels, and so on, but are what turns the recipe book of our DNA into us as organisms.

What these studies show is that while genetics is at the core and that certain genes may be implicated, there is no single gene involved. This is almost certainly a polygenic attribute in which multiple complex genetic and epigenetic mechanisms are involved. Added to this there seems no clear correlation with the genes that determine sex differentiation, suggesting this is a distinct attribute.

Genetic and Epigenetic Studies **Title**	**Published**	**Article**
Epigenetics Is Implicated in the Basis of Gender Incongruence: An Epigenome-Wide Association Analysis	2021	Pubmed
CBLL1 is hypomethylated and correlates with cortical thickness in transgender men before gender affirming hormone treatment	2023	Pubmed
The Use of Whole Exome Sequencing in a Cohort of Transgender Individuals to Identify Rare Genetic Variants	2019	Pubmed

Genotypes and Haplotypes of the Estrogen Receptor α Gene (ESR1) Are Associated with Female-to-Male Gender Dysphoria	2017	OUP
A polymorphism of the CYP17 gene related to sex steroid metabolism is associated with female-to-male but not male-to-female transsexualism	2008	Sciencedirect
A Common Polymorphism of the SRD5A2 Gene and Transsexualism	2007	Link Springer
The genetic basis of parental care evolution in monogamous mice	2017	Nature
Genetic, Epigenetic and Environmental Impact on Sex Differences in Social Behavior	2009	Sciencedirect
The genetics of sex differences in brain and behavior	2011	Pubmed
Brain feminization requires active repression of masculinization via DNA methylation	2015	Pubmed
Epigenetic mechanisms in sexual differentiation of the brain and behaviour	2016	PubMed
Genetic Link Between Gender Dysphoria and Sex Hormone Signaling	2018	OUP
The Biological Basis of Gender Incongruence	2022	InTechOpen

Psychosocial studies

As noted previously we have traditionally assumed that gender is purely a social construct and that one's gender identity is dependent entirely on one's upbringing and social environment. This has led to claims that social experiences or mental illness must cause people to believe they are transgender, with all sorts of wild theories being put forward – it's just confused sexuality, it's an attempt to escape difficult family environments/oppressive patriarchy, it's ideological indoctrination, the result of trauma and so on. However, there is not a great deal of research to back the psychosocial hypotheses and what exists does not support the claims.

Some research notes complex and varied social backgrounds but concluding gender incongruence is caused by these is irrational, unscientific and lacking specificity. The consistency of trans reported experiences across societies, demographics, cultures, religions, geographies and histories not only make such causes, at the very least, unlikely but also makes studying this and drawing any meaningful conclusions extremely difficult.

In fact, the studies of lived in experience (phenomenology) support the widely accepted view that this is natural condition rather than being a mental illness, but a condition that, for various identified reasons, gives rise to mental health issues.

The most recent psychosocial hypothesis is 'Raid Onset Gender Dysphoria' and 'Social Contagion', the idea that people and especially youngsters are suddenly choosing to be trans because they've been socially indoctrinated and told 'it's cool'. The research that led to this claim has subsequently been dismissed as unscientific and the conclusions bogus, with the research disowned by the originating University (It specifically asked parents who wouldn't accept their children were trans why they thought they'd come out as this). Subsequent research has also shown that the claim has no basis,

while it has been proven that gender identity cannot be changed or chosen, especially by ideological indoctrination. But this hasn't stopped the claim being heavily pushed by those who are attempting to deny the existence of trans folks, although one shouldn't dismiss that there may be a few who might try to claim they are trans falsely (and who then desist).

Psychosocial Studies **Title**	**Published**	**Article**
Australian children and adolescents with gender dysphoria: Clinical presentations and challenges experienced by a multidisciplinary team and gender service	2021	Sagepub
Young people with features of gender dysphoria: Demographics and associated difficulties	2014	Sagepub
Do Clinical Data from Transgender Adolescents Support the Phenomenon of "Rapid Onset Gender Dysphoria"?	2022	Sciencedirect
Gender dysphoria in adolescence: examining the rapid-onset hypothesis	2024	Link Springer
The phenomenology of gender dysphoria in adults: A systematic review and meta-synthesis	2020	Sciencedirect
Autobiographical memory phenomenology in transgender and cisgender individuals	2024	T&F
Association Between Recalled Exposure to Gender Identity Conversion Efforts and Psychological Distress and Suicide Attempts Among Transgender Adults	2019	JAMA

Persistence/Desistence studies

This is a subject area that needs consideration because it is one used extensively by those seeking to eradicate transgender folks – the claim being that most people desist or 'are cured' of being transgender and that ideological indoctrination is making more and more people, especially 'vulnerable' youth, falsely claim to be trans.

Given we know gender identity is immutable, genetic and not intrinsically tied to sex, the claim that folks do not persist in being trans or grow out of it is clearly false. That this is seen to happen has its roots not in biology but in society and our views and treatment of this which is backed up by the research. The terms desistence, detransition, dysphoria are imprecise terms and understanding of these is poor and varied, and this is being exploited by those are trying to eradicate trans folks (including presenting them as binaries rather than spectrums)

Firstly, and to be clear, the research shows that for those who go through the complete transition process, even those starting as children, regret and desistence rates are very small, repeatedly being shown to be less than 1%. To put that into context most major life changing events involving medical intervention, including having children, have regret rates from 8% (e.g. knee replacement) up to 60%

(e.g. Cosmetic surgery). Transgender healthcare is therefore is one of the most successful medical interventions practised. (Those that rush the process and try and cut corners are often those that report regret)

Secondly, transition is a 5-10 year step by step process that is exceedingly challenging. Social transition is the first and hardest step and comes before medical transition. In many societies education and understanding in gender and gender incongruence is poor and trans folks are not readily accepted making acceptance one of the most significant challenges. The research shows varied numbers who desist or 'detransition' but the 2015 U.S. Transgender Survey found that 8% of respondents reported having ever 'detransitioned'; 62% of that group reported having subsequently 'retransitioned'. 33% reported 'detransitioning' because it was too difficult, 31% due to discrimination, and 29% due to difficulty getting a job. Others reported the reason as being pressure from parents (about 36%), family members (26%), spouses (18%), and employers (17%). In short discrimination is the major cause for desisting.

Thirdly the research shows there are many different reasons why people initially seek consultations on their gender and therefore many different outcomes. As a subject that is poorly taught and understood some come to understand this is not their issue, but that this is, for example, confusion over sexuality (butch/camp), the result of some other trauma or medical condition(s) such as body dysmorphia. Others come to understand and accept that their position on the gender spectrum and their degree of dysphoria can be managed within their current lives with minor adjustments. Occasionally some find that despite a desire to transition the challenges of this outweigh their dysphoria (while those who may approach this frivolously always stop when they learn what is involved!) Whatever, these people are not detransitioners, desisting, being cured or 'stopping being trans'. They are simply finding out who they are, where they fit, and how to proceed with their lives and address the issue they have.

That is, of course, the purpose of medicine but it is an imprecise science and experience and evidence must continually be used to drive improvement. The treatment of gender incongruence has come on a long way over the past 100 years and is now very successful. That outcomes don't come out quite right for a few, in this case 1%, happens across medicine. But this should never be a reason for halting treatment for the 99% for whom it is successful, and should be the reason to seek to understand and improve.

In short, despite the considerable misinformation being put about desistence, the research supports the understanding that gender identity is fixed, persistent and exists across a spectrum and that gender dysphoria arises from the mismatch between assigned gender and actual gender. Both of these vary from individual to individual and determine how this is then managed. The current processes for diagnosis and treatment, though challenging due to a breadth of factors are actually very successful and while occasionally some show regret the numbers are very small compared to other commensurate medical treatments.

Persistence/Desistence Studies **Title**	**Published**	**Article**
Detransition and Desistance Among Previously Trans-Identified Young Adults	2023	Link Springer

A critical commentary on follow-up studies and "desistance" theories about transgender and gender-nonconforming children	2018	T&F
Consistency of Gender Identity and Preferences Across Time: An Exploration Among Cisgender and Transgender Children	2022	APA
A follow-up study of girls with gender identity disorder	2008	APA
Individuals Treated for Gender Dysphoria with Medical and/or Surgical Transition Who Subsequently Detransitioned: A Survey of 100 Detransitioners	2021	Link Springer
Transsexuality: Transitions, detransitions, and regrets in Spain	2020	Sciencedirect
An analysis of all applications for sex reassignment surgery in Sweden, 1960-2010: prevalence, incidence, and regrets	2014	Link Springer
Continuation of gender-affirming hormones in transgender people starting puberty suppression in adolescence: a cohort study in the Netherlands	2022	The Lancet
Access to care and frequency of detransition among a cohort discharged by a UK national adult gender identity clinic: retrospective case-note review	2021	CUP
Detransition-Related Needs and Support: A Cross-Sectional Online Survey	2022	T&F
Health Care Experiences of Patients Discontinuing or Reversing Prior Gender-Affirming Treatments	2022	JAMA
Misinformation Related to Discontinuation and Regret Among Adolescents Receiving Gender-Affirming Care	2024	JAH
Regret after Gender-affirmation Surgery: A Systematic Review and Meta-analysis of Prevalence	2021	PRS
Patient Satisfaction After Total Knee Replacement: A Systematic Review	2018	Pubmed
Factors Leading to "Detransition" Among Transgender and Gender Diverse People in the United States: A Mixed-Methods Analysis	2020	Sagepub
A systematic review of patient regret after surgery- A common phenomenon in many specialties but rare within gender-affirmation surgery	2024	AJS
Prevalence of detransition in persons seeking gender-affirming hormonal treatments: a systematic review	2025	OUP

Defining Desistance: Exploring Desistance in Transgender and Gender Expansive Youth Through Systematic Literature Review	2022	Sagepub
2015 US Transgender Survey	2017	Transequality

Miscellaneous studies

This group of studies cover a range of topics that complement the other study areas.

Firstly, there are group of studies that highlight that nature doesn't actually follow the simple rules our ideologies teach about sex and gender. For example, these demonstrate that some organisms have hundreds and sometimes thousands of sexes, that some animals are two sexes at the same time and can choose which one(s) to use, that others change sex during their lifetime.

They also show that in mammals (including potentially humans) it is possible to instigate sex change, turning ovaries into testes and vice versa, that humans can be born true hermaphrodites with both types of gonad, that every single person's genome is unique, varying around 0.1% from other humans, that humans can have both XX and XY chromosomes in their cells and indeed many other chromosome combinations than just XX or XY and that some humans are sexed as female at birth but grow penises and testicles when they reach puberty!

Secondly, we are considering the biology of gender here, not sex and its biology, which is involved in but does not entirely determine gender. So, there are a group of studies that look at some related aspects of this. Phantom limb syndrome, the reporting of mentally experiencing you have a limb that has been removed is common with >50% of amputees experiencing it. However trans gender individuals do not experience this post reassignment and some even report phantom limb syndrome pre-transition for sex features they have never had. Unusual gender variation is also found in nature. The white throated sparrow is an example that demonstrates four different sets of gender role behaviours which are known to be determined by genetics. This is complemented by studies that show biological manipulation can change gender role behaviours in mammals. Finally, there are many studies around gender role behaviours – matriarchal vs patriarchal societal species, tournament vs pair bonding species and how against our common understanding it is often the males who bring up offspring. These go alongside evolutionary psychology papers but are too numerous to detail here, though a couple of examples are included.

What these studies show is that nature doesn't do simple, binaries, immutability or conformity, as is taught and believed in society, but is complex and constantly mixes and varies things including with sex and gender. And they further demonstrate that gender (as in gender identity and gender role behaviours) is a distinct biological attribute and that transgender people have existed and been recognised throughout history.

Miscellaneous **Title**	**Published**	**Article**
Mammalian sex determination—insights from humans and mice	2012	Link Springer
DMRT1 prevents female reprogramming in the postnatal mammalian testis	2011	Nature

Somatic sex reprogramming of adult ovaries to testes by FOXL2 ablation	2009	Cell
The relationship between mating system and simultaneous hermaphroditism in the coral reef fish, Hypoplectrus nigricans (Serranidae)	1980	Sciencedirect
Adult sex change leads to extensive forebrain reorganization in clownfish	2024	Pubmed
Male microchimerism in women without sons: Quantitative assessment and correlation with pregnancy history	2005	AMJMed
Examining the prevalence of trans phantoms among transgender, nonbinary and gender diverse individuals: An exploratory study	2023	T&F
Occurrence of phantom genitalia after gender reassignment surgery	2007	Sciencedirect
Inside the Supergene of the Bird with Four Sexes (genders)	2021	Pubmed
Behavioral Characterization of a White-Throated Sparrow Homozygous for the ZAL2m Chromosomal Rearrangement	2012	Link Springer
Microglial Phagocytosis of Newborn Cells Is Induced by Endocannabinoids and Sculpts Sex Differences in Juvenile Rat Social Play	2019	Cell
A functional circuit underlying male sexual behaviour in the female mouse brain	2007	Nature
Galanin neurons in the medial preoptic area govern parental behaviour	2014	Nature
The neurobiology of parenting: A neural circuit perspective	2016	Wiley
Why men invest in non-biological offspring: paternal care and paternity confidence among Himba pastoralists	2020	Royal Society
The gonads of human true hermaphrodites	1981	Pubmed
Karyotypes Are Not Sexes	2021	Paradox
Why Even Bother with Sex?	2022	AUW
A new hypothesis may explain human parthenogenesis and ovarian teratoma: A review study	2023	Pubmed
Understanding Human Genetic Variation	2007	PubMed
Transgender history	2025	Wikipdia
Evolutionary Basis of Gender Dynamics: Understanding Patriarchy, the Pay Gap, and the Glass Ceiling	2025	JLS

Conclusions

Biology is complex, messy, and constantly varied and changing. It's how nature works (or how god made the world) and if it weren't this way we wouldn't exist today. It doesn't do binaries or uniformity or immutability and we make simplifications purely to give something for our limited brains to handle and use. However, these simplifications often prove to be fundamentally false, even when embedded in society, and societal views must, therefore, be adjusted as this arises. It has become clear that our western beliefs about sex and gender, what is biological, what is social construct and beliefs around them being intrinsically tied, binary and mutable/immutable are not correct. Transgender folks exist and exist because of their biology, with the studies above, though only a representative sample, showing :-

- That gender is recognised as a set of behaviours formed by our brains that comprises gender identity, including but not exclusively a sexual identity, and gender role behaviours.
- These behaviours exist throughout nature and are associated with offspring rearing and social development.
- That gender is genetically determined, that is hardwired, with a range of external factors playing a small role (both for gender identity and gender role behaviours). This fits with our modern understandings in behavioural biology.
- That gender identity is polygenic with no specific gene but a complex number of different genes involved, and those that are involved in sex differentiation are not determinant.
- That sex differential biology plays a role but is not determinant.
- That hormones may play a part but are not determinant.
- That transgender identities are real with brain structures and behaviours that are commensurate with their identified genders.
- That gender identity involves many different areas of the brain (as do behaviours).
- That gender identity cannot be changed by ideology, upbringing, talking therapies etc. Being transgender is not an ideology but a hardwired biological immutable condition, and something you are born as.
- There is no research evidence for psychosocial (ideology/indoctrination) causes to being transgender.
- That gender identities are not binary but exist across a bimodal spectrum. Non binary people exist and our division of the spectrum into two is purely a social construct.
- The multitude and varying cultural rules we apply to the gender divisions we create are sociological and are also called gender and are built on but not the same as biological gender.
- That our western ideological tying of sex and gender together and using them interchangeably is wrong. They are not intrinsically tied and therefore not interchangeable and while both have biological bases the biology is different.
- That a mismatch between the gender assigned at birth and actual gender identity can cause considerable dysphoria and accompanying mental health issues, that needs and benefits from treatment.
- That medical practice for transgender folks has advanced considerably over the past 100 years. Though complicated by many different factors it is successful in separating and dealing with those who need support to socially and, possibly, medically transition and those who do not, and to see these through to whatever transition point is appropriate for them. The regret rates are therefore considerably lower than most other life changing interventions.

- Inadequate education about the true nature of gender and its differences with sex and sexuality (as well as the true nature of these), has created a dangerous, toxic and discriminatory environment for transgender folks, that is being exploited by those with extremist ideologies.
- That sex is not binary nor immutable even in mammals/humans. It is actually exceedingly varied and complex. Our division of the sex spectrum into two is a social construct, and it is nigh on impossible to define what determines one side or the other. (That sex is immutable should not therefore be a protected belief in law as it disprovable)

In short, gender identity and being transgender is a genetically determined biological behavioural attribute that is not influenced by psychosocial factors, including ideology, and is not intrinsically tied to sex and sex biology. Those with extremist ideologies that are denying this and trying to eradicate trans folks will not succeed and society will eventually adapt to better accommodate gender diversity because nature and science always wins over ideology and gender (one's brain) is way more important than sex (one's genitalia).