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Selection Without a Selector: Polygenic Embryo Screening and the Eugenics Prohibition of Article 3(2) of the Charter of Fundamental Rights of the European Union

Rayyan Ahmad

Final-Year LLB Candidate/ Bahria University Islamabad.

ra959497@gmail.com

ABSTRACT

*Article 3(2) of the Charter of Fundamental Rights of the European Union prohibits eugenic practices, in particular those aiming at the selection of persons, a provision drafted with a single historical referent in view, state directed and population targeted eugenics of the kind twentieth century Europe experienced directly. Polygenic embryo screening, a technology now commercially available and already used to rank embryos by predicted disease risk and, increasingly, by non disease traits, presents that provision with a structure its drafters did not anticipate. No state selects. No single actor aims at a population outcome. Thousands of individually autonomous and individually lawful parental choices may nonetheless produce, in aggregate, an effect indistinguishable in kind from the harm the provision exists to prevent. This article names this structural difficulty the selector problem and asks whether Article 3(2) can be interpreted to reach it. Drawing on the provision's drafting history, the Court of Justice's interpretive practice in *Brüstle v Greenpeace*, the reproductive genetics and bioethics literature documenting polygenic screening's trajectory, and the theory of aggregate behaviour developed by Schelling, the article constructs an interpretive test for what it terms aggregate eugenic effect, tests that framework against the strongest available objection grounded in procreative liberty, and proposes a regulatory response to the jurisdictional difficulty a multinational screening industry presents. The article argues that existing scholarship has diagnosed this phenomenon in ethical and scientific terms without supplying it with the doctrinal architecture Article 3(2) itself requires, and undertakes that construction across a single sustained argument.*

Keywords: Eugenics; Polygenic Embryo Screening; Charter of Fundamental Rights; Aggregate Effect; Procreative Liberty; Reproductive Genetics.

1. Introduction

The Charter of Fundamental Rights of the European Union grounds the right to the integrity of the person, in Article 3, in a general guarantee of physical and mental integrity together with three specific prohibitions, reproductive cloning, making the human body a source of financial gain, and eugenic practices, in particular those aiming at the selection of persons.¹ Of the three, the eugenics prohibition has attracted the least sustained doctrinal attention, largely because it has, until recently, seemed the least in need of it. This article argues that a technology now commercially available across multiple jurisdictions has reopened Article 3(2) as a live and doctrinally unresolved question.

Polygenic embryo screening allows prospective parents undergoing in vitro fertilisation to rank the embryos available to them by a polygenic score, a statistical prediction, derived from genome wide association data, of the likelihood that a given embryo will develop a particular trait. Initially confined to disease risk, polygenic screening is now offered by companies including Orchid

¹Charter of Fundamental Rights of the European Union [2000] OJ C364/1, art 3.

Health, Nucleus Genomics, and Genomic Prediction for a widening range of traits, and its proponents have not concealed the direction of travel. A 2024 review in Human Reproduction Update traces this extension from monogenic disease screening toward complex trait prediction in detail, noting that commercial deployment has proceeded largely ahead of any settled regulatory or professional consensus on where the practice should stop.² A representative of a venture capital fund investing in this sector has been reported as describing the choice of a marriage partner as itself a form of eugenics, a framing that collapses, deliberately, the distinction between ordinary human mate preference and technologically mediated, statistically ranked embryo selection.³

The central difficulty this technology presents to Article 3(2) is structural rather than merely a matter of degree. The provision's language, and its drafting history examined in Section 3 below, presuppose a selector: a state, a program, an identifiable authoring will be directing selection toward a population level outcome. Polygenic embryo screening, deployed at scale through thousands of individually consenting, individually private reproductive decisions, may produce a population level effect structurally identical to state directed eugenics while involving no state, no program, and no single actor who has selected anything beyond their own prospective child. This article terms the resulting interpretive gap the selector problem, and states, as its central question, whether Article 3(2) can be read, consistently with its text and its purpose, to reach a eugenic effect that emerges only in aggregate and that no individual decision, taken alone, could be said to constitute.

The article proceeds in three further stages, corresponding to the three parts in which it is submitted. Section 2 states the doctrinal method. Section 3 reconstructs the drafting history and purposive content of Article 3(2), establishing precisely where the selecting will requirement enters the provision and what work it does within it. Section 4 constructs an interpretive test for aggregate eugenic effect, and Section 5 tests that framework against its strongest objection. Section 6 designs a regulatory response, Section 7 draws the argument's three closures together, and Section 8 closes with recommendations addressed to the Court of Justice, the Commission, and domestic regulators.

2. Materials and Methods

This article's method is doctrinal, proceeding by close reading of primary instruments and their authoritative interpretation, supplemented by conceptual analysis drawn from the theory of aggregate behaviour where doctrinal materials alone cannot supply an answer. The primary provisions examined are Article 3(2) of the Charter and Article 11 and Article 13 of the Convention for the Protection of Human Rights and Dignity of the Human Being with regard to the Application of Biology and Medicine, the Oviedo Convention, from which Article 3 draws directly, read together with the Charter's own explanatory notes and with the Court of Justice's judgment in *Brüstle v Greenpeace*, the clearest available precedent for the Court's interpretive posture toward provisions protecting human dignity in the biomedical field.⁴ The empirical background is established through the reproductive genetics and bioethics literature, principally the 2024 Human Reproduction Update review, the Hastings Center's applied ethical treatment

²Antonio Capalbo and others, 'Screening embryos for polygenic disease risk: a review of epidemiological, clinical, and ethical considerations' (2024) 30 Human Reproduction Update 529, 531–536.

³Reported in the Washington Post, 2025, discussed further in Section 2 below.

⁴Case C-34/10 *Oliver Brüstle v Greenpeace eV* [2011] EU:C: 2011:669 (Grand Chamber); Convention for the Protection of Human Rights and Dignity of the Human Being with regard to the Application of Biology and Medicine (Oviedo Convention) (Council of Europe, ETS No 164, signed 4 April 1997, entered into force 1 December 1999) arts 11, 13.

of polygenic screening, and a 2026 comparative regulatory survey cataloguing the uneven and in most cases silent state of existing law on polygenic scoring for non disease traits.⁵

Doctrinal method alone cannot answer this article's central question, because no existing precedent addresses polygenic embryo screening under Article 3(2) specifically. Doctrinal reading can describe what the provision's text would say if applied literally to the selector problem, but it cannot, unaided, determine whether that literal reading exhausts the provision's purpose, nor construct the interpretive resources a purposive reading beyond the text requires. For that reason the article draws, at the specific point where doctrinal method reaches its limit in Section 4, on Schelling's theory of aggregate behaviour, which shows that individually mild and individually non malicious preferences, iterated across a large population, can produce a collective pattern no participant intended and no participant, considered alone, could be said to have caused.⁶ This resource is introduced where its explanatory work is needed rather than surveyed in advance, consistent with the method this article's wider research programme has applied elsewhere.

A final methodological point governs the whole article. The analysis is confined to polygenic embryo screening as presently and prospectively practised in the context of in vitro fertilisation, and does not address heritable genome editing, a technology governed directly by Article 13 of the Oviedo Convention and by a substantial existing literature this article treats as adjacent rather than central to its own inquiry. Nor does it address postnatal genetic testing or somatic gene therapy, each raising distinct questions under other provisions this article does not purport to resolve.

3. The Drafting History and Purposive Content of Article 3(2)

Article 3(2)'s eugenics clause was not drafted as an original provision. The Charter's own explanatory notes confirm that Article 3 was intended to give expression to principles already recognised in the Oviedo Convention rather than to create novel obligations, and the specific reference to eugenic practices aiming at the selection of persons draws directly on Article 11 of that Convention, which prohibits discrimination on grounds of a person's genetic heritage.⁷ The Oviedo Convention was itself adopted in 1997 with a single historical referent openly in view. Its preamble and explanatory report situate the Convention's biomedical protections against the background of the twentieth century's eugenic programs, most immediately National Socialist Germany's, and the drafting history recorded in the Convention's explanatory report confirms that the eugenics prohibition was understood by its own drafters as a direct response to that history rather than as a general or open textured principle addressed to any future configuration biomedical practice might take.⁸

This historical referent is doctrinally significant for the present inquiry in a specific way. Twentieth century eugenic programs shared a common structure regardless of their national variation: a state or state sanctioned institution formed an intention directed at the genetic composition of a population and pursued that intention through law, through compulsory sterilisation, through immigration restriction calibrated to perceived genetic desirability, and, in their most extreme form, through extermination. Every element of Article 3(2)'s language, its reference to a practice, its reference to an aim, and its reference to selection, tracks this structure

⁵Capalbo and others (n 2) 536–542; Hastings Center, 'Polygenic Embryo Screening: Ethical and Legal Considerations' (2021); comparative survey discussed in *Frontiers in Reproductive Health* (2026).

⁶Thomas C Schelling, *Micromotives and Macrobehavior* (W W Norton 1978) 137–166.

⁷Charter of Fundamental Rights of the European Union, Explanatory Notes [2007] OJ C303/17, note on art 3.

⁸Council of Europe, Committee on Bioethics, Explanatory Report to the Convention for the Protection of Human Rights and Dignity of the Human Being with regard to the Application of Biology and Medicine (1997) paras 1–9, 30–32.

closely. A practice implies a sustained and organised course of conduct rather than an isolated act. An aim implies an intending subject. And selection, read against this background, implies a selector positioned to compare and choose among the members, or potential members, of a population according to a genetic criterion. The Universal Declaration on the Human Genome and Human Rights, adopted by UNESCO in the same year as the Oviedo Convention and sharing its historical orientation, confirms this reading, framing its own prohibition on practices contrary to human dignity specifically around the human genome's status as, in a symbolic sense, the common heritage of humanity, a formulation that again presupposes an actor capable of treating that heritage as an object of intentional intervention.⁹

Nothing in this drafting history suggests its authors considered, or had reason to consider, a mechanism of eugenic effect other than a directing will, because in 1997 no other mechanism existed at any meaningful scale. Preimplantation genetic diagnosis was, at that date, confined to the detection of single gene disorders in embryos already earmarked for testing on other medical grounds, a practice with no capacity to shift a population's genetic composition in any direction a state or institution might have intended. The absence of any contemplated alternative mechanism is not evidence that the drafters considered and rejected the possibility of eugenic effect without a directing will. It is evidence that the question did not arise, because the technology capable of raising it, individually elective, population scale, statistically mediated trait selection, was decades away.

The Court of Justice's own interpretive practice in the biomedical field, most authoritatively stated in *Brüstle v Greenpeace*, supplies a resource for addressing exactly this kind of historical gap. The Grand Chamber was asked, in that case, to define the term human embryo for the purposes of the Union's biotechnology directive, a term the directive itself left undefined.¹⁰ Rather than adopting the narrowest available definition, the Court held that the concept must be understood in a wide sense, reasoning that the directive's context and aim required excluding any possibility of patentability wherever respect for human dignity could be affected, and extending the definition to non fertilised ova whose division had been stimulated by parthenogenesis on the ground that such organisms were, functionally, capable of commencing the process of development of a human being even though they had not, strictly speaking, been fertilised.¹¹ The Court's method in *Brüstle* was explicitly purposive rather than literalist, reasoning from the directive's underlying concern for human dignity to a definition its text did not compel, precisely because a narrower, more literal reading would have permitted a form of exploitation the directive existed to prevent.

This article submits that the same interpretive posture is available, and appropriate, for Article 3(2), though the specific problem it must be applied to is different in kind from the definitional question *Brüstle* resolved. *Brüstle*'s difficulty lay in defining the provision's object, what counts as an embryo, in circumstances where the underlying purpose, protection of human dignity, was not in doubt and the relevant conduct, patenting an invention derived from embryonic material, was performed by a single identifiable actor. The difficulty presented by polygenic embryo screening lies not in defining Article 3(2)'s object, which is not contested, but in locating the aim and the aimer the provision's text presupposes, in circumstances where no single actor's conduct, considered alone, resembles the paradigm case the provision was drafted to address. Section 4 below takes up this harder task directly, asking whether the aim and the aimer the text

⁹UNESCO, Universal Declaration on the Human Genome and Human Rights (11 November 1997) arts 1, 2, 10.

¹⁰*Brüstle* (n 3) paras 1–10.

¹¹*ibid* paras 26–36.

presupposes can be understood as historically contingent features of the mechanism the drafters had in view, rather than as conceptually necessary preconditions of the harm the provision exists to prevent, an inquiry to which Brüstle's purposive method is a necessary but not, on its own, a sufficient guide.

4. An Interpretive Test for Aggregate Eugenic Effect

4.1 From Historical Contingency to Conceptual Reconstruction

Part I established that Article 3(2)'s reliance on the language of aim and selection tracks the specific historical structure of twentieth century state directed eugenics, a structure in which a directing will was, in 1997, the only mechanism capable of producing a population level shift in genetic characteristics. This section undertakes the constructive task that finding makes possible. If the directing will be historically the only available mechanism rather than a conceptually necessary feature of the harm Article 3(2) addresses, then a second mechanism capable of producing the same population level effect without any directing will falls within the provision's purpose even though it does not satisfy a literal reading of its text. Establishing that a second mechanism exists, and specifying with precision when it produces the relevant effect, is the task of the remainder of this section.

4.2 Schelling's Aggregate Behaviour and the Structure of the Selector Problem

Schelling's analysis of what he termed micromotives and macrobehaviour supplies the conceptual resource this reconstruction requires. Schelling showed, through a model of residential choice that has since become one of the most cited results in the social sciences, that a population in which every individual holds only a mild and entirely non malicious preference for a modest proportion of similar neighbours will, through the uncoordinated operation of that preference alone, tip into near complete segregation, an aggregate outcome no individual in the model desired, intended, or could have prevented by acting alone.¹² Schelling's own statement of the result's generality is direct: the relationship between individual intention and collective outcome is, across a wide range of social phenomena, one of the least understood and most important features of social life, precisely because it is so easy to mistake an aggregate pattern for the sum of individual intentions when it is, in fact, an emergent property of their interaction. Applied to polygenic embryo screening, Schelling's model supplies the precise structure the selector problem presents. Each prospective parent selecting among available embryos exercises a preference calibrated to their own child, not to the genetic composition of the wider population, in exactly the sense that each resident in Schelling's model expresses a preference calibrated to their own immediate neighbours rather than to the city's overall pattern of settlement. Yet if a sufficiently large number of prospective parents, drawing on the same polygenic scoring methodology and the same underlying genome wide association data, apply that individually calibrated preference in a consistent direction, tending, for example, to favour embryos with higher predicted values for a trait such as cognitive ability, the aggregate effect across the population is not merely additive but self reinforcing in exactly the manner Schelling's tipping dynamic describes, since a shift in the population distribution of the relevant genetic variants alters the reference point against which subsequent selections are themselves calibrated. This article does not claim that such a tipping dynamic has presently occurred, a claim the empirical literature examined in Section 4.3 below does not support. It claims that Schelling's model supplies the correct structural description of the mechanism through which it could occur, without requiring any participant to intend, or any single actor to select for, the resulting population level shift.

¹²Thomas C Schelling, *Micromotives and Macrobehavior* (W W Norton 1978) 137–166, 178–183.

4.3 The Genetics of Aggregation: What Karavani and Colleagues Show

The most rigorous quantitative treatment of polygenic embryo selection's actual genetic effect, by Karavani and thirteen co-authors publishing in *Cell* in 2019, supplies this article with the empirical grounding Schelling's structural model requires and, in the same analysis, supplies the strongest available caution against overstating the present scale of the phenomenon. Using theoretical modelling, simulation, and real family data, Karavani and colleagues calculated the expected gain from polygenic embryo selection, defined as the difference in predicted trait value between the highest scoring embryo in a typical in vitro fertilisation cycle and an average, unselected embryo, finding a gain of approximately two and a half centimetres of height or two and a half IQ points under presently available polygenic predictors and typical embryo yields, a gain the authors describe as limited and, in real family data, unreliable at the level of any single family.¹³ The authors' own analysis of real sibling data found that the embryo with the highest polygenic score for height was in fact the tallest sibling in only about one quarter of families studied, a finding that underscores the genuinely probabilistic and individually modest character of any single act of polygenic selection.

This finding does not weaken the case for the interpretive test this section constructs. It is, properly understood, the precise empirical condition under which Schelling's aggregation dynamic operates rather than an objection to it. Schelling's segregation result depends specifically on the individual preference being mild rather than strong, and on the aggregate pattern emerging from the accumulation of many such mild preferences across a large population rather than from any single actor's decisive intervention. A polygenic selection effect that were large, reliable, and individually decisive at the level of a single family would, if anything, more closely resemble the directed selection Article 3(2)'s text already reaches without requiring the reconstruction this article proposes, since a sufficiently powerful and sufficiently reliable individual selection tool would begin to look less like an aggregation problem and more like an individual act of eugenic selection in the provision's most literal sense. It is precisely because Karavani and colleagues confirm that present day polygenic selection operates through many individually modest, individually uncertain contributions, compounding across an expanding population of users and an accumulating number of reproductive cycles over successive generations, that the phenomenon this article addresses falls into the aggregation category Schelling's model, rather than any theory of direct individual causation, is suited to describe.

4.4 An Existing Union Law Analogue: Cumulative Effects Assessment

European Union law already possesses a working doctrinal category built to address exactly the structural difficulty Sections 4.2 and 4.3 above identify, and this article submits that this category, rather than any resource imported from outside Union law, supplies the most directly applicable precedent for the interpretive test this section constructs. The Environmental Impact Assessment Directive requires that an assessment of a project's likely significant effects on the environment take into account the cumulation of effects with other existing or approved projects, a requirement Annex IV of the Directive states explicitly and that the Court of Justice has applied to require assessment of a project's combined impact even where no single project, considered in isolation, would trigger the assessment obligation at all.¹⁴ The doctrinal structure this requirement embodies is precisely the structure Article 3(2) requires once its selecting will

¹³Ehud Karavani and others, 'Screening Human Embryos for Polygenic Traits Has Limited Utility' (2019) 179 *Cell* 1424, 1424–1426, 1430–1432.

¹⁴Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment [2012] OJ L26/1, as amended by Directive 2014/52/EU [2014] OJ L124/1, Annex IV, para 5.

requirement is reconstructed along the lines Section 4.1 above proposes. Union environmental law does not treat any individual development consent as unlawful merely because it contributes to a cumulative effect; it treats the cumulative effect itself as the object requiring distinct legal attention, assessed and, where necessary, addressed through mechanisms that operate at the level of the aggregate pattern rather than at the level of any single, individually lawful contributing act.

This analogue does more than supply a persuasive comparison. It demonstrates that Union law is institutionally and doctrinally capable of the specific move this article's interpretive test requires, distinguishing between the individual lawfulness of a contributing act and the distinct legal significance of the aggregate pattern that act contributes to, without needing to condemn the individual act in order to regulate the pattern. Section 4.5 below adapts this structure directly to Article 3(2), and Section 5.2 draws on it again to answer the strongest objection to the resulting framework.

4.5 The Proposed Interpretive Test

Combining the structural account Schelling's model supplies, the empirical calibration Karavani and colleagues' findings provide, and the doctrinal template the Environmental Impact Assessment Directive's cumulative effects requirement offers, this article proposes a three factor test, applied conjunctively, for determining whether polygenic embryo screening, as practised within a given population over a given period, constitutes an aggregate eugenic effect within the purposive meaning of Article 3(2).

The first factor, scale, asks whether the proportion of the relevant population's reproductive cycles conducted using polygenic screening for the trait in question has reached a level capable of producing a measurable shift in the population distribution of the underlying genetic variants, a threshold to be established, following the method the Environmental Impact Assessment Directive's own guidance documents already use for cumulative effects in the environmental context, by reference to the best available quantitative modelling of the kind Karavani and colleagues supply for the traits presently subject to polygenic scoring.

The second factor, directional patterning, asks whether the selections being made across the relevant population are directionally consistent, favouring higher or lower predicted values for the trait in question in a sufficiently uniform pattern to produce a population level shift rather than merely a wider distribution of individually idiosyncratic preferences. This factor is the direct operationalisation of Schelling's own insight that aggregation effects depend on directional consistency across individually mild preferences rather than on the mere fact of preference as such, and it is this factor above all that distinguishes the phenomenon this article addresses from the ordinary, protected exercise of individually varied reproductive choice.

The third factor, common technological mechanism, asks whether the selections contributing to the pattern identified under the first two factors are mediated through a common or substantially similar scoring methodology, such that the pattern can properly be attributed to the technology's own systematic properties rather than to a coincidental alignment of independently formed individual preferences. This factor addresses a difficulty Schelling's original model, developed for residential choice rather than reproductive technology, does not itself confront, namely the need to distinguish a technologically mediated aggregation, in which a shared scoring algorithm structures the available choices in a common direction, from an aggregation that would have emerged regardless of any shared technology, a distinction this article submits is essential to Article 3(2)'s purpose, since the provision is concerned with technologically or institutionally mediated selection rather than with the ordinary and unregulated diversity of human reproductive preference examined further in Section 5 below.

All three factors must be satisfied for the identification of an aggregate eugenic effect. A pattern satisfying scale and directional patterning without a common technological mechanism would reflect, at most, a coincidental alignment of independent preferences of the kind human reproductive choice has always exhibited without triggering eugenics doctrine. A pattern mediated through a common technological mechanism and reaching sufficient scale but lacking directional patterning, each family selecting according to its own distinct priorities among the traits a given scoring platform reports, would reflect diversity of outcome rather than the population level shift Article 3(2)'s purpose addresses. Only the conjunction of all three factors identifies the specific phenomenon this article's reconstruction of Article 3(2) is designed to reach.

Applying the test illustratively to the present state of the industry, described in Part I, clarifies both its operation and its present inapplicability. Height selection through polygenic screening presently satisfies, on the evidence Karavani and colleagues supply, only a modest degree of the first factor, since the measured gain of some two and a half centimetres per selection cycle, uncertain even at the level of a single family, has not been shown to translate into any measurable shift at population scale given the still limited proportion of births conceived through in vitro fertilisation with polygenic screening applied. Cognitive ability selection, by contrast, presents a closer case on the second factor, directional patterning, precisely because commercial marketing of cognitive polygenic scores, of the kind this article's Part I documented, actively encourages a uniform direction of preference, higher predicted scores treated as straightforwardly preferable, in a manner height selection, where preferences plausibly vary by family and by sex specific expectation, does not as clearly exhibit. Neither trait, on the evidence presently available, satisfies the first factor's scale threshold, a conclusion this article regards as the correct and expected result of applying a properly calibrated test to a technology still in its early stage of adoption, and one that confirms the test is capable of returning a negative result rather than treating every instance of polygenic selection as presumptively suspect.

4.6 Evidentiary Standard

This article proposes that the three-factor test be applied prospectively and periodically rather than retrospectively to any individual reproductive decision, mirroring the Environmental Impact Assessment Directive's own practice of assessing cumulative effects at the level of a defined class of projects over a defined period rather than at the level of any single development consent. Regulatory or judicial assessment under the test proposed in Section 4.5 would accordingly examine population level data, of the kind the polygenic screening industry itself already collects and, in several documented instances, has published in aggregate form, rather than requiring inquiry into any individual family's motives or decision making process, a design choice that both respects the individually protected character of each contributing decision, examined directly in Section 5 below, and avoids the practical impossibility of establishing eugenic intent at the level of any single reproductive choice.

5. Testing the Framework Against Its Strongest Objection

5.1 Procreative Liberty Stated at Its Strongest

The framework constructed in Section 4 faces one objection serious enough to threaten its legitimacy entirely if it succeeds, and this article states that objection in its strongest available form before attempting to answer it. Robertson's influential account of procreative liberty, developed specifically in relation to the reproductive technologies this article examines, defends the freedom to control the use of one's own reproductive capacity, including the freedom to select among available embryos on the basis of predicted genetic characteristics, as a fundamental exercise of personal autonomy that the state may restrict only on a compelling

showing of harm, a standard Robertson argues reproductive genetic selection does not, on its own terms, satisfy.¹⁵ Robertson poses the question this article's framework must confront directly: should parents be allowed to select offspring traits, and his own analysis answers substantially in the affirmative, subject only to constraints addressed to demonstrable harm to the resulting child rather than to any more diffuse concern about the aggregate social pattern such selections might produce.

This objection has direct doctrinal support within the very legal order Article 3(2) belongs to. The European Court of Human Rights held, in *Evans v United Kingdom*, that the concept of private life under Article 8 of the European Convention on Human Rights encompasses the right to respect for the decision to become a parent in the genetic sense, a holding the Grand Chamber reached specifically in the context of a dispute over the use of stored embryos and one that Article 52(3) of the Charter itself requires be given the same meaning and scope when interpreting the corresponding right to private and family life under Article 7 of the Charter.¹⁶ If the decision to become a parent in the genetic sense is protected as an aspect of private life at the highest level of the Union's own human rights architecture, an interpretation of Article 3(2) that treats the aggregate consequence of many individually protected genetic parenthood decisions as itself a prohibited practice risks placing two Charter rights in direct and, on this objection's view, irreconcilable conflict, restricting through Article 3(2) precisely the choice Article 7, read consistently with *Evans*, protects.

5.2 The Reply: Cumulative Assessment Without Individual Prohibition

This article's reply does not dispute that the decision to become a parent in the genetic sense, and the selection of a specific embryo for implantation, fall within the protection Article 7 of the Charter and Article 8 of the Convention extend to private and family life, consistent with *Evans*. It disputes instead that the interpretive test constructed in Section 4 requires restricting, prohibiting, or even scrutinising any individual decision of that kind, and it is precisely the Environmental Impact Assessment analogue developed in Section 4.4 that shows why this dispute is well founded rather than a semantic evasion of the objection's real force.

Union environmental law does not require, and has never required, that any individual development consent be refused, or even individually reassessed, merely because it forms part of a pattern that, in combination with other consents, produces a cumulative effect requiring assessment. The cumulative effects requirement operates entirely at the level of the aggregate pattern, generating obligations of assessment, monitoring, and, where a competent authority so determines, forward looking regulatory response, without disturbing the individual lawfulness of any consent already granted or the individual entitlement of any applicant to seek a further consent on its own merits. The interpretive test proposed in Section 4.5 is designed, deliberately, on this same structure. It does not ask whether any individual family's selection among available embryos was itself eugenic, a question this article agrees, consistently with Robertson's own analysis, would represent an illegitimate and practically unworkable intrusion into a decision *Evans* confirms is protected. It asks whether the population level pattern those individually protected decisions collectively produce has reached the scale, directional consistency, and technological common mechanism the three factor test specifies, a question addressed to the pattern itself and to the institutions and technologies that mediate it, principally the commercial

¹⁵John A Robertson, *Children of Choice: Freedom and the New Reproductive Technologies* (Princeton University Press 1994) 152–167, 169–172.

¹⁶*Evans v United Kingdom* (2008) 46 EHRR 34, App No 6339/05 (Grand Chamber, 10 April 2007) paras 71–72; Charter of Fundamental Rights of the European Union (n 1 in Part I) arts 7, 52(3).

providers whose scoring platforms structure the available choices in the first place, rather than to any individual prospective parent's exercise of Article 7's protection.

On this reply, Article 3(2) and Article 7 are not placed in conflict at all, because they are addressed to different objects. Article 7, read consistently with Evans, protects the individual decision. Article 3(2), read consistently with the reconstruction this article proposes, addresses the aggregate pattern those decisions may, under specific and demonstrable conditions, produce. The reply does not require Robertson's procreative liberty framework to be rejected, only to be recognised as answering a question, whether the individual decision is protected, that is different from the question this article's interpretive test asks, whether the aggregate pattern those protected decisions produce falls within Article 3(2)'s purpose. A legal framework that respected the first question's answer while declining to address the second would, this article submits, leave exactly the gap Section 3 of Part I identified, a gap the Environmental Impact Assessment analogue shows Union law is not, in other contexts, willing to leave unaddressed merely because addressing it requires distinguishing an aggregate pattern from its individually lawful constituent parts.

5.3 A Second Objection: Vagueness and the Line-Drawing Problem

A second and more practical objection concerns the interpretive test's administrability rather than its theoretical legitimacy. The three-factor test proposed in Section 4.5 requires threshold judgments, what scale is sufficient, what degree of directional patterning is sufficient, that the test itself does not reduce to a bright line rule, raising a concern that the test could be applied inconsistently or expanded, over time, well beyond the specific phenomenon it was designed to address.

This article's reply again draws on the Environmental Impact Assessment analogue, whose own cumulative effects requirement has operated for more than three decades without a fixed numerical threshold, relying instead on case by case assessment guided by published methodological guidance and subject to judicial review for manifest error, a model of administrable but non mechanical standard setting Union law already applies successfully in a structurally comparable context. This article proposes that the Committee or body responsible for developing the general guidance discussed in Section 6 below adopt a comparable approach, publishing methodological guidance for assessing scale and directional patterning calibrated to the best available population genetic modelling of the kind Karavani and colleagues' work exemplifies, updated as that modelling develops, rather than fixing a static numerical threshold in the text of the interpretation itself.

5.4 The Qualified Verdict

The engagement conducted in this section does not vindicate the framework constructed in Section 4 without qualification. Robertson's procreative liberty framework and the Evans line of authority correctly establish that no individual reproductive decision, including the decision to select among embryos on the basis of a polygenic score, may be restricted, scrutinised, or treated as presumptively suspect on the strength of this article's argument, and any interpretation of Article 3(2) claiming such an entitlement would deserve the objection's full force. What survives the objection, on the reply developed above, is considerably narrower and, this article submits, considerably more defensible: an aggregate pattern, identified by the conjunctive three factor test proposed in Section 4.5, addressed through the same kind of institutional and regulatory attention Union environmental law already directs at structurally identical aggregation problems, without requiring any individual family's protected choice to be second guessed. Part III of this article now turns to the specific institutional architecture such attention would require, and to the discussion and recommendations that complete the article's argument.

6. Regulatory and Institutional Response

6.1 The Jurisdictional Difficulty Restated

The interpretive test constructed in Part II identifies, in principle, when polygenic embryo screening has produced an aggregate eugenic effect within the purposive meaning of Article 3(2). Identifying the phenomenon is of limited value without an institution capable of applying the test and a mechanism capable of reaching the entities whose conduct the test is designed to assess. This difficulty is more acute for polygenic embryo screening than it is for many other subjects of Union biomedical regulation, because the commercial providers whose scoring platforms this article's third factor, common technological mechanism, treats as the relevant unit of technological mediation are, at present, concentrated outside the Union's own territory. Orchid Health and Nucleus Genomics both operate principally from the United States, and Genomic Prediction similarly, meaning that a Union institution seeking to apply the three-factor test proposed in Part II to the pattern these providers' services produce cannot straightforwardly rely on the ordinary territorial jurisdiction that grounds most of the Union's regulatory competence.

6.2 An Existing Regulatory Lever: The Data Protection Framework

This article submits that the Union already possesses a regulatory instrument capable of reaching these providers without requiring any new treaty or regulation, and that this instrument, rather than any bespoke mechanism, should form the first layer of the response this section proposes. The General Data Protection Regulation classifies genetic data as a special category of personal data under Article 9, triggering an elevated threshold for lawful processing, and extends its own territorial scope, under Article 3(2), to any controller or processor established outside the Union that offers goods or services to data subjects within it, a jurisdictional test that depends on the offering of services to Union residents rather than on the provider's own place of establishment.¹⁷ A polygenic embryo screening provider based in the United States that accepts genetic material or reports polygenic scores for prospective parents resident in a Member State is, on the ordinary application of this test, processing special category genetic data within the Regulation's territorial scope, regardless of where the provider's servers, laboratories, or corporate headquarters are located.

This jurisdictional reach supplies a workable foundation for the institutional architecture this section proposes, because it means the relevant Union and national data protection authorities already possess a documented, enforceable basis for requiring transparency from providers whose services reach Union residents, independently of where those providers are established. This article proposes that this existing basis be used specifically to require the kind of aggregate, population level reporting the evidentiary standard proposed in Part II, Section 4.6 depends upon, a reporting obligation considerably narrower than, and independently justifiable apart from, the substantive eugenics determination this article's three factor test performs, since data protection authorities already require documented lawful bases and impact assessments for high risk processing of special category data of exactly this kind.

6.3 The Proposed Layered Architecture

Building on the jurisdictional foundation Section 6.2 establishes, this article proposes a three-layer institutional architecture, sequenced according to the comparative speed and comparative institutional demands of each layer, mirroring the method this article's wider research programme has applied to structurally comparable governance problems elsewhere.

¹⁷Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 (General Data Protection Regulation) [2016] OJ L119/1, arts 3(2), 9(1).

The first layer is interpretive and immediate. The European Commission, or the Fundamental Rights Agency acting in its advisory capacity, should issue guidance applying the reconstruction of Article 3(2) developed in Part I and the interpretive test developed in Part II to polygenic embryo screening specifically, a step that requires no new legislative act and that responds directly to the gap the 2025 parliamentary question exposed without resolving.¹⁸ This layer would not itself carry binding legal force, but would supply the methodological reference point national regulators and data protection authorities require to apply the three factor test consistently across Member States, addressing directly the vagueness objection considered in Part II, Section 5.3.

The second layer is domestic and immediate, extending existing national regulatory categories rather than requiring new legislation in the first instance. The United Kingdom's Human Fertilisation and Embryology Authority has already excluded polygenic score calculation from the categories of embryo testing its governing legislation permits, a domestic regulatory precedent this article's wider background research identified and which supplies a concrete existing model, developed independently of this article's own framework, that other national regulators responsible for assisted reproduction could adapt, calibrated to the three factor test's scale and directional patterning criteria rather than to a blanket prohibition.

The third layer makes direct use of the data protection mechanism established in Section 6.2, requiring polygenic embryo screening providers offering services to Union residents to report, on a periodic and aggregated basis, the scale and directional distribution of the selections their platforms have facilitated, sufficient to permit application of the three-factor test without requiring disclosure of any individual family's data. This reporting obligation would be grounded directly in the providers' existing obligations under Article 9 of the General Data Protection Regulation to demonstrate a lawful basis for processing special category genetic data at the scale their commercial model involves, rather than requiring a novel legal basis addressed to eugenics specifically, and would supply the evidentiary foundation the first and second layers each separately require.

7. Discussion

The argument developed across this article's three parts closes the threefold gap its introduction identified, and this discussion draws the three closures together in a way no single part could achieve on its own, since each part necessarily proceeded before the next was available to complete the picture.

The foundational gap, the absence of any existing test of whether Article 3(2) can be interpreted to reach a eugenic effect without an identifiable selecting will, is closed by the combination of Part I's drafting history reconstruction and Part II's engagement with Schelling's model of aggregate behaviour and with the procreative liberty objection. Part I showed the selecting will requirement to be a historically contingent feature of the mechanism Article 3(2)'s drafters had in view rather than a conceptually necessary precondition of the harm the provision addresses. Part II showed that this reconstruction survives the strongest available objection, grounded in Robertson's procreative liberty framework and in *Evans v United Kingdom*'s protection of the decision to become a parent in the genetic sense, once the objection is engaged through the Environmental Impact Assessment Directive's own cumulative effects doctrine rather than around it, a doctrine that shows Union law already knows how to protect an individual lawful act while regulating the aggregate pattern it contributes to. The doctrinal gap, the absence of any interpretive test for aggregate eugenic effect, is closed by the three factor test constructed in

¹⁸European Parliament, Parliamentary Question E-001947/2025 (2025), discussed in Part I, Section 2.

Part II, Section 4.5, built from Schelling's structural model and calibrated against the empirical findings of Karavani and colleagues, and shown in Part II, Section 4.5 to return a negative result when applied to the present, still limited scale of the industry, a result this article regards as confirming the test's discriminating power rather than as an embarrassment to the argument. The institutional gap, the absence of any mechanism capable of reaching a multinational and largely non-Union based screening industry, is closed by the layered architecture proposed in Section 6 above, which grounds enforcement in the General Data Protection Regulation's own extraterritorial reach rather than requiring any new international instrument.

What this combination does not achieve is worth stating as plainly as what it does. The interpretive test constructed in Part II depends on population level data whose collection, even once the reporting obligation proposed in Section 6.3 is in place, will lag behind the technology's own development, meaning that any application of the test will necessarily assess a pattern somewhat older than the industry's current practice. The test's three factors, while designed for administrability, will require the kind of case-by-case judgment Part II, Section 5.3 acknowledged the Environmental Impact Assessment analogue itself requires, and this article cannot guarantee that guidance issued under the first layer proposed in Section 6.3 will resolve every such judgment consistently across Member States. And the working thesis on which the entire reconstruction depends, that the selecting will requirement is historically contingent rather than conceptually essential to Article 3(2)'s purpose, remains, as Part I acknowledged, an interpretive argument rather than a proposition the Court of Justice has yet endorsed, however strong the support *Brüstle v Greenpeace*'s own purposive method lends to it. These are not defects unique to this article's argument. They are the ordinary condition of any jurisprudential proposal addressed to a problem existing doctrine has not yet been forced to confront, and this article's sustained engagement with its own strongest objections across Part II is offered as evidence that its claims are calibrated to what the argument actually establishes.

8. Conclusion and Recommendations

This article has argued that Article 3(2) of the Charter of Fundamental Rights of the European Union rests on an assumption about the mechanism of eugenic harm, a directing will, that a specific and commercially available technology now places under direct strain, and that the provision, properly reconstructed through its own purposive method and tested against the strongest objections available to it, already contains, or can be read to contain, the doctrinal resources needed to address that strain. Polygenic embryo screening produces, through the accumulation of individually autonomous and individually protected reproductive choices, the structural possibility of a population level effect the provision's drafters addressed only in its state directed form, because no other form then existed. This article closes with recommendations addressed to three audiences, each capable of acting on the article's argument independently of the others.

To the Court of Justice and the European Commission, this article recommends the development of interpretive guidance applying Article 3(2), reconstructed along the lines Part I proposes, to polygenic embryo screening specifically, adopting the three-factor test developed in Part II as the operative standard, a development consistent with the purposive method the Court itself applied in *Brüstle v Greenpeace* and responsive directly to the gap the 2025 parliamentary question left open.

To national data protection authorities and assisted reproduction regulators, this article recommends the use of the General Data Protection Regulation's existing extraterritorial reach, examined in Section 6.2 above, to require periodic aggregate reporting from polygenic embryo screening providers offering services to Union residents, and the extension of existing embryo

testing regulatory categories, of the kind the United Kingdom's Human Fertilisation and Embryology Authority has already begun to develop, to incorporate the scale and directional patterning criteria this article's interpretive test specifies.

To the broader scholarly community, this article recommends further work in three directions this single article has been able to open but not complete: continued empirical monitoring of the industry's trajectory as the underlying genome wide association data on which polygenic scores depend continues to improve in predictive power, doctrinal research testing this article's three factor test against emerging domestic regulatory practice as it develops, and continued engagement with the procreative liberty objection this article has answered but, consistent with the qualified verdict reached in Part II, Section 5.4, not claimed to have settled beyond reasonable further contest. This article offers its own argument as a foundation for that further work rather than as its final word.

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