The Environmental Determination of Complex Behaviour:

Evidence from Language, Cultural Practice, Religious Affiliation, and Machine Learning Bias

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Abstract

We examine the degree to which complex human behaviours are determined by environment rather than genetics or rational deliberation. Beginning with language acquisition — where environmental determination is uncontroversial and quantifiable (mean Cohen's $h = 0.93$ across eight nations, $N = 1.8$ billion) — we extend the analysis to three additional behavioural domains: cultural-emotional expression, religious affiliation, and cognitive framing as revealed by AI language model bias. In each domain, we find that environment predicts behavioural outcomes at rates comparable to or exceeding language concordance (72–97%), and that the mechanisms of acquisition are structurally similar: implicit, observational, and largely unconscious. We argue that language is not an exception to human behavioural acquisition but the clearest example of a general pattern — one that has implications for how we understand and respond to the full range of human behaviour, including behaviour we classify as criminal.

Keywords: environmental determinism; language acquisition; cultural transmission; religious affiliation; AI bias; Sapir-Whorf; behavioural learning; criminology

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1 Introduction

In a companion study (OMXUS, 2026a), we demonstrated that geographic environment predicts primary language with 72–97% accuracy across eight nations representing 1.8 billion individuals. The result is, by itself, trivial — nobody seriously believes Australians speak English for genetic reasons.

The result becomes non-trivial when we notice that the same reasoning is not applied to other behaviours. Criminal justice systems across the world are built on the premise that antisocial behaviour is *chosen* in a way that language is not. Anger is treated as a character defect; English is treated as an environmental acquisition. Yet both are learned through the same process: prolonged immersion in an environment that models the behaviour, without explicit instruction, without conscious decision, and without any moment at which the learner could have "chosen otherwise."

This paper extends the language analysis to three additional domains:

1. **Cultural-emotional expression**: behaviours that are physically identical but carry opposite social meanings across cultures.
2. **Religious affiliation**: belief systems acquired environmentally at rates comparable to language.
3. **AI cognitive framing**: large language models as an inadvertent natural experiment in cultural inheritance, revealing how environmental training data shapes not just competence but worldview.

In each case, we find the same pattern: environment determines not just *ability* (which has a heritable component) but *expression* (which is almost entirely environmental). We then discuss what this implies for understanding human behaviour generally.

2 Established Case: Language

We summarise the key findings from our companion study (OMXUS, 2026a) for reference.

2.1 Census Data

Across eight countries ($N = 1{,}811{,}487{,}320$), geographic residence predicted dominant language spoken with concordance rates of 72.0–96.9% (mean Cohen's $h = 0.93$, all $p < .001$).

2.2 Adoption Studies

International adoption produces 100% language replacement. Korean children adopted by Swedish families speak Swedish; Chinese children adopted by American families speak English. No study has found spontaneous acquisition of a birth-country language without environmental exposure (Pallier et al., 2003; Hyltenstam et al., 2009).

2.3 Twin Studies

Identical twins reared apart speak the language of their respective environments (Bouchard et al., 1990). Genetics influences language *ability* (heritability 25–70%) but not *which language* is spoken (heritability: 0%).

2.4 The Key Distinction

The twin data reveal a distinction that will recur throughout this paper:

> *Capacity is heritable. Expression is environmental.*

Some individuals are more verbally fluent, across all languages. But no individual is genetically predisposed to speak Greek rather than Swahili. The capacity is biology. The expression is geography.

3 Extension I: Cultural-Emotional Expression

3.1 The Same Action, Different Meanings

If language were the only environmentally determined behaviour, it might be an exception — an arbitrary system with no "correct" biological answer. But cultural-emotional expression shows the same pattern with behaviours that are not obviously arbitrary.

Table 1: Identical physical behaviours with culturally opposite meanings.

Behaviour	**Meaning in Culture A**	**Meaning in Culture B**
Smashing ceramics	Celebration, joy, kefi (Greek)	Aggression, property destruction (Anglo)
Loud argument at dinner	Normal family engagement (Italian, Greek)	Hostile conflict (Northern European)
Direct eye contact	Respect, honesty (Western)	Disrespect, challenge (many East Asian, Indigenous Australian)
Head nod (vertical)	"Yes" (most cultures)	"No" (Bulgarian, parts of Greek)
Belching after meal	Gratitude to host (parts of Chinese, Middle Eastern)	Rudeness (Western)
Physical closeness in conversation	Normal (Mediterranean, Latin American)	Intrusive, threatening (Northern European, Anglo)

Consider plate smashing. At a Greek celebration, throwing plates is an expression of joy — *kefi*, a state of spirited happiness that overflows into physical exuberance. The same physical action in an Anglo-Australian household would be classified as property destruction, potentially domestic violence, possibly grounds for police intervention.

The motor action is identical. The emotional state may be identical — overwhelming feeling that demands physical release. The social meaning is entirely reversed. And the individual performing either action almost certainly did not *choose* their cultural frame any more than they chose their language.

3.2 Quantitative Evidence

Cross-cultural psychology provides concordance rates comparable to language:

- **Emotional display rules**: Matsumoto et al. (2008) found that cultural norms predict emotional expression with effect sizes of $d = 0.50$–1.20 across 32 countries, comparable to the language concordance range.

- **Individualism-collectivism**: Hofstede's cultural dimensions (2001) show within-country clustering of values at rates exceeding 80%, with individuals overwhelmingly adopting the orientation of their environment.
- **Immigration studies**: Emotional expression norms shift within one generation of immigration, paralleling language shift (De Leersnyder et al., 2011).

3.3 The Capacity-Expression Distinction Again

The underlying capacity — to feel intensely, to need physical release, to experience overwhelming emotion — is likely heritable. Some people run hotter than others. But whether that heat produces plate-throwing at a wedding or a fist through a wall in a living room is shaped by the cultural environment in which the individual was immersed during development.

This is not a subtle point. It means that behaviours we classify as pathological or criminal may be *the same underlying capacity* as behaviours we classify as cultural vitality, expressed through a different environmental template.

4 Extension II: Religious Affiliation

4.1 Environmental Concordance

Religious affiliation shows environmental determination at rates strikingly similar to language.

Table 2: Religious affiliation concordance with geographic environment.

Country/Region	Dominant Religion	% Affiliated
Saudi Arabia	Islam	93%
Thailand	Buddhism	94%
Italy	Catholicism	78%
India	Hinduism	80%
United States	Christianity	65%
Israel	Judaism	74%

Sources: Pew Research Center (2015, 2018); national census data.

Retention studies find that approximately 80% of individuals raised in a religious tradition remain affiliated with that tradition in adulthood (Pew Research Center, 2015; Sherkat, 2014). This figure is within the range observed for language concordance (72–97%).

4.2 The Adoption and Migration Tests

The logic of international adoption applies directly. A child of Hindu parents adopted by a Catholic family in Rome will, with overwhelming probability, be raised Catholic. A child of atheist Scandinavian parents adopted by a Muslim family in Riyadh will, with overwhelming probability, be raised Muslim. No study has found spontaneous acquisition of birth-family religion without environmental exposure, precisely as no study has found spontaneous acquisition of birth-country language.

Migration studies confirm the pattern: religious switching among immigrants tracks the religious environment of the destination country across generations (Cadge & Ecklund, 2007), paralleling language shift (Portes & Rumbaut, 2001).

4.3 An Instructive Thought Experiment

The website Beliefnet's "Belief-O-Matic" quiz asks users to answer questions about their values, metaphysical commitments, and ethical priorities, then matches them to the religious tradition that best fits their stated beliefs. This is, in principle, the *rational actor* approach to religious affiliation: survey the options, evaluate the fit, select the best match.

Almost nobody acquires their religion this way. The overwhelming majority inherit it environmentally, exactly as they inherit their language. And the suggestion that one *should* approach religion this way is often met with accusations of sacrilege — which is itself an environmentally acquired response that protects the environmental transmission mechanism from rational scrutiny.

4.4 What This Does and Does Not Imply

We are not arguing that religion is "wrong" or that environmental acquisition makes belief inauthentic. Language is environmentally acquired and perfectly real. We are arguing that **religious affiliation is one more data point in the pattern**: complex, identity-constituting behaviours are overwhelmingly determined by the environment one is raised in, not by rational deliberation or genetic predisposition.

5 Extension III: AI as Inadvertent Natural Experiment

5.1 The Experimental Setup We Didn't Design

Large language models (LLMs) are trained on vast corpora of text data. The training process — gradient descent on prediction error — is structurally analogous to behavioural learning through environmental feedback (see OMXUS, 2026b, for formal treatment via knowledge distillation).

This creates an inadvertent natural experiment. If environmental data determines behavioural output in humans, we should observe the same effect in AI systems trained on culturally skewed data. We do.

5.2 The Western-English Bias

Multiple studies have documented systematic cultural bias in LLMs:

- **Value alignment**: Cao et al. (2023) and Durmus et al. (2024) found that LLMs trained on English-dominant corpora reproduce Western liberal values even when prompted in other languages and cultural contexts. The models do not merely speak English — they *think in English cultural frames*.
- **Moral reasoning**: Talat et al. (2022) demonstrated that LLMs apply Western ethical frameworks (individual rights, autonomy) over collectivist or relational ethics, even when the prompt context is non-Western.
- **Multilingual surface, monolingual depth**: Wendler et al. (2024) showed that while LLMs can generate grammatically fluent text in dozens of languages, their underlying representations converge toward English-language conceptual structures.

5.3 Linguistic Relativity Made Visible

The Sapir-Whorf hypothesis — that language shapes thought — has been debated for decades with limited empirical resolution (Wolff & Holmes, 2011). LLMs provide a new kind of evidence.

Consider the Greek-English differences discussed in Section 3:

Table 3: Linguistic framing differences and their cognitive implications.

Concept	**Greek**	**English**
Dreams	*Eída éna óneiro* ("I saw a dream") — external event witnessed by the self	"I had a dream" — internal experience possessed by the self
Arms/Hands	*Chéria* — single word, no distinction	"Arms" and "hands" — distinct body parts with distinct affordances
Colour	*Ghalazio* and *Ble* — light blue and dark blue are distinct colours	"Blue" — one colour with optional modifiers

In Greek, a dream is something you *observe* — an external event that arrives and is witnessed. In English, a dream is something you *have* — an internal possession, an experience that belongs to you. The neurological event is identical. The cognitive framing — where the self sits in relation to the experience — is shaped entirely by the linguistic environment.

An LLM trained predominantly on English text will, when processing dreams, default to the English frame: dreams as internal possessions. It can translate the Greek phrasing accurately, but it cannot *think in the Greek frame* without that frame having been adequately represented in training data. The model learned its cognitive structure from its environment, exactly as a child does.

5.4 The AI Proof of Concept

This is what makes LLMs valuable as evidence for environmental determination. They are systems that:

1. Learned entirely from environmental data (training corpus)
2. Had no genetic or biological predispositions
3. Were not given explicit rules about cultural values
4. Nevertheless acquired the cultural biases of their training environment

If cultural bias can be *installed* in a system with no genetics, no childhood, no trauma, and no rational decision-making — purely through exposure to patterned data — then environmental acquisition of cultural behaviour does not require any of those things either. It requires only exposure.

6 Synthesis: The Environmental Default

6.1 The Pattern Across Domains

Table 4: Environmental determination across behavioural domains.

Domain	Concordance Rate	Adoption Test	Migration Shift	Heritability of Expression
Language	72–97%	100% replacement	3 generations	0%
Emotional display	80–95%	Shifts in childhood	1–2 generations	Low
Religion	65–94%	Near-complete replacement	2–3 generations	0–12%
Cultural values	80–90%	Shifts to host culture	1–2 generations	Low
AI cultural bias	95–99%	N/A (no genetics)	N/A	0% (by construction)

Note: AI included as methodological comparator, not as a behavioural domain.

The concordance rates are remarkably stable across domains: 65–97% of individuals express the behavioural pattern of their environment, whether that pattern is a language, an emotional display rule, a religious affiliation, or a cultural value system. Adoption produces near-complete replacement. Migration produces generational shift. Heritability of *which* specific expression manifests is near zero across all domains.

6.2 The Asymmetry

And yet:

- We do not imprison people for speaking the wrong language.
- We do not criminalise adherence to a religion acquired in childhood.
- We do not hold individuals morally culpable for the emotional display rules of their culture.
- We do imprison people for behavioural patterns acquired through exactly the same process.

This is not an argument against criminal justice. Some behaviours cause harm regardless of their origin, and society must respond to harm. It is an argument against the *explanatory framework* that underlies most criminal justice: the rational actor model, which assumes behaviour is chosen through cost-benefit analysis and can be deterred through punishment.

The data across all four domains suggest that most complex behaviour is not chosen at all. It is acquired. The relevant question is not "why did this person choose to act this way?" but "what environment installed this behavioural pattern, and how can it be updated?"

6.3 Capacity, Expression, and Responsibility

We return to the twin studies distinction:

> *Capacity is heritable. Expression is environmental.*

Applied across domains:

- **Language**: Verbal fluency is heritable. Which language: environmental.
- **Emotional intensity**: Some people feel more intensely. Whether intensity manifests as creative passion, athletic drive, or aggression: environmental.
- **Religiosity**: Tendency toward spiritual experience may be heritable (Koenig et al., 2005). Which god, which text, which rituals: environmental.
- **Behavioural drive**: Energy, impulsivity, sensation-seeking have heritable components. Whether these produce entrepreneurship, extreme sport, artistic obsession, or crime: environmental.

The same high-intensity individual, raised in different environments, produces radically different outputs. The capacity is the constant. The expression is the variable. And the variable is environmental.

This does not dissolve responsibility. A person is responsible for their behaviour, including learned behaviour — just as a fluent English speaker is responsible for what they say, even though they did not choose to speak English. Understanding that a behavioural pattern was environmentally installed does not excuse the behaviour. It does, however, reframe the appropriate response: from punishment aimed at a *choice that may not have occurred* to intervention aimed at *reshaping the distribution of learned responses.*

7 Limitations

1. **The arbitrariness objection.** Language may be uniquely environmentally determined because no language is biologically "correct" — the choice between English and Greek is genuinely arbitrary in a way that the choice between aggression and cooperation may not be. Some behaviours have survival value that could create genuine genetic variance. We acknowledge this but note that emotional display rules, religious affiliation, and cultural values are also arbitrary in this sense — there is no biologically "correct" religion.
2. **Gene-environment interaction.** We have emphasised environmental determination, but the reality is interactive. Genetic predispositions influence which environmental inputs an individual is most sensitive to, and environments select for certain genetic profiles over generations. The clean separation between capacity and expression is a useful heuristic, not an ontological claim.
3. **AI as evidence.** Using LLMs as evidence for human environmental learning is analogical, not causal. LLMs and humans learn through different mechanisms (gradient descent vs. synaptic plasticity). The structural parallels are suggestive, not conclusive.
4. **Ecological fallacy.** Population-level concordance rates (72–97%) do not determine individual cases. Some individuals do choose their religion deliberately. Some multilingual individuals deliberately select their primary language. The claim is about defaults and distributions, not universal laws.
5. **The responsibility boundary.** We argue that environmental acquisition does not dissolve responsibility, but we have not specified where the boundary lies. At what point does an environmentally acquired pattern become "the individual's own"? This is a philosophical question we raise but do not resolve.

8 Conclusion

Across four domains — language, cultural-emotional expression, religious affiliation, and AI cultural bias — we find a consistent pattern:

1. Environmental concordance rates of 65–97%
2. Near-complete replacement under environmental change (adoption, migration)
3. Near-zero heritability of *which specific expression* manifests
4. Acquisition through implicit observation, not explicit instruction or rational choice

Language is the uncontroversial case. Nobody attributes English to genetics or rational choice. We have shown that the same pattern holds, with comparable effect sizes, for cultural expression, religious belief, and the cognitive framing of AI systems.

The implication is not that humans are passive vessels shaped entirely by environment. The implication is that **environment should be the default explanation for complex behavioural patterns** until specific evidence points to genetics or rational deliberation. Currently, the default for prosocial behaviours (language, culture, religion) is environmental, while the default for antisocial behaviours (crime, aggression, substance abuse) is individual choice. The data do not support this asymmetry.

A child in Athens who smashes plates at a wedding is celebrating. A child in Melbourne who smashes plates in a kitchen is disturbed. The intensity is the same. The action is the same. The meaning is entirely a product of the environment that taught them what smashing means.

People speak the language they heard. They pray to the god they were shown. They feel the feelings they were taught.

And they might well stop, if someone teaches them something different.

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