

The Autotelic Ape: Challenge Propensity as the Fundamental Driver of the Hominin Lineage and a New Mandate for Affective AI.

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Summary

This paper argues that the fundamental trait separating the hominin lineage from Pan is not a specific adaptation, but an antecedent psychological "Challenge Propensity." While dominant theories, such as Tomasello's "Shared Intentionality" (SI) and Wrangham's "Cooking Hypothesis," explain critical results of human evolution, we posit that "Challenge" is the fundamental driver. This drive is evident as early as *Sahelanthropus tchadensis*'s tentative "experimentation" with bipedalism. We argue this "Challenge Propensity" is a behavioral tendency that evolved from a reactive mechanism into a recursive, autotelic engine. It applied itself to social structures, creating what we term "Challenging Cooperation"—a behavioral strategy of applying challenge to cooperation itself. We posit this strategy selected for the advanced cognitive architecture of "Shared Intentionality" (Tomasello) and enabled complex feats like cooking (Wrangham).

This drive, intrinsically rewarding as "Flow" (Csikszentmihalyi), explains our societal valuation of "Freedom" (the environment for challenge). We then diagnose the modern malaise linked to social media as a symptom of this core drive being stifled by "vainglory" (performative posturing), which depletes the user's "Body Budget" (Barrett) and fails to support stable relationships within cognitive limits (Dunbar's number). As a concrete solution, we propose 2DimeSmileS, an AI-driven service model. This platform uses a hybrid digital-physical design to facilitate "Challenging Cooperation," integrating AI as a core facilitator (based on Russell & Barrett) to support trust-building. We argue this AI-assisted social grooming may help extend the effective maintenance of human social networks, offering new models for well-being and governance.

1. Introduction

What makes us human? This question is fundamental not only to evolutionary anthropology but also to artificial intelligence (AI) research, which seeks to engineer human intelligence. This inquiry also connects to the practical challenge of how AI can contribute to extending the cognitive limit of stable social relationships, estimated to be around 150 people ("Dunbar's number" ^{*1}) [Dunbar 92].

Conventional theories have focused on advanced capabilities unique to humans. For instance, Tomasello argued that "Shared Intentionality" ^{*2}—the ability to form joint intentions of "we" with others—created cumulative culture and complex cooperation [Tomasello 14]. Wrangham argued that the technological innovation of "cooking" provided the energetic basis for a massive brain and led to social tolerance ("Self-domestication" ^{*3}) [Wrangham 09].

While these theories are powerful, they explain adaptations (results) after the emergence of the genus *Homo* and provide insufficient explanation for the "drivers" of the divergence prior to that. This paper proposes a psychological and behavioral "Challenge Propensity" ^{*4} as a more fundamental driver preceding these adaptations.

This hypothesis is based on the possibility that *Sahelanthropus tchadensis*, approximately 7 million years ago, was already "experimenting (challenging)" with the difficult behavior of bipedalism before being "forced" by the environment (in a mosaic environment) [Brunet 02]. We believe that this "Challenge Propensity" was the foundation that led to "free hands," enabling further "challenges" such as tool use, cooking, and sophisticated cooperation.

However, this essential human "Challenge Propensity" is severely stifled in modern digital society, particularly in social media (SNS). The purpose of this paper is to: (1) redefine human nature as "Challenge Propensity"; (2) present a framework in which this "Challenge Propensity" generated the behavioral strategy of "Challenging Cooperation" proposed in this paper, which in turn drove the development of Tomasello's "Shared Intentionality" as an execution platform; (3) analyze how modern SNS inhibits this nature based on emotion theory and the social brain hypothesis; and (4) propose a new mandate for AI, particularly Affective AI, to solve this problem, along with a concrete service model, 2DimeSmileS ^{*5}.

2. Related Work and the Positioning of this Paper: "Challenge" as Human Essence

The "Challenge Propensity" hypothesis in this paper does not negate existing major theories but positions itself as the fundamental driver that propelled them.

2.1 Shared Intentionality as "Challenging Cooperation" (Tomasello)

Tomasello's "Shared Intentionality (SI)" ^{*2} [Tomasello 14] is the flexible "OS" of human cooperation. However, why did only humans evolve this OS? We believe it is because humans directed their "Challenge Propensity" toward "cooperation" itself—that is, they engaged in "Challenging Cooperation" ^{*6} as proposed in this paper.

While cooperation in social insects is rigid, human cooperation constantly targets the method of cooperation itself for innovation, as in "This way is inefficient; let's try (challenge) another way". It is considered that the advanced cognitive ability of "Shared Intentionality," which involves sharing intentions with others and flexibly changing roles, was selected to execute this behavioral strategy of "Challenging Cooperation".

2.2 The Energetic Basis of "Challenge" (Wrangham)

Wrangham's "Cooking Hypothesis" [Wrangham 09] can also be reinterpreted from the perspective of "Challenge". Overcoming the instinctual fear of fire and controlling it is one of the greatest "challenges" for a biological organism. Furthermore, to suppress conflict over valuable cooked food and share it peacefully, a social "challenge" of suppressing aggression—what Wrangham calls "Self-domestication" (tolerance)—was necessary.

2.3 The Autotelic Nature of "Challenge" (Csikszentmihalyi)

If "challenge" were merely a "means" for survival, it should cease when the environment stabilizes. However, humans spontaneously continue "challenges" unrelated to survival (art, science, sports).

The reason for this can be explained by Mihaly Csikszentmihalyi's "Flow" ^{*7} theory [Csikszentmihalyi 90]. Flow is an optimal experience (happiness) felt when immersed in a task (challenge) of appropriate difficulty. In the process of evolution, individuals who felt pleasure in "challenging itself" acquired more skills and became selectively advantageous. As a result, "Challenge Propensity" is thought to have evolved into an "Autotelic" intrinsic motivation where the activity itself is the reward. This intrinsic motivation for "challenge" is the psychological basis for human society's instinctive desire for "Freedom" (= an environment where challenge is possible).

2.4 Cognitive Limits of "Challenging Cooperation" (Dunbar)

"Challenging Cooperation" is not infinitely scalable. Robin Dunbar found a correlation between neocortex size and group size in primates, proposing that the cognitive upper limit for humans to maintain stable social relationships is approximately 150 people (Dunbar's number) [Dunbar 92].

This limit is defined not merely by memory capacity but by the "temporal and cognitive costs" required for "Social Grooming" ^{*8} (conversation, etc., in humans) to maintain relationships. In other words, maintaining "Challenging Cooperation" (this paper) or "Tolerance" (Wrangham [Wrangham 09]) requires vast cognitive resources (what Barrett calls "Body Budget"), creating an upper limit on the number of bonds that can be maintained. This bottleneck is a critical target that modern AI should support.

3. Issues in Modern Society: Evolutionary Mismatch and the Necessity of AI

If human essence lies in "Challenge (especially Challenging Cooperation)," then the modern digital environment, particularly SNS, causes a profound mismatch ("Evolutionary Mismatch" ^{*9}) with this nature.

3.1 Inhibition of "Challenge" by "Vainglory"

Many current SNS platforms are designed to visualize and compete for individual status (number of "likes" and followers). This encourages a zero-sum game of "Vainglory" ^{*10} rather than cooperative "Challenge".

"Failure" is inevitable in "Challenge". However, in an environment of "Vainglory," "failure" leads immediately to a loss of status. Consequently, users fear failure, lose psychological safety, avoid difficult "challenges," and restrict themselves to safe, "performative" posts. This deprives users of the cognitive resources necessary for maintaining essential social bonds (= social grooming) as indicated by Dunbar's number [Dunbar 92], destroying the foundation of "Challenging Cooperation".

3.2 Depletion of "Body Budget" (Barrett)

Furthermore, this problem is severe from the perspective of affective science. According to Lisa Feldman Barrett's "Theory of Constructed Emotion" ^{*11}, emotion is a process by which the brain manages and predicts bodily resources ("Body Budget" ^{*12}) [Barrett 17]. Constant social comparison and "Vainglory" are perceived by the user's brain as a "social threat," placing a chronic load on the "Body Budget". This generates persistent unpleasant affect (high arousal/unpleasant = stress) and significantly lowers well-being.

Solving this evolutionary mismatch and restoring

"Challenging Cooperation"—the essence of humanity—in the digital society is the new mandate for modern AI, especially AI that understands and supports human emotion.

4. Proposed Method: AI-Facilitated Model for "Challenging Cooperation" – 2DimeSmileS

This paper proposes the conceptual design of a service model, 2DimeSmileS ^{*5}, which centers AI as a "facilitator of cooperation" as a concrete solution to the above issues.

4.1 Basic Design: Hybrid Model

This model is a hybrid model that integrates digital and physical realms to systematically dismantle "Vainglory" and foster "Challenging Cooperation".

§ 1 Digital (Anonymity): Support for "Challenge"

Information exchange is primarily anonymous, liberating users from individual status competition. This ensures psychological safety, allowing users to "enjoy" (Flow experience) "Challenge" (questions, information exchange) based on genuine curiosity without fear of "failure". Accumulated logs become the digital basis for "cumulative culture".

§ 2 Real (Face-to-Face): Building "Trust"

Digital logs are not an end in themselves but function as a "catalyst" for real dialogue and "Party Games" enjoyed together by people of all ages. This bridge to the real world becomes a place for practical training (= trust building) of "Tolerance" (Wrangham [Wrangham 09]) and "Shared Intentionality" (Tomasello [Tomasello 14]).

4.2 Dual Facilitation by AI (Approach to Extending Dunbar's Number)

The core of this model lies in AI actively supporting both the "Cognitive" and "Affective" aspects of humans, thereby attempting to alleviate and extend the cognitive bottleneck indicated by Dunbar's number [Dunbar 92]. By supporting efficient "Social Grooming" ^{*8} AI reduces relationship maintenance costs.

§ 1 Cognitive Facilitation (Assisting the Cooperation OS)

AI supports the construction of "Common Ground," which allows Tomasello's "Shared Intentionality" [Tomasello 14] to function.

- Positive Conversion by AI: AI converts negative words or aggressive expressions from users into constructive and positive language before presentation. This functions as a "Cognitive Prosthesis" ^{*13} that mitigates "Reactive Aggression" [Wrangham 09] in digital space, reducing social friction.

- Knowledge Sharing by AI: Depending on the context of the conversation or challenge, AI provides relevant trivia or

information at appropriate times. This functions as a "Digital Elder," enhancing the quality and success rate of cooperation.

§ 2 Affective Facilitation (Application of Affective AI)

Based on the theories of Russell and Barrett, AI supports users' emotional stability—specifically, the management of the "Body Budget" ^{*12}—which is the foundation of "Challenging Cooperation".

- Visualization of Affect (Russell): The system uses James Russell's "Circumplex Model of Affect" ^{*14} [Russell 80] to allow users to visualize their own emotional state on a two-dimensional map of "Valence (Pleasure/Displeasure)" and "Arousal (High/Low)".

- Affective Coaching by AI (Barrett): This visualization becomes a powerful practical tool in Barrett's "Theory of Constructed Emotion" ^{*11}. Based on the visualized emotional state, AI functions as a "coach" to optimize the user's "Body Budget". It recommends calm dialogue for users in an "Unpleasant/High Arousal" (stress) state, while suggesting "Party Games" (= "Challenge" leading to Csikszentmihalyi's "Flow" ^{*7}) as appropriate stimulation for users in an "Unpleasant/Low Arousal" (boredom) state.

Through this process, users acquire the skill to more precisely "construct" their own emotions—that is, "Emotional Granularity" ^{*15}—leading to improved well-being and the construction of stable cooperative relationships with others.

5. Discussion and Future Prospects

The 2DimeSmileS ^{*5} model proposed in this paper is more than just a communication tool. The system possesses the function for AI to aggregate and visualize human emotional states (Russell's model) and their background (Barrett's Body Budget).

This holds the potential to revolutionize political and economic governance. Whereas traditional governance models relied on low-resolution, delayed data such as opinion polls and market prices, this system can visualize in real-time the affective reactions generated during the community's process of "Challenging Cooperation".

If AI support lowers relationship maintenance costs and enables "Challenging Cooperation" with a larger number of people, this opens the path to a new bottom-up decision-making model facilitated by AI (governance via "Challenging Cooperation") at a scale exceeding Dunbar's number [Dunbar 92]. This could be an extremely important research subject for the Japanese Society for Artificial Intelligence, which studies political science, economics, "Human-AI Collaboration," and "Affective Computing".

6. Conclusion

This paper argued that the fundamental difference separating humans from chimpanzees is "Challenge Propensity," and that this propensity generated the behavioral strategy of "Challenging Cooperation," developed "Shared Intentionality" [Tomasello 14] as its execution platform, and manifested as "Cooking" (Wrangham [Wrangham 09]) and "Flow" (Csikszentmihalyi [Csikszentmihalyi 90]).

While modern SNS inhibits this nature through "Vainglory," depleting people's "Body Budgets" (Barrett [Barrett 17]) and making the maintenance of stable relationships indicated by "Dunbar's number" [Dunbar 92] difficult, the true mandate of AI must be the opposite. As in the 2DimeSmileS ^{*5} model proposed in this paper, revitalizing "Challenging Cooperation" in digital society by having AI deeply understand and support both the "Cognitive" and "Affective" aspects (Russell [Russell 80]) of humans is a critical task for future AI research and social design.

- *1 Dunbar's number: Proposed by primatologist Robin Dunbar. The cognitive upper limit of the number of people with whom one can maintain stable social relationships, calculated from the size of the human neocortex (approx. 150).
- *2 Shared Intentionality: Proposed by Tomasello. A cognitive basis (ability) unique to humans to form shared goals and intentions ("we" consciousness) with others and to divide roles and cooperate based on them.
- *3 Self-domestication: Proposed by Wrangham et al. The hypothesis that humans, in the process of evolution, achieved a reduction in aggression (especially reactive aggression) and an increase in tolerance, similar to domesticated animals, by themselves (through social selection).
- *4 Challenge Propensity: The central concept proposed in this paper. A psychological and behavioral trait not limited to reactive responses to the environment but involving active engagement and trial-and-error with tasks involving novelty or difficulty.
- *5 2DimeSmileS Concept Reference:
<https://2dimesmiles.com/about-2dimesmiles-application/>.
- *6 Challenging Cooperation: A concept proposed in this paper. A behavioral strategy unique to humans that constantly targets the "method" or "system" of cooperation itself for improvement and innovation (challenge), rather than merely cooperating.
- *7 Flow: Proposed by Csikszentmihalyi. An optimal experience involving a sense of elation and deep satisfaction that occurs when there is a balance between a task (challenge) of appropriate difficulty and one's own skills.
- *8 Social Grooming: Behavior in primates to maintain and strengthen social relationships through grooming, etc. In humans, conversation and empathetic exchanges correspond to this, requiring time and cognitive costs for relationship maintenance.
- *9 Evolutionary Mismatch: A state where rapid differences between the environment in which humans evolved (hunter-gatherer era, etc.) and the modern environment (post-agricultural, especially industrial/information society) cause physical and mental mechanisms that were

once adaptive to cause maladaptation or disease (e.g., obesity, stress) in the present day.

- *10 Vainglory: An SNS analysis term in this paper. A behavioral pattern where the primary purpose is to show off and compete for individual status (number of "likes", etc.) to others rather than substantive cooperation or challenge.
- *11 Theory of Constructed Emotion: Proposed by Barrett. The theory that emotions are not automatically "triggered" by specific brain regions (classical theory) but are "constructed" by the brain each time based on past experiences, current bodily state (Body Budget), and sensory information from the outside.
- *12 Body Budget: Proposed by Barrett. The process by which the brain predicts and efficiently manages/adjusts the body's energy allocation (glucose, water, salt, sleep, etc.). When this budget is in deficit, unpleasant affect, fatigue, and disease are said to occur.
- *13 Cognitive Prosthesis: A term referring to functions or tools where AI, etc., supplements or extends human cognitive abilities (memory, attention, judgment, etc.) from the outside.
- *14 Circumplex Model of Affect: Proposed by Russell. A model that posits that all emotional experiences can be placed on a map by a combination of two basic dimensions: "Valence (Pleasure/Displeasure)" and "Arousal (High/Low)".
- *15 Emotional Granularity: Proposed by Barrett. The ability to distinguish and construct emotional experiences not just at a coarse level like "good" or "bad," but with more precise and specific concepts like "happy," "proud," "grateful," or "anxious," "angry," "disappointed." Higher ability is said to lead to better management of the body budget and appropriate coping behaviors.

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