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OPINION

Personality as Compressed Social Information in Cooperative Partner Selection

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Human cooperation depends on selecting reliable partners under conditions of uncertainty and limited information. I propose that personality traits function as an informational architecture that compresses high-dimensional behavioral observations into low-dimensional representations optimized for prediction and social communication. From this perspective, the Big Five can be understood not merely as a psychometric taxonomy, but as a representational format that facilitates efficient partner choice in cooperative contexts. Compressed trait representations reduce cognitive load, enhance transmission through gossip, and promote reputational consensus. Within this framework, Agreeableness plays a central role in cooperation-dominant settings. I argue that Agreeableness may signal cooperativeness through two complementary mechanisms: by structuring intrinsic cost asymmetries between altruistic and exploitative behavior, and by increasing susceptibility to social learning and norm internalization. This account integrates personality psychology with evolutionary models of partner choice and indirect reciprocity.

Keywords
personality, cooperative partner choice, informational architecture, agreeableness, indirect reciprocity, gossip

Information compression to select cooperative partners

Cooperative partner selection constitutes a fundamental organizing principle of human social life. In the context of repeated interactions, individuals derive adaptive benefits from identifying partners who are likely to reciprocate and from avoiding those predisposed to exploitative behavior. Competitive altruism has been proposed as one mechanism underlying the emergence and stabilization of cooperation. In environments analogous to a "biological market," where individuals retain the freedom to select interaction partners, the signaling of generosity can confer reputational benefits, thereby generating incentives for increasingly prosocial behavior through reputation-based partner choice (Barclay, 2011, 2013; Hardy & Van Vugt, 2006). From the perspective of reciprocal altruism, explaining helping behavior requires that assistance ultimately be reciprocated and that the associated costs be offset (Trivers, 1971). When providing aid to an individual in need, the recipient's propensity for prosocial behavior serves as a key cue for anticipating future reciprocity because even when recipients possess the ability to reciprocate, helpers cannot expect to recover their costs unless recipients are also willing to do so. Using vignette-based experiments, Oda and Hayashi (2024) manipulated signals related to a stranger's potential for reciprocity. Their findings demonstrated that both the degree of prosociality and the controllability of the cause of the recipient's hardship, another potential cue, independently predicted participants' willingness to provide help. Because future behavior cannot be directly observed, partner selection relies on probabilistic inferences drawn from limited cues. The central theoretical question, therefore, is not whether traits exist, but whether and how specific trait dimensions function as socially usable signals of cooperative reliability.

When selecting cooperative partners, individuals must often make inferences under severe informational constraints. Future behavior cannot be directly observed, and decisions must therefore rely on limited, probabilistic cues. Under such conditions, it is more efficient to form stable, trait-based expectations (e.g., "this person is likely to be cooperative") than to evaluate each discrete action in isolation. Empirical research suggests that such inferences can be formed rapidly and with a nontrivial degree of accuracy. Studies on thin-slice judgments demonstrate that observers can extract meaningful information about personality from very brief exposures to behavior (Ambady & Rosenthal, 1992). Similarly, zero-acquaintance paradigms show that strangers can form consistent—and for some traits, accurate—judgments based on minimal behavioral samples (Borkenau & Liebler, 1992). Evidence from online contexts further indicates that naturally occurring behavioral traces, such as social media profiles, predict individuals' personality traits to some extent (Back et al., 2010). Taken together, these findings indicate that observers are capable of extracting relatively stable dispositional information from sparse and noisy behavioral input.

At the same time, what is observed about others consists of numerous situation-dependent actions, context-specific utterances, and seemingly inconsistent behaviors—in other words, high-dimensional and noisy data streams. Retaining and communicating such detailed information is cognitively costly. Under these constraints, some form of informational reduction becomes necessary. Classic research on impression formation supports this

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view. Asch (1946) demonstrated that impressions are not formed by simply aggregating independent traits, but rather by organizing information around a small number of central dimensions. Research on spontaneous trait inference further shows that traits are automatically inferred from behavior and are more likely than the behaviors themselves to be retained in memory (Uleman et al., 1996). Moreover, recent work suggests that observers estimate latent variables that are useful for predicting future behavior through interacting learning and memory systems (Amodio, 2025).

Taken together, these findings suggest that impression formation is not merely an evaluative process, but also a form of statistical learning that integrates noisy behavioral information into compact representations. One way to formalize this process is to view impression formation as a problem of compressing high-dimensional behavioral information into lower-dimensional representations that preserve predictive relevance. In information-theoretic terms, this can be understood as a form of dimensionality reduction, in which a system derives compact latent representations from complex inputs. This perspective closely parallels the information bottleneck framework (Tishby et al., 1999), which characterizes how a system can compress input information while retaining what is most useful for predicting a target variable. Applied to social cognition, observed behaviors constitute high-dimensional inputs, whereas future cooperative actions represent the prediction target. An efficient trait representation would therefore discard idiosyncratic details while preserving information relevant for forecasting future interactions. In this sense, personality traits may approximate a bottleneck-like solution that balances cognitive economy with predictive accuracy under informational constraints. Traits can be understood both as inferred latent variables and as phenotypic regularities that function as signals.

From the perspective of cognitive processing, however, the benefits of such compression include improved memory efficiency and more reliable prediction. Storing a limited set of trait representations is less costly than retaining numerous behavioral episodes, and stable latent representations provide more robust guidance for forecasting behavior than isolated instances. From an evolutionary perspective, similar ideas have been proposed in theories of partner selection and commitment. For example, Frank's (1988) commitment theory suggests that emotions and personality traits can function as self-binding mechanisms, making it rational for observers to attend to internal dispositions when making trust decisions. However, inferring such dispositions from repeated observation can be costly, particularly in the absence of prior interaction. Even thin-slice judgments require inferential processing and remain constrained by limited information.

Gossip as an efficient exchange of compressed information

Under these conditions, additional mechanisms that reduce the cost of information acquisition become especially valuable. One such mechanism is gossip. Individuals can rely not only on their own observations but also on reputational information when selecting cooperative partners. Models of indirect reciprocity and reputation-based cooperation, in particular, specify mechanisms through which individuals select others on the basis of summarized records of past behavior (Nowak & Sigmund, 2005; Ohtsuki & Iwasa, 2004). Within these frameworks, reputation serves as a predictor of future behavior that outweighs isolated, one-off actions; in practice, individuals rely on what can be conceptualized as a low-dimensional reputational index. Gossip is commonly defined as the sharing of information about an absent third party who is unaware of the exchange. It functions as a mechanism for transmitting information about others' traits and social evaluations without requiring direct interaction. Balliet et al. (2021) argue that gossip constitutes a central mechanism sustaining reputation-based indirect reciprocity. From an evolutionary perspective, gossip facilitates the dissemination of information about individuals' actions to third parties, thereby shaping reputation formation; reputation, in turn, influences subsequent cooperative behavior. At the group level, the anticipated social costs of becoming the target of gossip can promote more prosocial patterns of interaction among group members (Feinberg et al., 2014). Dores Cruz et al. (2021) report that the content of everyday gossip spans a broad range of individual attributes, encompassing the six major personality dimensions (HEXACO) as well as the primary dimensions of social perception—warmth, competence, dominance, and morality.

At this point, another advantage of informational compression—enhanced transmission efficiency—becomes particularly salient. Compressed trait representations are easier to communicate, retain, and retransmit, thereby providing a powerful foundation for the diffusion of gossip. For example, conveying that "N is gentle and generous" is more efficient than recounting specific episodes such as, "When a colleague made a mistake, N said, 'Let's think about it together,' before assigning blame," or "N listens attentively and nods until others have finished speaking." Informational compression also facilitates consensus formation within groups. Labeling someone as "gentle and generous" is more readily shared and collectively endorsed than transmitting multiple discrete behavioral examples, thereby accelerating the convergence of reputational judgments. Forming accurate partner-selection decisions based solely on personal observation requires substantial investments of time and cognitive effort. In contrast, the exchange of compressed reputational information through gossip allows individuals to distribute and thereby reduce the costs associated with information acquisition and processing.

Gossip confers fitness benefits on both individuals and groups. Individuals seeking to evaluate potential partners can thus reduce their cognitive load through this streamlining. At the same time, because individuals are themselves subject to evaluation by others, they can efficiently convey compressed information about themselves. From an evolutionary perspective, multilevel selection theory suggests that altruistic behavior evolves under conditions of "positive assortment" achieved through partner selection (Bowles & Gintis, 2011). Informational compression and efficient transmission may also facilitate mechanisms such as within-group ostracism by accelerating the convergence of reputational judgments, thereby promoting group-level fitness

advantages (Feinberg et al., 2014). On the other hand, the predictability of being a cooperative partner also increases the likelihood of being exploited by others (O'Dea et al., 2022). However, personality traits are not all positive. For example, traits such as Machiavellianism and psychopathy provide information that increases the predictability of exploitation. It is likely that these traits play a role in ostracism. Thus, while predictability may expose prosocial individuals to short-term exploitation, it simultaneously enhances the efficiency of partner selection and ostracism processes, allowing the long-term benefits of reliable social coordination to outweigh these costs. From this perspective, it is plausible that the psychological construct of personality evolved, at least in part, to serve this communicative and informational function.

The Big Five as compressed information for social prediction

Personality psychology has extensively documented the predictive validity and cross-cultural robustness of the Big Five structure. However, these studies have largely treated traits as descriptive taxonomies rather than as functionally specialized components of social decision-making systems. In parallel, evolutionary models of partner selection and indirect reciprocity have underscored the importance of reputational information, yet they often operationalize "cooperative quality" as a scalar variable (e.g., cooperate vs. defect) without linking it to a multidimensional trait structure. I propose that the Big Five factors function as a social information code in partner selection, compressing high-dimensional behavioral data into low-dimensional representations optimized for future prediction and social communication. The novelty of this approach lies in reconceptualizing the Big Five not merely as a psychometric measurement model, but as a candidate solution shaped by selection pressures for communicative efficiency and predictive utility, or as a culturally stabilized representational format that approximates such an adaptive solution. Observed behavior is context-dependent, multidimensional, and variable. However, social decision-making requires inferences about whether an individual will cooperate, act reliably, and behave predictably—in other words, the estimation of parameters governing behavioral distributions. The ideal axes of compression for such inferences would (1) possess strong predictive validity, (2) be cross-culturally transmissible, (3) capture substantial explanatory variance within a limited number of dimensions, and (4) be readily verbalizable.

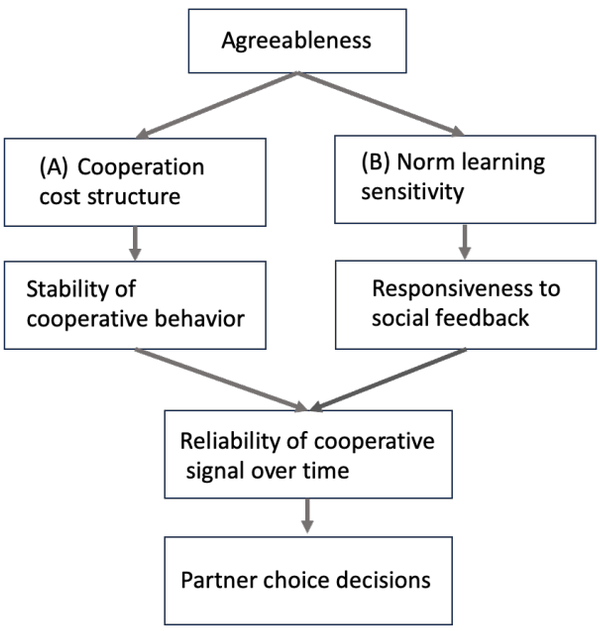
Within this broader framework of informational compression and transmission, the Big Five framework appears to satisfy several of these criteria, in that it captures substantial behavioral variance within a relatively small number of dimensions and provides a readily verbalizable structure for summarizing social information. At the same time, evidence regarding its cross-cultural generality is mixed, with some studies suggesting that the dimensionality and structure of personality vary across socioecological contexts (e.g., Smaldino et al., 2019). Accordingly, the present framework does not assume that a five-factor structure is universally optimal or inevitable. Rather, the Big Five may be understood as a historically and culturally stabilized representational format that approximates an efficient solution under particular ecological and communicative constraints. From this perspective, the five-factor model is not treated as a fixed optimum, but as one plausible compression scheme among a range of possible alternatives. Different environments may favor different levels of dimensionality or alternative trait structures, depending on the demands placed on social prediction and communication. This variability is consistent with the idea that personality structure reflects adaptive compression under local informational and social constraints, rather than a fixed universal architecture.

Of course, informational compression does not logically require a five-factor structure; alternative dimensional solutions are conceivable. Indeed, research in social cognition has proposed a universal two-dimensional model consisting of Warmth (encompassing friendliness, helpfulness, sincerity, trustworthiness, and morality) and Competence (encompassing intelligence, skill, creativity, and efficacy; Fiske et al., 2007). Whereas two-dimensional models may efficiently capture rapid evaluative impressions, the five-factor structure may provide greater resolution for forecasting behavior across extended interactions. If the Big Five reflects not only a psychometric regularity but also pressures for communicative efficiency, its convergence on five factors may represent an intermediate solution that maintains predictive resolution without excessive redundancy. If this account is correct, one empirical prediction follows: compressing behavioral matrices into five-dimensional vectors should maximize the accuracy of forecasting future behavior relative to alternative dimensional structures (in environments where the Big Five traits dominate).

While the five factors may be conceptualized as parameters governing behavioral distributions across distinct domains, the present article focuses specifically on cooperative partner selection and examines the functional significance of Agreeableness. Agreeableness, in particular, occupies a uniquely central role in cooperative contexts characterized by reciprocity and the risk of betrayal. Whereas Conscientiousness relates primarily to self-control and norm adherence, Agreeableness more directly signals concern for others, empathy, trust, and a preference for relational harmony. These characteristics systematically shift the expected distribution of altruistic versus exploitative behavior. From a decision-theoretic perspective, perceptions of Agreeableness alter the expected payoffs of repeated interactions, thereby influencing partner selection decisions. Crucially, I argue that Agreeableness functions as a signal of cooperativeness through two complementary mechanisms (see Figure 1). First, from a costly signaling perspective, Agreeableness can be conceptualized as a dispositional parameter that structures the subjective costs of cooperation. Empirical evidence indicates that agreeableness is robustly associated with empathy, prosocial motivation, and cooperative behavior (Graziano et al., 2007; Wilmot & Ones, 2022). These findings suggest that, at a dispositional level, highly agreeable individuals may experience lower subjective costs of prosocial action and greater psychological costs of norm violation or defection. In contrast, individuals lower in agreeableness appear more sensitive to situational incentives and constraints, resulting in less stable cooperative behavior across contexts (Graziano et al., 2007). Such patterns are consistent with the interpretation

of agreeableness as a parameter shaping both the intrinsic valuation of cooperation and responsiveness to social norms. Importantly, this cost asymmetry is not directly observed but is proposed as a theoretical interpretation supported by converging empirical findings linking Agreeableness to empathy and prosocial motivation. Because such intrinsic cost asymmetries are difficult to fake consistently over time, Agreeableness may function as an honest signal under repeated interaction.

Figure 1
Dual-pathway model of Agreeableness as a cooperative signal



Second, Agreeableness appears to increase susceptibility to social learning, particularly in the acquisition and internalization of reciprocity norms. Ehlert et al. (2020) conducted a longitudinal study examining whether social preferences cluster within naturally occurring social networks and identifying the mechanisms underlying such clustering. Across 57 newly formed school classes in Switzerland, students' social value orientation (SVO) and friendship networks were assessed at two time points separated by nine months. Cooperative dispositions were not randomly distributed but instead formed clusters within networks. Importantly, these clusters emerged primarily through social learning processes (i.e., peer influence) rather than through selective partner choice (i.e., forming ties with similar others). The authors concluded that cooperativeness spreads through social contagion and that cultural transmission plays a central role, with cooperative clusters strengthened mainly via learning rather than assortative affiliation. Consistent with this interpretation, Rawlings et al. (2022) examined whether Big Five traits predicted children's preferred learning strategies among UK children aged 7–11 who were introduced to unfamiliar puzzle boxes. Children higher in Agreeableness were more likely to observe a social demonstration rather than attempt the task independently. Moreover, among those who chose demonstration, higher Agreeableness predicted "innovation by modification"—altering or extending the demonstrated solution rather than merely copying it. These findings suggest that Agreeableness is associated not only with receptivity to social information but also with the active elaboration of socially acquired knowledge. The authors characterize this quality as "social glue." Highly agreeable individuals are also more sensitive to relational feedback and its reputational consequences. This sensitivity reinforces cooperative persistence, not only because cooperation carries relatively low intrinsic cost, but also because norm violations are corrected more rapidly. Thus, Agreeableness can be conceptualized both as a structural parameter shaping the cost function of cooperation and as a dynamic parameter regulating the speed of norm acquisition and adjustment. This dual-mechanism account clarifies a signaling-based interpretation of personality. Traits are not merely descriptive summaries of past behavior; rather, they function as parameters that shape both behavioral tendencies and responsiveness to social regulation.

This interpretation is consistent with Whole Trait Theory (Fleeson & Jayawickreme, 2015), which conceptualizes traits as density distributions of behavioral states generated by underlying psychological mechanisms. From this perspective, a trait reflects both a statistical regularity—how frequently certain states are enacted—and the processes that produce this distribution. Applied to Agreeableness, individuals high on this dimension would not behave cooperatively at all times; rather, they would display a distribution of states skewed toward prosocial behavior across situations. The proposed intrinsic cost asymmetries and heightened responsiveness to social feedback can be understood as mechanisms that generate and stabilize this distribution. Thus, Agreeableness functions not merely as a descriptive label but as a parameter governing both the frequency and regulation of cooperative states. Accordingly, in cooperative partner selection, Agreeableness should exert a disproportionately strong influence relative to other Big Five dimensions. Supporting this prediction, Harris and Vazire (2016) report that Agreeableness is the personality dimension most consistently associated with favorable outcomes in both friendship and romantic relationship contexts.

This framework advances three primary claims: (1) the Big Five constitute a socially functional predictive signaling space; (2) the intensity and relevance of signaling vary across traits and interaction domains; and (3) within cooperative markets, Agreeableness occupies a privileged role due to the combined effects of intrinsic cost structures and reciprocal learning dynamics. Several hypotheses follow from this framework:

H1: When behavioral information is limited or noisy, trait-based inferences will exert a stronger influence on partner-selection decisions than isolated, single-instance actions.
H2: In cooperation-dominant contexts characterized by repeated interaction and credible risks of defection, Agreeableness will exert a stronger influence on partner selection than other Big Five dimensions.
H3: Cooperative behavior exhibited by highly agreeable individuals will be especially stable and persistent over time, particularly under reputation or feedback mechanisms.

H4: Higher levels of Agreeableness will be associated with faster rates of normative learning.

Evolutionary research on the Big Five has primarily interpreted each trait as a frequency-dependent adaptive strategy shaped by environmental contingencies and life-history trade-offs (e.g., Nettle, 2006). Within this tradition, discussion has focused on how possessing a given trait relates to individual fitness and why trait variation persists within populations. The argument advanced here extends beyond frameworks that treat personality and reputation as parallel constructs. Instead, it integrates trait dimensions directly into the strategic logic of partner selection, positioning personality as an informational architecture that structures reputational inference and cooperative decision-making.

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Author contribution

Ryo Oda: Conceptualization, Funding acquisition, Investigation, Visualization, Project administration, Writing – original draft, Writing – review and editing.

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