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Governance Structures, Cultural Distance, and Socialization Dynamics: Further Challenges for the Modern Corporation

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Abstract
This paper relates cultural distance and governance structures. We suggest a model of cultural evolution that captures the idiosyncratic socialization dynamics taking place in groups of communicating and interacting agents. Based on these processes, cultural distance within and between groups or organizational units develops. Transaction cost theorists associate higher cultural distance with higher transaction costs. Therefore, one problem of economic organization is assessing alternative governance structures in terms of the socialization dynamics they enable that entail different intraorganizational transaction costs. We assume that transaction can be organized within governance structures that allow transaction cost economizing socialization processes.

Keywords
Cultural Distance, Governance Structures, Corporate Culture, Cultural Evolution, Firm Performance.

JEL Classifications
D21 ; D23 ; L25 ; M14 ; C61

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1. Introduction

This paper relates cultural distance (CD), as a further attribute of transactions, and governance structures. Standing in the tradition of Oliver E. Williamson (e.g., 1979, 1981, 2005), we suggest an additional problem of economic organization: assessing alternative governance structures in terms of the socialization dynamics they enable, which entail different intraorganizational transaction costs due to CD. We assume that transactions in organizations can be assigned to and organized within governance structures that allow transaction cost economizing socialization processes (see Commons, 1934; Coase, 1937). Our arguments are based on a model of cultural evolution that captures social interactions among agents (see Feldman & Cavalli-Sforza, 1975; Boyd & Richerson, 1985).

CD has been used as a key variable in many areas of organizational behavior (e.g., Kogut & Zander, 1993; Shenkar, 2001) and firms have been interpreted as multi-cultural teams (e.g., Lazear, 1999). We suggest that given certain socialization dynamics that occur in groups, processes of convergence and divergence in CD within and between organizational units take place. Furthermore, transaction cost theorists associate higher CD with higher efforts of transaction due to communication and information costs or less efficient intraorganizational transfer of knowledge and skills (e.g., Kogut & Zander, 1993; Buckley & Carter, 2004). Employees who have different cultures impose costs on an organization that would be absent were cultures homogeneous (e.g., Lazear, 1999). We argue that an organization can react to this challenge by choosing suited socialization governance structures that close CD between individuals or organizational entities.

Moreover, our socialization governance approach appeals to behavioral and cultural evolution theory. We suggest an innovative model of cultural evolution that captures socialization processes and the development of CD within and between groups or organizational units. For our purposes, we capture intra- and intergroup CD by measuring the variance in cultural trait values of agents.[1] The model describes the idiosyncratic learning and socialization dynamics taking place in groups of communicating and interacting agents and explains important aspects of governance structures and related transaction costs. Above all, it allows us to derive some general principles of socialization governance in organizations.

[1] A cultural trait is defined as an idea, norm, belief, attitude, habit, or value that is acquired by social learning and that influences an individual's behavior (e.g., Henrich et al., 2008). Cultural traits have long been used in anthropology as units of transmission that reflect behavioralcharacteristics of individuals or groups (e.g., O'Brian et al., 2010).

We examine these governance structures by incorporating several behavioral related variables of organizational development in our model of cultural evolution, such as a role model bias in cultural transmission and group-based learning. Given this perspective, our work is also a contribution to social interaction theory. This literature links social interactions with economic theory and includes several earlier works, such as Schelling (1972), Kirman (1993), and Ellison & Fudenberg (1995). Moreover, sociology investigates the important place of socialization in the evolution of cultures (e.g., French, 1956; Parsons, 1967). In line with these contributions, our model assumes an agent's cultural traits to be dependent on the cultural traits exhibited by other actors. In this context, humans' constrained psychological resources are a fundamental part of cultural evolution: imitating and learning from others, i.e., relying on purely social influences, are a means by which agents finesse the bounds of rationality (e.g., Richerson & Boyd, 2005). Cultural traits are transmitted by processes of cultural learning that require extended series of personal interaction (also Bisin & Verdier, 2000). Socialization processes within groups are based on such mechanisms of cultural transmission and their implications matter a lot to organizations and their efforts to craft governance structures that mitigate the problem of CD.

The paper is organized as follows. In Section 2, a model of the evolution of CD within and between groups or organizational units is specified. In Section 3, implications of socialization processes for intra- and intergroup CD are developed. Section 4 relates the governance of socialization and internal transaction costs and derives some principles of governance of socialization in organizations. Section 5 concludes.

2. The basic model of intra- and intergroup socialization processes

Our Markov-type model depicts the development of the variance in cultural trait values within and between groups of communicating and interacting agents. Besides norms, beliefs, attitudes, etc., group culture also summarizes more organizationspecific traits, such as organizational stories and shared experiences, rituals, symbolic manifestations, and solutions to problems (e.g., Higgins, 2005). The model draws on ideas originating from cultural evolution theory (e.g., Feldman & Cavalli-Sforza, 1975; Boyd & Richerson, 1985) and opinion formation models (e.g., DeGroot, 1974).[2] Let there be $i = 1, \dots, N$ members of a group. The value of a cultural trait j $(j = 1, \dots, M)$ of the ith individual at time t is $x_{ij,t}$. All traits considered are continuous in nature and treated

[2] Markov models of this kind have also been used widely in economics. See, e.g., Ellison and Fudenberg (1995).

independently. For a single cultural trait j, vector $x_{j,t}$ captures the state of the group, where $x_{j,t} = (x_{1j,t}, \dots, x_{Nj,t})'$. $\bar{x}_{j,t}$ is the group mean value of cultural trait j at time t.

A cultural trait j of an individual i is assumed to depend on the values of the same trait in all N members of the group and these members' weights, w_{ik}, in socialization. Each coefficient w_{ik} measures the dependence of the trait of the ith employee on the trait exhibited by the kth group member. Hence, employee i's value of a cultural trait j develops according to

$$x_{ij,t+1} = \sum_{k=1}^{N} w_{ik} x_{kj,t}. \tag{1}$$

Agents acquire their traits by learning from one another, i.e., an interdependent process of socialization takes place. Cultural transmission within a group can then be represented by a stochastic NxN matrix W that has as its elements the proportional contributions of each member of the group to the value of an individual's trait as captured by the weights, $w_{ik} : W = [w_{ik}]$ $(0 \leq w_{ik} \leq 1, i = 1, \dots, N, k = 1, \dots, N,$ and $\sum_{k=1}^{N} w_{ik} = 1, \forall i)$. For one cultural trait j, the change in a group's state is modeled as:

$$x_{j,t+1} = W x_{j,t} + \epsilon_t, \tag{2}$$

where $\epsilon_t = (\epsilon_1, \epsilon_2, \dots, \epsilon_N)'$ is a random component for each agent that represents individual learning (with mean zero and variance σ^2).[3] We assume ϵ_i and ϵ_k to be independent in a given cohort. Moreover, individual learning is independent between cohorts and across traits. Thus, the cultural trait of the ith employee at $t+1$ can be considered as the weighted influences of the traits of all group members at t including herself and the individual learning term ϵ_i Means and variances of cultural traits within and between groups of N individuals will be subject to change in the course of ongoing socialization processes.

From equation (2) we have $(t \rightarrow \tau)$

$$E(x_{j,t+1}) = W^{t+1} x_{j,0} \tag{3}$$

so that the expected value of $x_{j,t+1}$ is determined by its initial values and the spectral properties of W. Equations (2) and (3) describe the development for a single cultural trait. For more than one cultural trait, we can aggregate the group's state by a matrix X_t with $X_t = [x_{ij;t}]$.

[3] Due to this random term, CD between agents will never completely vanish. This component may also capture the influence of an environment to which agents adapt. The traits' distributions would then shift in the direction given by this selective force.

Moreover, within-group CD is measured by VAR_t^{WIG}, the intragroup variance in cultural trait values at time t (for a formal definition, see below). Employees constituting an organizational unit have different cultural backgrounds and have experienced idiosyncratic individual learning and socialization histories prior to and after entering the organization. Therefore, we expect a considerable degree of initial intragroup variance in cultural trait values. This measure of cultural distance will then change in the course of time depending on individual learning and socialization dynamics. CD between organizational units is captured by VAR_t^{BTG}, the variance in the difference of groups' mean values of cultural traits (also defined below).

The cultural transmission matrix, W, captures socialization and learning biases taking effect therein. Cultural learning biases are viewed as frugal, boundedly rational heuristics. Copying the cultural traits shown by other members of one's reference group is such a simple, general rule (e.g., Kirman, 1993). A more specific learning bias is based on prominent or prestigious role models in an individual's social environment. Single individuals, including ordinary managers, (corporate) entrepreneurs, or business leaders, often play outstanding roles in the socialization of employees (e.g., Schein, 1992). Indeed, evidence from social psychology and anthropology suggests that human agents are prone to adopt cultural traits that are shown by role models (Harrington, 1999; Henrich & Gil-White, 2001; Labov, 2006; Atkisson et al., 2012). Therefore, a cognitive disposition to imitate prominent agents takes effect in socialization.

To guide our analysis of group-bound socialization below and to integrate some very generic mechanisms of cultural evolution, we specify the transmission weights included in W as follows:

$$W = \begin{pmatrix} p+r-\frac{N}{\alpha} & \frac{1-p}{N-1}-\frac{r-\frac{N}{\alpha}}{N-1} & \frac{1-p}{N-1}-\frac{r-\frac{N}{\alpha}}{N-1} & \cdots & \frac{1-p}{N-1}-\frac{r-\frac{N}{\alpha}}{N-1} \\ \frac{1-p}{N-1}+r-\frac{N}{\alpha} & p & \frac{1-p}{N-1}-\frac{r-\frac{N}{\alpha}}{N-2} & \cdots & \frac{1-p}{N-1}-\frac{r-\frac{N}{\alpha}}{N-2} \\ \frac{1-p}{N-1}+r-\frac{N}{\alpha} & \frac{1-p}{N-1}-\frac{r-\frac{N}{\alpha}}{N-2} & p & \cdots & \frac{1-p}{N-1}-\frac{r-\frac{N}{\alpha}}{N-2} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ \frac{1-p}{N-1}+r-\frac{N}{\alpha} & \frac{1-p}{N-1}-\frac{r-\frac{N}{\alpha}}{N-2} & \cdots & \frac{1-p}{N-1}-\frac{r-\frac{N}{\alpha}}{N-2} & p \end{pmatrix}. \quad (4)$$

This cultural transmission matrix contains the mutual influence of peers in groups of changing sizes, N. Moreover, a role model bias is reflected by parameter r: agent $i = 1$ takes on the position of a prominent role model. Ceteris paribus, high values of r lead to relatively large elements in the first column and relatively small elements elsewhere, which is a prerequisite for this agent to be extraordinarily influential in shaping group members' cultural traits. Different values of r reflect the fact that individuals differ in their ability or effort to exert influence in the socialization of other agents. This can be due to differences in charismatic potential, prestige, personal work ethic, etc. or different levels of engagement in active leadership, such as face-to-face communication with employees (e.g., Langlois, 1998).

Whether to preferentially follow other group members or to mainly rely on one's own cultural trait values is another bias in cultural transmission. Parameter p in matrix W measures this tradeoff in socialization: if it takes on a relatively high value, then the diagonal elements imply that each individual strongly determines her own trait values, while other group members have a relatively small effect in that process. On the other hand, if p is low relative to the matrix's other elements, the group has a stronger influence on the values of a single individual's cultural traits, i.e., conformity and compliance are relatively strong (see Cialdini & Goldstein, 2004). Hofstede (1989) offers empirical support for the existence of this bias in socialization: one of his cultural dimensions used in cross-cultural comparisons is “individualism", the degree to which people learn to act as individuals rather than collectivistic as members of a cohesive group (also Nisbett et al., 2001). Similarly, Greif (1994) differentiates between collectivist and individualist cultures to explain behavioral and institutional differences between societies. We assume p values to also differ among organizations or units due to different corporate cultures in which agents either focus on their personal agendas or subscribe to (collective) firm goals.

Finally, entries are corrected for changing values of r, p, and N in a way that rows sum up to one. In this context, $\propto$ is a normalization parameter.

3. Implications of socialization processes for intra- and intergroup cultural distance

Besides cultural transmission in a group context, individual learning, as captured by the random component $\in$, is considered as a determinant of the development of agents' various cultural trait values. Since this component is assumed to be independent across traits, the following propositions apply to each of the M cultural traits in our model. Therefore, for ease of notation, the subscript j denoting a particular trait is suppressed in the analysis.

3.1. Convergence and stabilization of cultural trait values within groups

Let $V_t = E[(x_t - \overline{x}_t)'(x_t - \overline{x}_t)]$ denote the variance-covariance matrix for a given trait j, evolving according to the stochastic process characterized by W. Then, the intragroup variance at time t, measuring CD within the group, is given by the sum of the diagonal elements of V_t divided by $N-1$, i.e.,

$$VAR_t^{WIG} = \frac{1}{N-1} tr(V_t). \tag{5}$$

Our model demonstrates that CD within groups is reduced by shared socialization experiences among individual employees. For a regular Markov matrix, it can be shown that intragroup variance in cultural traits, VAR_t^{WIG}, decreases and stabilizes at a finite value in the course of group-bound socialization. Let us first assume a simplified cultural transmission table, W^S, in which no individual takes on the position of a particularly influential role model:

$$W^S = \begin{pmatrix} p & \frac{1-p}{N-1} & \frac{1-p}{N-1} & \cdots & \frac{1-p}{N-1} \\ \frac{1-p}{N-1} & p & \frac{1-p}{N-1} & \cdots & \frac{1-p}{N-1} \\ \frac{1-p}{N-1} & \frac{1-p}{N-1} & p & \cdots & \frac{1-p}{N-1} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ \frac{1-p}{N-1} & \frac{1-p}{N-1} & \frac{1-p}{N-1} & \cdots & p \end{pmatrix}. \tag{6}$$

If no cultural transmission between group members takes place, W^S equals the Identity matrix and each agent's cultural trait values follow a random walk driven by uncorrelated individual learning. In that case, within-group variance diverges. However, in the presence of joint socialization based on mutual cultural learning, the expected long-run intragroup variance is given by:

$$VAR^{WIG,S} = \lim_{t\to\infty} VAR_t^{WIG,S} = \sigma^2 \left(1 + \frac{\lambda^2}{1-\lambda^2}\right); \tag{7}$$ [4]

where λ refers to the $(N-1)$-fold non-unit eigenvalue of W^S, given by $\lambda = \frac{Np-1}{N-1}$.

[4] $VAR_t^{WIG,s} = \sigma^2 \left(1 + \lambda^2 \frac{1-\lambda^{2t}}{1-\lambda^2}\right) + \sigma_0^2 \lambda^{2(t+1)}$, where σ_0^2 measures the unbiased initial group variance.

Inserting that into Equation (7) yields:

$$VAR^{WIG,S} = \sigma^2 \frac{N-1}{N(1-p)\left(1+\frac{Np-1}{N-1}\right)}. \tag{8}$$

For p approaching unity, the situation of absent cultural learning can be interpreted as the limit case of Equation 8. While $p = 1$ implies agents who fully determine their own cultural trait values, p $p = 0$ leads to individuals who are exclusively subject to group influences. Hence, our first Proposition says:

Proposition 1 $VAR^{WIG,S} < \infty, \forall p \in [0,1)$ and $VAR^{WIG,S} \underset{p \to 1}{\longrightarrow} \infty$,
i.e., socialization reduces intragroup variance in trait values.

Proof. All proofs are given in the Appendix. □

If we take into account a manager or business leader in socialization characterized by a higher weight in cultural learning measured by the relative size of r, we can capture the corresponding effects by analyzing a cultural transmission matrix, W, as described by (4) above. In this case, intragroup variance, VAR_t^{WIG}, converges and stabilizes at a finite value and - under certain conditions – also decreases in the course of socialization. To establish these results, the following Lemma provides a compact expression for VAR_t^{WIG}. Let $\sigma_1^2 = \frac{1}{N}(x_{1,0} - \overline{x}_{-1,0})^2$ and $\sigma_{-1}^2 = \frac{1}{N-1}\sum_{k=2}^{N}(x_{k,0} - \overline{x}_{-1,0})^2$, where the former measures the initial distance of the model's trait to the average of all other group members, $\overline{x}_{-1,0}$, and the latter the unbiased initial trait variance for all non-role models.

Lemma 1 $VAR_t^{WIG} = \sigma^2\left(1 + \frac{\lambda_2^2}{N-1}\frac{1-\lambda_2^{2t}}{1-\lambda_2^2} + \frac{(N-2)\lambda_{N-2}^2}{N-1}\frac{1-\lambda_{N-2}^{2t}}{1-\lambda_{N-2}^2}\right) + \sigma_1^2\lambda_2^{2(t+1)} + \sigma_{-1}^2\lambda_{N-2}^{2(t+1)}$,

$\lambda_2 = \frac{Np-1}{N-1}$ and $\lambda_{n-2} = \frac{Np-1}{N-1} + \frac{r-\frac{N}{\alpha}}{N-2}$ are the non-unit eigenvalues of W.

Given the expression for the within-group variance provided by Lemma 1 above, Proposition 2 states the condition under which VAR_t^{WIG} decreases between two consecutive generations when a role model takes effect in cultural transmission:

Proposition 2 $VAR_t^{WIG} - VAR_{t-1}^{WIG} < 0$ if and only if
$\lambda_2^{2t}\left(\frac{\sigma^2}{N-1} - \frac{\sigma_1^2}{N}(1-\lambda_2^2)\right) + \lambda_{N-2}^{2t}\left((N-2)\frac{\sigma}{N-1} - \sigma_{-1}^2(1-\lambda_{N-2}^2)\right) < 0.$

Based on Proposition 2, the following Corollary provides sufficient conditions for VAR_t^{WIG} t to monotonically decrease or increase in the presence of a role model:

Corollary 1

1. If the variance introduced by individual learning, as measured by σ^2, is sufficiently small, VAR_t^{WIG} decreases monotonically.
2. If the role model and all non-role models initially share identical trait values, VAR_t^{WIG} increases monotonically.
3. If the model's weighted influence, $r - \frac{N}{\alpha}$, is sufficiently small and p sufficiently large, VAR_t^{WIG} increases monotonically.
4. For any given level of variance in individual learning, σ^2: if the initial intragroup variance among non-role models and the initial cultural distance of the model to the group's average trait value are sufficiently high, VAR_t^{WIG} decreases monotonically.

Finally, Proposition 3 shows that VAR_t^{WIG} stabilizes at a finite value:

Proposition 3 $$VAR_t^{WIG} = \lim_{t\to\infty} VAR_t^{WIG} = \sigma^2\left(1 + \frac{1}{N-1}\frac{\lambda_2^2}{1-\lambda_2^2} + \left(1 - \frac{1}{N-1}\right)\frac{\lambda_{N-2}^2}{1-\lambda_{N-2}^2}\right).$$

3.2. Divergence of cultural trait values between groups

Before turning to the further in-depth analysis of the determinants of VAR^{WIG} V, we scrutinize the development of the variance in trait values between separate groups. The model shows that each group of interacting and communicating agents will develop an idiosyncratic cultural endowment in the course of time. As a consequence, the variance in the difference of groups' mean values of cultural traits, VAR_t^{BTG}, increases as a linear function of time. Accordingly, CD between groups or organizational units necessarily grows proportionately to time if the groups' members do not (or rarely) interact with members of the other groups. We capture this argument formally in Proposition 4.

Proposition 4 VAR_t^{BTG} increases (asymptotically) as a linear function of time.

3.3. Roles models and cultural dimensions in group-bound socialization

Next, we deeper scrutinize the impact a role model has on the development of intragroup variance in cultural trait values, VAR^{WIG}. The model's (agent $i = 1$ in W) relative influence is measured by the parameter r. Proposition 5 describes the impact of the interplay of r and p on the limit of intragroup variance in trait values:

Proposition 5 VAR^{WIG} increases in r if and only if $p \geq p_{r,p}$, where $p_{r,p} = \frac{1}{N} - \frac{N-1}{(N-2)N}(r - \frac{N}{\propto})$.

From the finding formulated in Proposition 5 it follows that if $p < p_{r,p}$, intragroup variance in trait values is smaller the more influential a role model is in cultural transmission. Note, however, that if $p \geq \frac{1}{N}$, VAR^{WIG} necessarily increases in r. Finally, note that $p_{r,p}$ decreases in r.

Next, Proposition 6 captures the constraining influence of increasing group size N on the effect of r on VAR^{WIG}, i.e., on the effectiveness of role models in groupbound socialization. Let $P(N)$ denote the set of parameters (r, p) such that VAR^{WIG} decreases in r. Then, we can state the following result:

Proposition 6 The mass of $P(N)$ decreases in N for $N \geq 5$.

Moreover, since the development of intragroup variance in cultural traits is expected to vary with the sort and strength of cultural dimensions in W, such as, in our case, “individualism" and “collectivism", we analyze the effects of p on VAR^{WIG} by stating the following:

Proposition 7

1. In a cultural environment with $p \geq \frac{1}{N}$, VAR^{WIG} increases in p.

2. In a cultural environment with $p < \frac{1}{N}$, we differentiate two cases: (a) if $p < p_{r,p}$. VAR^{WIG} decreases in p. (b) If $p \geq p_{r,p}$, VAR^{WIG} decreases in p if and only if $\frac{\lambda_2}{(1-\lambda_2^2)^2} + (N-2)\frac{\lambda_{N-2}}{(1-\lambda_{N-2}^2)^2} < 0$.

The intuition is similar to the one underlying Proposition 5. Only if $p < \frac{1}{N}$, an increase of the weight each non-role model puts on her own trait decreases within-group variance. The differences in conditions arise from the fact that r only influences the off-diagonals of non-models, whereas p also changes the weight of an individual's own trait value.

Next, we analyze the impact of group size N on long-run within-group variance. The following Proposition 8 provides sufficient conditions for VAR^{WIG} to increase or decrease in N.

Proposition 8

1. In a cultural environment with $p_N > p \geq \frac{1}{N}$, VAR^{WIG} increases in N.

2. In a cultural environment with $p < \frac{1}{N}$, VAR^{WIG} decreases in N if $p < \min\{p_{r,p}, p_N\}$ or $\max\{p_{r,p}, p_N\} < p < p_{conv}$, where $p_N = 1 - \left(\frac{N-1}{N-2}\right)^2 \left(r - \frac{2}{\propto}\right)$ and $p_{conv} = \frac{1}{N} - \frac{N-1}{2(N-2)N}\left(r - \frac{N}{\propto}\right)$.

Thus, if p is sufficiently large, an increase in group size tends to raise the long-run within-group variance, whereas for sufficiently low values of p the reverse is true.

3.4. The pace of convergence of intragroup variance in cultural trait values

The convergence rate of the expected intragroup variance in cultural trait values is governed by group size, N, the role model's influence, r, and cultural dimensions such as the degree of “individualism" or “collectivism", measured by p. Consequently, the following Proposition relates the rate of convergence of VAR_t^{WIG} to the parameters r, p, and N:

Proposition 9

1. In a cultural environment with $p \geq \frac{T}{N}$, the rate of convergence decreases in p and r. The rate of convergence decreases in N if and only if $p < p_N$.

2. In a cultural environment with $p < \frac{1}{N}$, we consider two cases: (a) if $p < p_{conv}$, then the convergence rate increases in p and N. (b) If $p \geq p_{conv}$, then the rate of convergence decreases in p and r. The rate of convergence decreases in N if and only if $p < p_N$.

Thus, for intermediate ranges of p the rate of convergence decreases in N.

4. The governance of socialization in organizations and internal transaction costs

Our model of cultural evolution enables us to derive basal insights for organization theory concerning governance structures, socialization processes therein, and related transaction costs due to CD. We differentiate between alternative modes of organizational governance that differ in the kinds of socialization processes they enable. Hence, our contribution to the economics of governance (Williamson, 2005) concerns the implementation of organizational structures that economize on internal transaction costs by facilitating socialization processes that reduce CD between agents or groups. First, this section addresses the problem of CD as an additional attribute of transactions. Second, based on our formal analysis, it offers some principles of the governance of socialization that capture the problem of the development of intra- and intergroup CD. We show that concrete lessons for organization theory reside in our analysis above and that it is possible to derive refutable implications, inviting empirical testing.

4.1. CD as an attribute of transactions within organizations

Williamson (1979; 2002; 2005) names the transaction as the basic unit of analysis when it comes to characterize different governance structures that are meant to manage transactions. He defines several attributes of transactions - asset specificity, disturbances, frequency and adaptive needs - that are to be aligned with appropriate governance structures, which differ in their cost, in an economizing way. We argue that CD is another important attribute of transactions, especially in an intraorganizational context: transaction cost theorists associate higher CD with higher efforts of transaction due to communication and information costs or less efficient transfer of knowledge, competencies, and skills (e.g., Kogut & Zander, 1993; Nahapiet & Ghoshal, 1998; Buckley & Carter, 2004).[5] Disparate cultural endowments of agents, i.e., different languages, values, frames of reference, beliefs, norms, etc., underlie CD-induced internal transaction costs.

For example, employees responsible for encoding and decoding of knowledge in transactions not sharing implicit assumptions and interpretations cause additional costs in the intraorganizational transfer of knowledge. CD also explains general organizational performance, foreign investment, headquarter-subsidiaries relations, recruitment policies, and make-or-buy decisions (e.g., Shenkar, 2001). These impacts of CD on transaction costs in organizations are not covered by the established attributes of transactions: they are neither caused by uncertainty or disturbances due to incomplete contracts nor by asset-specificity of assets. Also a transaction's mere frequency of arms-

[5] CD between agents or populations also constitutes a barrier to economic development in general by causing higher costs of adoption and imitation of new technologies. For econometric evidence for this observation, see Spolaore and Wacziarg (2013).

length market interactions - without shared organizational socialization experiences of the parties involved - is not capable of dealing with CD among partners.

Consequently, the collaboration of employees who have different cultural backgrounds leads to higher intraorganizational transaction costs as compared to organizational units whose members conform to one culture. While disjoint skill sets of members of a multi-cultural group potentially yield diversity gains, communication and transfer problems due to CD entail higher costs of transacting (Lazear, 1999; van Knippenberg & Schippers, 2007). Lower CD in homogenous group cultures or between separate groups economizes on these costs and enables the putting together of disjoint skills and competencies more efficiently. A central lesson of our study of socialization dynamics in organizations is that they lead to different internal transaction costs for these are likely to vary with CD between agents or groups. Therefore, one strategy of firms to mitigate the problem of CD as an attribute of intraorganizational transactions is to devise governance structures supportive of socialization dynamics that close CD within and between groups or organizational units. Key features of socialization governance should vary along intraorganizational constellations of CD. Interpreting governance structures in this way infuses further operational content to this concept. Moreover, a comparative analysis of organizational structures in terms of their transaction costs due to CD becomes feasible as well as a corresponding predictive theory of economic organization.

4.2. Principles of socialization governance in organizations

Our model of cultural evolution demonstrates that alternative modes of socialization governance lead to convergence or divergence processes of intra- and intergroup CD. We suggest that the governance of socialization in organizations is complicated by the fact that employees have been presocialized in their prior social environments, for example, their national cultures (e.g., Ralston et al., 1997). People's behavior is strongly affected by their previous experiences in the family, school, and society as a whole. Hence, initial cultural trait values, the relative strength of learning biases, and cultural dimensions, such as “individualism" or “collectivism" (see Hofstede et al., 1990; Greif, 1994), are expected to vary among individuals due to prior socialization. These aspects of individuals' cultural backgrounds affect later intraorganizational socialization dynamics. Moreover, biases and cultural dimensions also differ across organizations endowed with different corporate cultures and may be subject to change as time elapses: while strong firm cultures emphasize collective goals, interaction, and identification, in other organizations agents may focus more on their personal, individual agendas. Therefore, when governing socialization processes in and between groups, organizations should take into account employees' prior socialization histories and a business unit's idiosyncratic culture for these take effect on agents' susceptibility to certain modes of socialization. In the following, we draw some concrete implications for organizational design from the theoretical insights of our formal analysis.

Based on a simplified cultural transmission table, W^S, which does not include an extraordinarily influential role model or business leader, Proposition 1 presents a general finding of socialization governance: group-bound joint socialization leads to a reduction of intragroup variance in cultural trait values, VAR_t^{WIG}, irrespective of individual learning processes. Communication and interaction among members decreases within-group CD. In fact, evidence from social psychology strongly supports the existence of such general convergence processes in groups as to the variance in behaviors, norms, attitudes, etc. (e.g., Festinger, 1950; Levine & Moreland, 1998). Hence, we claim that homogenization effects of shared socialization lower intraorganizational transaction costs via reducing intragroup CD. The first Principle of governance of socialization in organizations says:

Principle 1a Governance structures that allow shared socialization experiences among members of an organizational unit lower CD among individual employees and thus economize on internal transaction costs.

For example, according to Alba (1990), an “American culture" emerged from the convergence of dozens of “immigrant cultures" in the course of actively promoted “Americanization", a particular form of socialization. Mas & Moretti (2009) show that work ethos is a cultural trait whose variance and convergence among group members depend on the influence of employees' social environment within organizations and role models therein. Moreover, following Pettigrew & Tropp (2000), mixing between individuals with different cultural endowments and subsequent prolonged communication and interaction breaks down stereotypes and encourages deeper mutual understanding, a process expected to lower CD between agents. Hence, a distinctive advantage of the governance structure of the firm is that it provides a framework for group-bound socialization reducing CD among employees and thus internal transaction costs - a benefit not feasible via market contracting. This is another reason why firms exist as a form of economic organization (see Coase, 1937; Alchian & Demsetz, 1972; Hodgson, 2004; Cordes et al., 2011).

Business leaders play an outstanding role in socializing employees by providing influential models in cultural learning within groups (e.g., Schein, 1992). This implies that a model-based learning bias, measured by parameter r, takes effect in socialization, as described by our transmission matrix W. Proposition 2 delivers the condition for decreasing intragroup variance if we allow for a role model with constant r to take effect in socialization: since strong individual learning forces can offset the harmonizing effect of communication and interaction among employees in groups hosting a model, the variance in individual learning, σ^2, must not exceed a certain threshold. Otherwise, if individual learning introduces a too high amount of extra variation to trait values including those of the model, VAR_t^{WIG} and corresponding CD among group members increase. This leads to Principle 1b:

Principle 1b Group-bound socialization including a role model leads to a reduction of intragroup variance when individual learning forces are not too strong.

Consequently, as long as organizations avoid (weak) corporate cultures with high levels of individual learning, which indicate low group coherence and strong focus on personal (potentially opportunistic) agendas, within-group CD is expected to decrease due to shared socialization. This is consistent with empirical evidence from social psychology as to the harmonizing effects of group-bound communication including role models (e.g., Atkisson et al., 2012).[6]

The Corollary of Proposition 2 presents sufficient conditions for intragroup variance to monotonically decrease or increase. We find that in a culturally extremely homogeneous group - including the role model - with identical initial trait values, intragroup variance is expected to increase. VAR_t^{WIG} also raises in groups with sufficiently large values for p and a sufficiently small value for the model's weighted influence $\left(r - \frac{N}{\alpha}\right)$, indicating pronounced individualism and a low level of group interaction. However, if intragroup variance among peers and CD of the model to the group's average trait values are sufficiently high, then VAR_t^{WIG} decreases irrespective of the strength of individual learning forces. As initial within-group variance in traits reflects accumulated prior individual and cultural learning, it is likely to be high, also relative to learning biases. Hence, condition one in the Corollary on which Principle 1b is based is considered the default. Finally, Proposition 3 states that intragroup variance in cultural trait values stabilizes at a finite value in the course of group-bound socialization. Due to the homogenization effect of joint socialization in organizational units, variance in traits does not grow beyond a finite value irrespective of ongoing individual learning.

The consequence of idiosyncratic socialization processes in distinct (sub-) groups has been formulated by Proposition 4: the variance in the difference of the mean values of cultural traits between separated groups, denoted by VAR_t^{BTG}, increases (asymptotically) as a linear function of time. This has concrete implications for CD within organizations. Even if two groups consist of members that have all been socialized in the same culture and have acquired the same initial cultural endowment, subsequent within-group learning dynamics will, ceteris paribus, increase intergroup CD. This is due to two effects: (1) individual learning introduces variation to a group's cultural traits (as captured by the random component ϵ) and (2) the cultural transmission matrices capturing the respective groups' inner socialization dynamics will never be exactly identical. There will always be some variance in, for example, the influence of role models in socialization because of differences in personal characteristics, such as charismatic potential or prestige. In distinct groups, these changes in trait values are not "averaged

[6] Individual learning takes place at the cultural, not the skill level, where it may be beneficial (see Lazear, 1999).

out" but rather accumulated over time. From this follows a cultural divergence principle in socialization governance:

Principle 2 Idiosyncratic socialization processes within organizational units necessarily lead to an increase in intergroup CD and thus higher costs of transacting between them.

Organizational governance structures have to cope with this permanent challenge of rising intergroup CD. Given our first Principle of socialization governance, we expect shared socialization experiences to alleviate the problem of rising CD between organizational units. Hence, socialization governance structures that enable systematic exchange among groups and that establish ongoing intergroup communication lower intraorganizational transaction costs.

We also expect increasing intergroup CD in the case of a group partitioned into subgroups whose respective members confine themselves - at least to a great extent - to communicating with one another: variance in trait values within subgroups will then converge (Principle 1a), while CD between subgroups will grow (Principle 2).[7] If contributions of all subgroups are required for attaining unit goals, this process of divergence of CD between subgroups is likely to impair organizational performance via increased internal transaction costs. Business leaders may, therefore, deliberately devise socialization governance structures that avoid the emergence of isolated subgroups within business units. The development of distinct dialects for subgroups of a population provides an empirical example for increasing intergroup CD and concomitant convergence of CD within groups: Labov & Harris (1986) show that Black English of different metropolitan areas has converged, while it diverged at the same time from (White) Standard American English. The authors take this observation as an indicator of growing CD between these groups due to a low level of social interaction among them. The cultural divergence principle may also underlie appearing growth crises in organizations that have been split up in several non-communicating subgroups with increasing firm size.

In the following, we analyze further the within-group socialization processes affecting CD among employees. A role model's influence in group-bound socialization may be subject to change: a business leader may increase her weight, measured by r, in intragroup cultural transmission by augmenting the time spent for face-to-face communication and engagement in active leadership. r also increases when a new role model endowed with a higher charismatic potential or greater social skills is assigned to a group. Proposition 5 shows the concrete effects models' increasing influence has in socialization given a collectivistic (low p) or individualistic cultural environment (high p): as long as p is low $p < p_{r,p}$, a model's rising weight r in cultural transmission lowers

[7] The cultural transmission matrix allows for the existence of more or less isolated subgroups.

within-group variance in cultural traits and reduces intragroup CD.[8] We suggest three cases in which this condition is fulfilled: (1) a relatively low value of p may imply individuals presocialized in a collectivistic cultural environment rendering them more susceptible to group influence including the role model. (2) p is also low if a strong, participative, and cooperative corporate culture motivates employees - irrespective of their prior cultural backgrounds – to subordinate their personal agendas and subscribe to the group's and model's goals and values. (3) New recruits may rely on copying the cultural traits of peers as a frugal heuristic to identify locally adapted norms, values, attitudes, etc. in complex cultural environments. In all cases, employees would exhibit a high degree of coherence and identification with the organization (Akerlof & Kranton, 2005) reflected by the fact that they put a relatively low weight on own cultural traits and a relatively high one on those of peer employees and the model. These findings lead to a principle concerning the role of models in governing socialization:

Principle 3a Given collectivistic group cultures, governance structures relying on increasingly influential models in socialization lower intragroup CD and transaction costs.

If, on the other hand, p is high, i.e., $p \geq p_{r,p}$, then (1) a pronounced cultural dimension of “individualism" in prior socialization has led to agents less amenable to the influence of their social environment including a role model. (2) Agents' personal - potentially opportunistic - agendas are prioritized over the corporation's collective goals due to weak firm culture and a business leader's failure to keep up a collectivistic group culture with a sufficiently low p. In both cases, variance in trait values increases in r, i.e., assigning a more influential model or increasing an existing one's engagement in active leadership tightens the negative transactional effects of CD within a business unit.[9] Consequently, as to the assignment and weight of role models, the choice of modes of socialization governance depends on employees' cultural backgrounds and a firm's culture: models' final effect on intragroup variance in trait values is mediated by a group's culture.

Moreover, group size affects many aspects of group-bound socialization (e.g., Olson, 1994; Spoor & Kelly, 2004; Cordes et al., 2008). Proposition 6 formally shows an implication of growing group size for a role model's influence: it reduces her potential effectiveness in intragroup socialization by decreasing the set of parameters (p, r) such that intragroup variance in trait values decreases in r (for $N \geq 5$). Hence, the greater a unit's size, the more narrow is the range of group cultures and role model bias strengths within which a business leader can reduce CD among members. At the same time, the intensity of communication and the frequency of face-to-face contacts between a

[8] Formally, the additional weight of the model establishes a more balanced weighting of individuals' trait values.
[9] $p_{r,p}$ decreases in r, i.e., the higher a model's weight in socialization, the more narrow is the range of collectivist group cultures in which she can lower within-group CD.

business leader and a single group member necessarily dwindle with growing unit size (reflected by lower weights in W) reducing the model's capacity to influence group members and maintain a strong group culture. Consequently, a role model's influence in socialization is subject to constraints imposed by the size of organizational units. The implications of Proposition 6 lead to a “dilution principle" in socialization governance:

Principle 3b Increasing group size lowers a role model's effectiveness as a socialization governance response to reduce intragroup CD and corresponding transaction costs.

Due to the fact that the set of parameters (p, r) such that VAR^{WIG} falls in r decreases for $N \geq 5$, a role model's potential effect in socialization is maximized in a setting where few employees are paired with a business leader enabling intense social interaction. Such a strong mode of model-based socialization governance has been successfully employed by firms and is expected to reliably reduce intraorganizational CD.[10] Another interesting feature of this “dilution principle" of socialization governance concerns dynamic governance structure: the size-contingent constraints on the influence of business leaders in socialization constitute potential limits to firm growth or subunit size. These are, therefore, reasons for systematically appearing growth crises in organizational development (e.g., Greiner, 1998; Cordes et al., 2010) or poor performance of subunits (e.g., Wagner, 1995) due to increasing CD.

Above, Proposition 7 has shown how the development of intragroup CD and thus intraorganizational transaction costs is affected by the varying strength of cultural dimensions, in our case, those of ”individualism" and “collectivism". In an individualistic cultural environment indicated by relatively high values of $p\left(p > \frac{1}{N}\right)$, intragroup variance in cultural traits increases with a rising level of individualism, i.e., with growing p. Given a certain group size, this constellation is given in organizational units whose members already exhibit a relatively high level of “individualism" due to prior socialization or weak firm culture. A further increase in this dimension then turns agents even less susceptible to group-bound socialization. Members would focus more on their personal - potentially opportunistic - agendas, i.e., their own cultural traits, augmenting within-group CD. Furthermore, since the likelihood that $p \geq \frac{1}{N}$ holds increases, ceteris paribus, with growing group size, larger organizational units are prone to this problem of growing individualism. Given these insights, the next principle of socialization governance in organizations is this:

Principle 4a When individualism among employees increases, CD between agents and transaction costs are more likely to grow in larger groups or weak group cultures.

[10] See the case studies on the “Baxter Boys" (Higgins, 2005) or Southwest Airlines (Gittell, 2003).

This is in line with evidence from social psychology showing that members of larger or more anonymous groups tend to feel less attached to other members and participate less in collective activities (e.g., Kerr, 1989; Levine and Moreland, 1998; Forsyth, 2006) - potential manifestations of increased within-group CD. Moreover, resulting from Proposition 7 (1), organizational units composed of employees with a strong individualistic prior imprinting gain from more team-oriented cultures for a lower p decreases intragroup CD. These are reasons for organizations to keep unit sizes small and group cultures strong in transaction cost-minimizing socialization governance, especially when recruiting individualistically presocialized employees.[11]

In a collectivistic cultural environment characterized by low p values ($p < \frac{1}{N}$), we differentiate two cases: (1) as long as p does not exceed a certain threshold $\left(p < p_{r,p}\right)$, VAR^{WIG} decreases in p. In this case, a reduction of the influence of the group and more "self-reliant" agents would lower intragroup CD. (2) If the level of individualism exceeds this threshold, i.e., if $p \geq p_{r,p}$, then, for sufficiently small r, a further increase in individualism still reduces intragroup variance, otherwise VAR^{WIG} increases in p (see proof of Proposition 7). We state:

Principle 4b In pronounced collectivistic group cultures, a rising level of individualism reduces CD and intraorganizational transaction costs.

Principle 4b bears transaction cost-relevant implications for a firm's socialization governance: groups of agents who enjoyed presocialization in very collectivist environments profit - up to a limit - from a corporate culture emphasizing a higher degree of individual autonomy.

Proposition 8 (1) delivers additional insights on the impact of unit size N on intragroup variance in cultural traits: in groups characterized by an individualistic cultural environment ($p \geq \frac{1}{N}$), an increase in size entails higher final VAR^{WIG}.[12] From Proposition 8 (2) it follows that in a sufficiently collectivistic culture $\left(p < \min\{p_{r,p}, p_N\}\right)$, growing size of an organizational unit lowers long-run within-group variance in trait values. We propose this principle:

Principle 4c While in individualistic cultures rising unit size leads to higher final within-group CD and transaction costs, it can lower variance in trait values in collectivistic groups.

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[11] When asked in an interview how to maintain Google's corporate culture while the organization is growing, the firm's founders argued for the existence of a "natural size for human organizations" and that creating (sub-)groups of this size "...can retain a lot of that culture" (Lashinsky, 2008).

[12] For $p_N > p \geq \frac{1}{N}$. Since p_N takes on relatively large values, this condition is met in most individualistic cultures. See proof of Proposition 8 for details.

This finding qualifies the general social psychological evidence on the (negative) effects of increasing group size: the addition of new group members can, within the limits of a pronounced collectivistic cultural environment, also foster group coherence.[13]

Next, we look at the determinants of the pace of convergence of intragroup variance in cultural trait values in the course of socialization. A higher pace of convergence yields organizations transaction cost-related advantages: more rapid convergence is associated with lower final within-group CD and faster reaching of a transaction cost-minimizing level of CD. Following Proposition 9, the cultural dimensions of "individualism" and "collectivism" affect the pace of convergence: if $p \geq \frac{1}{N}$, i.e., if individualism among employees is relatively high, the rate of convergence of VAR^{WIG} decreases with an increasing level of individualism, as reflected by a growing p. This is associated with higher final within-group CD. The stronger agents rely on their own cultural trait values in socialization, i.e., the less susceptible to group influence they are, the slower is convergence. The same holds true for intermediate values of p in collectivistic cultures $\left(p < p_{conv} < \frac{1}{N}\right)$. This implies, on the other hand, that decreasing values of p cause a higher pace of convergence in these cultural settings. However, if $p < p_{conv} < \frac{1}{N}$, an increasing p raises the rate of convergence and lowers final CD in a group. In such a pronounced collectivistic culture with strong employee interaction and identification, agents taking more effect in their own socialization accelerate convergence. We state:

Principle 5a More collectivistic group cultures mostly accelerate socialization and lower final within-group CD. The opposite holds for increasing individualism.

Hence, firms can cope with intraorganizational CD and corresponding transaction costs by deliberately implementing more collectivistic, participative firm cultures or recruiting employees presocialized in collectivistic environments. In most organizational settings, these governance measures enable more rapid socialization and lower final CD. Google Inc., to give an example, implements a strong corporate culture with members highly motivated to contribute to the organization's collective goals (see Finkle, 2012). This is combined with at hierarchies and high levels of discretion that facilitate innovation by employees.

Furthermore, also following from Proposition 9, group size affects convergence: in individualistic group cultures with $p \geq \frac{1}{N}$, the pace of convergence of intragroup variance decreases and final within-group CD increases with growing group size.[14]

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[13] In this case, individual learning forces offset each other better when additional agents join the group.

[14] For $p < p_N$. Since p_N takes on rather high values, this condition is fulfilled for a broad range of individualistic group cultures (see proof for details).

As shown by Proposition 9 (2), also in collectivistic cultural environments with $p < \frac{1}{N}$, the rate of convergence of trait values decreases with growing N in the case of intermediate values for $p(p_{conv} \leq p < p_N)$. Only in strong collectivistic cultures with sufficiently low values of $p(p < p_{conv})$, the rate of convergence grows with increasing N. Hence, in most cultural settings, socialization in small groups facilitates a higher pace of convergence and lower final intragroup variance in trait values relative to larger groups. Face-to-face communication, cooperation, and identification are relatively more intensive in smaller groups and foster convergence (e.g., Levine and Moreland, 1998; Forsyth, 2006). This observation is captured by a “socialization in small groups principle":

Principle 5b Governance structures that rely on small group socialization allow for faster convergence of, and lower final variance in, cultural traits within an organizational unit.

Hence, a firm can rely on a mode of governance of socialization based on small organizational units to more rapidly and effectively cope with internal CD and corresponding transaction costs.

According to Proposition 9 and in line with earlier findings, in group cultures with a sufficiently high degree of individualism $(p \geq p_{conv})$, a role model's increasing influence, as measured by r, reduces the pace of convergence of VAR^{WIG} leading to higher final within-group CD. This finding is captured by our last principle of socialization governance:

Principle 5c In individualistic cultural environments, increasing a model's influence delays the convergence of trait values and raises CD and transaction costs among group members.

Consequently, the assignment of role models as a means of socialization governance can have adverse effects on intraorganizational transaction costs depending on group culture.

Given these principles, organizations can implement alternative modes of socialization governance to reduce internal transaction costs in businesses where CD is relevant: allowing group-bound socialization experiences among employees (Principles 1a and b), organizing intergroup exchange (Principle 2), increasing role models' influence in groups endowed with a certain culture and size (Principles 3a and b, 5c), creating group cultures that enable fast and effective variance-reducing socialization processes (Principles 4a-c, 5a), and adjusting group size to facilitate socialization in small units reducing CD among employees (Principle 5b).

5. Conclusion

In this paper, we have claimed that cultural distance (CD) is an important attribute of transactions. Adding to Williamson's problem of economic organization, we suggested that the governance of socialization processes has the potential to economize on intraorganizational transaction costs by lowering CD between employees or groups. We have been discussing socialization processes based on a model of cultural evolution that explains the development of CD within and between groups or organizational units. Specific socialization dynamics in these entities are, we have argued, a determinant of CD and related transaction costs in corporations. Some general principles of the governance of socialization in organizations have been suggested.

Socialization processes as modes of governance are a means to deal with CD among employees and is considered a key purpose of organizations. Characteristics that define an organization's socialization governance structure include shared or divided social experiences in (sub-)groups, the assignment and influence of role models, group sizes, the cultural background of employees, specific cultural dimensions taking effect in group-bound social interaction, and the implementation of certain cultures in business units. The alternative modes of governance resulting from these characteristics are defined by the particular socialization dynamics they facilitate. They yield differential capacities of organizations to adapt internal structures in a transaction cost-minimizing way.

It is the governance form of the firm that enables intraorganizational socialization processes that potentially lower intra- and intergroup CD and that are not feasible via market contracting. This provides another motive for choosing the organizational form of the firm. Organizations have the capacity to capture transactional benefits arising from the governance of socialization experiences, i.e., a further challenge for the modern corporation is to align governance structures with socialization dynamics.

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Appendix: Proofs

Proof of Proposition 1. Taking the limit w.r.t. p in equation (8) yields the claim. □

Proof of Lemma 1. Following Feldman and Cavalli-Sforza's (1975) analysis of the properties of within-group variance, we know that

$$V_{t+1} = \tilde{P}W^{t+1}V_0W'^{t+1}\tilde{P} + \sigma^2\tilde{P} + \sigma^2\tilde{P}\sum_{k=1}^{t} W^kW'^k\tilde{P}. \tag{.9}$$

where $\tilde{P} = 1 - P$, and P is a matrix whose rows all equal $(1/N, \dots 1/N)$.

$$\begin{aligned} VAR_t^{WIG} &= \frac{tr\left(\tilde{P}W^{t+1}V_0W'^{t+1}\tilde{P} + \sigma^2\tilde{P} + \sigma^2\tilde{P}\sum_{k=1}^{t} W^kW'^k\tilde{P}\right)}{N-1} \\ &= \sigma^2 + \frac{tr\left(\tilde{P}W^{t+1}V_0W'^{t+1}\tilde{P}\right)}{N-1} + \frac{tr\left(\sigma^2\tilde{P}\sum_{k=1}^{t} W^kW'^k\tilde{P}\right)}{N-1} \\ &= \sigma^2 + \frac{tr\left(\tilde{P}W^{t+1}V_0W'^{t+1}\tilde{P}\right)}{N-1} + \sum_{k=1}^{t}\frac{tr\left(\sigma^2\tilde{P}W^kW'^k\tilde{P}\right)}{N-1} \end{aligned} \tag{.10}$$

The last term can be simplified: with eigenvalues $\lambda_1 = 1$, $\lambda_2 = \frac{N_p - 1}{N-1}$ and $\lambda_3 = \cdots = \lambda_N = \frac{N_p - 1}{N-1} + \frac{r - N/}{N-2} \equiv \lambda_{N-2}$, it follows that

$$tr\left(\sigma^2\tilde{P}W^kW'^k\tilde{P}\right) = \sigma^2\left(\lambda_2^{2k} + (N-2)\lambda_{N-2}^{2k}\right). \tag{.11}$$

Equation (.11) derives from $W^k = (Q\Lambda Q^{-1})^k = Q\Lambda^k Q^{-1}$, and accordingly $W'^k = \left(Q\Lambda^k Q^{-1}\right)'$, where the columns of Q correspond to the set of eigenvectors of W. More precisely, let $Q = (v_1', v_2', \dots, v_N')$ with v_i being the eigenvector associated with λ_i. eigenvectors are given by $v_1 = (1, \dots, 1), v_2 = \left(r - \frac{N}{\alpha} - \frac{1-p}{r} + \frac{1-p}{N-1}, 1, \dots, 1\right), v_k = -e_2 + e_k, k = 3, \dots, N$.

Hence,

$$\begin{aligned} \sum_{k=1}^{t}\frac{tr\left(\sigma^2\tilde{P}W^kW'^k\tilde{P}\right)}{N-1} &= \frac{\sigma^2}{N-1}\sum_{k=1}^{t}\left(\lambda_2^{2k} + (N-2)\lambda_{N-2}^{2k}\right) \\ &= \frac{\sigma^2}{N-1}\left(\lambda_2^2\frac{1-\lambda_2^{2t}}{1-\lambda_2^2} + \lambda_{N-2}^2\frac{1-\lambda_{N-2}^{2t}}{1-\lambda_{N-2}^2}\right). \end{aligned} \tag{.12}$$

For the middle term, we have:

$$\frac{tr\left(\tilde{P}W^{t+1}V_0W'^{t+1}\tilde{P}\right)}{N-1} = \frac{1}{N}(x_1-\overline{x}_{-1})^2\lambda_2^{2i} + \frac{1}{N-1}\sum_{k>1}(x_k-\overline{x}_{-1})^2\lambda_{N-2}^{2i}. \quad (.13)$$

The first term in parenthesis on the right-hand side of equation (.13) is the initial variance between the role model's trait value and the average of all other employees. It is decreasing geometrically. The second term describes the initial variance among all ordinary employees excluding the role model. Combining (.12) and (.13) yields the claim. □

Proof of Proposition 2. Given the expression for VAR_t^{WIG} by Lemma 1 we have:

$$\begin{aligned} VAR_t^{WIG} - VAR_{t-1}^{WIG} < 0 \Leftrightarrow \\ \sigma_1^2\lambda_2^{2t}(\lambda_2^2-1) + \sigma_{-1}^2\lambda_{N-2}^{2t}(\lambda_{N-2}^2-1) + \frac{\sigma^2}{N-1}\left(\lambda_2^{2t} + (N-2)\lambda_{N-2}^{2t}\right) < 0 \Leftrightarrow \\ \lambda_2^{2t}\left(\frac{\sigma^2}{N-1} - \frac{\sigma_1^2}{N}(1-\lambda_2^2)\right) + \lambda_{N-2}^{2t}\left((N-2)\frac{\sigma}{N-1} - \sigma_{-1}^2(1-\lambda_{N-2}^2)\right) < 0. \end{aligned} \quad (.14)$$

□

Proof of Corollary 1.

1. For $\sigma \to 0$: $VAR_t^{WIG} - VAR_{t-1}^{WIG} < 0, \forall t$.
2. Note that $\frac{\sigma^2}{N-1} - \sigma_1^2(1-\lambda_2^2) < 0 \Leftrightarrow \frac{\sigma^2}{(N-1)(1-\lambda_2^2)} < \sigma_1^2$ and $(N-2)\frac{\sigma^2}{N-1} - \sigma_{-1}^2(1-\lambda_{N-2}^2) < 0 \Leftrightarrow \frac{(N-2)\sigma^2}{(N-1)(1-\lambda_{N-2}^2)} < \sigma_{-1}^2$.
3. $\sigma_1^2 = \sigma_{-1}^2 = 0 \Rightarrow \lambda_2^{2t}\frac{\sigma^2}{N-1} + \lambda_{N-2}^{2t}(N-2)\frac{\sigma^2}{N-1} > 0$.
4. Under these conditions, both eigenvalues are close to one. Note that $\lim_{\lambda_2,\lambda_{N-2}\to 1} VAR_t^{WIG} - VAR_{t-1}^{WIG} = \sigma^2 > 0$. □

Proof of Proposition 3. Taking the limit o VAR_t^{WIG}f w.r.t. time yields the claim. □

Proof of Proposition 4. Again, we consider a particular trait j. Let $y_{t+1} = W_y y_t + \epsilon_{y,t}$ and $z_{t+1} = W_z z_t + \epsilon_{z,t}$ denote the transition processes for this trait within the two groups, where ϵ_y and ϵ_z are independent. Thus, $VAR_t^{BTG} = E\left[\left(\overline{y}_t - \overline{z}_t\right)^2\right]$. Recall that $y_{t+1} = W_y^{t+1}y_0 + \sum_{k=0}^{t} W_y^k \epsilon_{y,t-k}$. Hence, $\overline{y}_{t+1} = \overline{W_y^{t+1}x_0} + \sum_{k=0}^{t}\overline{W_y^k\epsilon_{y,t-k}}$.

$$\overline{W_y^{t+1}x_0} = \overline{Q_y \Lambda_y^{t+1} Q_y x_0} = \sum_{i=1}^{N_y} \phi_{y,i}^{t+1} y_i, \tag{.15}$$

where

$$\begin{aligned}\phi_{y,1}^{t+1} &= -\frac{(N_y-1)(N_y-(N_y-1+b_y)\lambda_2^{t+1})}{N_y(N_y-1)(b_y-1)} \underset{t\to\infty}{\longrightarrow} \frac{1}{1-b_y}, \\ \phi_{y,i\geq 2}^{t+1} &= \frac{N_y b_y-(N_y-1+b_y)\lambda_2^{t+1}}{N_y(N_y-1)(b_y-1)} \underset{t\to\infty}{\longrightarrow} \frac{b_y}{(N_y-1)(b_y-1)}\end{aligned} \tag{.16}$$

Where $b_y = \frac{r_y - \frac{N_y}{\alpha_y-(1-p_y)}}{r_y - \frac{N_y}{\alpha_y} + \frac{1-p_y}{N_y-1}}$. Expressions for $\overline{W_y^k \epsilon_{y,t-k}}$, $\overline{W_y^{t+1} y_0}$, and $\overline{W_z^k \epsilon_{z,t-k}}$ can be derived analogously.

$$E\left[(\overline{y}_t-\overline{z}_t)^2\right] = E\left[\left(\overline{W_y^t x_0} + \sum_{k=0}^{t-1}\overline{W_y^k \epsilon_{y,t-k}} - \overline{W_z^t z_0} - \sum_{k=0}^{t-1}\overline{W_z^k \epsilon_{z,t-k}}\right)^2\right] \tag{.17}$$

$$\overset{E[\epsilon_{y,t-k}]=0}{\underset{E[\epsilon_{z,t-k}]=0}{=}} \left(\overline{W_y^t x_0} - \overline{W_z^t z_0}\right)^2 + E\left[\left(\sum_{k=0}^{t-1}\overline{W_y^k \epsilon_{y,t-k}} - \sum_{k=0}^{t-1}\overline{W_z^k \epsilon_{z,t-k}}\right)^2\right] \tag{.18}$$

$$\overset{\epsilon_y,\epsilon_z}{\underset{indep.}{=}} \left(\overline{W_y^t x_0} - \overline{W_z^t z_0}\right)^2 + E\left[\left(\sum_{k=0}^{t-1}\overline{W_y^k \epsilon_{y,t-k}}\right)^2\right] + E\left[\left(\sum_{k=0}^{t-1}\overline{W_z^k \epsilon_{z,t-k}}\right)^2\right] \tag{.19}$$

$$\overset{\epsilon_{y,t},\epsilon_{y,s},\epsilon_{z,t},}{\underset{\epsilon_{z,s}\ indep.}{=}} \left(\overline{W_y^t x_0} - \overline{W_z^t z_0}\right)^2 + \sum_{k=0}^{t-1} E\left[\left(\overline{W_y^k \epsilon_{y,t-k}}\right)^2\right] + \sum_{k=0}^{t-1} E\left[\left(\overline{W_z^k \epsilon_{z,t-k}}\right)^2\right] \tag{.20}$$

Plugging in equation (.16) and its analogs into (.20) gives us:

$$\left(\overline{W_y^t x_0} - \overline{W_z^t z_0}\right)^2 + \sum_{k=0}^{t-1} E\left[\left(\sum_{i=1}^{N_y}\phi_{y,i}^k \epsilon_{y,t-k}\right)^2\right] + \sum_{k=0}^{t-1} E\left[\left(\sum_{i=1}^{N_z}\phi_{z,i}^k \epsilon_{z,t-k}\right)^2\right] \tag{.21}$$

$$\overset{\epsilon_{y,t},\epsilon_{y,s},\epsilon_{z,t},\epsilon_{z,s}}{\underset{independent}{=}} \left(\overline{W_y^t x_0} - \overline{W_z^t z_0}\right)^2 + \sum_{k=0}^{t-1}\sigma_y^2 \sum_{i=1}^{N_y}(\phi_{y,i}^k)^2 + \sum_{k=0}^{t-1}\sigma_z^2 \sum_{i=1}^{N_y}(\phi_{z,i}^k)^2.$$

Note that $\sum_{i=1}^{N_y}(\phi_{y,i}^k)^2$ and $\sum_{i=1}^{N_y}(\phi_{z,i}^k)^2$ converge. Therefore, asymptotically, the variance in the difference of two different groups' mean values of a cultural trait increases linearly in time. □

Proof of Proposition 5. According to Proposition 3, VAR_t^{WIG} converges and stabilizes at a finite value. We now study the impact of r and p on this limit: Recall, $VAR^{WIG} = \sigma^2(1 + \frac{1}{N-1}\frac{\lambda_2^2}{1-\lambda_2^2} + \left(1-\frac{1}{N-1}\right)\frac{\lambda_{N-2}^2}{1-\lambda_{N-2}^2}$ Thus, the effects of the parameters r and p on VAR^{WIG} are determined by their influences on the eigenvalues. First, note that λ_2

is independent of r. Note further that λ_{N-2} increases in r. However, its impact depends on the sign of λ_{N-2}. We distinguish three cases:

1. If $p \geq \frac{1}{N}$, then $0 \leq \lambda_2 < \lambda_{N-2}$. In this case, λ_{N-2} increases in r and thereby also $\frac{\lambda_{N-2}^2}{1-\lambda_{N-2}^2}$ increases. Hence, VAR^{WIG} decreases.
2. If, on the other hand, $p < \frac{1}{N}$ and $\lambda_2 < \lambda_{N-2} < 0$, then λ_{N-2} increases in r while $\frac{\lambda_{N-2}^2}{1-\lambda_{N-2}^2}$ decreases. Hence, VAR^{WIG} decreases.
3. If $p < \frac{1}{N}$ and $\lambda_2 < 0 \leq \lambda_{N-2}$, then λ_{N-2} increases in r and thereby $\frac{\lambda_{N-2}^2}{1-\lambda_{N-2}^2}$ increases. Hence, VAR^{WIG} increases.

Thus, VAR^{WIG} increases if and only if $0 \leq \lambda_{N-2}$, i.e. $\frac{N_p - 1}{N-1} + \frac{r - \frac{N}{\alpha}}{N-2} \geq 0 \Leftrightarrow p \geq \frac{1}{N} - \frac{N-1}{(N-2)N}\left(r - \frac{N}{\alpha}\right)$, which defines the critical value $p_{r,p}$.

Proof of Proposition 6. There are three restrictions that must hold:

1. the weight of the role model is smaller than 1: $p + r - \frac{N}{\alpha} < 1 \Leftrightarrow p < 1\frac{N}{\alpha} - r$,
2. the model's weighted inuence is positive: $r - \frac{N}{\alpha} > 0 \Leftrightarrow r > \frac{N}{\alpha}$,
3. VAR^{WIG} decreases in r: $p < p_{r,p} = \frac{1}{N} - \frac{N-1}{(N-2)N}\left(r - \frac{N}{\propto}\right)$.

The last condition can be expressed by: $p < p_{r,p} = \frac{1}{N} - \frac{N-1}{(N-2)N}\left(r - \frac{N}{\propto}\right) = \frac{1}{N} + \frac{N-1}{(N-2)\propto} - \frac{N-1}{(N-2)N} r$. In the following, we show that the third restriction is the binding condition. We see that $\frac{1}{N} + \frac{N-1}{(N-2)\propto} < 1 < 1 + \frac{N}{\propto}$, i.e., the axis intercept of 1. lies above the one of 3. Set $k \equiv r - \frac{N}{\alpha}$. Then, inequality 1. transforms into: $p = 1 - k$. Moreover, inequality 3. Can be expressed as: $p = \frac{1}{N} - \frac{N-1}{(N-2)N} k$. We find that these two lines have an interception with $k > 1$ implying that $r > 1$ must hold. Therefore, the limiting line of 3. (for $0 < r < 1$) lies below the limiting line of 1. Finally, we evaluate the limiting line of 3. at $r = 1$ and find that: $\frac{1}{N} + \frac{N-1}{(N-2)\propto} - \frac{N-1}{(N-2)N} 1 > 0$.

From this it follows that the set of parameters (p, r) for which VAR^{WIG} decreases in r is given by

$$P(N) = \int_{\frac{N}{\alpha}}^{1} \left(\frac{1}{N} + \frac{N-1}{(N-2)\alpha} - \frac{N-1}{(N-2)N} r \right) dr \\ = \left(\frac{1}{N} + \frac{N-1}{(N-2)\alpha} \right) \left(1 - \frac{N}{\alpha} \right) - \frac{N-1}{2(N-2)N} \left(1 - \left(\frac{N}{\alpha} \right)^2 \right). \tag{.22}$$

The derivative of this expression w.r.t. N yields: $\frac{1}{4}\left(-\frac{2}{\propto^2}+\frac{(a-2)^2}{\propto^2(N-2)^2}-\frac{3}{N^2}\right)$. For large N, this term is negative because the middle term becomes very small. More precisely: $-\frac{2}{\propto^2}+\frac{(\propto-2)^2}{\propto^2(N-2)^2}-\frac{3}{N^2}<\frac{1}{(N-2)^2}-\frac{3}{N^2}<0$ for $N\geq 5$. This implies that for $N\geq 5$ the parameter region $P(N)$ decreases with an increasing N. □

Proof of Proposition 7. According to Proposition 3, VAR_t^{WIG} converges and stabilizes at a finite value. We now study the impact of p on this limit: Recall, $VAR^{WIG}=\sigma^2\left(1+\frac{1}{N-1}\frac{\lambda_2^2}{1-\lambda_2^2}+\left(1-\frac{1}{N-1}\right)\frac{\lambda_{N-2}^2}{1-\lambda_{N-2}^2}\right)$. Thus, the effect of the parameter p on VAR^{WIG} is determined by its influence on the eigenvalues. Note that both eigenvalues increase in p. However, the impact depends on the signs of λ_2 and λ_{N-2}. We distinguish three cases:

1. If $p\geq\frac{1}{N}$, then $0\leq\lambda_2<\lambda_{N-2}$. In this case, both eigenvalues increases in p and thereby $\frac{\lambda_2^2}{1-\lambda_2^2}$ and $\frac{\lambda_{N-2}^2}{1-\lambda_{N-2}^2}$ also increase. Hence, VAR^{WIG} increases.
2. If, on the other hand, $p<\frac{1}{N}$ and $\lambda_2<\lambda_{N-2}<0$, then both eigenvalues increase in p while $\frac{\lambda_2^2}{1-\lambda_2^2}$ and $\frac{\lambda_{N-2}^2}{1-\lambda_{N-2}^2}$ decrease. Hence, VAR^{WIG} decreases.
3. Finally, if $p<\frac{1}{N}$ and $\lambda_2<0\leq\lambda_{N-2}$then both eigenvalues increase in p while $\frac{\lambda_2^2}{1-\lambda_2^2}$ decreases and $\frac{\lambda_{N-2}^2}{1-\lambda_{N-2}^2}$ increases. Thus, the effect on VAR^{WIG} depends on the strengths of the two opposing effects. Note that $\lambda_{N-2}=0\Leftrightarrow p=p_{r,p}$ (see Proposition 5), which defines the critical value for p. Taking the derivative of VAR^{WIG} w.r.t. p yields the last claim. □

Proof of Proposition 8. Recall $VAR^{WIG}=\sigma^2\left(1+\frac{1}{N-1}\frac{\lambda_2^2}{1-\lambda_2^2}+\left(1-\frac{1}{N-1}\right)\frac{\lambda_{N-2}^2}{1-\lambda_{N-2}^2}\right)$. Thus,

$$\frac{\partial VAR^{WIG}}{\partial N}=\frac{\partial\alpha}{\partial N}x+\alpha\frac{\partial x}{\partial\lambda_2}\frac{\partial\lambda_2}{\partial N}+\frac{\partial\beta}{\partial N}y+\beta\frac{\partial y}{\partial\lambda_{N-2}}\frac{\partial\lambda_{N-2}}{\partial N}, \tag{.23}$$

Where $x=\frac{\lambda_2^2}{1-\lambda_2^2}$, $y=\frac{\lambda_{N-2}^2}{1-\lambda_{N-2}^2}$, $\alpha=\frac{1}{N-1}$, and $\beta=1-\frac{1}{N-1}$. Note that $\frac{\partial\beta}{\partial N}=-\frac{\partial\alpha}{\partial N}>0$. Because of $N>3$ we have $\beta>\alpha>0$. Furthermore, $\frac{\partial\lambda_2}{\partial N}>0$. Taken together, we obtain:

$$\frac{\partial VAR^{WIG}}{\partial N}=\underbrace{\frac{\partial\alpha}{\partial N}}_{<0}(x-y)+\underbrace{\alpha}_{>0}\frac{\partial x}{\partial\lambda_2}\underbrace{\frac{\partial\lambda_2}{\partial N}}_{>0}+\underbrace{\beta}_{>0}\frac{\partial y}{\partial\lambda_{N-2}}\frac{\partial\lambda_{N-2}}{\partial N}. \tag{.24}$$

1. According to equation (.24), $x < y$, $\frac{\partial x}{\partial \lambda_2} > 0$, and $\frac{\partial y}{\partial \lambda_{N-2}} \frac{\partial \lambda_{N-2}}{\partial N} > 0$ is sufficient for $\frac{\partial VAR^{WIG}}{\partial N} > 0$. Note that $\frac{\partial x}{\partial \lambda_2} > 0$ implies $\frac{\partial y}{\partial \lambda_{N-2}} > 0$, because $\lambda_{N-2} > \lambda_2$. Hence, the three conditions are equivalent to $x < y$, $\frac{\partial x}{\partial \lambda_{N-2}} > 0$, and $\frac{\partial \lambda_{N-2}}{\partial N} > 0$, $x < y$ is equivalent to $\lambda_2 > 0$ or $\lambda_2 < 0 \wedge \lambda_{N-2} > -\lambda_2$, a positive partial derivative of x is equivalent to $\lambda_2 > 0$, and the positive derivative of λ_{N-2} is equivalent to $p < p_N$. Taken together, the three conditions are equivalent to $\lambda_2 > 0 \wedge p > p_N$. Noticing that $\lambda_2 > 0 \Leftrightarrow p < \frac{1}{N}$ completes the proof of the first claim.
2. According to equation (.24), $x > y$, $\frac{\partial x}{\partial \lambda_2} < 0$, and $\frac{\partial y}{\partial \lambda_{N-2}} \frac{\partial \lambda_{N-2}}{\partial N} < 0$ is sufficient for $\frac{\partial VAR^{WIG}}{\partial N} < 0$, $x > y$ is equivalent to $\lambda_2 < 0 \wedge \lambda_{N-2} < -\lambda_2$, a negative partial derivate of x is equivalent to $\lambda_2 < 0$. Regarding $\frac{\partial y}{\partial \lambda_{N-2}} \frac{\partial \lambda_{N-2}}{\partial N} < 0$, two cases can be distinguished: (1) $\frac{\partial y}{\partial \lambda_{N-2}} < 0 \wedge \frac{\partial \lambda_{N-2}}{\partial N} > 0$, which is equivalent to $\lambda_{N-2} < 0$ and $p < p_N$. (2) $\frac{\partial y}{\partial \lambda_{N-2}} > 0 \wedge \frac{\partial \lambda_{N-2}}{\partial N} < 0$, which is equivalent to $\lambda_{N-2} > 0$ and $p > p_N$. In case (1), the three conditions are equivalent to λ_2, $\lambda_{N-2} < 0$ and $p < p_N$, which translate to $p < \frac{1}{N} \wedge p < p_{r,p} \wedge p < p_N$. This is the first condition in the second claim. In case (2), the three conditions are equivalent to $\lambda_2 < 0 \wedge 0 < \lambda_{N-2} < -\lambda_2$ and $p > p_N$, which translate to $p < \frac{1}{N} \wedge p > p_{r,p} \wedge p < p_{conv} \wedge p > p_N$. This is the second condition in the second claim. □

Proof of Proposition 9. Note that the rate of convergence is governed by the largest nonunit eigenvalue of W (see Karlin and Taylor, 1975). In the following, we therefore analyze the impact of r and p on $\max\{|\lambda_2|, |\lambda_{N-2}|\}$. We distinguish three cases:

1. If $p \geq \frac{1}{N}$, then $0 \leq \lambda_2 < \lambda_{N-2}$. In this case, the partial derivatives of λ_{N-2} determine the impact of p and r on the rate of convergence. Sindce λ_{N-2} increases in p and r, the rate of convergence decreases in p and r. Further, note that $\frac{\partial \lambda_{N-2}}{\partial N} > 0$ if and only if $p < p_N = 1 - \left(\frac{N-1}{N-2}\right)^2 \left(r - \frac{2}{\alpha}\right)$. Thus, the rate of convergence decreases if and only if $p < p_N$.
2. If, on the other hand, $p < \frac{1}{N} (\Rightarrow \lambda_2 < 0)$ and $\lambda_{N-2} < |\lambda_2|$, the partial derivatives of λ_2 determine the impact of the respective parameter on the rate of convergence. Since λ_2 increases in p and N and does not depend on r, the rate of convergence increases in p and N.
3. Finally, if $p < \frac{1}{N} (\Rightarrow \lambda_2 < 0)$ and $\lambda_{N-2} \geq |\lambda_2|$, the partial derivatives of λ_{N-2} determine the impact of the respective parameter on the rate of convergence. Since λ_{N-2} increases in p and r, the rate of convergence decreases in p and r. Again, $\frac{\partial \lambda_{N-2}}{\partial N} > 0$ if and only if $p < p_N$.

Note that the for $p < \frac{1}{N}$, the condition $\lambda_{N-2} \geq |\lambda_2|$ is equivalent to $\frac{N_p - 1}{N-1} + \frac{r - \frac{N}{\propto}}{N-2} \geq \frac{1 - N_p}{N-1} \Leftrightarrow p \geq \frac{1}{N} - \frac{N-1}{2(N-2)N}\left(r - \frac{N}{\propto}\right)$, which yields the critical value p_{conv} .□

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