

# Endogenous Identity in a Social Network

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## Abstract

Interaction with individuals from other socioeconomic classes has been shown to be a main driver for social mobility. We employ tools of social identity theory and network analysis to show how exposure to individuals of different social identities can lead to interactions with them, and an adoption of their identity, creating social mobility. We find that even if all individuals have the same ability, they may endogenously choose different identities, leading to different classes and actions. In particular, we derive a sufficient condition for such an equilibrium to exist, which equates to a novel measure of *cohesion*. Furthermore, we show that the most socially mobile individuals (changing their identity) are those who either have few connections or a more heterogeneous mix of identities in their connections. Finally, we show that upward social mobility increases action levels in society, but not necessarily welfare.

Keywords: Social Identity, Socio-Economic Mobility, Diffusion, Cohesion, Social Networks.

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# 1 Introduction

The lack of socioeconomic mobility is a long-standing worry for policymakers. A recent study by Chetty et al. (2022a) has shown that a leading factor detrimental to economic mobility is a lack of mixing among individuals of different socioeconomic classes. However, reducing such a homophily in interactions is difficult. In Chetty et al. (2022b), it is estimated that only about half of the degree of homophily is due to opportunities to meet others of different socioeconomic classes and the other half to what the authors call a *friending bias*. Clearly, policies that favor mixing among different classes need to incorporate the willingness by the individuals to sincerely interact with others of different classes. Simply mixing social classes is not in itself sufficient. The problem of reducing individuals' friending bias is complicated further by our lack of understanding of what is driving it.

We argue that an important aspect underlying both friending bias and in general the effectiveness of social mixing is the role played by social identities. Literature on identity (see, e.g., Akerlof and Kranton, 2000; Shayo, 2009, 2020) has highlighted the importance of a feeling of “belonging” to a specific group for behavior. Individuals aim to conform to a standard specific to their identity, and care about the identity they belong to. Consequently, we stipulate that disadvantaged individuals will benefit from mixing with others of higher socioeconomic status if they have a feeling of belonging to the same group, while they will disregard each other otherwise. The question for policy makers then becomes, how to enable such a feeling of belonging, if that is possible at all.

We know from previous work (see, e.g., Atkin, Colson-Sihra and Shayo, 2021; Stets et al., 2021) that identities are indeed fungible. The main question we aim to address in the present paper is which factors impact individuals' choice of identities? To do so, we build a novel model of identity and action choice in which individuals are embedded in a given social network and

their identities affect their utility directly in three ways: (i) individuals care directly about the number of their connections who are of the same identity as themselves, (ii) individuals care about conforming both to a *prescribed* action of their identity as well as the average action of their neighbors *of the same identity*, and (iii) individuals care about belonging to an identity that has a high social status.

Within this framework, individuals choose both which action level to take, and their identity, thus they are able to partially choose the network to which they belong.

We initially employ a model in which the underlying network is fixed, and all individuals are characterised by the same ability. Our first result shows that under identical abilities, differences in equilibrium actions are due entirely to differences in the identity chosen by the individuals. This result both links our work to Genicot and Ray (2017) and the importance of aspirations for outcomes, but it also captures the basic conundrum of the lack of social mobility: Assume identity is captured by economic class. If there exist both a “high” and a “low” class, with the high class prescribing higher actions than the low one, *ex ante* completely identical individuals may still end up choosing different action levels, solely due to their respective identities, and not because of intrinsic differences in their abilities.

In fact, with homogeneous abilities, the efficient outcome would be one where all individuals coordinate on choosing the intrinsically most attractive identity. While this is always an equilibrium, we derive conditions under which additionally either a less attractive identity is chosen by all, or indeed multiple identities coexist in a Nash equilibrium. This latter condition is related to, though distinct from, measures of *cohesion* previously suggested in the literature on diffusion of actions in a network. It requires that there exists at least one group in the network who have a large enough *difference* between the number of connections they have to others within their group and those outside it.

This condition, unsurprisingly, is also related to an individual’s decision to change their identity. In practical terms it implies that, *ceteris paribus*, individuals with (i) fewer direct neighbors, and (ii) a more balanced distribution of identities in their neighborhood, will be more reactive to changes in the relative attractiveness of identities and thus more socially mobile.

In our model, homophily in identities breeds homophily in actions: The more homophilous the identity network, the more individuals are locked into the identity of their neighbors, and as these share the same prescribed action, we will observe homophily in actions as a consequence. The role of number of neighbors of a given identity chimes well with arguments put forward in Stets et al. (2021), who argue that the salience of an identity is increasing in the frequency with which an individual meets others of that identity.

In all, our three-factor model of identity, despite being highly stylized for tractability, replicates a large number of empirical regularities surrounding the role of social connections in individual behavior: Regarding identities themselves, our model predicts that even individuals identical in their abilities can, in equilibrium, exhibit different identities and actions. It introduces in an intuitive and tractable manner a cost to changing identity, through the loss of connections, which predicts a “stickiness” of identities. Among the factors affecting which identity becomes salient, recent research has focused on the cognitive cost of switching identities (Zinn et al., 2022). Finally, the benefits of being connected to others of the same identity breed homophily in identities, which causes homophily in observed actions and a lack of social mobility.

Our model is related to several literatures.

As a model of identity theory, our novelty arises from the direct benefits that connections of the same identity provide, and the inclusion of a “keeping up with the Joneses” peer effect: In contrast to the seminal works in identity theory, we assume that individuals care not only about reaching a(n) (abstract) prescription of their identity, but also about what others around

them do.

Our model builds on existing models of social identity theory in economics. Akerlof and Kranton (2000) and Shayo (2009) make seminal contributions, formalising social identity in economics and introducing the notion of status dissonance costs which are core parts of the modelling framework (see Costa-Font and Cowell (2015) for a survey). A number of recent papers extend or apply Shayo’s approach (see for example, Klor and Shayo (2010); Gennaioli and Tabellini (2019); Grossman and Helpman (2021); Lindqvist and Östling (2013), and Shayo (2020)). As here, these papers allow individuals to choose their identity, and exogenously fix the identity’s prescribed action. Importantly, they ignore the role of the number of direct neighbors an individual has of the same identity, although being a crucial factor in social identity theory (see Cameron, 2004).

Our assumption that individuals care about choosing an action similar to the average of their neighbors (of the same identity) links us to the literature on peer effects (see, e.g., Bramoullé, Djebbari and Fortin, 2020*a* for an excellent overview of the literature). Technically, within this literature we are most closely related to Ushchev and Zenou (2020), in that individuals care about the *average* action taken by their neighbors, not the sum. The two assumptions imply vastly different roles for network positions in equilibrium actions.<sup>1</sup> More precisely, as already stated, the peer effects in our model are a “Keeping up with the Joneses” effect (see below). In contrast to this literature, however, in our model individuals have some influence on their neighborhood, through their choice of identity.

Our paper is most closely connected to a relatively recent strand of the “Keeping up with the Joneses” literature that uses an explicit network to allow

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<sup>1</sup>The seminal paper on peer effects when the sum of neighbors’ actions matters is Ballester, Calvó-Armengol and Zenou (2006), which introduces a measure of network centrality – called Bonacich centrality (first defined by Katz (1953) and Bonacich (1987)) – as the Nash equilibrium of a game of social interactions. Under our assumptions, this does not hold.

for very rich patterns of social comparisons. The broader literature on social comparisons in consumption is very old – dating at least to Veblen (1899) and Duesenberry (1949) in economics<sup>2</sup>. An explicit network was first introduced into social comparison models by Ghiglino and Goyal (2010).

Other recent contributions include Immorlica et al. (2017) and Bramoullé and Ghiglino (2022).<sup>3</sup>

The paper is also related to the literature on diffusion of behavior and coordination games on networks. The role of the identity of neighbors in an individual’s own choice of identity (and the conditions on coexistence of multiple identities) follows thresholds models such as the seminar works of Morris (2000) and Granovetter (1978), as well as Chwe (2000), Gagnon and Goyal (2017) and related literature (see, e.g., the overview in Jackson and Zenou, 2015). Indeed, we show that under the assumption of a unique ability level, our model can be cast as a threshold model in which each individual’s thresholds (both if measured as absolute or percentage of neighbors choosing an identity) are increasing in their degree. This implies, among other things, that, *ceteris paribus*, individuals with fewer neighbors are more likely to change their identity than those with more neighbors.<sup>4</sup>

Zenou and co-authors study the dynamics of integration of minorities<sup>5</sup>.

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<sup>2</sup>Before explicit networks were introduced, most authors either assumed that people care about their consumption relative to the population average (Abel, 1990; Clark and Oswald, 1996; Ljungqvist and Uhlig, 2000; Luttmer, 2005) or about their rank within the population (Frank, 1985*a,b*, 2001; Hopkins and Kornienko, 2004). More recent contributions include Heffetz (2011); Frank, Levine and Dijk (2014); Drechsel-Grau and Schmid (2014); Alvarez-Cuadrado, Casado and Labeaga (2016); Jinkins (2016); Bertrand and Morse (2016) and De Giorgi, Frederiksen and Pistaferri (2020).

<sup>3</sup>By also using an explicit network, our paper relates to the literature of network games – Jackson and Zenou (2015) and Bramoullé, Galeotti and Rogers (2016) provide detailed surveys. Our contribution to this literature is to show how network games of this kind can be added to models from social identity theory.

<sup>4</sup>Concurrently to the present paper, Langtry, Taylor and Zhang (2024) introduce a threshold model with heterogeneous thresholds, which are however unrelated to the degree of individuals.

<sup>5</sup>Verdier and Zenou (2017), Sato and Zenou (2020), Olcina, Panebianco and Zenou (2024) and Itoh, Sato and Zenou (2024)

The modelling choices are very different from ours. In particular, Olcina, Panebianco and Zenou (2024) study the dynamics of integration of a minority in a social network where integration raises productivity while deviations from the preferred level of integration have a cost. The dynamics is determined by the myopic update of the preferred integration level. They show that the steady state depends on the position of the individual in the network and on the initial preferred level of integration.

Finally, the paper is related to the peer effect literature (see Bramoullé, Djebbari and Fortin (2020*b*) for a survey). In particular, there is evidence that labour choices are affected by peer effects and social comparisons (Collewet, de Grip and de Koning, 2017; Cornelissen, Dustmann and Schönberg, 2017). By interpreting the actions as labour choices, we show that in some topology agents remain in identities that induce lower effort and therefore lower output. The progression from low to high effort can be assimilated to socio-economic mobility.

The rest of the paper proceeds as follows. Section 2 introduces the model and derives the equilibrium. Section 3 focuses on the determinants of (a lack of) social cohesion and mobility in identities, while Section 4 discusses welfare implications and outlines the next steps in the development of the paper. Section 5 concludes.

## **2 The Model**

### **2.1 Social Identity Theory**

Our model is based on social identity theory. Originally, the social psychology literature has adopted a three-factor model (see Cameron, 2004). Belonging to a certain identity provides utility to individuals through three channels: A cognitive factor (how often one thinks about being of a certain identity), an emotional factor (receiving positive utility from identifying with a certain

identity), and through how many ties one has with others of a given identity. However, following Shayo (2009) the economic literature has adopted a dual formulation. In it, associating with a particular identity confers both a certain status to the individual and prescribes a specific action level. Individuals prefer identities with a higher status, but incur a cost whenever their actual action differs from the prescribed action of the identity. We incorporate these two factors in our model, but add the in-group ties dimension from social identity theory: Individuals' utility is increasing in the number of connections they have to others of the same identity. At the same time, they wish to conform to the average action of these connections. The following section sets up the model formally.

## 2.2 Preliminaries

We consider a society comprised of  $n \geq 2$  individuals, each of which can be of either one out of (finitely many)  $m \geq 2$  identities  $I$ . The total number of individuals that choose to be of identity  $I$  is  $n_I$ . Individuals are embedded in a network  $\mathbf{g}$ , which is connected. The network's adjacency matrix  $\mathbf{G} = [g_{ij}]$  is an  $(n \times n)$ -matrix with  $\{0, 1\}$  entries and two individuals  $i$  and  $j$  are connected if and only if  $g_{ij} = 1$ . Links are undirected, such that  $g_{ij} = g_{ji}$  and we assume that there are no self-loops, i.e.,  $g_{ii} = 0$ . Similarly, for each identity  $I$ , we can construct the adjacency matrix  $\mathbf{G}_I = [g_{ij,I}]$ , which is an  $(n_I \times n_I)$ -matrix that keeps track of the connections between individuals of the same type, i.e.,  $g_{ij,I} = 1$  if and only if  $g_{ij} = 1$  and  $i$  and  $j$  share the same identity  $I$ .

Each individual  $i = 1, 2, \dots, n$  is described by their *social identity*  $I$ , their *ability*  $w_i \in \mathbb{R}_+$ , their position in the network  $\mathbf{g}$ , and their action level  $x_{i,I} \in \mathbb{R}_+$ . Out of these variables, their position in the network  $\mathbf{g}$  and their ability are exogenously given, while they can choose their identity and their action levels. We add a subscript  $I$  to individual  $i$ 's action level, as the same individual may choose different action levels, depending on their choice of



identity. The position in the network determines the number of neighbours  $d_i$  that individual  $i$  has. Given the number of neighbours  $d_i$ , we denote by  $d_{i,I}$  the number of  $i$ 's neighbours that are of identity  $I$ . Finally, we denote by  $\hat{\mathbf{G}}_{\mathbf{I}} = [\hat{g}_{ij,I}]$  the row-normalised  $(n_I \times n_I)$ -matrix with entries  $\hat{g}_{ij,I} = g_{ij,I}/d_{i,I}$ .

Each identity  $I$  confers upon its members a status  $\mu_I$  and prescribes them to take a certain action  $v_I$ .

### 2.3 Preferences

Following Shayo (2009), we assume that belonging to an identity  $I$  confers a certain status,  $\mu_I$ , to its members, but that the identity also prescribes a certain action level,  $v_I$ . We assume that prescribed actions and status level are positively related, i.e., for any two identities  $I$  and  $J$ , whenever  $v_I \geq v_J$  then also  $\mu_I \geq \mu_J$ , with equality if and only if both identities  $I$  and  $J$  coincide. This assumption is not necessary to derive our results, but it captures the intuitive idea that in most scenarios we might well expect such a positive correlation, and it eases the exposition. Individuals value having an identity with a high status, but they dislike taking an action far away from its prescribed action.

In addition, we assume that individuals compare their own action level  $x_{i,I}$  to the average action level taken by their neighbours *of the same identity*,  $\bar{x}_{i,I}$ . Intuitively speaking, we consider that individuals not only measure their own action against that generally prescribed by their identity group (such as, e.g., identity “wealthy” prescribing a certain - high - consumption level). They also compare their action to what their friends of the same type do, e.g., when identifying as “wealthy”, they compare their own consumption to that of their neighbours who are also “wealthy”.<sup>6</sup> We furthermore assume that individuals obtain utility from having neighbors of the same type as themselves. That is,

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<sup>6</sup>The idea that individuals might separately care about conforming to both an identity’s prescribed action and the average action in their neighborhood has been introduced in sociology by Cialdini, Kallgren and Reno (1991), who call the first “descriptive” and the second “injunctive” norms.

we reintroduce in our model the third factor originally stipulated by social choice theory. Formally, the utility of individual  $i$ , choosing action  $x_{i,I}$  and identity  $I$ , when faced with network  $\mathbf{g}_I$  and the vector of actions  $\mathbf{x}_{-i,I}$  of all other individuals of type  $I$  is given by

$$U(I, x_{i,I}, \mathbf{x}_{-i,I}, \mathbf{g}_I) = \mu_I + \beta d_{i,I} + x_{i,I} - \frac{1}{2w_i} x_{i,I}^2 - \frac{\alpha}{2} (x_{i,I} - \bar{x}_{i,I})^2 - \frac{\gamma}{2} (x_{i,I} - v_I)^2, \quad (1)$$

where  $\beta, \alpha, \gamma \geq 0$  are parameters. They measure the importance that individuals put on having neighbors of the same identity ( $\beta$ ), on conforming to the average action these neighbors take ( $\alpha$ ) and on conforming to the prescribed action of their chosen identity ( $\gamma$ ). The average action of  $i$ 's neighbors of identity  $I$ ,  $\bar{x}_{i,I}$ , is given by

$$\bar{x}_{i,I} = \sum_{j \in I} \hat{g}_{ij,I} x_j. \quad (2)$$

It is worthwhile to note that by equation (1), individuals' ideal action would simply be  $x_{i,I} = w_i$  if they did not feel any pressure to conform, i.e., it would be independent of their identity. Whenever individual  $i$  feels pressure to conform, they are better off the closer the average neighbor action and/or the prescribed action is to their ability.

## 2.4 Equilibrium

The equilibrium of the model is defined as a two stage, non-cooperative game. In stage 1, individuals choose their identity  $I$ , taking as given the action profile  $\mathbf{x}_I$ . In stage 2, being aware of everybody's identity, individuals choose  $x_{i,I}$  to maximise equation (1).

Individuals solve this game by backward induction. Starting from stage 2, the first order condition of equation (1) with respect to  $x_{i,I}$  yields:

$$x_{i,I} = b_i[1 + \gamma v_I + \alpha \bar{x}_{i,I}], \quad (3)$$

where

$$b_i = \frac{1}{\gamma + \alpha + 1/w_i}, \in (0, w_i].$$

Individuals with a higher ability  $w_i$  also have a higher value of  $b_i$ , which in fact collapses to the value of ability whenever considerations to conform are absent.

To derive the vector of equilibrium actions, it is useful to define  $\tilde{\mathbf{G}}_I = [\tilde{g}_{ij,I}]$ , where  $\tilde{g}_{ij,I} = b_i \hat{g}_{ij,I}$ . Note that, as only neighbors of the same identity matter for individual  $i$ 's comparison group, we can solve for the equilibrium action profiles of each identity separately.

With our notation in place, the Nash equilibrium action profile of individuals of identity  $I$  can be derived to be

$$\mathbf{x}_I^* = [1 + \gamma v_I] \mathbf{H} \mathbf{b}_I, \quad (4)$$

where

$$\begin{aligned} \mathbf{x}_I^* &= (x_{1,I}^*, x_{2,I}^*, \dots, x_{n_I,I}^*)^T, \\ \mathbf{b}_I &= (b_{1,I}, b_{2,I}, \dots, b_{n_I,I})^T, \\ \mathbf{H} &= [h_{ij,I}] = (\mathbf{I} - \alpha \tilde{\mathbf{G}}_I)^{-1} = \sum_{k=0}^{\infty} \alpha^k \tilde{\mathbf{G}}_I^k. \end{aligned}$$

Equation (4) allows us to state the following Proposition regarding existence of a Nash equilibrium in actions, and the determinants of the action level.

**Lemma 1** *There always exists a unique Nash equilibrium in action levels for each identity. Each individual's equilibrium action level is a weighted average of their own ability, the prescribed action for their identity, and the abilities of all other individuals of that identity to whom they are path-connected.*

It is worthwhile to note that, while the network overall is connected, individual choices of identity may lead to disconnected subcomponents, as far as the influence of neighbors on action levels is concerned.

We can also see that, for a given position in the network  $\hat{\mathbf{G}}_{\mathbf{I}}$ , individuals with higher abilities will take higher actions. In fact, abilities play a double role. As we can see from equation (3), higher abilities directly lead to higher actions. In addition, they also increase the reactivity of an individual's action level to both the prescribed action and the average action level of their neighbors.

The equilibrium action profile  $\mathbf{x}_{\mathbf{I}}^*$  in equation (4) leads to the equilibrium neighbor action profile of

$$\bar{\mathbf{x}}_{\mathbf{I}}^* = [1 + \gamma v_{\mathbf{I}}] \hat{\mathbf{G}}_{\mathbf{I}} \mathbf{H} \mathbf{b}_{\mathbf{I}}. \quad (5)$$

In stage 1, individuals compare the different levels of utility they would obtain under the available identities, and choose identity  $I$  that maximizes their utility, given  $x_{i,I}^*$ . Given equation (4) and Lemma 1, we can state the following result regarding the choice of identity.

**Lemma 2** *Define  $V_{i,I} = \max U(I, x_{i,I}^*, \mathbf{x}_{-i,\mathbf{I}}^*, \mathbf{g}_{\mathbf{I}})$  as the value function of individual  $i$  if they choose identity  $I$ . A Nash equilibrium in identities is such that  $V_I \geq V_{-I}$  for all individuals  $i$ .*

With Lemmas 1 and 2 in place, we can state formally how an equilibrium in our society looks like. We look for a Nash equilibrium in strategies, where no individual wishes to change either their action level  $x_{i,I}$ , nor their identity  $I$ , taken as given both the action levels of other individuals and their identities.

**Proposition 1** *An equilibrium in the society is such that all individuals choose their action level according to equation (4) and their identity to maximize their value function as described in Lemma 2. Such an equilibrium always exists.*

In equilibrium, actions of individual  $i$  are increasing in own ability, in the prescribed action of their chosen identity,  $v_I$ , and in the abilities of all others of the same identity to whom  $i$  is path-connected.

With our result on the existence of an equilibrium in place, we now turn to the question of what implications our three-factor model of social identity has for the existence of multiple identities in a society and (lack of) social mobility.

To focus on the forces of conformism, both to ones neighbors and to ones prescribed action, at work, we now make a simplifying assumption, that will be relaxed at the end of the paper.

**Assumption 1** *The entire population is homogeneous in abilities, such that  $w_i = w$  for all individuals  $i$ .*

Under Assumption 1, the equilibrium action profile  $\mathbf{x}_I^*$  in equation (4) can be simplified further:<sup>7</sup>

$$\mathbf{x}_I^* = [1 + \gamma v_I] \left[ \sum_{k=0}^{\infty} (\alpha b)^k \hat{\mathbf{G}}_I^k \right] \mathbf{b} \quad (6)$$

and as  $\hat{\mathbf{G}}_I$  is a row-stochastic matrix this allows us to derive explicitly

$$x_{i,I}^* = x_I^* = [1 + \gamma v_I] \frac{1}{\gamma + 1/w}, \quad (7)$$

which implies a value function of

$$V_{i,I} = \mu_I + \beta d_{i,I} + \frac{1}{2(\gamma + 1/w)} \left[ 1 + \gamma v_I \left( 2 - \frac{v_I}{w} \right) \right] \quad (8)$$

for individual  $i$  of identity  $I$ . This leads us to our first, general, result for a society comprised of homogeneous individuals.

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<sup>7</sup>See the proof of Proposition 2 for details.

**Proposition 2** *If abilities are identical, all individuals of the same identity choose the same action level. Action levels are increasing in prescribed actions  $v_I$  and  $w$ . Utility is increasing in  $v_I$  if and only if  $v_I < w$ .*

Proposition 2 follows immediately from equations (7) and (8) and its proof focuses on their derivation. It is noteworthy that all individuals of the same identity choose identical action levels, independent of the network structure.<sup>8</sup> These action levels lie between the level of abilities and the prescribed action level of the chosen identity, and are increasing in both. It follows immediately that even homogeneous individuals (in abilities) will, in equilibrium, exert differential action levels if they choose to identify with groups that prescribe different actions. Note that, unlike in models of conspicuous consumption, a higher action level is not a waste in our model *by assumption*. In fact, if action  $x$  represents overall consumption, or working hours, society may benefit from higher action levels. We will return to this point, and its relation to individual utility, in our discussion on welfare effects in Section 4. We now show that a multiplicity of identities may arise even in such a homogeneous population.

## 3 Multiplicity of Identities

### 3.1 Coexistence of Identities

The motivation for this paper has been the ongoing discussion about social mobility, or its lack, in society. We now show how our three-factor model of social identity, despite being very stylized, can reproduce these patterns. For the remainder of the paper we assume that Assumption 1 holds, unless explicitly stated otherwise.

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<sup>8</sup>As highlighted in Ushchev and Zenou (2020), this result does not hold in peer effect models *à la* Ballester, Calvó-Armengol and Zenou (2006), where identical individuals take different action levels, depending on their network position.

Under Assumption 1, all individuals are *ex ante* identical (in abilities), and it appears that the underlying network plays no role in their choice of action level. Yet, we now show that neighborhoods matter for identity choice, and the possibility that multiple identities coexist in society. We consider the case of two possible identities  $A$  and  $B$ . In our derivations, we make use of the following definitions:

**Definition 1** Let  $\tilde{V}_I = V_{i,I} - \beta d_{i,I}$  denote the “intrinsic” value associated with identity  $I$ .

**Definition 2** Let  $c \in \Re$  be defined by

$$c = \frac{1}{\beta} \left[ \frac{\gamma}{2(\gamma + 1/w)} \left[ v_B \left( 2 - \frac{v_B}{w} \right) - v_A \left( 2 - \frac{v_A}{w} \right) \right] - (\mu_A - \mu_B) \right]$$

The parameter  $c$  is derived by dividing the difference in intrinsic values of identities  $A$  and  $B$  by the importance to an individual of having neighbors of their own identity,  $\beta$ . Thus, it captures the relative difference in two identities’ intrinsic values. For ease of exposition, we work with  $c \leq 0$ , i.e., identity  $A$  is intrinsically more “attractive”. All else equal, the higher the status of  $A$ , the lower is  $c$ .

**Proposition 3** A Nash Equilibrium in identities is such that all individuals for which  $d_{i,A} - d_{i,B} \geq c$  choose identity  $A$  and all others choose identity  $B$ .

The condition stated in Proposition 3 is derived straightforwardly by calculating  $V_{i,A} - V_{i,B}$  and noting that each individual will optimally choose identity  $A$  if this term is weakly positive, and  $B$  otherwise. Proposition 3 highlights that the choice of identity will depend on its status  $\mu_I$ , how far away from ability  $w$  the prescribed action  $v_I$  is, and - for each individual  $i$  - how many neighbors of type  $I$  they have. Generally, identities who offer higher status, a prescribed action closer to abilities, and/or more neighbors,

are preferred by individual  $i$ . The two-factor model of identity following Shayo (2009) focuses on the trade-off between status and prescribed action, i.e.,  $c$ . Within our setup, it would predict individuals to choose identity  $A$  if and only if  $c \leq 0$ . In fact, the two-factor model would predict that in a homogeneous population, all individuals will choose the same identity and that a multiplicity of identities in society could only be based on a diversity of abilities.

In our three-factor model instead, individuals also consider the relative number of neighbours they gain or lose from choosing one identity over another. The importance of current neighbors in an individual's choice recalls the principles behind results on contagion and co-existence of conventions studied, e.g., in the seminal work of Morris (2000) and in general the work on the diffusion of networked goods: The gain in utility by changing one's identity from one to another must be large enough to compensate for any loss in neighbors by this choice. It is possible that an individual is willing to associate themselves with an identity that is not the intrinsically most attractive one, if this is offset by a high number of direct neighbors of that identity.

The importance of neighbors of different identities in choosing one's own gives rise to the possibility of multiple equilibria. Figure 1 illustrates this for two stylized networks. Using the condition for an individual to choose identity  $A$ , which is  $d_{i,A} - d_{i,B} \geq c$ , we can derive the values of  $c$  for which each of the depicted networks is an equilibrium, which are as shown. Note that, depending on the value of  $c$ , more than one realised network may be an equilibrium.

At the same time, the existence of multiple equilibria is not sufficient to ensure that there exists an equilibrium in which both identities coexist. For example, for  $c \in (-2, 2]$ , both networks in panel (b) of Figure 1 are equilibria, but there exists no equilibrium in which both identities  $A$  and  $B$  are present.

To establish a general result on the coexistence of multiple identities, we



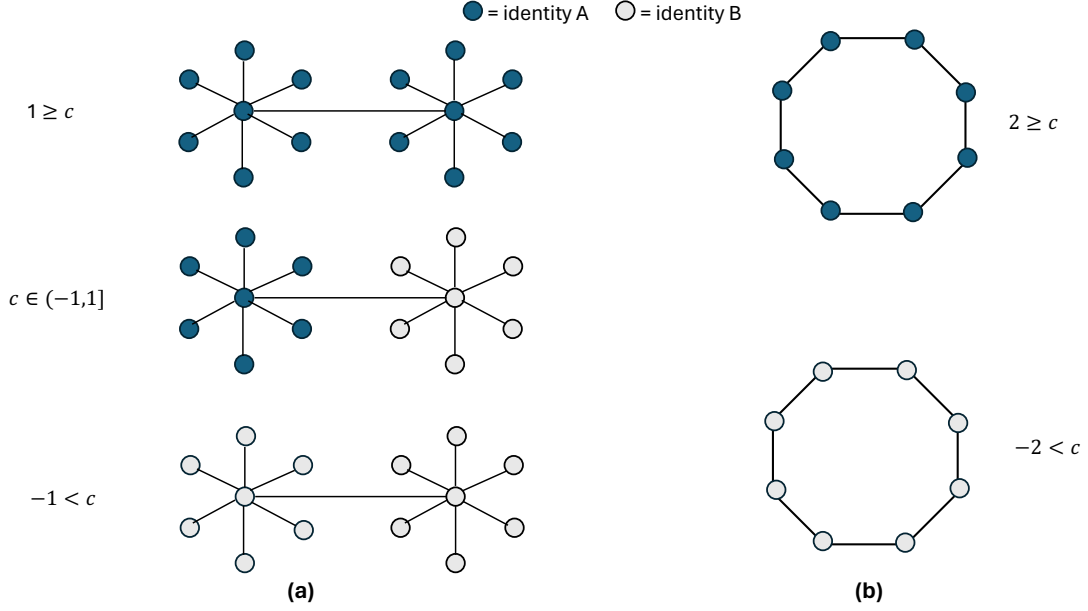


Figure 1: Examples of Equilibrium Networks

employ the following definition.

**Definition 3** Let  $S \in n$  be a finite subgroup of the population. For any  $i$  belonging to  $S$ , let  $k_i(S) \in \mathbb{Z}$  be defined by

$$k_i(S) = d_{i,ingroup} - d_{i,outgroup}.$$

That is, the number of links individual  $i$  has to others within the same group, minus the links they have to others outside that group.

This allows us to state the following result regarding which identities may be chosen in equilibrium.

**Proposition 4** There always exists an equilibrium in which all individuals choose the intrinsically more valuable identity (here, A). In addition:

- *There exists an equilibrium in which all individuals choose the intrinsically less attractive identity (here,  $B$ ) if and only if  $\min d_i > |c|$ .*
- *There exists an equilibrium in which multiple identities coexist if there is at least one group  $S$ , such that all  $i$  within  $S$  have  $k_i(S) > |c|$ .*

It is obvious that there always must exist an equilibrium in which all individuals choose the intrinsically more valuable identity. Similarly, if all individuals initially were to choose the less valuable identity, due to neighborhood effects, this will be an equilibrium as long as the difference in intrinsic valuation between the two identities is not “too large”, where Proposition 4 quantifies that “too large” is related to the minimum degree in the network. Finally, and most interestingly, Proposition 4 also shows that multiple identities may coexist if there is at least one group in the network who are sufficiently *inward looking*, by having a sufficiently higher number of direct links within their group than outside of it.

This last result is closely related to the existence of a *diffusion threshold* in the contagion literature, and coexistence of multiple actions as discussed in, e.g., Morris (2000). In fact, we now show how the existence of an equilibrium in which multiple identities coexist affects the diffusion of identities.

## 3.2 Diffusion of Identities

Threshold models of diffusion are prevalent, whereby nodes take a given action whenever more of their neighbors than a given threshold have taken the action. These thresholds have been modeled either as an absolute number of neighbors (such as in, e.g., Granovetter, 1978; Leister, Zenou and Zhou, 2021; Chwe, 2000; Gagnon and Goyal, 2017) or as a proportion of neighbors (see, e.g., the seminal studies by Morris, 2000; Jackson and Storms, 2023). In the present paper, individuals also change identity if a certain threshold is reached. However, in contrast to the previous literature, it is the *difference*

between neighbors of one vs. another type that has to be above a certain threshold. Indeed, we can re-write our own condition to choose identity  $A$  as

$$\begin{aligned}
 d_{i,A} - d_{i,B} &\geq c \\
 d_{i,A} - (d_i - d_{i,A}) &\geq c \\
 d_{i,A} &\geq \frac{1}{2}(c + d_i) \\
 &\geq q_i,
 \end{aligned} \tag{9}$$

which highlights that individuals with higher degrees have a higher threshold of neighbors choosing  $A$  before they themselves do so. Note the difference to other threshold models: In absolute threshold models,  $q_i = q$  (independent of an individual's degree) and while in proportional threshold models,  $q_i$  is also increasing in degree,  $\frac{d_{i,A}}{d_i}$  is constant. As  $c \leq 0$  however, equation (9) shows that also this measure is increasing in degree in our model.

**Proposition 5** *Individuals change their identity from  $B$  to  $A$  if more than a threshold  $q_i \in (0, 1)$  of their neighbors choose identity  $A$ . This threshold is increasing in the number of neighbors they have ( $d_i$ ) and decreasing in the difference of the intrinsic values of the two identities ( $c$ ).*

The proof of Proposition 5 follows directly from inspection of equation (9). It implies that individuals with fewer connections are more *socially mobile* in the sense that, *ceteris paribus*, they are more reactive to an increase in the relative attractiveness of identity  $A$  than those with more connections. It also implies that the density of the network is a factor which will affect how socially mobile the society is overall. Roughly speaking, the denser the network, *ceteris paribus*, the more important is the role of neighbors in the choice of identity, and the more likely it is that an individual will simply choose the identity of the majority of her neighbors. Since this is a circular argument, individuals and their neighbors may coordinate on either of the available identities, in equilibrium.

We can further specify conditions under which, starting from a network in which all individuals are of a unique identity, an intrinsically more valuable identity may diffuse. We make the following assumption about how individuals update their choice of identity.

**Assumption 2** *Assume that, when updating their identity, individuals myopically best respond to the current identity of their neighbors.*

Specifically, we consider a society in which all individuals choose identity  $B$  at given  $c$ .

**Proposition 6** *Assume that at  $c$ , all individuals are in an equilibrium in which they choose identity  $B$ . Let the intrinsic value of identity  $A$  increase such that now  $c' < c$  and assume that individuals myopically best respond to the identity choice of their neighbors. Then the following holds:*

- *A necessary condition that a decrease to  $c' < c$  causes any individual to change their identity is that  $\min d_i \leq |c'|$ .*
- *A necessary condition that identity  $A$  diffuses through the entire network is that there does not exist any group  $S \subset n$  such that all  $i$  within  $S$  have  $k_i(S) < |c'|$ .*
- *A sufficient condition that all individuals change their identity to  $A$  is that  $\max d_i - 2 \leq |c'|$ .*

We illustrate the diffusion in Figure 3.2 for a specific network.

Note that the minimum degree here is  $d_{min} = 1$ , such that  $|c'| \geq 1$  to initiate any change in identity. Once this condition is satisfied, the individual with degree 1 changes their identity, which in turn implies that their neighbor changes their identity, too (panel  $b$ ). Further decreases such that  $c' \in (-3, -2]$  incentivize individuals of degree 2 to change their identity, in turn making their neighbors prefer identity  $A$  as well (panel  $c$ ). Note how in

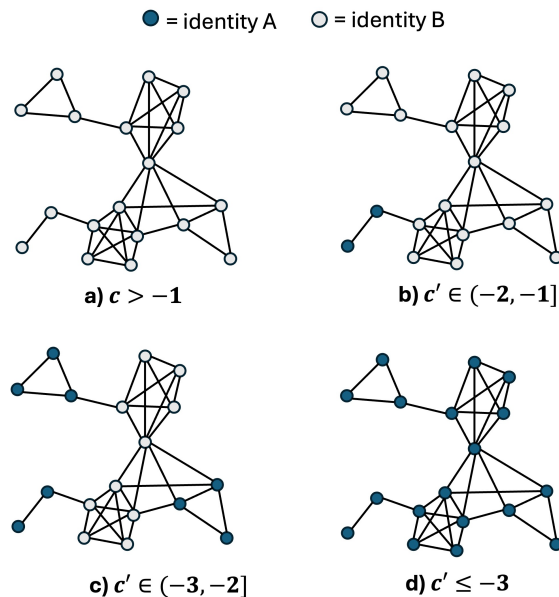


Figure 2: Diffusion of identity  $A$  in response to a decrease in  $c$ .

panel  $c$ ) further diffusion is halted by the fact that the individuals of identity  $B$  form a set  $S$  in which the minimum  $k_i(S) = 3$ , such that  $k_i(S) > |c'|$  for all of them. Once  $c'$  decreases even further, diffusion of identity  $A$  in the network is complete.

There is no general proof for the effect of underlying changes in  $c$ . However, the following algorithm provides a way to obtain the new equilibrium network. Note that this algorithm is a natural adaptation of the  $q$ -core algorithm described in Gagnon and Goyal (2017) to our environment, where the measure of interest is the *difference* in links within and without a group, instead of an absolute number.

**Algorithm 1** Assume there exist two identities  $A$  and  $B$  with  $\mu_A > \mu_B$  and  $v_A > v_B$ , such that  $c < 0$ . Consider a network with allocations of identities and actions that is an equilibrium, with set  $\mathbb{B}$  comprising all nodes of identity  $B$ . Let  $c$  change to  $c' < c$ . Then, in step 1, calculate for each node in  $\mathbb{B}$  the

number  $d_{i,A} - d_{i,B}$  and change their identity to A if  $d_{i,A} - d_{i,B} \geq c'$ . In step 2, recalculate the set  $\mathbb{B}$  and the corresponding  $d_{i,A} - d_{i,B}$ . Change the identity of all nodes  $i$  for whom  $d_{i,A} - d_{i,B} \geq c'$  to A. Reiterate until no such node remains.

### 3.3 An Application to Social Mobility

The motivating question of this paper has been whether social identity theory may contribute to our understanding of a lack of social mobility, in particular under which conditions mixing across classes benefits social mobility. With our results on coexistence and diffusion of identities in place, we turn to a specific policy example to highlight how our model may be interpreted as one of social mobility.

To this end, we analyze a stylized scenario that aims to inform on the policy of a common space in schools highlighted in Chetty et al. (2022b). First, note that our model is in line with the main distinction made in their paper: *Exposure* to individuals of varying identities - measured as the fraction of individuals of different identities in the network - is necessary to allow cross-identity connections, but not sufficient. If *friending bias* is high - which translates into a high degree of homophily, i.e., most connections are between individuals of the same identity - cross-identity connections are less likely to be made.

Chetty et al. (2022b) highlight the case of a US high-school in which duplication of rooms like the cafeteria led to students unintentionally segregating themselves. Students whose parents were of lower socio-economic status (SES) predominantly frequented one cafeteria, and those with higher SES parents the other, in an example of *friending bias*. Restructuring to create a unique cafeteria took place in response to this.

In the vocabulary of our model, we can think of students inheriting the SES of their parents when they first enter the network, and then being allowed to change this, in response to the network they find themselves in. We can

then construct the following example.

**Policy Example: Social mobility through integration**

For concreteness, we make a number of assumptions about students and their potential network.

1. Nodes ( $i$ ) represent students in a school, (prescribed) actions ( $x_i, v_I$ ) represent effort levels in studying, and abilities ( $w_i$ ) represent abilities of students.
2. Each student  $i$  has the same ability, independently of their SES,  $w_i = w$ .
3. There exist two SES,  $H(igh)$  and  $L(ow)$ , with both status ( $\mu_I$ ) and prescribed effort levels ( $v_I$ ) higher in the high SES than in the low SES. Students can freely choose their own SES, such that the set of identities is  $I = \{H, L\}$ .
4. Students enter the school system with the SES of their parents.
5. Half of the students have parents of high SES and half with low SES, such that initially  $n_H = n_L = 0.5n$ .
6. Each student has  $d$  direct neighbors (friends), which are drawn randomly from the population of students who frequent the same cafeteria.

We now consider two scenarios: In **Scenario 1**, students are segregated in two different cafeterias, according to their parents' SES. In **Scenario 2**, the entire student body interacts randomly in one unique cafeteria. Remember that our condition for choosing one identity over another (equation (9)) states now that the high SES will be adopted by a student if and only if

$$d_{i,H} - d_{i,L} \geq c. \tag{10}$$

Note that we now do not restrict  $c$  to be a specific sign, as we have no information which identity would be intrinsically more valuable. Our model leads to the following choices of SES.

**Solution Policy Example:** *Consider the Example of school segregation vs integration above. We find that:*

1. In **Scenario 1**, all students choose the SES of their parents as their own identity if and only if  $c \in (-d, d)$ .
2. In **Scenario 2**, all students choose the same SES. If  $c \leq 0$ , this is the high SES, and if  $c > 0$ , it is the low SES.

Note that the only difference in the two scenarios is the number of neighbors that students have of each SES, intrinsic valuations are the same. Note also that in Scenario 2, it is possible that integration will lead to fewer students choosing a high SES identity. However, if in this case students choose the low SES, they do so because it does indeed maximize their utility, though not their effort levels.

In the above Example we made a number of simplifying assumptions worthy of discussion. First of all, we assumed that all students are of the same ability  $w$ . Generalising this will imply that all students have an added incentive to choose the identity whose prescribed effort level is closest to their own ability. In this case again, the more heterogeneous students' neighborhoods are, the easier it is for them to choose the SES that matches their own abilities best. Second, our result that the second scenario leads to a unique choice of identity is to a large extent based on our assumption that all students have the same number of neighbors. Based on our results in Propositions 4 and 5, a more general degree distribution would be more likely to lead to a mixed identity equilibrium even in Scenario 2. Finally, we have assumed away any type of homophily in the selection of friends in Scenario 2, as well as assuming that both groups are of equal size. If either was not the case, we would again



broaden the range of parameters for which we observe multiple identities in Scenario 2. Homophily in friendships in particular will imply that students are less likely to change away from the SES of their parents. However, note that, as long as there will be at least a minimum of mixing across SES in a unique room, the likelihood of social mobility for students will always be higher in Scenario 2 than in Scenario 1. We now turn to the question of whether social mobility is in fact a desirable characteristic of society, from a welfare perspective.

## 4 Welfare

Under our assumption that all individuals have the same level of abilities, it is immediate from equation (8) that individual and societal welfare are maximized if all individuals choose the intrinsically more valuable identity, as described in Definition 1. Any coexistence of multiple identities, or an equilibrium in which all choose the less intrinsically valuable identity, then, reduce welfare.

It is worthwhile noting, however, that the intrinsically more valuable identity is not necessarily the identity with the highest status  $\mu_I$ , nor with the highest prescribed action  $v_I$ . Without introducing a specific functional form that describes how prescribed action and status of an identity are related, it is not possible to categorically state which identity is the intrinsically most valuable one. We have no good reason to stipulate one particular form. Therefore, we instead introduce two illustrative examples that highlight the potential welfare effects of upward social mobility, i.e., a situation in which individuals may change their identity to the one with the higher status.

**Welfare Example 1: Welfare-enhancing upward mobility.** Assume again that there are two identities,  $A$  and  $B$ , with prescribed actions

$$v_A = w + \frac{1}{2}w; \quad v_B = w - \frac{1}{2}w$$

and statuses  $\mu_A > \mu_B$ . The intrinsic values of these identities then differ only through the difference in status:

$$\tilde{V}_{i,I} = \mu_I + \frac{1 + \frac{3}{4}\gamma w}{2(\gamma + 1/w)}$$

that is, all individuals (and therefore society overall) would be best off if all chose identity  $A$ . Given our results in Proposition 3 on the choice between identities  $A$  and  $B$ , we know that individual  $i$  will choose identity  $A$  if and only if

$$d_{i,A} - d_{i,B} \geq \frac{1}{\beta}(\mu_B - \mu_A).$$

Now consider again the networks depicted in Figure 1. Depending on the exact difference in statuses of identities  $A$  and  $B$ , *each* of the depicted networks may be an equilibrium. In particular, if the status of identity  $A$  is sufficiently close to that of identity  $B$  (exactly, if  $\mu_A - \beta < \mu_B$ ), all networks in panel (a) are equilibria, and welfare-enhancing upward mobility may be blocked by the importance to individuals of being “similar” to their social connections.

**Welfare Example 2: Welfare-reducing upward mobility.** Assume instead again that identity  $A$  provides a higher status than identity  $B$ ,  $\mu_A > \mu_B$ , but that now

$$v_A = 2w; \quad v_B = w.$$

Now, the intrinsically more valuable identity is the one of *lower* status if

$$2(\mu_A - \mu_B) < w \frac{\gamma}{\gamma + 1/w}.$$

Colloquially, the increased pressure of conforming to the higher status identity’s prescribed action makes individuals worse off, unless they are being compensated by a “high enough” increase in status.

In this case, the opposite inefficiency from the first example may take

place, namely that individuals are choosing a higher status identity to conform with their social contacts, even if they were better off choosing to low status identity. Mirroring the first example, if the condition

$$\beta > \frac{\gamma w}{2(\gamma + 1/w)} - (\mu_A - \mu_B) > 0$$

holds, all the depicted networks in Figure 1 are equilibria, while a coordination on identity  $B$  would be welfare maximizing.

The above examples and discussion assume that the welfare of society is measured as the sum of all individual utilities. As actions are strictly increasing in the prescribed actions of identities, it is immediate that any measure which focuses on total overall action levels (e.g., output, consumption, education spending, effort levels) will be maximized if all individuals choose the identity that prescribes the highest action level.

## 5 Conclusions

While the continuing lack of socioeconomic mobility remains somewhat of a puzzle, interactions across socioeconomic classes have been shown to be a leading factor in overcoming it (see. e.g., (Chetty et al., 2022*a,b*)). The problem for policy makers remains how to translate exposure to higher socioeconomic classes into interactions. The present paper utilizes the tools of social identity theory and network analysis to shed light on possible factors affecting such interactions. Following the identity literature, we postulate that social interactions only affect behavior of individuals if they feel a sense of similarity with each other, i.e., if they share the same identity. We therefore construct a three-factor model of identity, in which individuals are freely able to choose their identity. They obtain utility both from an exogenously assigned status of their utility as well as the number of direct neighbors they have of the same identity. While individuals obtain positive utility from

choosing an action level, they also aim to conform this level both to the average action level among their neighbors of the same identity, and to an exogenously prescribed action level of that identity. Higher socioeconomic classes can be translated as identities with a higher status / higher prescribed action level.

We find that even if all individuals are identical in their abilities, it is possible that multiple identity configurations are equilibria. In particular, we derive conditions under which multiple identities coexist in the society. These conditions are different from previously employed threshold conditions of diffusion models, and roughly translate to a proportional threshold condition in which the threshold is increasing in the degree of the individual. This also implies that, *ceteris paribus*, individuals with fewer connections are more likely to change their identity in response to exogenous changes in the attractiveness of identities. We furthermore derive necessary and sufficient conditions for an intrinsically attractive identity to diffuse completely through a network, as well as an algorithm to calculate the diffusion step by step. We apply our results to an example of how mixing across social classes can lead to social mobility through the channel of changing identities. Finally, we show by example that upward social mobility might be welfare-reducing.

At present, our analysis focuses on individuals with homogeneous abilities. The next step is to consider heterogeneous individuals. This consideration will introduce a *negative* effect of being connected to others of your own identity: Under homogeneity in abilities, the “Keeping up with the Joneses” effect of being connected to others of the same identity is muted and identity choice becomes a coordination game. With heterogeneous abilities, instead, some individuals connected to others that have very different abilities might find themselves in an anti-coordination game, in which they prefer to minimize peer pressure by choosing an identity different from their neighbors.

# A Proofs

## A.1 Proof of Lemma 1

It is easy to see from equation (4) that the two variables which determine  $x_{i,I}^*$  are the prescribed action  $v_I$  of identity  $I$ , and the vector  $\mathbf{b}_I$ . This in turn depends, in addition to the preference parameters, on the endowments  $w_i$  of individuals of identity  $I$ . It is noteworthy to point out that, while we assume  $\mathbf{G}$  to be connected, it is possible that not all individuals who choose to be of identity  $I$  are connected through a path, and therefore  $\tilde{\mathbf{G}}_I$  may not be connected. This aspect of  $\tilde{\mathbf{G}}_I$  however is preserved in  $\mathbf{H}$ .

Existence and uniqueness of the equilibrium in equation (4) follows the arguments put forward in Ushchev and Zenou (2020), who consider a game of conformism with average neighbor action: It is easy to show that  $\tilde{\mathbf{G}}_I$  is derived from a row-stochastic matrix, and in fact that each row sums up to  $b_i$ , which is less than 1 for all  $i$ . In addition,  $\alpha b_i < 1 \forall i$ , which ensures that the spectral radius of  $\alpha \tilde{\mathbf{G}}_I$  is always less than 1 and the determinant of  $\mathbf{I} - \alpha \tilde{\mathbf{G}}_I$  is different from zero.

Existence also derives logically from the fact that, without a need to conform to neighbors' actions, each individual's optimal action is well-defined and given by a weighted average of their endowments  $w_i$  and the prescribed action  $v_I$  of their chosen identity. Conformism among neighbors, by equation (3), can only lead to a compression of the distribution of optimal actions within each identity.

## A.2 Proof of Proposition 1

By Lemma 1, there exists a unique best response in actions for individual  $i$  for each identity they may choose. As the number of potential identities from which  $i$  may choose is finite, each individual has a finite set of strategies available in the game. Consequently, a Nash equilibrium always exists.

### A.3 Proof of Proposition 2

In a homogeneous society,

$$b = \frac{1}{\gamma + \alpha + 1/w}$$

for all agents, and hence  $\mathbf{b}_I = \mathbf{b}$ , independent of which individuals choose which identity. This also implies that  $\tilde{\mathbf{G}}_I = b\hat{\mathbf{G}}_I$  and consequently,  $\mathbf{H} = \sum_{k=0}^{\infty} (\alpha b)^k \hat{\mathbf{G}}_I^k$ . Plugging these expressions into equation (4) yields equation (6). As  $\hat{\mathbf{G}}_I$  is a row-stochastic matrix, so is  $\hat{\mathbf{G}}_I^k$  for any  $k$ . This implies that for any  $k$ , we have that  $\hat{\mathbf{G}}_I^k \mathbf{b} = b$ , and therefore

$$\begin{aligned} \mathbf{x}_I^* &= [1 + \gamma v_I] \sum_{k=0}^{\infty} (\alpha b)^k b \\ &= [1 + \gamma v_I] b \frac{1}{1 - \alpha b} \end{aligned}$$

and substituting the value for  $b$ , we arrive at equation (7), and plugging this in turn into the expression for  $V_{i,I}$  yields equation (8). Proposition 2 follows immediately from these expressions.

### A.4 Proof of Proposition 3

The proof follows immediately from equation (8) in the main text. Individual  $i$  chooses identity  $A$  over  $B$  if and only if their value function given by equation (8) is higher for identity  $A$  than for identity  $B$ . Comparing the two and re-arranging yields the expression in Proposition 3. To allow both identities to co-exist, the condition must hold for some  $i$ , and must be violated for others.

## A.5 Proof of Proposition 4

Under homogeneous abilities, all individuals of the same identity choose the same action level  $x^*$  and therefore, individuals do not suffer any loss from conforming to their neighbors of the same identity. On the other hand, neighbors of another identity are irrelevant for utility. Thus, all individuals prefer to have as many neighbors of the same identity as possible, and  $V_{i,I}$  is maximized by choosing the identity that maximizes  $\tilde{V}_i$  and having all of ones neighbors of that identity. Therefore, all individuals choosing the intrinsically more valuable identity is trivially always an equilibrium.

The existence of a second equilibrium, in which all individuals choose the intrinsically less valuable identity, depends on the difference between the intrinsic values,  $c$ . The proof proceeds as follows: Note that, given a value of  $c$ , individuals are most likely to choose identity  $B$  if all of their neighbors are also of identity  $B$ . We thus consider a network in which all individuals are of identity  $B$ . For each individual, this choice is optimal if and only if  $-d_i < c$ . This implies that the most likely individual to instead prefer identity  $A$  is the individual with  $\min(d_i)$ . Consequently, if the condition  $-\min(d_i) < c$  holds, it holds for all individuals in the network, and all choosing identity  $B$  is a Nash equilibrium. Assume conversely that the condition is violated. Then, the individual with the lowest degree has instead an incentive to choose identity  $A$ , and it is no longer an equilibrium for all individuals to choose  $B$ . This completes the proof of the second equilibrium.

The proof of existence of the mixed identity equilibrium is by construction. Assume that there exists at least one group  $S \in n$  such that all individuals within it have at least  $k_i(S)$  links more to others *within* that group than outside of it. Assume that all of these individuals choose identity  $B$ . This implies that, even if all nodes outside this group were to choose identity  $A$ , for all nodes within  $S$  we would still have that  $d_{i,A} - d_{i,B} \leq -k_i(S)$  and consequently, the condition  $-k_i(S) < c$  would imply that it was optimal for the individuals within  $S$  to choose identity  $B$ . This completes the proof.

## A.6 Proof of Proposition 6

The first two parts of the Proposition follow the arguments in the proof of Proposition 4. In particular, starting from a society in which all choose identity  $B$ , the individuals with the lowest degree have the highest incentive to change their identity to  $A$ . If even these individuals prefer identity  $B$ , i.e., if  $-\min d_i < c'$ , then nobody will change their identity in response to the decrease in  $c$  to  $c'$ .

Similarly, as shown above, the existence of a finite group  $S \subset n$  in which all individuals have at least  $k_i(S)$  more links within the group than out of it precludes these individuals from changing their identity to  $A$ , even if all individuals outside that group chose  $A$ .

Finally, a sufficient condition for  $A$  to diffuse through the entire network is that the individual with the maximum degree were to change their identity to  $A$  the moment only one of their neighbors did so. This is the stated condition.



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