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Social identity and social free-riding

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ABSTRACT

We model individual identification choice as a strategic group formation problem. When choosing a social group to identify with, individuals appreciate high social status and a group stereotype to which they have a small social distance. A group's social status and stereotype are shaped by the (exogenous) individual attributes of its members and hence endogenous to individuals' choices. Unless disutility from social distance is strong enough, this creates a strategic tension as individuals with attributes that contribute little to group status would like to join high-status groups, thereby diluting the latters' status and changing stereotypes. Such *social free-riding* motivates the use of soft exclusion technologies in high-status groups, which provides a unifying rationale for phenomena such as hazing rituals, charitable activities or status symbols that is not taste-based or follows a standard signaling mechanism.

1. Introduction

Since the seminal paper by Akerlof and Kranton (2000) economists have scrutinized how social identity affects economic behavior and outcomes.[1] As a result, there is by now substantial empirical evidence documenting how having a particular social identity affects individual decision making.[2] However, an individual's social identity is by no means outside the control of the individual itself. Rather, there are many situations in which individuals can influence their social identity. In fact, Akerlof and Kranton even claim that "*choice of identity may be the most important economic decision people make*". Despite this, how individuals choose their social identity and how these decisions in turn actually shape social structure has received considerably less attention.[3]

The present paper aims to fill this gap. It shifts the focus from the effects of existing group identities on individual behavior to the analysis of how individuals choose these identities, thereby treating group identification as a choice variable. We analyze these choices under the assumption that individuals maximize their identity utility. To model the latter, we build on two well-established results from social psychology: Individuals like to identify with high status groups and dislike social distance between their own characteristics and the stereotype of the group they identify with. A crucial insight of our model is that individual identification choices thus become strategic and interdependent: Both status and distance depend

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1 See, for example, Akerlof and Kranton (2002, 2005) and Chen and Chen (2011). Akerlof and Kranton (2010) provide an overview.

2 See, for example, Benjamin et al. (2010), Chen and Li (2009), Cohn et al. (2013), Cohn et al. (2014), Goette et al. (2006), Klor and Shayo (2010), and Rustagi and Veronesi (2016).

3 Shayo (2009) is a notable exception. His model analyzes how social identity considerations might explain why individuals are willing to support redistribution policies which are not maximizing their individual material payoff. We compare the two papers in Section 5.

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on a group's stereotype, which itself depends on the characteristics of the individuals who identify with the respective group.

We analyze the resulting strategic considerations and their behavioral implications within a simple game-theoretical model. In our large-game approach, two different types of players decide simultaneously which of two social groups to identify with.[4] We show under which conditions the respective game among members of a society exhibits conflicts of interest regarding the composition of different social groups. In turn, we argue that such conflicts of interest can explain why distinctive group characteristics may emerge endogenously. We show that distinctive group characteristics and actions can be interpreted as deterrence mechanisms allowing individuals whose characteristics contribute more to group status (*high types*) to segregate from low contributors (*low types*).

A key insight of our model is that low types have an incentive to engage in *social free-riding* under very general conditions. Within our paper, the term "social free-riding" refers to a situation in which low type individuals identify with a social group consisting of (at least some) high type individuals. As the group's social status depends on the characteristics of its members, low types thereby free ride on the high type members' status contributions. Social free-riding thus parallels free-riding behavior known from standard public goods provision problems in which low contributors can benefit from the contributions of others. In our model, low types want to identify with groups consisting of high types in order to experience high social status. In doing so, they impose two negative externalities on those high types. First, they drag down their group's social status. Second, they change the group's stereotype, thereby increasing social distance to this stereotype for high types. As our first main result, we show that there always exists an equilibrium featuring full social free-riding in which all social groups are indistinguishable. This corresponds to a society without any segregation. High types suffer from this situation as they would benefit from segregation but lack the possibility to hinder low types from identifying with the same group. Yet, if disutility through higher social distance is relatively strong as compared to utility from higher social status, there also exists an equilibrium featuring full segregation, in which individuals from the two types perfectly separate into different groups. In this case, there is no social free-riding incentive and thus also no conflict of interest between different types: Low types want to segregate themselves, as the reduction in social distance outweighs the potential gain of an increase in social status. High types prefer this scenario as they form a homogeneous social group with no social distance and high social status. Low type individuals, on the other hand, are deterred from identifying with the high types' social group as their respective social distance would be too large.

The desirability of such a situation from the perspective of high types raises the question if and how they can foster segregation even if social free-riding incentives for low types dominate. A key result of our paper is that under one simple assumption, there always exists a deterrence technology allowing high types to separate themselves and prevent low types from identifying with the same group. A deterrence technology represents a costly action carried out by members of a group that affects the group's stereotype, that is, it produces group-specific features. For instance, such an action could correspond to simple material expenditures but also specific activities in turn becoming stereotypical for the respective group. Thus, this action increases social distance for individuals who identify with the group as long as they do not carry out the action themselves. By increasing the disutility from social distance or respectively increasing the costs of reducing it to the previous level, carrying out this costly action lets high types deter low types from social free-riding and thus facilitates a full segregation equilibrium.

The separation mechanism we illustrate might appear similar to that of standard signaling models, but differs in important ways: The costly action is not carried out because of its observability and thus through its influence on beliefs of other individuals. Rather, it is the individual's intrinsic motivation to adhere to the stereotype of the group she identifies with that makes her undertake the action.[5] Carrying out the action reduces social distance towards the respective group and thus makes it less costly to identify with this group. However, as the benefits of identifying with a specific group are heterogeneous with respect to an individual's own type, a deterrence mechanism can achieve a separating equilibrium. This also represents a distinction to standard signaling models which typically assume heterogeneity in the costs of the action leading to separation. In contrast, we show how heterogeneity in the returns to the action arises through the specific structure of social identity. Overall however, this distinction from standard signaling models is not our main contribution. Rather, the point is to illustrate how the basic components of social identity create the motivation and the possibility to make use of such a mechanism.

Considering the robustness of our results, we investigate evolutionary as well as myopic best-reply dynamics. It turns out that the social free-riding equilibrium is not robust. If the full segregation condition from above is not fulfilled,[6] high types constantly try to separate from low types who follow them. As a result, in the absence of a deterrence technology, high types are only temporarily and partially able to segregate themselves and society converges to a situation in which all individuals identify with the same group. However, this limit case again triggers similar dynamics towards the other group, leading to a cyclical pattern: There is permanent change in social structure with high types starting out to separate from the majority, but their distinctiveness finally being fully absorbed by low types imitating them, that is identifying with the same group.

[4] Within the social identity terminology, the terms *social category* and *social group* are used interchangeably. For the sake of readability, we use the term *social group* throughout the paper.

[5] Our approach is thus loosely related to Benabou and Tirole (2011) who rationalize costly actions as self-signaling devices, although through an entirely different mechanism.

[6] That is, if disutility through higher social distance is relatively strong as compared to utility from higher social status.

Yet, if the deterrence technology is available, the resulting full-segregation equilibrium is a local attractor and hence much more robust.

2. Framework and main assumptions

We now provide an overview and justification of the three main assumptions imposed by our model. We describe their foundation in the existing literature and show that they are based on characteristic and well-established findings from a body of literature in social psychology called the "Social Identity Approach".[7] Our setup resembles that of Shayo (2009) in the sense that both analyze individuals' decisions to identify with social groups, focusing on the effects of social status and social distance.

In the economic literature, the notion that one's social identity influences individual utility was introduced by Akerlof and Kranton (2000). Their framework assumes agents' preferences to be endogenous and interconnected due to their dependence on memberships in social groups: Individuals benefit if group characteristics are favorable and suffer the more they deviate from a particular group's stereotype. As a result, individual behavior and the consequential utility gained from it are to a large extent determined by individual choices of social group memberships, which is the key choice variable in our model.

More precisely, Akerlof and Kranton (2000) introduce an identity component I_j into individual j's utility function. In the proposed framework, utility derived from social identity depends on the social categories $\mathbf{c_j}$ the individual identifies with, where a higher social status of a particular group may increase utility. A social group is characterized by certain ideal prescriptions $\mathbf{P}$ and the individual has characteristics $\epsilon_\mathbf{j}$. Utility derived from identity depends on how well individual characteristics fit the group stereotype. Furthermore, $\mathbf{P}$ also captures prescriptions in terms of actions and individual j's identity utility depends on how well its own actions $\mathbf{a_j}$ and others' actions $\mathbf{a_{-j}}$ match these prescriptions. In total, individual utility is then given by $U_j = U_j(\mathbf{a_j}, \mathbf{a_{-j}}, I_j)$ with $I_j = I_j(\mathbf{a_j}, \mathbf{a_{-j}}, \mathbf{c_j}, \epsilon_\mathbf{j}, \mathbf{P})$. Our analysis is in the spirit of this framework.

2.1. Identity choices

Many economic applications of the Social Identity Approach focus on the effect of belonging to a specific social group on subsequent behavior. In contrast, our model describes how individuals *choose* social groups to identify with, given that their preference structure reflects social identity considerations. Importantly, we will treat this main choice variable as in principle unrestricted. There are *no* formal institutional reasons hindering an individual to identify with any social group. Not identifying with a specific social group thus reflects an optimal (however not necessarily conscious) decision by individuals instead of a simple restriction of the choice set. In plain words, if an individual does not identify with a specific group, it is not because she is unable to but because she is unwilling to. This also implies that group members have no power to refuse the categorization decision of another individual. The idea behind this is that identification with a group is a purely *cognitive* concept: there is no formal way to stop an individual from feeling belonging to a group. Within the SIT literature, a social group is said to be a cognitive entity being meaningful to subjects at a particular point in time (Tajfel, 1974). It is, therefore, *not* necessary to think of a group in terms of a face-to-face relationship between a number of individuals.

The notion of individuals *choosing* social groups to identify with represents a key ingredient of the Social Identity Approach. SIT argues that individuals seek to derive self-esteem from their membership in social groups (Tajfel et al., 1971; Tajfel, 1972) and this affects the decision whether to become and remain member of a particular social group.[8] If a particular social group does not contribute to an individual's positive self-image, she might leave and identify with other groups if boundaries are permeable (Tajfel, 1974).

Importantly, note that individuals cannot "opt out" of the categorization process by not identifying with any group. That is, although an individual's self-image is not solely determined by its social identity, it at least partially depends on the individual perceiving itself as part of a specific group.[9]

[7] More specifically, the Social Identity Approach consists of two distinct theories – Social Identity Theory (SIT) and Self-Categorization Theory (SCT). Generally speaking, it addresses the role of group membership/belonging for individual preferences and hence behavior. Experimental evidence supporting our three core assumptions in an economic context can be found in Hett et al. (2016).

[8] Tajfel (1974) assumes that *"an individual will tend to remain a member of a group and seek membership of new groups if these groups have some contribution to make to the positive aspects of his social identity; i.e. to those aspects of it from which he derives some satisfaction"* (p. 82). Wichardt (2008) argues that when being confronted with different dimensions of groups, individuals focus the more on a particular group the more it offers them a high positive contribution to their identity in a certain context.

[9] For our model, this implies that high types cannot simply "form an own group" with them being the only member and thereby side-step the free-riding problem but rather always have to choose one group to identify with. In this sense, an individual can never have *no* social identity. Tajfel (1978a) argues that behavior in general can be represented on a bipolar continuum, where pure intergroup behavior and pure interpersonal behavior build the extreme cases. At the first extreme, characteristics and preferences solely drive individual behavior as an individual. At the second, an individual's group memberships are the sole drivers of her actions. Given this continuum, social identity processes gain importance whenever situations are defined in the intergroup context.

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2.2. Group status

As a first key motivation underlying identification decisions, we assume that the social status of a particular social group plays a decisive role as (a) individuals like to identify with social groups that have a higher social status and (b) this status is endogenous and only depends on the composition of a particular social group, i.e. characteristics of the group's members.

SIT follows (Festinger's (1954)) theory of social comparison and assumes that individuals have a desire for a positive self-image (Tajfel, 1972, 1978b; Tajfel et al., 1971; Tajfel and Turner, 1979). As an individual's social identity is part of her self-image, SIT concludes that individuals like to see their own social groups as *good* groups, particularly in comparison to other social groups. Thus, individuals prefer to identify with those social groups whose status is particularly high.

The assumption that group status is endogenous is in line with Akerlof and Kranton (2000). In particular, a social group's status can depend on the characteristics, behavior, or decisions of those individuals who identify with this very group. Identity therefore creates a new type of externality, as individuals' actions can have meaning for others by affecting group status through changing group stereotypes.[10]

2.3. Social distance

As another central component influencing individual identification choices we assume that (a) individuals like to identify with social groups whose stereotypes are similar to their own characteristics and actions and that (b) group stereotypes are endogenous and depend on the composition of a particular social group, i.e. the characteristics and actions of the group's members.

These assumptions are derived from Self-Categorization Theory, which addresses the question of what makes individuals seeing themselves as members of certain social groups (Turner, 1982, 1985; Turner et al., 1987, Turner et al., 1994).[11] SCT argues that individuals cognitively represent their social groups in terms of stereotypes.[12] Akerlof and Kranton (2000, p. 719) follow this idea and state that utility from identity "*depends on the extent to which j's own and others' actions correspond to prescribed behavior*" indicated by the respective group's stereotype. Turner et al. (1987) argue that by identifying with a social group an individual adapts its typical characteristics as behavioral norms. However, these norms or stereotypes are not (necessarily) exogenous, but may emerge endogenously from group members' characteristics and actions. As for social status, identity concerns can again create an externality also with respect to social distance: When the composition of a social group changes, this affects the group's stereotype (Akerlof and Kranton, 2000). A social group's members are, then, perceived to be more or less representative for the respective group (in comparison to its prototype).

3. Theoretical model

3.1. Players, strategy spaces, preferences

Let there be a unit mass of individuals. Each individual i is characterized by an exogenous social attribute (individual characteristic, attitude) $\theta_i \in \{\theta_H, \theta_L\}$. Our aim in this paper is not to explain where this attribute comes from, whether it is truly intrinsic or acquired; rather, we take it as given in the short run and interchangeably call it the individual's "type". θ_i will be decisive for the social status and stereotype of the group that individual i identifies with. Think of individuals of type θ_H as making a "high" individual contribution to the group's social status and type θ_L as making a "low" individual contribution to the group's social status. For convenience, we assume without loss of generality that $\theta_H = 1$ and $\theta_L = 0$, and call individuals of the former type "high types", the latter "low types". Fraction $\lambda \in (0,1)$ of individuals are high types, given which the average type in the population is λ. Individuals decide simultaneously and independently to identify with one of two possible groups A or B. Let g_i denote individual i's choice of group. Recall that there are no formal barriers to entry into any group.[13] We shall make the assumption that

[10] Akerlof and Kranton (2000) illustrate this idea with the following example: A man who wears a dress (which is understood as a symbol of femininity) might decrease the social group "men"'s social status and, thus, threaten the identity of other men. Another example comes from Goldin (1990). In her model, men lose status when women work in their jobs as these jobs might then be assumed to be less physically demanding or difficult. In the model by Shayo (2009), it is possible that poor individuals prefer less redistribution although they would have a higher disposable income if there was more redistribution. The main mechanism behind this result is that by dismissing a redistribution policy, individuals can increase the status of their national group and thus gain utility by identifying with it. Klor and Shayo (2010) provide supporting experimental evidence for this. A detailed discussion of differences and similarities between Shayo (2009) and our approach is presented in Section 5.

[11] Falk and Kneel (2004) show how low social distance can be optimal if individuals choose their reference groups in order to manage self-improvement and self-enhancement.

[12] Self-categorization is said to occur as a function of *fit* (Oakes, 1987, Oakes et al., 1991): A group distinction is perceived to have a high level of *normative fit* whenever social behavior and group membership are in line with stereotypical expectations. Self-categorization theorists claim that "*group identity not only describes what it is to be a group member, but also prescribes what kinds of attributes, emotions and behaviors are appropriate in a given context*". (Hornsey, 2008, p. 209).

[13] See Section 2.1.

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while an individual's type is private information, the average type λ_k among the members of group k is perfectly observable and known to all.[14]

Individuals are assumed to have homogeneous preferences and care about two aspects of groups when they make their identification decision: (a) social status of the group and (b) social distance to the group's stereotype. As for the former, we assume that the average type λ_k in group k characterizes group k's social status (henceforth "group status").[15] As for the latter, we assume that there are two separate and independent components to a group's stereotype, and hence two separate "kinds" of social distance. First, a *type-based* component which is exogenous given individuals' group choices; and second, a so-called *action-based* component which derives from an additional choice individuals may have to make about the acquisition of an observable social attribute.

Regarding the type-based component, we assume that group k's stereotype, too, is given by the group's average type λ_k, and let $d(\theta_i, \lambda_k)$ denote Euclidean distance between individual i's type θ_i and group k's stereotype λ_k, so that d maps onto the unit interval. We call this distance "type-based social distance". Our interpretation of $d(\cdot)$ is that it is "intrinsic" and unalterable by behavior, at least in the short run, given group choices.[16] However, group status and type-based social distance, while exogenous *given group choices*, are still ultimately endogenous in the sense that they are determined by the body of individuals who choose to identify with a particular group.

We construct the second, action-based component of a group's stereotype by assuming that each individual i, in addition to choosing a group, has to decide about an endogenous and observable social attribute (individual action, characteristic, attitude) $a_i \in \{0,1\}$, where $a_i = 1$ involves a (utility) cost c_i that may or may not be type-specific. For the sake of brevity, we call this choice the individual's "action". A strategy in the full model thus consists of a group choice as well as an action, taken simultaneously. Letting $\overline{a}_k$ denote the share of individuals locating in group k who choose action $a_i = 1$, $D(a_i, \overline{a}_k)$ denotes Euclidean distance between individual i's action and group k's average action (again assuming values in the unit interval). We shall call this distance "action-based social distance".

To summarize, individual i's utility from identifying with group $g_i = k$, $k \in \{A, B\}$, and choosing action $a_i \in \{0,1\}$, has three components:

$$u\left(k, a_i \middle| \theta_i, \lambda_k, \overline{a}_k\right) = U(\lambda_k, d(\theta_i, \lambda_k), D(a_i, \overline{a}_k)) \tag{1}$$

where it is understood that others' choices are summarized in $(\lambda_k, \overline{a}_k)$. To finalize our specification of preferences, we assume that $U(\cdot)$ is strictly *increasing* in group status and strictly *decreasing* in both distance components. Individuals would, *ceteris paribus*, like to identify with a group with high status, but would at the same time, *ceteris paribus*, like to minimize their social distance to the chosen group's typical attributes. This creates an inherent tension for the low types (neglecting action-based distance for the moment): on the one hand, type-based social distance $d(\cdot)$ is exogenous from the individual's point of view given others' choices, so if they identify with a high-status group they will automatically suffer from some type-based social distance. On the other hand, they can derive a benefit from *social free-riding*, that is joining a group with as many high types as possible and enjoying the high group status without diluting it.[17] High types, by contrast, do not face such a trade-off: for them, the higher group status, the lower type-based distance. In consequence, they would always like to be among themselves.

To acquaint the reader with our notation, we give some simple examples: for instance, $U(1,0,0)$ denotes the utility of a high type identifying with a group with only high types where no one chooses the costly action, and $U(1,1,0)$ denotes the utility of a low type joining that very same group. Further, $U(1,0,1)$ denotes the utility of our high type in a high type group where everyone takes the costly action, except our individual (and perhaps countably many others) who hence suffers maximal social distance with respect to this attribute. She can avoid this social distance by taking the costly action herself, yielding utility $U(1,0,0) - c_i$ where i is her index.

In the analysis that follows, we will first study equilibrium group choices without the endogenous observable attribute, hence ignoring the $D(\cdot)$ component. In that case, if social free-riding is sufficiently attractive to low types, we predict a (generically) unique social free-riding equilibrium, i.e. a mixed-strategy equilibrium in which type composition will not vary across groups and each group will hence be representative of society as a whole. We thence proceed to show how costly actions can help high types coordinate on "locking out" low types, leading to full segregation. There always exists such a costly action if action-based distance (i.e. social distance regarding the endogenous attribute) is sufficiently important, even if costs are not type-specific, but of course type-specific costs make it cheaper for the high types to achieve separation. This latter corollary is an illustration of certain hazing rituals, which we will discuss in Section 5.

3.2. Equilibrium social free-riding

We start by ignoring action-based distance and assume that utility arises only from group status and social distance with respect to the exogenous attribute, that is, $u(k|\theta_i, \lambda_k) = U(\lambda_k, d(\theta_i, \lambda_k))$. Our equilibrium concept is that of Nash equilibrium, but

[14] This reflects our focus on the part of an individual's self-image that follows from social instead of individual identity. This implies that group instead of individual characteristics matter.

[15] As discussed in Section 2.2, group status is thus endogenous and depends on the attributes of its members.

[16] Think of attributes like beauty, gender, or abilities.

[17] An individual is said to engage in social free-riding if $\theta_i < \lambda_k$ holds.

we do impose a within-type symmetry restriction: all low types choose to identify with group A with probability q_A whereas all high types choose to identify with that same group with probability p_A. The resulting status of group A is then simply $\lambda_A = \frac{\lambda p_A}{\lambda p_A + (1-\lambda) q_A}$, and since $p_A \lambda_A + (1-p_A)\lambda_B = \lambda$, we have $\lambda_B = \frac{\lambda - p_A \lambda_A}{1-p_A}$ for group B. As we will point out in the Extensions, this assumption can be relaxed, but we keep it here for the sake of expositional clarity.

Proposition 1 *(Existence and uniqueness of social free-riding equilibrium): Any* $p_A = q_A =: p \in (0,1)$ *constitutes an equilibrium of the game and there are no other completely mixed strategy equilibria.*

Proof. The first part of the proof is obvious since, having measure 0, no single individual can affect group status through her identification choice and all individuals are trivially indifferent between social groups whenever $\lambda_A = \lambda_B$. To show that this is the only completely mixed strategy equilibrium, suppose without loss of generality that $p_A > q_A$. Then a high type individual currently identifying with group B would strictly profit from switching to group A.∎

In words, any mixed strategy equilibrium leads to entirely indistinguishable groups, where both groups are entirely representative of society as a whole. Both groups consist of high and low type individuals, yielding a situation in which θ_L individuals free-ride on θ_H individuals' contributions to their group's social status. In particular, the high types do not succeed in creating any niche for themselves. Whether or not we would like to include the boundary cases $p=1$ and $p=0$ as equilibria is a matter of technical detail and of no consequence to the message of Proposition 1, however, for the sake of completeness we assume that if all individuals identified with one and the same group (say, A), and a single individual were to deviate, then that lone deviator would experience status λ (an individual's status signal being almost infinitely noisy) but social distance 0 (knowing that she would be alone) and so high types would always profit from such a deviation. More interesting is the question whether in addition to this generic no-segregation equilibrium type, there exists a fully segregating equilibrium, that is a pure strategy equilibrium in which $p_A \in \{0,1\}$ and $q_A = 1-p_A$.[18] Our next proposition establishes a simple necessary and sufficient condition.

Proposition 2 *(Existence of full-segregation equilibrium): A fully segregating equilibrium exists if and only if* $U(1,1) \le U(0,0)$, *that is, the benefit to low types of social free-riding cannot compensate for the associated increase in social distance.*

The proof is straightforward: high types would never want to deviate to the low type group, so only low types face an incentive constraint which is exactly the one stated in the Proposition. As a consequence of Propositions 1 and 2, we observe that whenever $U(1,1) > U(0,0)$, there is a (generically) unique equilibrium prediction of no segregation: all groups have the exact same status and are representative of the population as a whole.[19] This is a fairly undesirable outcome for the high types who would rather be among themselves, and if they could coordinate on a separating technology, they might want to do so, even if it came at a small cost. We illustrate this in the next section, where we reintroduce the endogenous social attribute a_i and type-based distance $D(\cdot)$ to our analysis.

A final question to be answered is whether social free-riding and full segregation are indeed the only two equilibrium states of the population. A simple and intuitive assumption is sufficient to rule out semi-separating equilibria where high types concentrate in one social group whereas low types mix.

Assumption 1: $U(\lambda_k, \lambda_k)$ is strictly monotonic in $\lambda_k \in [0,1]$.

This assumption implies, in particular, that whenever the low-type incentive constraint is not met, i.e. whenever $U(1,1) > U(0,0)$, we also have that $U(\lambda_k, \lambda_k) > U(0,0)$ for any interior λ_k, so low types are always pulled toward groups with higher status. In a sense, the assumption ensures that our utility functions are "scale-free" and hence the choice $\theta_i \in \{0,1\}$ is truly without loss of generality. In the Appendix B, we discuss classes of utility functions that meet our auxiliary assumption. In particular, Assumption 1 (and also Assumption 2 which will be presented below) is compatible with linear-in-its-arguments utility functions, exponential specifications, and simply multiplicative utility functions. Appendix C briefly illustrates the ramifications of Assumption 1 being violated.

Corollary 1: *If Assumption 1 holds, then there are no equilibria apart from the ones identified in Propositions 1 and 2.*

Having established conditions under which it is impossible for the high types to achieve any degree of separation, we now turn to analyzing whether and how they might *endogenously* coordinate on a technology – the aforementioned "costly action" – that would guarantee equilibrium separation when this is not otherwise possible.

3.3. Equilibrium with the endogenous observable attribute

In this section we return to our full specification $u = U(\lambda_k, d(\theta_i, \lambda_k), D(a_i, \overline{a}_k))$. That is, we reintroduce an endogenous social attribute (action a_i) which allows individuals to endogenously affect group characteristics beyond their exogenous type, thereby also influencing the social distance of other individuals who want to identify with this group. The intuition is that individuals can produce visible characteristics that become typical for the group they identify with, e.g. a specific type of

[18] Of course, if one exists, then two exist, since group labels are interchangeable.

[19] Note that this result extends to *any* finite number of groups.

appearance (clothing, tattoos, body strength, status symbols) and this may deter others from joining. In our model, high types can – given segregation – increase the social distance between their group's stereotype and the low types by investing in such an endogenous attribute (read: by taking the costly action $a_i = 1$), as long as the low types do not themselves invest. It will be shown that this mechanism facilitates equilibrium segregation even when costs are not type-specific. We hence show how social identity concerns – or more specifically the threat of social free-riding – may explain why certain social groups develop and maybe even over-emphasize specific visible characteristics that do not simply follow from a direct intrinsic preference.[20]

3.3.1. Type-independent costs

Suppose action $a_i = 1$ carries a type-independent utility cost $c > 0$. Our question now is whether the high types can achieve equilibrium segregation by co-ordinating on the costly action when they could not otherwise have done so, that is, when the condition of Proposition 2 is not met in case no one (or everyone) produces the costly attribute: $U(1,1,0) > U(0,0,0)$. There exists a fairly intuitive set of sufficient conditions for this to be the case, which we now state as assumptions.

Assumption 2: (a) $U(0,1,0) \geq U(1,0,1)$ and (b) $U(1,1,0) - c \geq U(1,1,1)$.

High social status cannot compensate for the disutility from (maximal) action-based distance: if a group of high types were to coordinate on choosing the costly action $a_i = 1$,then no individual,whether of high (a) or low (b) type,would like to be in that group without choosing the costly action themselves. In other words,inequality (a) assumes that a high type would rather join the low social status group than belong to the high social status group without taking the costly action when everyone else in the high status group is taking the costly action. Inequality (b) says that a low type who joins the high social status group would rather take the costly action than suffer from action-based distance.[21] [22] Assuming this to be true, we can state and prove our final result.[23]

Proposition 3 *(Costly endogenous attributes facilitate segregation)*: *Suppose that $U(1,1,0) > U(0,0,0)$. If Assumption 2 holds, then there exists an open interval $\mathcal{I} \subset \mathbb{R}_{++}$ such that,for all $c \in \mathcal{I}$, a full-segregation equilibrium exists in which only the high types choose $a_i = 1$.*[24]

Proof. We construct an equilibrium in which high types choose group A and low types choose group B. Since $U(1,1,0) > U(0,0,0)$, this is not possible if either all individuals choose $a_i = 0$ or all individuals choose $a_i = 1$. Moreover, it cannot be an equilibrium if only the *low* types choose $a_i = 1$ since $U(1,1,0) > U(0,0,0) > \max\{U(0,0,1), U(0,0,0) - c\}$. Hence it must be the case that only the high types choose $a_i = 1$. The constraints that must be satisfied for this to indeed be an equilibrium are

$$U(1,0,0) - c \geq \max\{U(1,0,1), U(0,1,0)\} = U(0,1,0) \tag{2}$$

for the high types and

$$U(0,0,0) \geq \max\{U(1,1,0) - c, U(1,1,1)\} = U(1,1,0) - c \tag{3}$$

for the low types, where in both cases the second equality follows from Assumption 2. The low type constraint entails $c > 0$ since, again, $U(1,1,0) > U(0,0,0)$. Rearranging and combining Eqs. (2) and (3), we get the following necessary and sufficient condition for the existence of a feasible interval for the cost parameter:

$$U(1,0,0) - U(1,1,0) \geq U(0,1,0) - U(0,0,0).$$

This is always satisfied strictly since $U(1,0,0) > U(1,1,0)$ and $U(0,0,0) > U(0,1,0)$.∎

3.3.2. Type-specific costs

Proposition 3 shows that in the presence of a costly and observable endogenous attribute and sufficiently strong social distance with respect to this attribute, high types may be able to achieve equilibrium segregation even if production costs of these attributes are not type-specific. However, this segregation comes at a cost to the high types. If they were free to choose the technology c they would of course like to coordinate on the lower bound $c = U(1,1,0) - U(0,0,0) =: \underline{c}$ resulting from the low types' incentive constraint. This lower bound could be further lowered if actions with type-specific costs could be found. Specifically, any tuple (c_H, c_L), where $c_L > c_H > 0$ are the type-specific utility costs of some observable attribute, will generate a separating equilibrium given that $c_L \geq \underline{c}$ and $c_H \leq U(1,0,0) - U(0,1,0)$, conditions that by virtue of Proposition 3 are

[20] Note, however, that these endogenous attributes cannot be interpreted as status symbols (and, thus, signaling group status) since group status will still depend on the group's members' average θ.

[21] We thank an anonymous referee for proposing this very concise wording of the interpretation of our assumption.

[22] Both parts of Assumption 2 are easily satisfied by penalizing action-based distance sufficiently. We discuss this in more detail in our Appendix B, where we present different types of utility functions that satisfy Assumption 2.

[23] Assumption 2 is the tightest sufficient condition for segregation we were able to find at this level of generality. To obtain necessity, one must restrict the class of utility functions. We explore the very common restriction of additive separability in Appendix B.1 and show that in this case, part (b) of Assumption 2 becomes necessary for separation.

[24] "Generically unique" here means unique up to swapping the roles of groups A and B.

trivially satisfied whenever c_L is at its lower bound. If high types had some discretion in choosing such an exclusion technology from some feasible set $C \in \mathbb{R}^2_{++}$ of cost vectors, therefore, they would choose the element that minimizes c_H subject to $c_L \geq \underline{c}$.[25]

4. Robustness of findings

4.1. Symmetry of mixed strategy equilibrium

Our equilibrium specification involves a symmetry assumption which can be relaxed to one of "measure consistency" as follows: let p_A^i be individual i's probability of identifying with group A if i happens to be a high type individual (for low types the analogue is q_A^i). A measure-consistent mixed strategy equilibrium would then be a Nash equilibrium in which $\lambda_A = \frac{\lambda \hat{p}_A}{\lambda \hat{p}_A + (1-\lambda)\hat{q}_A}$, where $\hat{p}_A = \frac{1}{\lambda}\int_0^\lambda p_A^i di$ and $\hat{q}_A = \frac{1}{1-\lambda}\int_\lambda^1 q_A^i di$, and Proposition 1 goes through without modification, that is, the two social groups will in equilibrium be statistically indistinguishable in terms of their composition.

4.2. A more general specification of observed group status

Our assumption that a group's observed status equals the actual average of its members' contributions θ_i can be easily motivated, however our results can be generalized far beyond this special case to capture, or at least approximate arbitrarily closely, other interesting summary statistics. To see this, let $\hat{\lambda}_A$ denote group A's *observed* status – which now replaces λ_A as the first argument in individuals' utility functions – and define $\hat{\lambda}_A := \frac{(\mu p_A \lambda)^\kappa}{(\mu p_A \lambda)^\kappa + (q_A(1-\lambda))^\kappa}$, where $\mu, \kappa > 0$ are independent parameters.[26] Clearly, this specification nests our basic model ($\hat{\lambda}_A = \lambda_A$) by setting $\mu = \kappa = 1$. μ is a weighting factor and captures how salient the presence of high types is in a group. As μ tends to infinity, observed status tends to the indicator function $\mathcal{I}(p_A > 0)$ (one high type individual in the group is enough to yield maximal group status) whereas observed status tends to $1 - \mathcal{I}(q_A > 0)$ as μ tends to zero (one low type individual suffices to sink group status to a minimum). κ on the other hand controls the weight of the majority in a group, such that observed status tends to the group's median type as $\kappa \to \infty$. Conversely, and least interestingly for our discussion, $\hat{\lambda}_A$ tends to 1/2 as $\kappa \to 0$, which could be interpreted trivially as status being entirely unobservable or irrelevant. Crucially, all our results hold for all admissible values of (μ, κ). Finally, our results hold in spirit even under the corner assumptions "$\mu = 0$", "$\mu = \infty$" and "$\kappa = \infty$". These special cases are discussed in the Appendix A.

4.3. Coalition-proofness and finite-player considerations

Ours is a static, large-game framework. We chose it to illustrate as simply as possible a strategic tension which inevitably results from combining the basic tenets of Social Identity Theory and Self-Categorization Theory, the two components of the Social Identity Approach. In society at large, the assumption that any given individual's status is difficult to identify at first glance, and thus cannot significantly influence her social group's status, would seem natural, but of course the question arises how robust our social free-riding equilibrium is.[27] We will first address this question from a static perspective before turning to a dynamic one in the next subsection.

Our no-segregation equilibrium extends to a finite-player specification of our model where there are N_H high and N_L low types and hence each individual does have a measurable impact on group status. It is now unique among the symmetric mixed-strategy equilibria, requiring $p_A = q_A = 1/2$: otherwise a high type could profitably deviate toward the less populated group. Ruling out semi-separating equilibria ($p_A \neq q_A$) is a more nuanced operation, since low types need to balance their negative impact on group status against the reduction of social distance; it can be shown, however, that Assumption 1 is again sufficient to rule out such equilibria, acting as a tie-breaker. Hence again, if there cannot be full segregation in equilibrium, there can be no segregation at all. On the other hand, mixed-strategy equilibria especially in multi-player games are often knife-edge and hence it is no surprise that ours, too, fails a simple coalition-proofness test: any strictly positive measure of high types would, if they could so coordinate their choices, collectively deviate by putting probability 1 on the least populated group.

[25] There are possible worlds in which the cheapest type-discriminating technology in C is more expensive for the high types than the most expensive non-specific technology, but will nevertheless be chosen since the latter cannot achieve separation. See Section 5 for an application.

[26] $\hat{\lambda}_B$ is defined analogously.

[27] The fully segregating equilibrium can easily be made strict and is hence not part of the analysis here.

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4.4. Dynamics

What might happen if, starting from a situation of social free-riding, there were such a coordinated deviation? We can study this question by postulating a simple replicator equation of the type

$$\frac{\dot{x}_i}{x_i} = u(A|\theta_i, x_i, x_{-i}) - \mathbb{E}[u(\cdot|\theta_i, x_i, x_{-i})], \quad i \in \{H, L\}$$

where x_i denotes type i's probability of identifying with group A.[28] Assuming there exists no full-segregation equilibrium, then, the coalition's deviation would trigger a bandwagon effect as the remaining high types would immediately want to follow their peers. Under Assumption 1, the low types would follow suit, so that the high types could only achieve temporary segregation – asymptotically, absent any shocks, the entire population converges toward group A, leaving a vanishing group B populated mainly by low types. However, this extreme point is not an equilibrium, and so (assuming a permanent ongoing risk of small mutations) eventually, with probability 1, a positive measure of high types would deviate to the now essentially unpopulated group B, triggering the same pattern of flight and pursuit as before but in the other direction.[29] The same "flip-flopping" pattern would result under other, coarser monotone dynamics, notably myopic best-reply behavior, and is reminiscent of the fashion cycles pointed out in Pesendorfer (1995). The main point is that, even though the social free-riding equilibrium is easily upset, without recourse to a separation technology, the high types will not achieve permanent segregation.[30] If there is a strictly separating costly action, on the other hand, the resulting fully separating equilibrium is strict, therefore at least locally stable and hence, once reached, can only be upset by large deviations.[31]

5. Applications and discussion

Our model provides a unifying rationale for a series of phenomena related to social structure. For example, consider the social group of individuals active within a charitable organization. Several desirable characteristics, for example being altruistic and caring about the well-being of others, might usually be ascribed to such people, reflecting θ_H in our model. In our interpretation, it is this average group characteristic instead of their actions that creates the group's high social status. In the absence of a deterrence technology, less altruistic individuals themselves might also want to identify with this group due to its high social status. As a result, those individuals actually contributing to the group's high social status in the first place would suffer from social free-riding: The group stereotype changes due to the presence of low types who are not that altruistic, reducing the group's social status and increasing social distance between high types and the new group stereotype. This situation would resemble the social free-riding equilibrium. Now imagine that high types spend time on honorary activities and – maybe most importantly – cannot spend this time to earn money in a commonly paid job. In our model, this corresponds to the production of the observable attribute a_i, incurring (opportunity) costs c. Now, on the one hand, identifying with this high social status group without producing a_i oneself is not optimal, as it implies a deviation from the group stereotype such that the resulting disutility from social distance outweighs the potential gain in social status. On the other hand, if the costs for producing the attribute are high enough, they also outweigh the respective gain in social status following identification with the group. As a result, a_i constitutes a deterrence device, preventing low types from social free-riding, while θ_H type individuals, that is the actually altruistic individuals, nevertheless identify with this group bearing the respective costs. Only due to the additional disincentive c – which could in our example be interpreted as the material unattractiveness of charitable activities – high types are able to separate themselves and secure their group's high social status. If charitable activities were financially attractive, low types would also engage in them, thereby destroying the group's high social status.[32]

Another application is the existence of hazing rituals associated with identifying with certain social groups like gangs or fraternities. In our interpretation, complying with the ritual is not done in order to trigger an explicit permission to identify with the group – recall that individuals are fundamentally unrestricted in their identification decisions. Rather, it is done in order to reduce social distance to the group's stereotype by carrying out its characteristic action. Thus, the deterrence technology makes sure that only high types find it worthwhile to bear its costs.[33]

[28] Replicator equations are not normally defined for large games. We take this shortcut to illustrate a point rather than being formally exact. We also implicitly assume continuity of the utility function in this subsection.

[29] It is an unfortunate artefact of our large-game specification that the set of asymptotically stable rest points is not a subset of the Nash equilibria, as would be the case in any finite-player specification (see e.g. Weibull, 1995). Our assumption of permanent mutations (which can, for instance, be interpreted as reduced-form coordinated deviations) works around this pitfall. Specifically, imagine a stochastic process around the deterministic replicator dynamics whose mean field approximation exhibits constant-amplitude, constant-frequency cycles.

[30] Milchtaich and Winter (2002) in a related but different study point out a dynamic process in which separation may in fact be an asymptotically stable state.

[31] For an analysis of such large or accumulated deviations, see Young (1993).

[32] Note that while it would be plausible to assume that charitable activities should come at a lower utility cost to high types that assumption is not necessary in our framework.

[33] One can easily imagine the costs to carrying out the action to be type-specific. Imagine that the stereotypical member of a certain gang is supposed to have several tattoos. It might well be the case that the utility costs to get inked depend on the individual's type.

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Furthermore, our model provides an explanation for the existence of status symbols which differs from standard arguments of status signaling (Glazer and Konrad, 1996). Suppose θ_i reflects an individual's level of wealth and prosperity. Consequentially, a group consisting of primarily wealthy individuals also enjoys a high social status. However, it might be that although the average level of wealth within a group is easily observable, the same is not true for individual wealth (θ_i).[34] In such a situation, status goods can act as a deterrence mechanism: In our interpretation, the cognitive dissonance of deviating from the group's stereotype is too costly in order to identify with a specific social group without following its individual prescriptions like buying specific status symbols.[35] In standard signaling models, buying a status symbol would be required in order to signal being the wealthy type to others. In contrast, given the cognitive nature of social identity, in our interpretation it is done in order to minimize social distance.

From a theoretical perspective, the key mechanism in our model is driven by the fact that social distance and social status are evaluated with respect to the same entity – a group's stereotype – and are thereby linked. As a group's stereotype depends only on the characteristics and actions of its members, a strategically interdependent situation arises whose nature explicitly hinges on the connection of status and distance: If a group's stereotype only affected social distance, the resulting strategic situation would not carry a conflict of interest. In contrast, if it only affected social status, free-riding could not be prevented without type-specific technologies. However, precisely due to its additional effect on social distance, a “better” (in the sense of a higher λ) group stereotype serves high types more than low types, as it reduces social distance for the former and increases it for the latter. It thus allows high types to realize a net benefit even if carrying the costs of a deterrence mechanism.

Once one considers the more general case of group formation, it appears interesting and worthwhile to more explicitly analyze the interaction of social distance and social status in situations where both dimensions are derived more separately than in our current framework. Such an extension may give rise to other strategic considerations and consequently very different theoretical mechanisms than the one we illustrate. However, as stated above, we feel that this analysis lies beyond the scope of this paper as it would distract from the particular theoretical mechanism we want to highlight, and thus leave it as a potential avenue for future research. We feel that our framework provides a useful conceptual underpinning for such an endeavor. For instance, one could consider expanding the model to feature a two-dimensional type space – which in the simplest version would imply four different types – and see how these interact in our basic group formation problem.

In our model the costly action affects group status at most indirectly, by enabling type segregation. One could of course extend the analysis and allow for a direct effect on group status. As long as that effect is weak, our result on segregation goes through. Once the direct effect dominates, however, segregation is impeded by two forces: one, the free-riding motive for low types becomes too strong (joining the high-type group becomes more profitable for a given cost c); and two, even within the group of high types a free-riding problem now emerges (remaining in the high-type group but avoiding the costly action).

There are some papers related to ours. Our setup is similar to that of Shayo (2009) in the sense that both analyze individuals' decisions to identify with social groups, focusing on the effects of social status and social distance. However, the mechanism we document is quite different: Shayo shows how social identity considerations are able to explain why individuals are willing to support policies which are not maximizing their individual material payoff. The driving force behind this possibility is that poor individuals can benefit from sacrificing their own material payoff as this increases their nation's social status. In some sense, the model thus explains how adopting an identity based upon an attribute shared by others (nationality) leads to internalizing their material payoffs due to social identity considerations. In Shayo's model, group status depends on (1) exogenous factors and (2) a group's material payoffs relative to a reference group. Social distance to a particular group is exogenous. In contrast, our model features a more explicit conflict of interest, as both group status and social distance only depend on group stereotypes which arise endogenously and depend on actual group members' characteristics and actions. It is the endogenous group stereotype (and, thus, the endogeneity of group status and social distance to individual identification choices) that gives rise to the notion of social free-riding in our model. It thus lies at the heart of our paper, as it motivates deterrence behavior later on. Shayo's model, in contrast, does not feature social free-riding and consequently also no motive for deterrence. In his model, it is actually good for the rich if the poor identify with the nation as this yields lower taxes and a higher social status (but no effect on social distance).

Kosfeld and von Siemens (2011) analyze a mechanism of a spirit similar to ours within the context of corporate culture and preferences for cooperation. How seemingly unproductive behavior to reduce free-riding can emerge endogenously within groups in the religious context is analyzed by Iannaccone (1992). Aimone et al. (2013) provide experimental evidence and test the role of voluntary sacrifice for group formation. However, in contrast to our approach, these studies either focus on cooperation behavior and/or analyze situations in which screening out low types provides an additional benefit to in-group members as it also affects the relative costs of carrying out the costly action. Another closely related paper is Chen et al. (2015). They experimentally investigate segregation in a decentralized matching framework with complementarity of the production function. Similar to the mechanism presented in our paper, their results show that high types prefer to segregate. In contrast to our approach, low types risk being rejected by their high type matching partner. When being able

[34] In general, you know that people who identify with the social group “banker” are wealthy although you cannot surely tell for every individual who identifies with this social group.

[35] Once again, note that although these status symbols can act as a signaling device which reduces social distance with respect to the endogenous social attribute, they do not add to the group's social status in this approach.

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to choose among two different markets (one with an entry fee, one without), high types are more likely to choose the second one – the one without entry fee – yielding a situation in which low types choose to enter the costly market and pay entry costs to lower the probability of an unsuccessful match with a high type.

6. Conclusion

In this paper, we shed new light on the role of social identity in economic decision-making. We shift the focus from the effects of existing group identities on individual behavior to the analysis of individual identification decisions. We build on three key insights from the Social Identity Approach: (1) Individuals decide which social groups to identify with, which makes social identity explicitly endogenous. (2) Individuals derive utility from social status of groups they identify with and prefer high status groups to low status groups. (3) Individuals suffer from being more different as compared to their groups' stereotypes (social distance). A key novelty of our approach is that social status of groups and their respective stereotypes depend on which individuals identify with them. They are thus determined by individuals' decisions which groups to identify with, rendering identification choices strategically interdependent.

Our model analyzes this interdependency of individual identification decisions and social structures. We impose two types of individuals which either make a high contribution to a group's social status (high types) or a low one (low types). As first central result, we find that if social status matters sufficiently in comparison to social distance, social free-riding occurs: Low types want to benefit from high types' contributions to group status, thereby reducing overall social status of the group and increasing social distance to the endogenous group stereotype, thus harming original group members. The second central result shows that high types can exploit endogenously determined social attributes to deter low status individuals from social free-riding. We thereby show how social identity concerns and the threat of social free-riding might explain specific patterns in observable group characteristics.

The fact that previous research has found large effects of group identities on behavior underpins the potential relevance of our theoretical mechanism, as it improves our understanding of how the societal structures these group identities are formed upon actually emerge in the first place.

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Appendix A. Alternative summary statistics for group status – extreme cases

We here briefly discuss the extreme cases of our generalized specification for group status as discussed in Section 4.2. While these special cases are much less congruent with our assumptions on the observability of individual status, they are frequently used summary statistics. We focus on two aspects, (a) the existence condition for a fully segregating equilibrium and (b) the existence and uniqueness of our *social free-riding* equilibrium. Again, all equilibria pointed out have mirror images that are obtained by swapping indices A and B.

A.1. "Min" specification

Suppose a group's status is determined by its member with the lowest type. Then $\lambda_k = 0$ for any group in containing at least one low type.[36] Then segregation becomes easier for the high types since the low-type incentive constraint now reads $u(0,0) \leq u(0,1)$ and it follows from our basic assumptions that this is always true.

The set of mixed-strategy equilibria is now huge since any $1 > q_A > 0$ now yields status 0 in both groups, making all players trivially indifferent. In spirit, all of these equilibria are *social free-riding* equilibria since there is no way for the high types to achieve any degree of segregation.

[36] A somewhat relaxed specification would be that $\lambda_k = 0$ for any group containing a strictly positive *measure* of low types. In this case, the low-type incentive constraint is entirely unaltered and nothing changes compared to our baseline case.

A.2. "Max" specification

Suppose a group's status is determined by its highest-type member. Then the low-type incentive constraint, which is the existence condition for our full-segregation equilibrium, is left unchanged. As for the mixed strategies, it is now easy to see that any $1 > p_A > 0$ yields status 1 in both groups, again yielding a large set of equilibria which are again all non-segregating.

A.3. "Median" specification

Suppose finally that a group's status is determined by the median status among its members. The first thing to note is that, each individual being infinitesimally small, the low-type incentive constraint is again unchanged. When studying mixed strategies, details depend on the type mix in the original population and we need to separate two cases:

$\lambda = \frac{1}{2}$: Proposition 2 is entirely upheld, i.e. any $p_A = q_A =: \overline{p} \in (0,1)$ forms a mixed-strategy equilibrium with status 1/2 in both groups. All of these equilibria are entirely non-segregating and (even without Assumption 1) there are no other mixed-strategy equilibria: as soon as $p_A \neq q_A$, status is 1 in one group and 0 in the other, implying high types have a profitable deviation.

$\lambda > \frac{1}{2}$: All $p_A = q_A =: \overline{p} \in (0,1)$ are still equilibria, but now even $p_A > q_A$ can be sustained in equilibrium as long as $(1-p_A)\lambda > (1-q_A)(1-\lambda)$ since group status will still be 1/2 in either group and hence all players indifferent. Any $p_A \neq q_A$ outside the so defined range can however not be sustained in equilibrium for the same reason as above, namely that status would be 1 in one group and 0 in the other. The case $\lambda < \frac{1}{2}$ is treated entirely analogously.

Appendix B. Utility functions satisfying Assumptions 1 and 2

In this section we shall argue that Assumptions 1 and 2, while somewhat restrictive, are not that difficult to satisfy. Especially Assumption 2, which has two parts, turns out to be relatively innocuous since all that is required to satisfy both inequalities is a sufficiently high penalty on action-based distance. Simultaneously satisfying Assumption 1 may impose additional restrictions. We proceed constructively in this section, outlining classes of functions that do the job rather than providing a full characterization.

To begin with, let $f, g, h \in C^1$ be three strictly monotonically increasing functions mapping the unit interval onto itself (this normalization of ranges is without loss of generality since scaling can be addressed with the free parameters introduced below). Now, first suppose that U is additively separable in its arguments, such that we can write

$$U(\lambda, d, D) = \alpha f(\lambda) - \beta g(d) - \gamma h(D)$$

with $\min\{\alpha, \beta, \gamma\} > 0$. Satisfying both parts of Assumption 2 now simply requires (a) $\gamma \geq \alpha + \beta$ and (b) $\gamma \geq c$, which is easily ensured by choosing γ sufficiently high. Additionally satisfying Assumption 1 is possible if either $f = g$ (choose any $\alpha > \beta$) or the derivatives of f and g are bounded (choose α sufficiently above β). With $f \neq g$ and unbounded derivatives, on the other hand, Assumption 1 may be impossible to satisfy. Letting e.g. $f(x) = x^{\frac{1}{2}}$ and $g(x) = x^{\frac{1}{4}}$, it is easy to see that there for every tuple $\{\alpha, \beta\}$ exists $\tilde{x}_{\alpha\beta} \in (0,1)$ such that $\alpha f(x) - \beta g(x) < 0$ for all $x \in (0, \tilde{x}_{\alpha\beta})$.

Any strictly monotonically increasing transformation of our additively separable specification yields identical conditions. Letting for instance $\hat{x} := -e^{-x}$ we obtain the commonly used exponential utility function

$$\hat{U} = -e^{-U} = -e^{-(\alpha f(\lambda) - \beta g(d) - \gamma h(D))} = \hat{f}^{\alpha} \hat{g}^{-\beta} \hat{h}^{-\gamma},$$

from which it follows that this widely used class of utility functions can also be made compatible with our assumptions.

Finally, we can show that the above insights still roughly translate (with a caveat) to the case where U is multiplicative. The caveat is that U may not be well-defined (the problem being division by 0), necessitating the use of some "shifters". Possibly the simplest example of an easy-to-handle multiplicative specification is the function

$$U(\lambda, d, D) = \frac{1 + \alpha f(\lambda)}{(1 + \beta g(d))(1 + \gamma h(D))},$$

which can be made to satisfy Assumptions 1 and 2 with restrictions almost identical to those derived in the additively separable case (γ sufficiently large and $\alpha > \beta$; $f = g$ or bounded derivatives on both). In sum, we argue that Assumptions 1 and 2, while seemingly restrictive, do admit some widely used classes of utility functions.

B.1. From sufficiency to necessity

Assumption 2 is the tightest sufficient condition for separation we were able to find at this level of generality. In general, depending on the specific choice of utility function, it is possible for Assumption 2 to be violated while equilibrium segregation is still possible. To obtain insights into necessity, one must restrict the class of utility functions. Using our additively separable specification as an example, we here show that part (b) of the Assumption is in fact necessary for segregation in that class of utility functions.

Let $U(\lambda, d, D) = \alpha f(\lambda) - \beta g(d) - \gamma h(D)$ as above. Then, as shown, the two parts of Assumption 2 boil down to $\gamma \geq \max\{\alpha+\beta, c\}$. The two incentive constraints (for high and low types, respectively) simplify to

$$\alpha - c \geq \max\{\alpha - \gamma, -\beta\}$$

and

$$0 \geq \max\{\alpha - \beta - c, \alpha - \beta - \gamma\}$$

From Proposition 3 we know that segregation is always possible when both parts of Assumption 2 are satisfied: in particular, for our specification, from the incentive constraints we get $c \in [\alpha - \beta, \alpha + \beta] \cap \mathbb{R}^+$, which always contains an open interval. We now discuss the three alternatives: (i) part (a) is violated and part (b) satisfied; (ii) (a) is satisfied and (b) violated; and (iii) both parts are violated.

(iii) Suppose both parts are violated, so $\gamma < \min\{\alpha+\beta, c\}$. It is then impossible to satisfy the high-type incentive constraint, which now reads $\gamma \geq c$. Hence segregation is not possible in equilibrium.

(ii) Here we have $c > \gamma \geq \alpha + \beta$, which is in direct contradiction to the high-type constraint $\alpha + \beta \geq c$. Hence segregation is not possible in equilibrium.

(i) Finally, in this case we have $\alpha + \beta > \gamma \geq c$, which implies the high-type incentive constraint is always satisfied. Taking into account also the low-type incentive constraint, we obtain $(\alpha + \beta >)\gamma \geq c \geq \alpha - \beta$, an interval which may or may not be empty depending on parameter choices. For instance, choosing $\alpha = 6$, $\beta = 2$ and $\gamma = 5$ yields a nondegenerate interval for c to achieve segregation.

In conclusion, we see that part (b) of Assumption 2, that is $\gamma \geq c$, is necessary but not sufficient for segregation if U is additively separable. In words, action-based distance must be sufficiently important. Part (a) is in itself neither necessary nor sufficient.

Appendix C. Semi-separating equilibria when Assumption 1 is violated

Suppose there exists $\lambda^* \in (0,1)$ such that $U(\lambda^*, \lambda^*) = U(0,0)$. Then there exists another equilibrium (modulo relabeling) in which all high types locate in group A while low types mix between A and B such that $\lambda_A = \lambda^*$ (and $\lambda_B = 0$). Low types are then by construction indifferent while high types strictly prefer the higher-status group. This also implies that if there are several "crossing points" $\{\lambda_1^*, \ldots, \lambda_k^*\}$ there exist k additional equilibria with status λ_k^* in group A and status 0 in group B (again modulo relabeling). The key point that a *fully* separating equilibrium does not exist whenever $U(1,1) > U(0,0)$ is however unaffected by the status of Assumption 1.

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