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## Ethnic stereotypes and preferences on poverty assistance

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## **Ethnic Stereotypes and Preferences on Poverty Assistance**

*Ágnes Horváth and Béla Janky*

**Abstract**

The authors introduce a simple model of public preferences on poverty assistance. Their focus is on the roles played by the socioeconomic status of a potential welfare recipient and the stereotypes about his/her ethnic group in shaping taxpayers' preferences on appropriate assistance. The model assumes that status not only informs one about the recipient's material needs but also sends noisy signals about his/her 'deservingness'. Ethnic stereotypes about work ethic, in turn, help to process those noisy signals. The authors show that the influence of stereotypes on welfare preferences tends to diminish as the status of a potential recipient approaches middle-class standards. Their model points to the potential of institutional and media framing of poverty assistance in the ethnicization of welfare preferences.

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**Keywords** Poverty assistance; welfare preferences; social preferences; deservingness; stereotypes

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## 1 Introduction

Fighting poverty is an enduring task even in affluent postindustrial societies. What is more, the image of the poor is often ethnicized which makes the designing of public poverty assistance programs not only an economic policy question, but a politically sensitive challenge as well. A number of studies concluding that the stigma on poverty would be stronger where low status was identified with some ethnic minority groups (Gilens, 1999; Alesina and Glaeser, 2004) have attracted considerable attention in the past decade.

However, the 'heterogeneity kills solidarity' thesis has also been subject to strong critique (e.g. Albrekt-Larsen, 2006); and cross-country investigations of attitudes and actual spending provide mixed evidence (e.g. Soroka et al., 2006; Finseraas, 2009; Dahlberg et al., 2012).

In this paper, we shed light on a possible mechanism that could partly account for the complex relationship between ethnic heterogeneity, image of the poor and public support for poverty assistance. We draw on psychological theories regarding poverty attributions and stereotypes in order to explore the interplay of perceived poverty and ethnic prejudice in the process of forming judgments on welfare recipients. Our model could support the conjecture that taxpayers' judgments on the very poor (as opposed to the moderately poor) are particularly prone to the influence of (ethnic) stereotypes.

In the next section, we contrast the popular 'ethnic preferences' model with a more nuanced view on the mechanisms leading to the ethnicization of welfare preferences. We introduce our model of preferences on poverty assistance in Section 3. This model relies on deservingness as a key concept in the taxpayer's mind, and incorporates the concept of stereotype as a prior belief relating to deservingness. It also assumes that a welfare recipient's socioeconomic status does not only bear implications regarding the extent of material needs, but also sends noisy information about his/her deservingness. Some crucial implications of the model are presented in Section 4. In particular, we show that the influence of stereotypes on welfare preferences tends to diminish as the status of a potential recipient approaches middle-class standards. Section 5 shortly addresses the possible lessons learned from our model.

## 2 Ethnicization of Welfare Preferences

Freeman (1986) and Weede (1986) warned already early on in the 1980s that the popularity of the welfare system may deteriorate in societies where poverty is ethnicized. More recently, Alesina and Glaeser (2004) has explored this idea in more depth. Arguments based on ethnic preferences may easily be employed to take account of the evidence on the ethnicization of welfare attitudes. Ethnic preferences imply a desire to discriminate among ethnic groups. In other words, individuals give larger weight to the wealth of their own ethnic group members than that of needy people belonging to other groups. Such assumptions have been used in several political economy models and empirical analyses of welfare preferences (e.g Luttmer, 2001; Dahlberg et al., 2012; Lindqvist and Ostling, 2013).

However, Alesina and Glaeser's (2004) provocative hypothesis regarding the coming era of welfare state retrenchment following mass immigration in Europe has been subject to strong critique; and some scholars have questioned whether heterogeneity kills solidarity in any institutional setting (Taylor-Gooby, 2006; Albrekt-Larsen, 2006; Albrekt-Larsen and Dejgaard, 2013). In fact, the results of expanding the 'heterogeneity kills solidarity' hypothesis to a wider variety of welfare regimes seem to be mixed. The findings of Dahlberg et al. (2012) have supported Alesina and Glaeser's (2004) analysis. A series of other empirical studies, on the other hand, have not (e.g. Finseraas, 2009; Mau and Burkhardt, 2009; Stichnoth and Straeten, 2009).

The ethnic preferences model, i.e. the simplest proposed underlying mechanism supporting the hypothesis, has also been criticized. Habyarimana et al. (2007), for instance, directly test the mechanisms that may undermine public good provision in ethnically heterogeneous communities. They reject the ethnic preference hypothesis and suggest network based explanations instead.

The classical psychological theory of attributions also provides an alternative to the ethnic preference model. This approach traces the ethnicization of welfare preferences back to stereotypical beliefs about the personality traits of the poor. In this framework, taxpayers are ready to support those whose poverty is a result of bad luck but not a lack of efforts. Stereotypes about the work ethic of the (perceived) target groups influence taxpayers' judgments of responsibility. These

judgments, in turn, determine what they see as *deserved* assistance. Empirical evidence seems to support this approach. Questionnaire surveys show that when individuals form opinions about poverty assistance, a primary concern is whether welfare recipients deserve the benefits they receive (Iyengar, 1991; Cook and Barrett, 1992; Gilens, 1999; Van Oorschot, 2000; Albrekt-Larsen, 2006; Petersen et al., 2011). In particular, these surveys find that people's perceptions of recipients' effort to find work drive welfare opinions. For example, Gilens (1999) argues that middle-class Americans would be ready to support the deserving poor, but the media generates an impression that the majority of the poor is undeserving: it tends to classify needy people as predominantly black who have long been stereotyped as lazy. This urges many Americans to oppose public poverty assistance programs. Note that a similar approach has already been present in economic research on poverty assistance (Fong, 2001).

Our formal model draws on the above theoretical underpinnings. We incorporate one additional factor, however. We not only distinguish the poor from the non-poor. Instead, our model treats the potential recipient's socioeconomic status as a continuous variable (c.f. Janky and Varga, 2013). We assume that the degree of the beneficiary's poverty is an important information for the benevolent taxpayer. As the degree of poverty increases, so does the appropriate amount of pecuniary assistance. But there is another side of the coin: a lack of economic success inevitably raises doubts about the target person's own efforts to escape dependence on other people's help. Those doubts increase as status decreases. Stereotypes about the potential recipient's personality also play a crucial role: they can moderate the inferences taxpayers may draw from observing the recipient's status. Stereotypes are modelled as the taxpayer's prior beliefs on the potential recipient's work ethic. These beliefs could be modified in light of the recipient's observed status.

Our model of preferences on poverty assistance follows Besley and Coate (1992) (see also Alesina and Angeletos, 2005). They also assume that voters intend to help distressed and deserving individuals but are uncertain about the recipients' behavioral traits. In a companion paper, Janky and Varga (2013) introduce a model which is fairly similar to the subsequent one. Nonetheless, that model does not address the role of group-specific stereotypes.

### 3 A poverty-assistance model

In this section, we develop a simple model of compassionate citizens' preferences on the optimal level of compensation for a poor individual. In the model, poverty assistance is based on the deservingness principle and we use observable socioeconomic status as a noisy signal for effort. The model predicts that, due to imperfect observation of the poor person's actual opportunities and behavioral traits, larger misfortune may lead to smaller compensation. We also show that the level of poverty has an impact on the influence of prior stereotypes on the degree of compensation.

Let us denote by  $N$  the set of adult individuals of a society in which members are bound together by norms of solidarity. Citizens of this society adopt a naïve model for understanding their fellow citizens' varying economic performances. They assume that the economic success of an adult individual  $j \in N$  is a function of personality traits and situational factors. Thus,  $w_j = g(e_j, f_j)$ , where  $w$  is a measure of living standards,  $e_j$  is the level of effort  $j$  has made to earn money, and  $f_j$  is the overall effect of fate or fortune.

Let us start with a simple model of the compassionate citizen's ( $i$ ) preferences over poverty:

$$U_i = V(w_i) + \sum_j D_{ij}(w_j, e_j, f_j) \quad (1)$$

where  $D_{ij}$  expresses  $i$ 's (dis)utility stemming from her observing of the distress of misfortunate fellow citizens. In the subsequent analysis we concentrate on the pure effects of social preferences, namely,  $D_{ij}$ . In this way, we simplify our analysis without altering our qualitative results.

Consider the citizen's simple model of economic success which assumes that current socioeconomic status is the sum of the effects of efforts and fortune, that is  $w_j = e_j + f_j$  (c.f. Alesina and Angeletos, 2005). Two types of individuals are supposed to exist: lazy and diligent ones. Lazy people exert zero effort, diligent ones exert high efforts. That is,  $e_j = 0$  or  $h$ , where  $h > 0$ . As  $f_j$  accumulates all the factors the taxpayer is ready to compensate  $j$  for,  $f$  is modeled as a continuous

variable and its conditional distribution is:  $f | e = 0 \sim N(0, 1)$ ,  $f | e = h \sim N(0, r)$  where  $1 < r$ . By introducing  $r$ , we capture the interaction between effort and fortune within the framework of a simple additive model (for a different solution, see Janky and Varga, 2013).

The compassionate citizen (she) cares about those whose living standards fall below the average of the diligent citizens, and exert high effort. Observing a fellow citizen, her (dis)utility function takes the following form:

$$\begin{aligned} D_{ij} &= 0 \quad \text{for } w_j \geq h \quad \text{or } e_j = 0, \text{ and} \\ D_{ij} &= w_j - h \quad \text{for } w_j < h \text{ and } e_j = h \end{aligned} \tag{2}$$

Social preferences imply a support for assistance that compensates a (relatively) low status and diligent  $j$  for bad fortune:  $c_{ij} = h - w_j$ .

However, the compassionate citizen faces an observational problem. While an individual's socioeconomic status can be observed by fellow citizens, efforts and fortune are private information. Any citizen's decision regarding the optimal degree of compensation is supported by a) her observation of the potential recipient's status, b) her stable beliefs in a specific model of income generation (based on the above parameters), and c) her prior assumption regarding the recipient's personality ( $e_j$ ).

The benevolent citizen maximizes her social preference-based expected utility by supporting a compensation  $c_{ij} = (h - w_j)Pr(e_j = h | w_j, p_{ij})$ , where  $p_{ij}$  is the prior likelihood of  $j$  being diligent ( $i$ 's stereotype on  $j$ 's personality).<sup>1</sup>

## 4 Status, Stereotypes and Poverty Assistance

Similarly to the model presented by Janky and Varga (2013), our analysis highlights the possibility that the stigmatizing effect of poverty could overwhelm the feelings of solidarity induced by distress. We refer to this phenomenon as the '*poverty-assistance paradox*'. Our Proposition 1 delineates conditions under which this kind of paradox may arise.

<sup>1</sup> See A.1 and A.2 in the Appendix for a detailed analysis of the optimal level of the compensation.

Let us denote by  $c_{ij}$  the optimal level of compensation.

**Proposition 1** (*Poverty-assistance paradox.*) *In the simple poverty-assistance model, there always exists a small enough  $w_j$  relative to  $h$  and low enough values of  $\underline{p} > 0$  and  $\underline{r} > 1$  such that  $\frac{\partial c_{ij}^*}{\partial w_j} > 0$  holds for all  $0 < p_{ij} < \underline{p} < 1$  and  $1 \leq r < \underline{r}$ . See appendix for the proof.*

In other words, a negatively stereotyped poor person (values of  $p_{ij}$  and  $w_j$  are low) faces a risk of losing (support for) transfers as he becomes even poorer, in spite of the fact that the compassionate citizen's social preferences would dictate full compensation of the deserving poor people for any loss of income. What is more, even the a priori better trusted individuals could experience the effect of the poverty-assistance paradox should they become poor enough. Corollary 1 explicates this statement.

**Corollary 1** *In the simple poverty-compensation model, one can always find low enough values  $\underline{w}$  and  $\underline{r} > 1$ , such that  $\frac{\partial c_{ij}^*}{\partial w_j} > 0$  holds for all  $w_j < \underline{w}$ ,  $1 \leq r < \underline{r}$  and  $0 < p_i < 1$ . See appendix for the proof.*

The poverty-assistance paradox stems from the signal low status sends about the lack of efforts in a society in which citizens believe that luck plays only a minor role in economic success ( $r$  is small). However, Proposition 1 and its corollary on the poverty-assistance paradox do not tell us anything about the varying effects of stereotypes.

As far as the role of stereotypes is concerned, it is easy to see that the amount of preferred compensation  $c_{ij}^*$  increases in  $p_{ij}$  at any level of  $w_j < h$  (see A.5 in the Appendix). That is, the more the taxpayer trusts the poor recipient, the larger transfer she is ready to allocate to him.

The question remains, however, of how the effect of prior stereotypes depends on the recipient's status? Previous research suggests that ambiguous information reinforces the role of stereotypes in human decision making. A basic tenet of our theory is that low status tends to be perceived as a noisy signal of laziness. On the other hand, mid-level status may be a strong signal of deservingness. At certain levels of the status hierarchy neither positive nor negative signals prevail. This type of ambiguity lays the ground for stereotype-based judgments.



Proposition 2 describes the conditions under which compassionate citizens increasingly base their judgments about assistance on prior stereotypes (positive and negative alike) as the recipients become poorer.

**Proposition 2** (*Positive poverty-stereotype interaction*). *In the simple poverty-compensation model, there always exist a  $\underline{w} < h$  close enough to  $h$  and high enough values  $\underline{p} < 1$  and  $\underline{r}$ , such that  $\frac{\partial c_{ij}^*}{\partial w_j \partial p_{ij}} < 0$  holds for all  $\underline{w} < w_j < h$ ,  $0 < \underline{p} < p_{ij} < 1$  and  $1 \leq \underline{r} < r$ . See appendix for the proof.*

The positive poverty-stereotype interaction means that the difference between compensation of two equally poor, but differently stereotyped individuals increases as they become poorer.

To sum up, while the poverty-assistance paradox stems from the strong negative signal low status sends about personality, the positive poverty-stereotype interaction is fostered by the lack of a strong positive signal in cases where one's status is not high enough.

## 5 Conclusion

In this paper, we have presented a simple model of a compassionate citizen's (social) preferences on the optimal level of assistance for a poor individual. In the model, poverty assistance is based on the deservingness principle; and the citizen uses observable status as a noisy signal for effort. The model predicts that due to imperfect observation of the poor person's actual opportunities and behavioral traits, larger misfortune may lead to smaller compensation (c.f. Janky and Varga, 2013).

The crucial implication of our model regards the variability of the influence of stereotypes. This characteristic differentiates our approach from ethnic-preference models. In particular, we have shown that the impact of negative stereotypes on the preferred assistance may diminish as the target person's status converges on middle-class standards.

Questions remain, however, about the ranges of parameters and the levels of socioeconomic status for which the positive interaction could emerge. Preliminary

simulations suggest that under realistic parameter values, stereotypes tend to matter more in judging those belonging to the poorest 1-3 percent than those around the 10th-15th percentile from below.

This tendency is in line with our recent empirical findings (Janky et al., 2014). Based on a video-vignette experiment we investigated the influence of a potential welfare recipient's characteristics on the respondents' preferences on poverty assistance. The ethnic context played a minor role in shaping attitudes when hints of moderate poverty were presented. In contrast, when facing reports on a severely distressed community, subjects reacted strongly to ethnic cues. Nonetheless, the experiment was not a direct test of our model.

Future research could address the parametrization of the model by extended simulations and empirical validations. Moreover, a political economy model of voting on poverty assistance could also bring our rational choice analysis closer to the empirical evidence on policy preferences.

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## A Appendix

### A.1 Optimal compensation level $c^*$

We assume that  $w = e + f$  where  $e$  is a discrete variable, and its distribution is:  $\Pr(e = 0) = 1 - p$  and  $\Pr(e = h) = p$ ;  $f$  is a continuous variable and its conditional distribution is:  $f | e = 0 \sim N(0, 1)$ ,  $f | e = h \sim N(0, r)$  where  $1 < r$  (we denote the conditional distributions by  $f_1$  and  $f_r$ , respectively). Then,

$$\begin{aligned} c^* &= (h - x) \Pr(e = h | w = x) \\ &= (h - x) \frac{\Pr(e = h) \Pr(w = x | e = h)}{\Pr(w = x)} \\ &= (h - x) \frac{\Pr(e = h) \Pr(h + f_r = x)}{\Pr(e = h) \Pr(h + f_r = x) + \Pr(e = 0) \Pr(f_1 = x)} \end{aligned} \quad (3)$$

Because of continuity of  $f$  and  $h$  being a constant we get:

$$\begin{aligned} c^* &= \lim_{\varepsilon \rightarrow 0} (h - x) \frac{\Pr(e = h) \Pr(f_r \in [x - h, x - h + \varepsilon])}{\Pr(e = h) \Pr(f_r \in [x - h, x - h + \varepsilon]) + \Pr(e = 0) \Pr(f_1 \in [x, x + \varepsilon])} \\ &= \lim_{\varepsilon \rightarrow 0} (h - x) \frac{p [F_r(x - h + \varepsilon) - F_r(x - h)]}{p [F_r(x - h + \varepsilon) - F_r(x - h)] + (1 - p) [F_1(x + \varepsilon) - F_1(x)]} \\ &= (h - x) \frac{p \Phi_r(x - h)}{p \Phi_r(x - h) + (1 - p) \Phi_1(x)} \end{aligned} \quad (4)$$

Note that

$$\Phi_r(x - h) = \frac{1}{\sqrt{2\pi r^2}} e^{-\frac{(x-h)^2}{2r^2}} \quad \text{and} \quad \Phi_1(x) = \frac{1}{\sqrt{2\pi}} e^{-\frac{x^2}{2}}$$

where  $e$  stands for the base of natural logarithm.

## A.2 Marginal change of $c^*$ implied by changing $x$

$$\begin{aligned}
 \frac{\partial c^*}{\partial x} &= \frac{\partial \left( (h-x) \frac{p\Phi_r(x-h)}{p\Phi_r(x-h) + (1-p)\Phi_1(x)} \right)}{\partial x} \\
 &= -\frac{p\Phi_r(x-h)}{p\Phi_r(x-h) + (1-p)\Phi_1(x)} \\
 &\quad + (h-x) \frac{p\Phi_r'(x-h) [p\Phi_r(x-h) + (1-p)\Phi_1(x)]}{[p\Phi_r(x-h) + (1-p)\Phi_1(x)]^2} \\
 &\quad - (h-x) \frac{p\Phi_r(x-h) [p\Phi_r'(x-h) + (1-p)\Phi_1'(x)]}{[p\Phi_r(x-h) + (1-p)\Phi_1(x)]^2}
 \end{aligned} \tag{5}$$

We know that

$$\begin{aligned}
 \Phi_r'(x-h) &= -\frac{x-h}{r^2} \Phi_r(x-h) \quad \text{and} \\
 \Phi_1'(x) &= -x\Phi_1(x)
 \end{aligned}$$

Hence,

$$\begin{aligned}
 \frac{\partial c^*}{\partial x} &= \frac{-p\Phi_r(x-h)}{p\Phi_r(x-h) + (1-p)\Phi_1(x)} + (h-x) \frac{p\Phi_r(x-h) \left(-\frac{x-h}{r^2}\right) [p\Phi_r(x-h) + (1-p)\Phi_1(x)]}{[p\Phi_r(x-h) + (1-p)\Phi_1(x)]^2} \\
 &\quad - (h-x) \frac{p\Phi_r(x-h) \left[ p\Phi_r(x-h) \left(-\frac{x-h}{r^2}\right) + (1-p)\Phi_1(x)(-x) \right]}{[p\Phi_r(x-h) + (1-p)\Phi_1(x)]^2} \\
 &= -\frac{p\Phi_r(x-h) [r^2 p\Phi_r(x-h) + (1-p)\Phi_1(x)(r^2 - (x-h)^2 + xr^2)]}{r^2 [p\Phi_r(x-h) + (1-p)\Phi_1(x)]^2}
 \end{aligned} \tag{6}$$

Using the substitutions  $a = -\frac{(h-x)^2}{2r^2}$  and  $b = -\frac{x^2}{2}$  we get:

$$\frac{\partial c^*}{\partial x} = \frac{-pe^a}{r^2 [pe^a + (1-p)e^b]^2} \left[ r^2 pe^a + (1-p)e^b (r^2 - (x-h)^2 + xr^2) \right] \tag{7}$$

where  $e$  stands for the base of natural logarithm.

### A.3 Proof of Proposition 1

Based on (7) one can express the conditions for the poverty assistance paradox as follows:  $\frac{\partial c_i^*}{\partial x} > 0$  iff  $uv > 0$ , where

$$u = -\frac{pe^a}{r^2 [pe^a + (1-p)e^b]^2}, \quad \text{and} \quad v = r^2 pe^a + (1-p)e^b(r^2 - (x-h)^2 + xr^2)$$

One should see immediately that  $u < 0$  for any  $0 < p < 1$  and  $1 < r$ , and for any values of  $x$  and  $h$ . Hence, iff  $v < 0$ , then the poverty-assistance paradox exists. That is, iff

$$r^2 pe^a + (1-p)e^b(r^2 - (x-h)^2 + xr^2) < 0 \tag{8}$$

then Proposition 1 holds. Rearranging (8), we get

$$\begin{aligned} r^2 pe^a + (1-p)e^b r^2(1+x) &< (1-p)e^b(x-h)^2 \\ \frac{p}{1-p} e^{a-b} + (1+x) &< \frac{(x-h)^2}{r^2} \end{aligned} \tag{9}$$

Recall, that  $a = -\frac{(h-x)^2}{2r^2}$  and  $b = -\frac{x^2}{2}$ . Hence, one can always find a low enough value of  $r > 1$  for which  $a < b$  holds, that is  $e^{a-b} < 1$ . In addition, if  $p$  is close enough to 0, the first term in (9) becomes an arbitrarily small number. In this case, we only need

$$1+x < \frac{(x-h)^2}{r^2} \tag{10}$$



which will always be true if  $x < -1$ . But there exists a low enough value of  $r > 1$  and  $-1 < x < 1$  for which (10) also holds if

$$\begin{aligned} 0 < h < x - r\sqrt{1+x} \\ r\sqrt{1+x} < x \end{aligned} \tag{11}$$

That is, one can always find a small enough  $x$  relative to  $h$  and low enough values of  $p > 0$  and  $r > 1$ , for which (9) holds and thus, the poverty assistance paradox emerges.

#### A.4 Proof of Corollary 1

To see this, let us rearrange (9) in the following way:

$$\frac{p}{1-p}e^{a-b} < \frac{(x-h)^2}{r^2} - 1 - x \tag{12}$$

By continuity, it is self-evident, that for any  $0 < p < 1$ , one can find a large negative number  $x = \underline{w}$ , and a value  $\underline{r}$  close enough to 1, for which (12) and thus, (9) are satisfied, so Corollary 1 holds.

#### A.5 Marginal change of $c^*$ implied by changing $x$ and $p$

First, let us present  $\frac{\partial c_i^*}{\partial p_i}$  as follows:

$$\frac{\partial c_i^*}{\partial p} = re^{a+b} \frac{h-x}{(pe^a + (1-p)re^b)^2} \tag{13}$$

Where again  $a = -\frac{(h-x)^2}{2r^2}$  and  $b = -\frac{x^2}{2}$ . One can easily see that compensation is increasing in  $p$  if  $x < h$ . However, the question remains how the size of the impact of  $p$  on  $c_i^*$  depends on  $x$ .

$$\begin{aligned} \frac{\partial c^*}{\partial x \partial p} &= \frac{\partial \left( \frac{-pe^a}{r^2 [pe^a + (1-p)e^b]^2} [r^2 pe^a + (1-p)e^b (r^2 - (x-h)^2 + xr^2)] \right)}{\partial p} \\ &= -\frac{e^a}{r^2 (pe^a + (1-p)e^b)^3} \left( -pe^a + (1+p)e^b \right) [r^2 pe^a + (1-p)e^b (r^2 - (x-h)^2 + xr^2)] \\ &\quad + \left( e^a r^2 - e^b [r^2(1+x) - (h-x)^2] \right) \frac{-pe^a}{r^2 [pe^a + (1-p)e^b]^2} \end{aligned} \quad (14)$$

### A.6 Proof of Proposition 2

As  $e^a, e^b, p$  are all positive, for  $\frac{\partial c^*}{\partial x \partial p} < 0$  we need

$$\left( -pe^a + (1+p)e^b \right) [r^2 pe^a + (1-p)e^b (r^2 - (x-h)^2 + xr^2)] > 0 \quad (15)$$

and

$$e^a r^2 - e^b [r^2(1+x) - (h-x)^2] > 0 \quad (16)$$

(15) is positive if:

$$\begin{aligned} r^2 pe^a + (1-p)e^b (r^2 - (x-h)^2 + xr^2) &> 0 \\ \frac{p}{1-p} e^{a-b} + (1+x) &> \frac{(x-h)^2}{r^2} \end{aligned} \quad (17)$$

*and*

$$\begin{aligned}
 -pe^a + (1+p)e^b &> 0 \\
 \frac{p}{1+p} &< e^{b-a}
 \end{aligned}
 \tag{18}$$

Note that (17) is the reverse of (9). Hence, one can always find a high enough value of  $r > 1$  for which  $a > b$  holds, that is  $e^{a-b} > 1$ . In addition, if  $p$  is close enough to 1, the first term in (17) can become an increasingly large number. Besides (17), we also need the first term of (15) to be positive:

Similarly to (17), for (18) to hold we need again  $p$  values close enough to 1 and high enough values of  $r > 1$ .

For (16) to be positive we need:

$$e^a r^2 > e^b \left[ r^2(1+x) - (h-x)^2 \right] \tag{19}$$

(19) always holds if

$$\begin{aligned}
 0 &> e^b \left[ r^2(1+x) - (h-x)^2 \right] \\
 1+x &> \frac{(x-h)^2}{r^2}
 \end{aligned}
 \tag{20}$$

Note that (20) is the reverse of (10).

That is, one can always find an  $x$  close enough to  $h$  and high enough values of  $p > 0$  and  $r > 1$ , for which (15) and (16) holds and thus, the positive stereotype interaction emerges.

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