**Study Design:**

**Hypotheses:**

1. Prestige bias, defined here as preferentially copying demonstrators who have been copied by others, is only adaptive, and thus only employed, when the previous copiers had access to demonstrators’ success information, and not when previous copiers only had access to irrelevant information
2. Prestige bias, as previously defined, is only adaptive, and thus only employed, when direct access to demonstrators’ success is unavailable; otherwise direct cues of success will be preferred.
3. When based on demonstrators’ success information, prestige bias, as previously defined, is as adaptive as directly using success information.

**Methods**:

*Participants:*

Ten teams of 10 participants for each condition (300 participants altogether) will be recruited via Mechanical Turk. All participants must be above the age of 18. All participants will be given a monetary reward for their time of $10, and will have the opportunity of winning a bonus payment of $20 by exceeding a certain number of points during the task.

*Materials:*

The experimental program Dallinger is used to generate a game in which teams of players can play and interact simultaneously. Participants answer 100 questions with two alternative answers each; one correct and one incorrect. The 100 questions are split into four categories of 25 questions each. The categories are named “Geography quiz”, “Weight estimation”, “Language quiz”, and “Art quiz” to participants. An example question for each category is given below:

Geography quiz:

Which City is nearest to Leipzig?

a) Berlin b) Prague

Weight estimations:

How much does an average camel weigh?

a) 480 kg  b) 180 kg

Language quiz:

The word “pisică” means ‘cat’ in which language?

a) Romanian b) Hungarian

Art Quiz:

Who died in 1519?

a) Pablo Picasso b) Leonardo da Vinci

*Procedure:*

Participants are given 100 binary choice questions based on four different general-knowledge or ‘trivia’ style categories, 25 in each category. Participants have fifteen seconds to answer each question. If participants don’t know the answer to a question, they are given the opportunity to “Ask Someone Else.” This button allows them to see information about other participants (‘demonstrators’) who have answered that question. The information they see depends on the condition, detailed below. They can then choose a demonstrator whose answer they will use for that question. If the chosen demonstrator answered the question correctly, the copying participant will also score a point for that question. If the demonstrator was incorrect, they will not. No one will receive feedback on whether their answer was right or wrong at any point.

Our study comprises three conditions (A, B and C):

**Condition A: (Irrelevant demonstrator information, copying cues only)**

**Round A1 (first 40 Qs):** When choosing to “Ask Someone Else”, participants will be able to see the randomly-generated Player ID of each participant who answered that question and copy one of those demonstrators’ answers. Player ID is an *irrelevant* cue, providing no information about demonstrator performance.

**Round A2 (subsequent 60 Qs):**

When choosing to “Ask Someone Else”, participants are asked what type of information about the demonstrators they would rather see, their player ID or the number of times they were copied in Round 1. They can then copy the answer of one of the demonstrators, with the chosen information (player ID or number of times copied) displayed.

**Condition B: (relevant demonstrator information, copying cues only)**

**Round B1:** When choosing to “Ask Someone Else”, participants will be able to see the individual score of each participant who answered that question and copy one of those demonstrators’ answers. Score is a *relevant* cue, providing direct information about demonstrator performance.

**Round B2:** When choosing to “Ask Someone Else”, participants are asked what type of information about the demonstrators they would rather see, their player ID or the number of times they were copied in Round 1. They can then copy the answer of one of the demonstrators, with the chosen information (player ID or number of times copied) displayed.

**Condition C: (relevant demonstrator information, copying and success cues available)**

**Round C1:** When choosing to “Ask Someone Else”, participants will be able to see the individual score of each participant who answered that question and potentially copy one of those demonstrators’ answers. Score is a *relevant* cue, providing direct information about demonstrator performance.

**Round C2:** When choosing to “Ask Someone Else”, participants are asked what type of information about the demonstrators they would rather see, their score in Round 1, or the number of times they were copied in Round 1. They can then copy the answer of one of the demonstrators, with the chosen information (score or number of times copied) displayed.

**Predictions:**

1. When choosing to “Ask Someone Else” in conditions B1 and C1, participants preferentially copy the highest-scoring demonstrator. This is an assumption-check to make sure that subsequent copying frequency cues are genuine signals of performance.
2. When choosing to “Ask Someone Else” and copy frequency is chosen in conditions B2 and C2, participants choose to copy the most-copied demonstrator. This is an assumption-check to make sure that people are actually employing prestige bias when it is potentially useful. No directional prediction is made about condition A2, as prestige cues are irrelevant here.
3. Of those participants who choose to “Ask Someone Else”, a higher proportion choose to view demonstrators’ copy frequency (i.e. choose prestige) in condition B2 than in condition A2. This is because in round B2 copy frequency is based on score from round B1, and therefore should be correlated with performance, while the alternative choice, player ID, is not. In round A2, however, there should be no preference between choosing to view demonstrators’ player ID or copy frequency, because copy frequency is based on player ID from round A1, and therefore provides no further information. This prediction tests hypothesis 1.

Of those participants who choose to “Ask Someone Else”, a higher proportion choose to view demonstrators’ copy frequency (i.e. choose prestige) in condition B2 than in condition C2. This is because in round B2 copy frequency is based on score from round B1, and therefore should be correlated with performance, while the alternative choice, player ID, is not. In round C2, however, there should be a preference for choosing to view demonstrators’ score over copying frequency. This is because score provides direct information about performance, and copying frequency provides only indirect information. This prediction tests hypothesis 2.

1. The overall frequency of copying (i.e. choosing to “Ask Someone Else”) is higher in conditions C2 and B2 than in condition A2. This is because C2 provides direct success information and B2 provides copying cues that are linked to success information via round B1, while A2 provides no relevant direct or indirect success information. This is an assumption check for prediction 6, to test whether prestige bias is adaptive (hypothesis 3).
2. Participants score higher in conditions C2 and B2 than in condition A2. This tests hypothesis 3 that prestige bias is as adaptive as directly using success information, but only when it is based on success information.

***Analyses:***

We will run and compare a series of Bayesian multi-level mixed models using the *Rethinking* package in R and Stan (McElreath 2016).

**Analysis 1 (Predictions 1 and 2):**

To test Prediction 1, that participants preferentially copy the highest scoring demonstrator, data from all instances of copying in Conditions B1 and C1 when score information was available will be used for a multilevel binomial model (Model 1). To test Prediction 2, that participants preferentially copy the most copied demonstrator, a similar model will be run but for data from all instances of copying in Conditions B2 and C2 when copying information was available (Model 2). In both cases, the demonstrators will be coded as “highest scoring/copied” or not, to check if participants were consistently choosing the top scorer/most copied out of those that were available for that copying instance. “Highest scorer” or “Most copied” will be the outcome variable. We will use a multilevel model with varying intercepts for group and participant. In these models, the intercept term will tell us whether participants tended towards the highest scorer / most copied. A separate but identical model (Model 2.1) will be run for the data from Condition A2, as we do not have a priori predictions for whether they choose the most copied demonstrator when demonstrator information is irrelevant.

topCopyB1,C1 ~ intercept + 1|Participant + 1|group (1)

presCopyB2,C2 ~ intercept + 1|Participant (2)

presCopyA2 ~ intercept + 1|Participant (2.1)

(NB subscripts indicate the conditions from which data is used)

**Analysis 2 (Predictions 3 and 4):**

To test Predictions 3 and 4 a generalised linear mixed model (Model 3) of all data from Round 2 (i.e. A2, B2 and C2) will be used with “chose prestige” (i.e. chose to view the number of times the demonstrator was copied in round 1) as the binomial outcome variable (yes or no), condition as the predictor variable, and varying intercepts for participant and group. The estimates for each condition parameter will allow us to directly compare choices in each condition and infer if participants were most likely to choose prestige in condition B2 than in condition A2 (prediction 3), and more likely to choose prestige in condition B2 than in condition C2 (prediction 4). We will also directly compare model predictions for each condition. We will also include a model with varying intercepts for condition too (Model 3.1), to account for potential uneven sampling from each condition (uneven copying instances). We will use a variety of model comparison measures to decide if the varying effects model improves estimation or affects inference in any way.

Chose\_prestigeA2,B2,C2 ~ intercept + condition + 1|Participant + 1|group (3)

Chose\_prestigeA2,B2,C2 ~ intercept + 1|condition + 1|participant + 1|group (3.1)

**Analysis 3 (Predictions 5 and 6):**

To test Prediction 5 a generalised linear mixed model of all data from Round 2 will be used with ‘copied’ as the binomial outcome variable (chose to copy, i.e. “Ask Someone Else”, or not). To test Prediction 6, a general linear mixed model of data from each condition will be used with final score of each participant as the outcome variable and Condition as the predictor variable, with a varying intercept for participant and group. Based on how variable copying is between conditions, and whether varying intercepts for condition improved model fit in model 3.1, we will also use varying intercepts for condition in model 4 as outlined below.

CopiedA2,B2,C2 ~ intercept + 1|condition + 1|Participant + 1|group (4)

Final ScoreA2,B2,C2 ~ intercept + condition + 1|Participant + 1|group (5)