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Applying Simplifying Heuristics when Making Judgment under Uncertainty – A Field Study

Tristan Nguyen¹

¹ Fresenius University, Finance & Accounting Department, Infanteriestr. 11a, 80797 Munich/Germany; Email: tristan.nguyen@hs-fresenius.de

Abstract

This paper studies the so-called Take the Best (TTB) and the other two related heuristics which are Take the last (TTL) and the Minimalist heuristics to collect more evidence on these heuristics and then make comparison on performance of these heuristics' potential users who have different degree of knowledge. People actually adhere to the recognition heuristics (RH) so often when facing inferential choice between a recognized object and a novel one. It is a main purpose of our empirical field study to look for evidence on what decision makers really do to arrive at their final choice in cases where both objects in the choice task are recognized. Will they still stick to recognition cue, or will they follow TTB or TTL or the Minimalist heuristic or will they resort to other type of strategies? Our results are somehow ambiguous. In sum, the cues the participants really picked up from their minds when taking the task and revealed by themselves in the interviews are more diverse and complicated than the anticipated ones.

Keywords: Decision Making, Heuristics, Uncertainty Behavioral Economics, Field Experiment

JEL: D01, M20

1. Decision Making with Recognition Heuristic

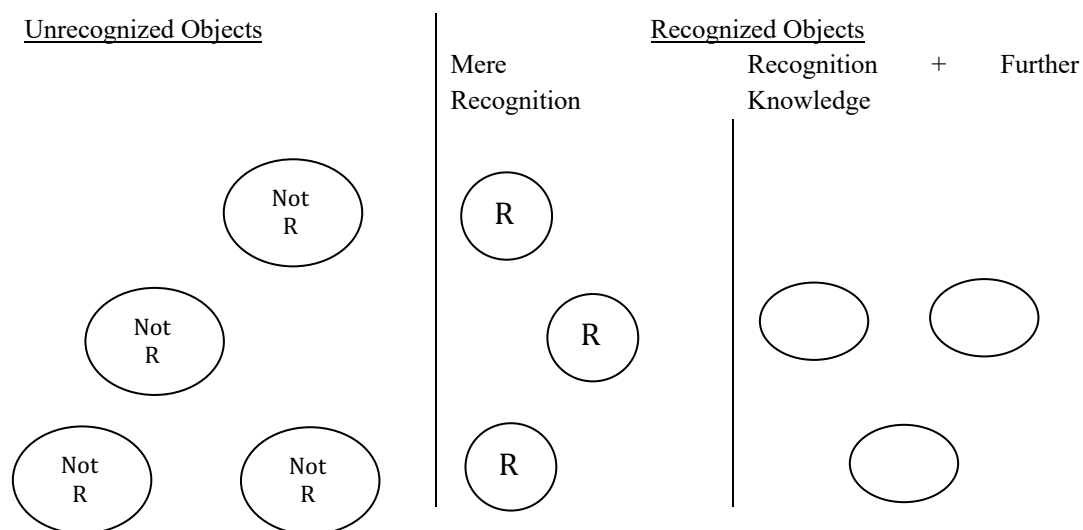
Whether an individual can come up with a good quality decision or judgment under time constraint, limited knowledge and computational capacity of a human brain and how he performs this as a process are prominent questions that have drawn much attention and efforts of the scientific community to solve. Decision making theories have gone through a long history from the very first normative models which base on the basic assumption of human unbounded rationality. The new perspective of human bounded rationality, in which decisions makers may not be consistent or are unable to integrate all relevant information into the decision making process due to his cognitive limitations or due to time constraint, has paved the way for the development of abundance of descriptive theories as attempts to give explanations to the deviations from normative models.

Simon (1947) was with his book “Administrative Behavior” and his later works in “theories of “bounded rationality” (Simon, 1955, 1956, 1978 and 1980) a pioneer to many of the later concepts in behavioral economics (Kalantari, 2010; Kerr, 2007, 2011). He was one of the first scientists to analyze organizational decision making under uncertainty by considering the constraints under which decisions are made. The central idea of bounded rationality concept proposed by Simon is that due to human’s cognitive limitations and due to the fact that in many real-world situations, optimal strategies are unknown or unknowable, decisions are made by a process called as ‘*satisficing*’ rather than by ‘*optimizing*’. The term ‘*satisficing*’ - a blend of ‘*sufficing*’ and ‘*satisfying*’, has been used to denote problem solving and decision making process which involves steps of setting an aspiration level, searching for alternatives until one is found that meets the aspiration level and selecting that alternative (Simon, 1978). Simon’s notion of bounded rationality and satisficing approach has soon been adopted by many other scientists to construct their own models of human decision making (Kahneman, 2003, 2011; Gintis, 2006; Callebaut, 2007).

How are decisions made under uncertainty? Our mind applies logic, statistics, or heuristics (Gigerenzer & Gaissmaier, 2011). The simplest heuristic among the ‘fast and frugal heuristics’ proposed by Gigerenzer and his research group (Gigerenzer & Goldstein, 1999a) is the Recognition Heuristic (RH), which may be employed alone or employed at the very first step when applying other heuristics in the family of ‘*satisficing*’ heuristics (i.e. Take-the-best heuristic, Take-the-last heuristic and The Minimalist) in inferring choice tasks. Concretely, when one is facing a pair of options in a choice task in which he/she has to infer which of the two has a higher (or lower) value on some criterion (e.g. larger, faster, ...), the recognition heuristic, if employed, says that “if one of two objects is recognized and the other is not, then infer that the recognized object has the higher value”. The condition for RH to work well is when recognition is a good indicator of a high value on the criterion estimated i.e. the recognition validity is high.

Before bringing in an illustration for RH, it is important to distinguish ‘mere recognition’ from ‘degree of knowledge’. Mere recognition is binary feeling that we have or have not experienced something before, which can be considered as a minimal state of knowledge (see *Figure 1*). This shows that RH can help to make decision only in cases where one object is recognized and the other is not. For cases in which both objects are recognized or neither of the two objects is recognized (i.e. the recognition cue does not discriminate between the two options), then decision makers must resort to other heuristics using knowledge beyond mere recognition or may make decision based on random guessing.

Figure 1: Recognition Heuristic



The family of ‘fast and frugal heuristics’ applicable in a two-alternative choice tasks is constructed by combining or switching between such decision making strategies. In general, the three heuristics share some common features which are involving limited search using step-by-step procedures, having simple stopping rules and basing decision on only one reason or cue (one-reason decision making mechanism); yet, they are different in the way

further information (i.e. cues and cue values of the objects) are searched. The following step-by-step breakdown of the three heuristics (with binary probability cues) tells us more.

Step 0 (same for all three heuristics): Recognition heuristic is employed at this very first step and the result of this step determines which action should be taken next.

- If one object is recognized and the other is not, then choose the recognized one.
- If neither of the two objects is recognized, then choose randomly between the two objects.
- If both objects are recognized, then go to step 1.

Step 1: Search for cue(s) and cue values that indicate higher (or lower) value on the criterion estimated. Limited search works in a step-by-step way: cues are looked up one by one until the stopping rule is satisfied.

- The Minimalist: Draw a cue randomly (without replacement) and look up the cue values for the two objects.
- Take-the-last (TTL): Applicable only if records of which cues discriminated in previous similar tasks/problems have been built up. If such records are available or retrievable, choose the cue that stopped search in the most recent task/problem that the subject has faced. Then look up the cue values of the two objects.
- Take-the-best (TTB): Choose the cue with the highest validity that has not been tried for the respective choice task. Then look up cue values of the two objects.

Step 2 (same for all three heuristics): Stopping rule to stop search for cues and cues values.

- If the cue discriminates which means one object has a positive cue value ("1") and the other does not (i.e. either "0" or unknown value), then stop search and move to Step 3.
- If the cue does not discriminate, then go back to Step 1 and search for another cue.
- If no further cue is found, then make a random choice between the two objects.

Step 3 (same for all three heuristics): Decision rule. Predict that the object with the positive cue value has the higher value on the criterion.

The transparent algorithms as presented above are supposed to make the whole information-gathering and decision making process involved in these heuristics easily traceable. They also enable putting those heuristics into test for confirming or disconfirming its validity and effectiveness (Gigerenzer & Goldstein, 1996 and Gigerenzer & Goldstein, 1999b).

2. Research Design and Methodology

With a large number of certain evidence that people actually adhere to the RH so often when facing inferential choice between a recognized object and a novel one, it is a necessity now to focus on seeking evidence on what decision makers really do to arrive at their final choice in cases where both objects in the choice task are recognized. Will they still stick to recognition cue, or will they follow TTB or TTL or the Minimalist heuristic (i.e. base their inferential choices on probability knowledge cues in a non-compensatory way), or will they resort to other type of strategies? Another critical question that should be tackled when studying heuristics is the deference in heuristic users' performance. In the studying cases i.e. knowledge- based decisions, the question raised is that whether participants with better knowledge can perform better than the ones with less knowledge.

This paper is an attempt to find the answers for the above questions. However, this paper does not deal with tracking down the whole decision making process but rather only deals with two basic signs of TTB, TTL, the Minimalist heuristics:

- Inferential choices are based on knowledge cues, and
- Inferential choice is made based on one cue only if such cue discriminates between the two objects

If both of the two signs mentioned above are found in a specific choice task, then that participant is considered as a potential user of TTB, TTL or the Minimalist in that case. The second purpose is to make comparison of

performance between the participants with better knowledge and the others in terms of accuracy and speed of making choices. For such purposes, the research is designed on the qualitative approach basis. Twenty (20) participants will be invited to join an experiment in which they will have to deal with two certain tasks.

In the main task, participants will be asked to deal with the following inferential choice task: *“Which country/dependent territory in each pair has the larger population?”*¹ However, before engaging in the main task, participants will be asked to identify which countries (or dependent territories) they can recognize in the list of 100 populous countries of the world (ranking from the 6th to 105th most populous countries in the world in 2018). And then for each participant, ten (10) pairs of countries/ dependent territories will be drawn out randomly from the list of 100 countries which have been identified as ‘recognized’ by that participant to make a list of ten (10) pairs of recognized countries. After the experimenter draws out 10 pairs of countries and fills in the pre-printed questionnaire, the questionnaire then will be given to the participant in order for him/her to do the main task (see *Appendix 1*).

To give participants an incentive to exert more effort in the task, participants are promised (in the instruction of the task) that they will have a chance to receive a gift voucher as a reward if they have the highest number of correct answers and with less time needed compared to other participants who have the same most correct answers. No specific time restriction will be imposed in order to enable participants to do the task at their own speed so that it is more likely that participants can recall exactly what they have thought of while solving the task. Instead, the time consumed to complete all of ten pairs of each participant will be measured (by the experimenter). For the second task: Right after handling the answer sheet, the participant will be asked to recall what he/she has already done in the main task and answer the follow-up question for each pair of countries: *“What makes you come up with an inference that the country you chose has larger population than the other one in each pair?”* (see *Appendix 2*). The participant is expected to give explanation what reasons (or cues) that he/she bases his/her inferential choice on. These pieces of information will enable the experimenter to identify which decision strategy the participant has applied in each pair of countries.

Table 1: Anticipated probability knowledge cues

| PROBABILITY CUE(S) | ECOLOGICAL VALIDITY OF THE CUE | HOW THE CUE SUPPOSEDLY CORRELATES WITH TARGET VARIABLE (I.E. POPULATION OF A COUNTRY) |
|-----------------------------|--------------------------------|---|
| LAND AREA | 0.8353 | POSITIVELY |
| FERTILITY RATE | 0.5127 | POSITIVELY |
| DEATH RATE | 0.4694 | NEGATIVELY |
| DENSITY | 0.4635 | POSITIVELY |
| NET MIGRANTS | 0.4308 | POSITIVELY |
| AGING POPULATION | N/A | |
| ENVIRONMENT | N/A | |
| ECONOMIICS DEVELOPMENT | N/A | |
| HEALTHCARE CONDITION | N/A | |
| WELFARE POLICY | N/A | |
| EDUCATION | N/A | |
| SEX STRUCTURE OF POPULATION | N/A | |
| GEOGRAPHIC LOCATION | N/A | |
| WEATHER CONDITIONS | N/A | |

¹ Country’s population is a suitable object for studying inferential choice decision making for the reason that there are many determinants or influencing factors on population of a country, which can be considered as potential probability cues that may be invoked to solve the task, whereas people’s knowledge on this type of general knowledge are often uneven and limited.

To deal with potential probability cues prior to conduct the experiment, the experimenter engaged in quick interviews with five (5) participants (who will not be asked to join the official tasks) to test whether a participant is able to retrieve from memory for any cue(s) relating to a country's population, and what cues they can think of in just a short time. The question was "Which factors do you think that indicate larger/smaller population size of a country?" All of them were able to list out a few cues within a few minutes. All these anticipated cues are presented in the following table together with the ecological validity of each cue if related data enabling such calculation is available and accessible. The ecological validities of the cues were solved using EXCEL. For any cue which ecological validity cannot be calculated, the 'ecological validity' column will be remarked "N/A" (see Table 1).

This list of potential cues and their ecological validity (if possible to calculate) will be used as a reference source and is expected that can give good explanation for good/bad performance of the participants who are identified as potential users of TTB/TTL/the Minimalist in specific pairs of countries.

3. Empirical Results

3.1 Strategy Selection

All participants taking the main task have the same base i.e. ten pairs of countries in which both are recognized, yet they all have different degree of knowledge about the countries in the tasks. The result shows that participants choose decision strategy basing on their degree of knowledge relating to the two countries in each pair. There are several strategies observed across all choices of all participants.

(i) *Familiarity:*

When facing two countries which the participants do not have any specific information about, they tend to choose in favor of the one which sounds more familiar. The same tendency has been observed for pairs of countries in which the participant feels he knows more about one country but cannot recall any specific information. In this case, he will choose in favor of the one he thinks he knows more about.

(ii) *Recognition plus further information:*

In some cases, when participants know nothing but the name of one country in a pair and can recall one fact or specific information about the other country in that pair which cannot help to reach a direct solution or to apply TTB (or the like), he chooses the one he knows a fact or specific information about. Some other participants may know something about the two countries but still base their decisions on a piece of information like "Country A is a populous country" which they have read in newspaper or have known from the media rather than looking for cues or cue values that distinguish between two countries.

(iii) *Fluency heuristic:*

There is only one case in which participant no.15 revealed that she picked Hungary over Zimbabwe basing on the speed of information retrieval about the two countries. She recognized Hungary and recall some information faster than Zimbabwe then she picked Hungary without considering the information has been searched. This decision strategy fits the FH best and is the only one case across all cases.

The results that there are a number of cases in which participants really applied the above mention strategies give more evidence that in cases where decision makers face a pair in which both objects are recognized, they still can rely on the recognition cue plus further sign or information to help making choices.

(iv) *Direct solution:*

This strategy has been taken by participants who have enough certain information to make a logical deduction or to apply exclusion rule to arrive at the decisions.

(v) *Knowledge-cue-based strategy:*

When participants have some information about the two countries and can distinguish the two countries on one or more than one criterion, they take it as cues to make inferential choice. There are a large number of choices which have been made based on one cue only. These cases can be considered as that the participants are potential users of TTB or the two related heuristics because decisions in these cases have been made based on knowledge cue in a non-compensatory fashion. If the cue value about one country is unknown (missing information) or cue values of both are known but do not clearly distinguish then the participant tends to search for other cues and cue values. If no other can be found then decision will be based on the previous cue and choice will be made in favor of the country of which cue value is known if it is a positive value.

However, besides a large number of participants following this strategy, there are some cases in which the participants combined more than one cue in the inferential choice (knowledge cues combined) and the cue values of those cues suggested the same choosing tendency between the two countries. There are some cases where decisions based on more than one cue but the cue values found suggesting conflicting choosing tendencies. It means that in these cases, decisions were overturned or dominated by a cue which discriminates the two countries better than the other cues do according to the participants' own knowledge. These cases are evidence for knowledge cue based decisions in a compensatory fashion.

(vi) *Random guess:*

Participants made random choices in the two following scenarios:

- They have no information about the two countries and the familiarity cue does not discriminate between the two i.e. the two countries sound the same familiar.
- They know some information but it does not distinguish the two countries. This scenario is considered as part of TTB or TTL or the Minimalist heuristic in which the heuristic users search for cue(s) and cue values however no cue discriminates between the two options, then they must base their choices on random guess.

(vii) *Mixed strategies:*

There are many cases in which the participants revealed some specific information which tells us that they seem to combine more than one strategy in their choice decisions. The choices, results (whether choices are correct or not) and the decision strategies are presented in *Appendix 3*.

3.2 Decisions based on knowledge cues

Cues that participants base their decisions on which have been observed across all choices together with possible cue values and choice tendencies for each cue are to be discussed one by one as follows:

(i) *Continent cue*

There are many cases in which participants consider the geographical location of the countries as a cue. This is obviously not a binary cue. Basically, there are seven available cue values consisting of Asia, Africa, North America, South America, Antarctica, Europe and Australia. Most of participants who base their choices on this cue have the tendency to pick an Asian country over a European country with a straight explanation that Asian countries are more populous than European countries. The same tendency has been observed in choices of pairs including one African country and a European country, or of pairs including one South American country and a European country.

However, for pairs which includes an Asian country and a African country, most of participants tend to not base on this cue but rather look for another cue or for further specific information. This means these participants consider 'Asian country' and 'African country' values as 'not discriminated' between the two countries. The same tendency occurs for pairs consisting of a South America country and an Asian country or pairs including a South America country and an African country. In a few cases, participants seem to base their choices on 'continent cue', however, when taking the explanations they revealed in the interview into account, the choices made actually were based on another type of cue rather than continent cue.

(ii) Land area cue

This is a cue with the highest ecological validity as previously calculated before conducting the experiment. In reality, one can hardly remember and recall a exact number of land area of a country, even approximate value. Rather, when facing two countries, participants tend to look for any information enabling them to make relatively comparison between the two countries' land area. So, basically, there are three comparison results which can be taken into account for inferential choices: one country's land area is larger than or smaller than or as same as that of the other in a pair. The result of the experiment shows that there is large proportion of participants who chose a country they know or think that it has larger land area than the other. There is a dominating number of cases in which participants apply knowledge cues to reach at the decision have based their choices on 'Land area cue' alone.

A few cases in which participants combined other cues before making choices have been seen. In some cases, information revealed by the participant shows that they intended to make choice in favor of one country basing on another cue like density cue or continent cue, then changed their decisions when taking land area cue into account. In other words, this is the sign that these participants followed the compensatory decision strategy in which their decision is overturned by one cue which shows a more highly discrimination between the two countries.

Among the countries appeared in the pairs, there are two special case which are Russia and Hong Kong. Participants who took land area cue into account always choose Russia in favor of another country whenever it is included in a pair. Their explanation in the interview confirms that they picked Russia because the land area cue in a pair including Russia and any country else is a highly discriminated cue because of the fact that Russia is among the largest countries in the world. For Hong Kong case, choosing tendency is reversed because of the fact that Hong Kong is a very small island.

(iii) Density cue

Taking the previously-calculated ecological validities as a reference, density cue's validity is slightly less than chance level, which suggests that this cue may not be a good cue to base on. However, from what shown in results of the experiment, in a few cases participants did consider density cue in the decision process but it is often combined with or dominated by another cue. There is only few choices which were based on density cue alone.

Density cue is found to be taken into account by the participants who have information about the geographic conditions or environment of a country such as a mountainous country, country with extreme weather or having a large part of its land area covered by forests, country's altitude is lower than the sea level.

One conflicting trend which can be observed from the results is that when facing a pair consisting of Hong Kong and another country, participants who revealed they had considered land area cue did pick the other country in the pair over Hong Kong whereas participants who had considered density cue would choose in favor of Hong Kong.

(iv) Fertility rate cue

According to the calculation before the experiment, this cue has an ecological validity just slightly above chance level. Results of the tasks show that in a few cases participants did base on this cue alone to reach the final choice and in a few cases this cue is combined with other cues.

Some confuses arose when determining decision strategy and the cue(s) in the decision when it comes to fertility rate cue because most of participants infer the cue values of the fertility rate (in the form of the comparative relation between the two countries in terms of fertility rate) from other cues. For example, participant no.7 picked Bolivia over Hungary and explained that Hungary is in Europe where most of the countries has low fertility rate whereas Bolivia is a country in South America where countries are known having high fertility rate. He applied the same strategy for Austria-Ghana pair.

Another cue which is closely related to fertility rate cue is Chinese culture cue. This cue was referred to by only few participants, for instance participant no. 2 and no. 20, when they faced a pair which includes Hong Kong or

Taiwan for the reason that these territories are influenced by Chinese culture which prefers large-size families with a lot of children.

(v) Economics cue: developed, developing, poor countries

Some participants recognized the country with a piece of information about its geographic location i.e. they can tell that country belongs to which continent, however, interpreted it as or combined it with a different cue that is whether that country is a developed or a developing or a poor country. The general choice tendency basing on this type of cue alone is that participants tend to choose a developing country or a poor to be more populous than a developed one and to choose a poor country to be more populous than a developing country.

Some participants did not tell in specific whether it is a developed, developing country, but rather chose the one they knew that it is less developed than the other in the pair. Some participants which based decisions on economics cue inferred that the more developed country to be more populous with the explanation that more developed countries have better health care system which implies a lower death rate. In a few cases, participants interpreted the information found relating to economics cue in terms of fertility rate cue. For instance, if a country is a developing country then it is more likely to have higher fertility rate than a developed country thus is more likely to be more populous.

(vi) Death rate cue

Like density cue, death rate cue has an ecological validity less than chance level. There are fewer cases in which the death rate cue is observed to be resorted to than cases in which other cues are based on to make choices. If participants have any information that tells them one country has a high death rate (or higher death rate than the other), they tend to choose the other country in the pair. The results show that only few participants considered this information as a cue. A cue related to death rate cue is the war zone cue (i.e. whether the country is in a zone that war often occurs like in the Middle East).

(vii) Migrants cue

As previously calculated, migrants cue has the lowest ecological validity in the anticipated cue lists. There are only few cases in which decisions are based on migrants cue and Germany appears in most of those cases and the explanation for choosing is that Germany has a lot of migrants.

4. Conclusion

In sum, the cues the participants really picked up from their minds when taking the task and revealed by themselves in the interviews are more diverse and complicated than the anticipated ones. There are some correlations between some cues, therefore, in some cases it is hard to precisely determine whether the decision is based on one cue or more and on which cue(s).

In some cases, different participants facing the same pairs of countries and having the same piece of information do not always base on the same cue or interpret this same information in the same way. Consequently, they did not always make the same choice in a same situation, or they made the same choice but due to different reasons in the very same case. In cases where choices have been made based on knowledge cues, there are a large number of choices made basing on one cue only which discriminates the two countries in the pair. However, there are a number of cases in which participants tend to integrate more than one cue in their decisions. In many cases among those, choices were overturned by one cue against the other cues.

In comparison of participants' performance in terms of accuracy and speed, the participants with better knowledge did perform better compared to the rest of participants except two participants with lower degree of knowledge but somehow performed as well as the two participants who exert best knowledge. Besides, the time needed is longer in the case the better knowledge participant tried to recall more specific knowledge. The surprising result that the two participants who took the longest time in the task drew the least correct choices compared to others raise a question that taking longer time in making a decision is really good or bad.

References

- Callebaut, W. (2007). Herbert Simon's silent revolution. *Biological Theory*, Vol. 2(1), pp. 76-86.
- Gigerenzer, G. & Goldstein, D.G. (1996). Reasoning the Fast and Frugal Way: Models of Bounded Rationality. *Psychological Review*, 62(1), pp. 650-669.
- Gigerenzer, G. & Goldstein, D.G. (1999b). Betting on one good reason: The Take The Best Heuristic. In G. Gigerenzer & P.M. Todd & The ABC Research Group (Eds.), *Simple heuristics that make us smart*, pp.75-95. New York: Oxford University Press.
- Gigerenzer, G. & Goldstein, D.G. (1999a). The Recognition Heuristic: How ignorance makes us smart. In G. Gigerenzer & P.M. Todd & The ABC Research Group (Eds.), *Simple heuristics that make us smart*, pp.37-58. New York: Oxford University Press.
- Gigerenzer, G. and Gaissmaier, W. (2011). Heuristic decision making. *Annual Review of Psychology*, Vol. 62, pp. 451-482.
- Gintis, H. (2006). The foundations of behavior: the beliefs, preferences, and constraints mode. *Biological Theory*, Vol. 1(2), pp. 123-127.
- Kahneman, D. (2003). A perspective on judgment and choice: mapping bounded rationality, *American Psychologist*, Vol. 58(9), pp. 697-720.
- Kahneman, D. (2011). *Thinking, Fast and Slow*. Farrar, Straus and Giroux, New York.
- Kalantari, B. (2010). Herbert A. Simon on making decisions: enduring insights and bounded rationality. *Journal of Management History*, Vol. 16 (4), pp. 509-520.
- Kerr, G. (2007). The development history and philosophical sources of Herbert Simon's Administrative Behavior. *Journal of Management History*, Vol. 13 (3), pp. 255-268.
- Kerr, G. (2011). What Simon said: the impact of the major management works of Herbert Simon. *Journal of Management History*, Vol. 17(4), pp. 399-419.
- Simon, H.A. (1947). *Administrative Behavior*, 1st ed., Free Press, New York.
- Simon, H.A. (1955). A behavioral model of rational choice. *The Quarterly Journal of Economics*, Vol. 69 (1), pp. 99-118.
- Simon, H.A. (1956). Rational choice and the structure of the environment. *Psychological Review*, Vol. 63(2), pp. 129-138.
- Simon, H.A. (1978). On how to decide what to do. *Bell Journal of Economics*, Vol. 9 (2), pp. 494-507.
- Simon, H.A. (1980). The behavioral and social science. *Science*, Vol. 209, pp. 72-78.

Appendix 1: Questionnaire for Task 1**QUESTIONNAIRE FOR RESEARCH PAPER ON DECISION MAKING PROCESS IN TWO-ALTERNATIVE CHOICE TASK**

Please give your answers to the same question for ten (10) different cases by choosing one of two countries (or dependent territories) in each of the ten (10) pairs below.

Please note that you will have a chance to receive a gift if you have the highest number of correct answers (and with less time, in case there are two or more participants have the same number of correct answers).

Start the task at: ____:____ (time)

Which country/dependent territory in each pair below has the larger population?

- | | |
|------------------------------------|--------------------------------|
| 1/ <input type="checkbox"/> _____ | <input type="checkbox"/> _____ |
| 2/ <input type="checkbox"/> _____ | <input type="checkbox"/> _____ |
| 3/ <input type="checkbox"/> _____ | <input type="checkbox"/> _____ |
| 4/ <input type="checkbox"/> _____ | <input type="checkbox"/> _____ |
| 5/ <input type="checkbox"/> _____ | <input type="checkbox"/> _____ |
| 6/ <input type="checkbox"/> _____ | <input type="checkbox"/> _____ |
| 7/ <input type="checkbox"/> _____ | <input type="checkbox"/> _____ |
| 8/ <input type="checkbox"/> _____ | <input type="checkbox"/> _____ |
| 9/ <input type="checkbox"/> _____ | <input type="checkbox"/> _____ |
| 10/ <input type="checkbox"/> _____ | <input type="checkbox"/> _____ |

Finish the task at: ____:____ (time)

Participant's name: _____. Phone No. _____

Finish at: ____:____ (Please fill in the time you finish)

Appendix 2: Follow-up questionnaire

| FOLLOW-UP QUESTIONNAIRE (For the experimenter) |
|--|
| <p>Please answer the following question:</p> <p><i>What makes you come up with an inference that the country you chose has larger population than the other one in each pair?</i></p> <p>1st pair: _____ _____</p> <p>2nd pair: _____ _____</p> <p>3rd pair: _____ _____</p> <p>4th pair: _____ _____</p> <p>5th pair: _____ _____</p> <p>6th pair: _____ _____</p> <p>7th pair: _____ _____</p> <p>8th pair: _____ _____</p> <p>9th pair: _____ _____</p> <p>10th pair: _____ _____</p> <p>Participant's name: _____. Phone No. _____</p> |

Appendix 3: Participants' results and reasons for the choice decisions²

| Partici- pant no. | pairs of countries | | Correct choice | Total time consumed (seconds) | STRATEGY | cue remark | Remark (why choose) |
|----------------------|--------------------|------------------|-------------------|-------------------------------------|--------------------------------------|-------------------------------------|--|
| 1 | Myanmar | Germany | | | Knowledge cue - non compensation | continent cue | An Asian country vs a European country: Asian countries are often more populous |
| | Czech Republic | Hong Kong | | | Knowledge cue - non compensation | continent cue | An Asian country vs a European country: Asian countries are often more populous |
| | Netherlands | Cambodia | | | Knowledge cue - non compensation | continent cue | An Asian country vs a European country: Asian countries are often more populous |
| | Colombia | Russia | X | | Knowledge cue - non compensation | Land area cue | Russia's land area is very large. |
| | Cuba | Iran | | | Random guess | | Having no specific information about the 2 countries |
| | Nepal | Greece | X | | Knowledge cue - non compensation | economics cue | Less developed countries are often more populous than developed countries. |
| | Chile | Japan | X | | Recognition plus further information | | Read somewhere Japan is a populous country, no specific information about Chile. |
| | Italy | Malaysia | | | Knowledge cue - non compensation | continent cue | An Asian country vs a European country, bc Asian countries are often more populous |
| | France | Jordan | | | Knowledge cue - non compensation | economics cue | Less developed countries are often more populous than developed countries. |
| | Hungary | Bolivia | | | Random guess | | Having no specific information about the 2 countries |
| | | | 3 | 48 | | | |
| | | | | | | | |
| 2 | Myanmar | Germany | X | | Knowledge cue - non compensation | Land area cue | Germany is larger than Myanmar -> incorrect |
| | Czech Republic | Hong Kong | | | Knowledge cues combined | Economics cue + Chinese culture cue | Czech Republic is more developed. Hong Kong is influenced by Chinese culture which prefers large-size families with more children. |
| | Netherlands | Cambodia | X | | Recognition plus further information | | Read somewhere about Amsterdam's population which is quite large, know something about Cambodia but no specific information. |
| | Colombia | Russia | X | | Recognition plus further information | | Russia belonged to the Soviet Union in the past and is a populous country. |
| | Cuba | Iran | | | Random guess | | Having no specific information about the 2 countries |

² Note: The countries in bold letters are the participants' choices

| Partici- pant no. | pairs of countries | | Correct choice | Total time consumed (seconds) | STRATEGY | cue remark | Remark (why choose) |
|----------------------|--------------------|-----------|-------------------|-------------------------------------|---|---|--|
| | Madagascar | Greece | | | Knowledge cue - compensation | Land area cue + Density cue + fertility rate (Decision is dominated by Land area cue and Density cue) | Greece is a large country -> incorrect + Madagascar has large area of forests so less density -> correct + Madagascar has higher fertility rate -> correct |
| | Nepal | Iraq | X | | Random guess | | Having no specific information about the 2 countries |
| | Chile | Japan | | | Knowledge cues combined | Fertility rate cue + aging country cue | Japan is an aging country, has low fertility rate because of rising number of young people who are not interested in getting marriage. |
| | Italy | Malaysia | X | | Random guess | | Because no cues distinguish btw the 2 countries. |
| | France | Jordan | X | | Knowledge cue - non compensation | Land area cue | Jordan is a small country -> correct |
| | | | 6 | 73 | | | |
| 3 | Myanmar | Germany | X | | Knowledge cue - non compensation | Land area cue | Germany is larger than Myanmar -> incorrect |
| | Czech Republic | Hong Kong | X | | Knowledge cue - non compensation | Land area cue | Hong Kong is very small -> correct. Czech Republic is a large country -> incorrect. |
| | Netherlands | Cambodia | | | Knowledge cue - non compensation | Land area cue | Cambodia is larger than Netherlands -> incorrect |
| | Colombia | Russia | X | | Knowledge cue - non compensation | Land area cue | Russia is larger than Colombia -> correct |
| | Uganda | Iran | | | Knowledge cue - non compensation | continent cue | Uganda is in Africa, Iran is in Asia. African countries are often more populous than Asian countries. |
| | Madagascar | Greece | X | | Knowledge cue - non compensation | continent cue | Madagascar is in Africa, Greece is in Europe. African countries are often more populous than European countries. |
| | U.K. | Hungary | X | | Recognition plus further information | | U.K. comprises several portions so it is populous. |
| | Nepal | Iraq | X | | Knowledge cue - non compensation | Land area cue | Iraq is larger than Nepal -> correct. |
| | Chile | Japan | | | Knowledge cue - non compensation | continent cue | Chile is a country in South America. A South American country is more likely a populous country. |
| | Italy | Malaysia | | | Knowledge cues combined | continent cue + Land area cue | Italy is a European country. Malaysia is an Asian country AND comprises many small islands so it has larger land area-> correct. |

| Partici- pant no. | pairs of countries | | Correct choice | Total time consumed (seconds) | STRATEGY | cue remark | Remark (why choose) |
|----------------------|-----------------------|---------------------|-------------------|-------------------------------------|--|---------------|--|
| | | | 6 | 46 | | | |
| 4 | Myanmar | Germany | | | Knowledge cue - non compensation | Economics cue | Myanmar is less developed than Germany. Less developed countries are often more populous than developed countries. |
| | Czech Republic | Hong Kong | x | | Knowledge cue - non compensation | Land area cue | Hong Kong is smaller than Czech Republic. |
| | Netherlands | Cambodia | | | Knowledge cue - non compensation | Economics cue | Less developed countries are often more populous than developed countries. |
| | Colombia | Russia | x | | Knowledge cue - non compensation | Land area cue | Russia is larger than Colombia. |
| | Uganda | Iran | x | | Familiarity | | Choose the one which sounds more familiar |
| | Madagascar | Greece | | | Familiarity | | Choose the one which sounds more familiar |
| | U.K. | Hungary | x | | Random guess | | |
| | Nepal | Iraq | x | | Familiarity | | Choose the one which sounds more familiar |
| | Chile | Japan | x | | Random guess | | |
| | Italy | Malaysia | | | Random guess | | |
| | | | 6 | 46 | | | |
| 5 | Hungary | Bolivia | | | Familiarity + Knowledge cue - non compensation | Land area cue | Country which is more familiar seems to be smaller and so to be less populous. |
| | Austria | Ghana | | | Familiarity + Knowledge cue - non compensation | Land area cue | Country which is more familiar seems to be smaller and so to be less populous. |
| | Kenya | Saudi Arabia | | | Familiarity + Knowledge cue - non compensation | Land area cue | Country which is more familiar seems to be smaller and so to be less populous. |
| | Thailand | Somalia | | | other strategy | | |
| | Myanmar | Germany | x | | other strategy | | |
| | Czech Republic | Hong Kong | x | | Knowledge cue - non compensation | Land area cue | Hong Kong is a small territory which belongs to China, so its land area is small. |
| | Netherlands | Cambodia | x | | other strategy | | |
| | Mozambique | Venezuela | x | | Familiarity | | Know more about Venezuela |
| | Belgium | Morocco | | | other strategy | Land area cue | |
| | Colombia | Russia | x | | Knowledge cue - non compensation | Land area cue | Colombia is developed from a small island. Russia is very large. |

| Parti- pant no. | pairs of countries | | Correct choice | Total time consumed (seconds) | STRATEGY | cue remark | Remark (why choose) |
|--------------------|-----------------------|---------------------|-------------------|-------------------------------------|--------------------------------------|--|--|
| | | | 5 | 48 | | | |
| 6 | Hungary | Bolivia | | | Familiarity | | Choose the one which sounds more familiar |
| | Madagascar | Greece | | | Recognition plus further information | | Watched 'Madagascar' film -> scarce population |
| | Austria | Ghana | x | | Knowledge cue - non compensation | economics cue | Less developed countries are often more populous than developed countries. |
| | Kenya | Saudi Arabia | x | | Knowledge cue - non compensation | economics cue | Kenya needs international aids -> poor country |
| | Thailand | Somalia | x | | Familiarity | | Know more about Thailand |
| | Myanmar | Germany | | | other strategy | | Myanmar is closer to Vietnam and more populous than Vietnam |
| | Czech Republic | Hong Kong | x | | Knowledge cue - compensation | Density cue + Land area cue (Decision is overturned by Land area cue) | Although Hong Kong's density is high, its land area is very small. So its population is small. |
| | Netherlands | Cambodia | | | Knowledge cue - non compensation | economics cue | Less developed countries are often more populous than developed countries. |
| | Nepal | Iraq | | | Random guess | | No information. Guess. |
| | Israel | Serbia | | | Random guess | | No information. Guess. |
| | | | 4 | 105 | | | |
| 7 | Hungary | Bolivia | x | 74 | Knowledge cue - non compensation | fertility rate cue | Hungary: European country -> low fertility rate, Bolivia: South America country -> high fertility rate. |
| | Madagascar | Greece | x | | Direct solution | | Greece's population was only about 10 million (5 years ago) whereas Madagascar is among the largest islands in the world. |
| | Austria | Ghana | x | | Knowledge cue - non compensation | fertility rate cue | Same as the first case. Austria: European country -> lower fertility rate, Ghana: African country -> high fertility rate. |
| | Kenya | Saudi Arabia | | | Knowledge cue - compensation | continent cue + Land area cue (decision is overturned by Land area cue) | Kenya is an African country which is more likely to be more populous, however, Saudi Arabia is the largest countries among the Gulf countries. |

| Parti- pant no. | pairs of countries | | Correct choice | Total time consumed (seconds) | STRATEGY | cue remark | Remark (why choose) |
|--------------------|-----------------------|----------------------|-------------------|-------------------------------------|--------------------------------------|---|--|
| | Thailand | Somalia | x | | other strategy | Consider continent cue, but decision is based on some specific information. | Somalia is an African country which is more likely to be more populous, however, Thailand is one of the most populous countries in Southeast Asia whereas Somalia is extremely poor. |
| | Myanmar | Germany | x | | Knowledge cues - non compensation | Consider Land area cue -> not distinguish. Decision based on migrants cue | Land area of the two countries are about the same, Germany is the largest countries in Europe and has a lots of migrants |
| | Czech Republic | Hong Kong | x | | Direct solution | | Hong Kong's population was only about 7 million (5 years ago) whereas Czech Republic is a large country. |
| | Netherlands | Cambodia | x | | Direct solution | | Cambodia's population is only about 5 to 10 million (5 years ago) whereas Netherlands has a large number of migrants. |
| | Nepal | Côte d'Ivoire | | | Knowledge cues combined | Density cue + Fertility rate cue | Nepal is a mountainous country so its population is scarce, whereas Ivory Coast -like Ghana case - is a country with high fertility rate |
| | Uganda | Iran | x | | other strategy | Consider continent cue, but decision is based on some specific information. | Uganda is an African country, located close to Kenya, however, it cannot be the case that it has larger population than Iran does because Iran is originated from the Persian Empire which was populous and its land area is large also. |
| | | | 8 | | | | |
| 8 | Hungary | Bolivia | | | Familiarity | | Choose the one which sounds more familiar |
| | Madagascar | Greece | | | Familiarity | | Know more about Greece. Do not know anything about Madagascar. |
| | Austria | Ghana | | | Familiarity | | Austria sounds more familiar. Not sure but maybe Ghana is in Africa |
| | Kenya | Saudi Arabia | x | | Recognition plus further information | | Kenya is an African country and seems populous (watched on TV). |
| | Thailand | Somalia | x | | other strategy | | Somalia is an African country. Thailand's population approximates Vietnam's population. |
| | Myanmar | Germany | x | | Recognition plus further information | | Myanmar has a lot of Islamic inhabitants (-> incorrect info). Know more about Germany, but cannot tell in specific. |
| | Czech Republic | Hong Kong | x | | Knowledge cue - compensation | Density cue + land area cue (Decision is overturned by Land Area cue) | Hong Kong is crowded but very small. |

| Partici- pant no. | pairs of countries | | Correct choice | Total time consumed (seconds) | STRATEGY | cue remark | Remark (why choose) |
|----------------------|--------------------|----------------------|-------------------|-------------------------------------|----------------------------------|--|---|
| | Netherlands | Cambodia | x | | Random guess | | No cue distinguish between the two countries. |
| | Nepal | Côte d'Ivoire | | | Random guess | | No information. Guess. |
| | Uganda | Iran | x | | Familiarity | | Iran sounds more familiar. No information about Uganda. |
| | | | 6 | 62 | | | |
| 9 | Myanmar | Germany | | | Knowledge cue - non compensation | continent cue | Myanmar is an Asian countries. Germany is a European country. Most of Asian countries are more populous than European countries. |
| | Czech Republic | Hong Kong | | | Knowledge cue - non compensation | density cue | Hong Kong's density is high. Czech Republic's density is low. |
| | Netherlands | Cambodia | | | Knowledge cues combined | density cue + land area cue | Netherlands is a developed country and its altitude is lower than the sea level so its density is low. Cambodia is a large country. |
| | Colombia | Russia | x | | Knowledge cue - non compensation | land area cue | Russia is a very large country compared to other countries. |
| | Madagascar | Greece | x | | Random guess | | Madagascar is an island. Not sure about Greece's land area, so guess. |
| | Nepal | Iraq | x | | Knowledge cue - non compensation | Density cue | Nepal is a mountainous country so its population is scarce. No specific information about Iraq. |
| | Chile | Japan | | | Knowledge cues combined | Continent cue + Fertility rate cue + young/aging country cue | Chile is a South American country. Japan is an aging country and has low fertility rate. |
| | Italy | Malaysia | | | Knowledge cue - non compensation | continent cue | Malaysia is an Asian country. Italy is a European country. Most of Asian countries are more populous than European countries. |
| | Israel | Serbia | x | | Knowledge cues combined | land area cue + death rate cue | Israel is not large and in the war zone. No specific information about Serbia. |
| | Bolivia | Hungary | x | | Random guess | | Hungary is used to belong to the Soviet Union (-> incorrect info). Do not know any information about Bolivia. So, guess. |
| | | | 5 | 36 | | | |
| 10 | Greece | Madagascar | | | Random guess | | Madagascar is an island. Greece is used to be the center of Western civilization and has a long developing history. Guess. |

| Parti- pant no. | pairs of countries | | Correct choice | Total time consumed (seconds) | STRATEGY | cue remark | Remark (why choose) |
|--------------------|--------------------|----------------------|-------------------|-------------------------------------|--------------------------------------|--|---|
| | Uganda | Iran | x | | Random guess | | Uganda: African country, Iran: Asian country; know where they are on the map but these do not tell anything, so guess. |
| | Austria | Ghana | x | | Knowledge cue - non compensation | continent cue | Austria: European country, Ghana: African country. African countries are more populous than European country. |
| | Kenya | Saudi Arabia | | | Recognition plus further information | | The participant works in a trade finance dept of a bank and knows that Saudi Arabia has a lot of trade transactions with Vietnam. No information about Kenya. |
| | Thailand | Somalia | x | | Knowledge cues combined | | Somalia: African country, poor. Thailand: Asian country with many well-known and crowded cities. |
| | Myanmar | Germany | x | | Knowledge cue - non compensation | migrants cue | Germany has a lot of migrants. |
| | Czech Republic | Hong Kong | | | Knowledge cue - compensation | Land area cue + Density cue (Decision is overturned by Density cue) | Hong Kong is a small territory but it is very crowded. |
| | Netherlands | Cambodia | x | | Knowledge cue - non compensation | land area cue | As I remember, Netherlands' land area is quite large' |
| | Nepal | Côte d'Ivoire | x | | Knowledge cue - non compensation | Density cue | Nepal: large of land area covered by forests. Ivory Coast: near the sea. |
| | U.K. | Hungary | x | | Recognition plus further information | | U.K. comprises 4 portions. |
| | | | 7 | 90 | | | |
| 11 | Hong Kong | Taiwan | | | Knowledge cue - non compensation | land area cue | Hong Kong's land area is larger than Taiwan (-> incorrect.) |
| | Rwanda | Mexico | x | | Recognition plus further information | | Rwandan genocide. |
| | Japan | Chile | | | Knowledge cues combined | land area cue + fertility rate cue | Japan: smaller, lower fertility rate compared to Chile. |
| | Kenya | Russia | x | | Knowledge cue - compensation | land area cue + fertility rate cue (decision is dominated by Land area cue) | Russia: very large, low fertility rate. |
| | Somalia | Hungary | | | Knowledge cue - compensation | Consider continent cue, decision is overturned by Land area cue | Somalia: African country. But Hungary is larger than Somalia -> incorrect. |

| Parti- pant no. | pairs of countries | | Correct choice | Total time consumed (seconds) | STRATEGY | cue remark | Remark (why choose) |
|--------------------|---------------------|---------------------|-------------------|-------------------------------------|--------------------------------------|---|---|
| | Belgium | Haiti | x | | Knowledge cue - non compensation | land area cue | Haiti is very small. |
| | Senegal | Myanmar | x | | Knowledge cue - non compensation | land area cue | Myanmar is larger than Senegal. |
| | Uganda | Malaysia | | | Knowledge cue - non compensation | land area cue | Malaysia is larger than Uganda. |
| | Bolivia | Philippines | | | Knowledge cue - non compensation | land area cue | Philippines is smaller than Bolivia |
| | Nepal | Iraq | x | | Knowledge cue - non compensation | land area cue | Iraq is larger than Nepal |
| | | | 5 | 80 | | | General strategy: base on land area, density and fertility rate. Land area comparison bases on memory about those countries on the map. |
| 12 | Nepal | Senegal | x | | Familiarity | | Nepal sounds more familiar |
| | Madagascar | Hong Kong | | | Knowledge cue - non compensation | economics cue (different choosing tendency) | Hong Kong is more developed. |
| | Haiti | Tanzania | x | | Knowledge cue - non compensation | economics cue (different choosing tendency) | Tanzania is more developed. |
| | Malaysia | Saudi Arabia | | | Random choice | | Random choice |
| | Cameroon | Taiwan | x | | Knowledge cue - non compensation | Land area cue | Taiwan is small, Cameroon is larger. |
| | Italy | Peru | x | | Knowledge cue - non compensation | economics cue (different choosing tendency) | Italy is more developed. |
| | Bolivia | Iraq | | | Knowledge cue - non compensation | economics cue (different choosing tendency) | Bolivia is more developed. |
| | Serbia | South Africa | x | | Knowledge cue - non compensation | Land area cue | South Africa's land area is larger. |
| | Chile | U.K. | | | Random choice | | Random choice |
| | Ethiopia | Hungary | | | Recognition plus further information | | "Because Hungary is a happy country." |
| | | | 5 | 57 | | | |
| 13 | Malaysia | Bulgaria | | | Knowledge cue - non compensation | Land area cue | Malaysia is smaller than Bulgaria |
| | Saudi Arabia | Algeria | | | Familiarity | | Saudi Arabia sounds more familiar |
| | Haiti | Peru | | | Knowledge cue - non compensation | Land area cue | Haiti is in Africa where there is populous. |

| Partici- pant no. | pairs of countries | | Correct choice | Total time consumed (seconds) | STRATEGY | cue remark | Remark (why choose) |
|----------------------|--------------------|------------|-------------------|-------------------------------------|---|----------------------------------|--|
| | Israel | Serbia | x | | Random choice | | Random choice |
| | Mexico | Ecuador | x | | Knowledge cue - non compensation | Land area cue | Mexico is larger than Ecuador |
| | Iraq | Chile | | | Knowledge cue - non compensation | Land area cue | Iraq is not a large country, Chile is larger. |
| | Venezuela | U.A.E | | | Recognition plus further information | | Read an article about U.A.E which reads that U.A.E is a populous country. |
| | Hong Kong | Bangladesh | | | Knowledge cue - non compensation | Chinese culture cue | Hong Kong belongs to China so it is populous |
| | Tanzania | Greece | x | | Random choice | | Random choice |
| | Mali | Nepal | x | | Familiarity | | Do not know anything about Mali. Have heard something about Nepal. |
| | | | 4 | 60 | | | |
| 14 | Mozambique | Venezuela | x | | Knowledge cue - non compensation | continent cue | Venezuela is in South America |
| | Honduras | Turkey | | | Random choice | | Random choice because economics cue and land area cue do not discriminate. |
| | Belgium | Morocco | | | Random choice | | Random choice because economics cue and land area cue do not discriminate. |
| | Belarus | Germany | x | | Knowledge cue - non compensation | Land area cue | Base on land area |
| | Colombia | Russia | x | | Knowledge cue - non compensation | Land area cue | Base on land area |
| | Iran | Malaysia | | | Knowledge cue - non compensation | Density cue | Choose Asian country because Asian countries have high density. |
| | Thailand | Bangladesh | | | Knowledge cue - non compensation | Density cue | Choose Asian country because Asian countries have high density. |
| | Ethiopia | Israel | | | Random choice | | Random choice because economics cue and land area cue do not discriminate. |
| | Nepal | Chile | | | Random choice | | Random choice because economics cue and land area cue do not discriminate. |
| | Canada | Uganda | | | Knowledge cues combined | Land area cue + economics cue | Canada is larger and more developed. |
| | | | 3 | 105 | | | General strategy: base on continent cue, economics cue (how developed the country is) and which is more popular on media |

| Parti- pant no. | pairs of countries | | Correct choice | Total time consumed (seconds) | STRATEGY | cue remark | Remark (why choose) |
|--------------------|-----------------------|-------------|-------------------|-------------------------------------|-------------------------------------|---------------------------------------|---|
| 15 | Chile | Germany | | | Knowledge cues combined | Land area cue + fertility rate cue | Land area cue (Chile is larger than Germany) -> Note: incorrect info. Chile has a lower education level than Germany so its fertility rate is high whereas Germany has a low fertility rate. |
| | Israel | North Korea | | | Familiarity | | Know more about Israel. |
| | Madagascar | U.A.E | | | Recognition plus information | | Madagascar is in Africa but do not know about its population. U.A.E 's population size is not small. |
| | Morocco | Peru | | | Familiarity | | Peru sounds more familiar |
| | Iran | Cambodia | | | Knowledge cues combined | Fertility rate cue + Land area cue | Cambodia has a high fertility rate. Iran has a small land area-> Note: incorrect |
| | Zimbabwe | Hungary | | | Fluency heuristic | | Choose Hungary because of faster retrieval of information. |
| | Colombia | Japan | | | Knowledge cue - non compensation | Land area cue | Colombia's land area is larger than Japan. |
| | Bolivia | Honduras | x | | Familiarity | | Choose the one which sounds more familiar |
| | Cuba | Angola | | | Familiarity | | Choose the one which sounds more familiar |
| | France | Jordan | x | | unknown | | Jordan's land area is smaller than France. Base on land area and density... (uncertain) |
| | | | 2 | 205 | | | |
| 16 | Cambodia | Mozambique | | | Knowledge cue - non compensation | Decision based on economics cue | Cambodia is in Asia and Mozambique is in Africa: not distinguish, Land area of the two countries are about the same. Cambodia is more developed. |
| | South Korea | Australia | x | | Knowledge cue - non compensation | Fertility rate cue | Australia is an aging country with a high quality of living conditions -> lower fertility rate compared to an Asian country like South Korea. |
| | Dominican Republic | U.K. | x | | Knowledge cue - non compensation | Economics cue | Based on economics development. U.K. is more developed (then they have better living condition -> lower death rate) |
| | Sri Lanka | Germany | x | | Knowledge cue - non compensation | Land area cue | Sri Lanka's land area is smaller than Germany. |
| | U.A.E. | Sudan | | | Knowledge cue - non compensation | Land area cue | Based on land area |
| | South Africa | Cameroon | x | | Familiarity | | No information about Cameroon. Heard of South Africa more often. |
| | Angola | Ukraine | x | | Familiarity | | Heard of Ukraine more often. |

| Parti- pant no. | pairs of countries | | Correct choice | Total time consumed (seconds) | STRATEGY | cue remark | Remark (why choose) |
|--------------------|--------------------|-------------|-------------------|-------------------------------------|--------------------------------------|-----------------------------|---|
| | Philippines | Spain | | | unknown | | Think both are the same, however, choose Spain because of its long history of development |
| | Canada | Cuba | | | unknown | | Canada is more developed and its land area is larger, however its density is low. Cuba is a developing country so its labor force is large. |
| | Italy | Malaysia | | | Knowledge cue - non compensation | Land area cue | Based on land area |
| | | | 5 | 50 | | | |
| 17 | Iraq | Egypt | x | | Knowledge cues combined | | Read somewhere that Egypt is populous. Iraq is in the war zone -> high death rate. |
| | Somalia | Chile | x | | Familiarity | | Chile sounds more familiar. |
| | Germany | Algeria | x | | Knowledge cue - non compensation | Land area cue | Algeria is a small country in Africa or in West Asia and the size of the country (on the map) is not large. Certain that Germany is a very large country. |
| | France | Ecuador | x | | Random guess | | Random guess |
| | Thailand | Mozambique | | | unknown | | Have some information about Mozambique which are black people, a populous country and has a large number of poor people. |
| | Philippines | Cuba | x | | Direct solution | | Philippines is more populous than Cuba by transitive comparison with Vietnam's population (certainly know that Philippines are more populous than Vietnam and Vietnam is more populous than Cuba) |
| | Niger | Peru | x | | Familiarity | | Choose the one which sounds more familiar |
| | Portugal | Jordan | x | | Familiarity | | Choose the one which sounds more familiar |
| | Romania | Honduras | x | | Familiarity | | Choose the one which sounds more familiar |
| | Pakistan | Uzbekistan | | | Recognition plus further information | | A friend once said that there are many flights to Uzbekistan |
| | | | 8 | 36 | | | |
| 18 | Chile | Germany | | | Knowledge cues combined | Land area cue + Density cue | Germany is smaller than Chile because most of European countries are small -> Incorrect. Germany's density is low because most of European countries has low density. |
| | Israel | North Korea | | | Knowledge cue - non compensation | Density cue | Israel's density is higher than North America |

| Parti- pant no. | pairs of countries | | Correct choice | Total time consumed (seconds) | STRATEGY | cue remark | Remark (why choose) |
|--------------------|--------------------|------------------|-------------------|-------------------------------------|---|---------------|---|
| | Madagascar | U.K. | x | | Recognition plus further information | | U.K. is a populous country (read on newspaper) |
| | Morocco | Peru | x | | Random choice | | Random choice |
| | Philippines | Cambodia | x | | Knowledge cue - non compensation | Land area cue | Cambodia's land area is very small. (Participant's hometown is next to Cambodia). |
| | Zimbabwe | Hungary | | | Familiarity | | Do not know much about Zimbabwe, so pick Hungary |
| | Russia | South Sudan | x | | Knowledge cue - non compensation | Land area cue | Russia's land area is larger. |
| | Bolivia | Honduras | | | Familiarity | | Honduras sounds more familiar |
| | Congo - DR | Angola | | | Familiarity | | Angola sounds more familiar |
| | France | Jordan | x | | Familiarity | | Know more about France (thanks to reading newspaper and listening to the news). |
| | | | 5 | 36 | | | |
| 19 | Mozambique | Venezuela | x | | Random choice | | Random choice after considering continent cue (Venezuela is in South America, Mozambique is in Africa) |
| | Honduras | Turkey | x | | Familiarity | | Know more about Turkey |
| | Belgium | Morocco | | | Random choice | | |
| | Kazakhstan | Mexico | x | | Knowledge cues combined | Density cue | Kazakhstan is in West Asia -> low density due to severe weather conditions. Mexico is one among the populous countries. |
| | Belarus | Germany | x | | Familiarity | | Know more about Germany. |
| | Colombia | Russia | x | | Direct solution | | Russia is among the top of most populous countries. |
| | Iran | Malaysia | | | Knowledge cue - non compensation | War zone cue | Iran is in the Middle East which is more likely to be less populous. |
| | Thailand | Bangladesh | | | Recognition plus further information | | Both countries are in Asia. Thailand is among the populous countries in Asia. |
| | Ethiopia | Israel | x | | Direct solution | | Israel's population is only about 6 million people. -> correct. |
| | U.K. | Uganda | x | | Direct solution | | U.K. is among the top of most populous countries. |
| | | | 7 | 31 | | | |
| 20 | Australia | Cambodia | x | | Knowledge cues combined | | Australia has large land area and no war. |

| Partici- pant no. | pairs of countries | | Correct choice | Total time consumed (seconds) | STRATEGY | cue remark | Remark (why choose) |
|----------------------|--------------------|--------------------|-------------------|-------------------------------------|-------------------------------------|---------------------|---|
| | Chile | Germany | | | Knowledge cues combined | | Chile is in South America and is a developing country. |
| | Japan | Taiwan | | | Knowledge cue - non compensation | Chinese culture cue | Taiwan is influenced by Chinese culture which prefers large-size families with more children. |
| | Cuba | Hong Kong | | | Knowledge cue - non compensation | Chinese culture cue | Hong Kong is influenced by Chinese culture which prefers large-size families with more children. |
| | Myanmar | South Korea | | | Random guess | | Random guess, no information discriminates |
| | Philippines | Canada | x | | Knowledge cue - non compensation | continent cue | Asian countries are more populous. |
| | Venezuela | Thailand | x | | Knowledge cue - non compensation | continent cue | Asian countries are more populous. |
| | Italy | Mexico | x | | Knowledge cue - non compensation | continent cue | European countries are less populous than South American country. |
| | North Korea | Malaysia | x | | Knowledge cue - non compensation | Economics cue | North Korea is sanctioned due to developing nuclear weapons and thus less developed than Malaysia. |
| | U.K. | Russia | x | | Knowledge cue - non compensation | Land area cue | Russia has the largest land area in the world. |
| | | | 6 | 33 | | | |