Recognition effects and noncompensatory decision making strategies

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Abstract

Oppenheimer (2003) challenged the empirical evidence for the recognition heuristic by pointing to the possibility that existing demonstrations may have confounded recognition with a person's existing knowledge. In two experiments we remove the possibility of such a confound by independently manipulating recognition in a way similar to the "overnight fame" paradigm of Jacoby, Kelly, Brown and Jasechko (1989). We found evidence for a recognition effect, but neither compensatory nor noncompensatory decision making strategies seem to be able to completely explain our results. We discuss what modification to these strategies may be necessary.

Introduction

Gigerenzer and Todd (1999) proposed that when people make decisions, rather than using all possible information that they could, they use "fast and frugal" heuristics selected from an adaptive toolbox. Gigerenzer and Goldstein (1996) showed that such heuristics can lead to decisions as good or better at achieving the organisms goals as more resource intensive strategies. This *adaptive rationality* approach challenges the traditional approaches to rationality (see Chater, Oaksford, Nakisa, & Redington, 2003).

Goldstein and Gigerenzer (2002) proposed that the toolbox includes the recognition heuristic, which can be applied "If one of two objects is recognized and the other is not, then infer that the recognized object has the higher value with respect to the criterion." (p.76) In this sense it is an example of one-reason decision making, though it can also act as a subroutine in heuristics that use information beyond recognition, such as the *Take the Best* heuristic (Gigerenzer & Goldstein, 1996). Such heuristics embody Simon's (1956) concept of *bounded rationality*, which suggests organisms seek enough information for a good decision rather than spending resources on obtaining all relevant information.

However it is apparent from attempts to gather evidence for or against the recognition heuristic that there are some conceptual disagreements. In this paper we present our understanding of the heuristic and its relationship to other concepts of how recognition cues are used, and we present a new methodology for examining recognition as a process.

Previous studies

As evidence for people's use of the recognition heuristic, Goldstein and Gigerenzer (1999, 2002) showed that which German cities Americans recognized affected their choices for which of a pair of German cities was larger. However Oppenheimer (2003) challenged this empirical evidence for the recognition heuristic by suggested that because Goldstein and Gigerenzer used the 30 largest German cities, recognition was confounded with actual city size. Thus recognition itself may be irrelevant as a cue or combined with other cues. Such confounds exist in all their demonstrations because they state that the heuristic should only be found to be used when recognition has a correlation with the correct answer via an ecological valid mediator.

To remove this confound Oppenheimer (2003) presented a cities pairs task, in which recognition could not have a valid correlation because one city was fictional, and thus there was no correct answer. Furthermore the real cities, with which the fictional cities were paired, were either small or famous for reasons unrelated to size. Two studies tested the hypothesis that when subjects were presented with a city they recognized and one they did not, then preference for the recognized city would not be above chance (specifically, he tested if more than 50% of participants chose the recognized city). Both studies found that significantly fewer than 50% of participants chose the recognized cities.

Oppenheimer (2003) suggests that Goldstein and Gigerenzer's (2002) evidence showing that greater than 50% of subjects choose the city they recognized is consistent with them using the recognition heuristic. However because other cues may be confounded with recognition, these results are also consistent with strategies that combine cues together. For examples these other cues could be combined in tallying strategies, weighted additive models, or regression models and produce results consistent with the recognition heuristic. Oppenheimer claims that by demonstrating that cues that should be associated with recognition (cues indicating small in his experiments, those indicating big in Goldstein & Gigerenzer) influences the extent to which subjects chose the recognized city, he has shown that there is no evidence for the recognition heuristic. This interpretation of the data is disputable, partly because exactly what question this data addresses is arguable.

Distinguishing related questions

Experiments on the recognition heuristic have addressed three questions that are related but not necessarily the same:

1) Are there recognition effects on choice? Demonstrating this requires showing that people's choices are influenced by recognizing one option and not the other. This question generates a testable prediction that Oppenheimer's (2003) data addresses: that subjects should prefer the recognized city at a rate greater than chance. He finds no evidence for this, and claims that Goldstein and Gigerenzer's (2002) evidence for it was due to confounds. However this question is not equivalent to the second.

2) Do people use the recognition heuristic? Oppenheimer (2003) states that "The recognition heuristic posits that individuals will use no information aside from mere recognition to make city size estimations." Goldstein and Gigerenzer almost certainly disagree with this statement. Gigerenzer and Todd (1999, p.32) state that different heuristics may be applied to a choice between two options, and which is applied depends on the person's knowledge. The recognition heuristic is most likely applied when the decider has no information except recognition. *When* it is applied then only recognition information should be used, but there is no claim in Goldstein and Gigerenzer (2002) that the recognition heuristic is always applied. Their own data show that the recognition heuristic is not always applied. Gigerenzer and Todd (1999, p. 32-33) briefly consider the question of how heuristics are selected and suggest that task and available cues determine it. Although their concept of a "toolbox" of heuristics implies that selection is critical, a valid criticism may be that how this is done is an under-developed aspect of their approach. In this they are not unusual as Falk and Konold (1997, p. 305) point out that it hard to make predictions regarding the representatives heuristic because "there is no established procedure for deducing how it will be implemented in a specific task."

3) Is recognition used in a noncompensatory way? Goldstein and Gigerenzer (2002) propose that the recognition heuristic is a noncompensatory algorithm, as are other algorithms proposed by Gigerenzer and Todd (1999). A prototypical noncompensatory algorithms is a lexicographic strategy (see Payne, Bettman, & Johnson, 1993). Cues are arranged in a hierarchy based on validity then starting from the top, one cue at a time is considered until one is found that discriminates between the options. In contrast, a compensatory strategy (such as linear regression or multi-additive models) integrates all cues in making a choice, although they may be given different weightings. A flow diagram of a noncompensatory algorithm in which recognition is the first cue considered is given by Gigerenzer and Goldstein (1996, Figure 2). The stopping rule for such an algorithm is the first cue considered that distinguishes between options. Characteristic of such algorithms is that a decision made on the basis of a higher cue cannot be reversed by cues lower in the order Goldstein and Gigerenzer (p. 82). The recognition heursitc is a special case of a noncompenstory strategy, so recognition need not be the first cue considered in noncompensatory strategies. Gigerenzer and Goldstein and Gigerenzer and Todd discuss various noncompensatory algorithms.

Possibly Oppenheimer's (2003) most interesting claim is that his data showing that people chose the recognized city less than 50% of the time shows that recognition is not used in a noncompensatory way. It is worth examining his arguments for this claim. He argues that if people are only sometimes using the recognition heuristics, then the problematic question of how they decide which heuristic to use is raised. If the task determines it then why was a recognition effect in Goldstein and Gigerenzer's (2002) paired-city task, but not Oppenheimer's (2003)? If the cues presented in the task determine which algorithm is used, then all cues have to be considered, undermining the efficiency of the "one-reason" decision making. Thus it is not as "frugal" in terms of processing and information as Goldstein and Gigerenzer claim.

If more than one cue is available then implicit in the claim that cues are ordered in a hierarchy is that cues must be considered at some level. The defining characteristic of a noncompensatory algorithm seems to be how the cues are combined at the decision point. In compensatory algorithms all available cues are integrated requiring some form of trade-off between those that favor different options, whereas in noncompensatory algorithms at the point of decision only one cue is considered and there are no trade-offs. Whether this means that noncompensatory algorithms are inherently more "frugal" than compensatory algorithms depends on what sort of assumptions are made about cue ordering or cue trade-off processes.

If competing subjective cue validities determine the order in which cues are considered by noncompensatory algorithms, then it would be predicted that the nature of the cues available in addition to recognition would influence the extent to which recognition determined the choice between two options. Thus Oppenheimer's (2003) evidence that other cues may moderate the impact of differential recognition on a choice does not in itself show that recognition is used in a compensatory algorithm.

In both Goldstein and Gigerenzer (2002) and Oppenheimer (2003) recognition was confounded with other information. To more effectively test how recognition is used requires a way to manipulate recognition free of any confounds.

Manipulating recognition

In existing studies of the heuristic, recognition has always been a pseudo-independent variable; that is, the studies have not manipulated recognition but instead examined the impact of what subjects recognized due to life experience.

We manipulated recognition by pursuing Goldstein and Gigerenzer's (2002) suggestion that recognition might be induced in a way analogous to the "overnight fame" effect found by Jacoby, Kelly, Brown and Jasechko (1989). Jacoby, et al. presented participants with a list of unfamiliar names that were included on a later list of names to which participants were asked to respond: famous or nonfamous? They were more likely to choose as famous the arbitrary names from the initial list. We used a similar methodology with small German cities to examine if induced recognition could affect the choice of which of two cities was larger.

To induce recognition we gave participants one of two *induction lists* consisting of eight German cities or towns (Zwickau, Leverkusen, Regensburg, Offenbach, Ulm, Stralsund, Coburg, Dormagen; or, Bochum, Gelsenkirchen, Darmstadt, Krefeld, Schweinfurt, Goslar, Lingen, Iserlohn) plus three irrelevant small cities. Participants were asked to count the number of syllables they thought each city name contained. We conducted a pilot experiment to confirm that these induction lists could induce recognition. Eight members of the Michigan State University participant pool were given one of the induction lists, and nine the other list. After spending 30 minutes on unrelated tasks, participants were presented with a list of 20 small German cities, including the 16 from the two induction lists. For each city they were asked if they remembered seeing the city on the list they were given earlier. They recognized more cities from their own induction list (M = 85%) than from the list they had not been given (M = 11%), $t(32) = 18.62$, $p < .001$. Therefore the pilot experiment supported our assumption that presenting the syllable list would induce later recognition.

Aims of the experiments

In two experiments using induced recognition we examined recognition effects and how other cues may moderate any effect. This allowed us to address two of the three questions we outlined regarding recognition

1) Are there recognition effects on choice? Oppenheimer (2003) claims that the Goldstein and Gigerenzer's (2002) results are flawed because of confounds, but his experiments intentionally introduce another confound. To clearly establish whether there are recognition effects in the cities-pairs task requires a version with no confounds.

2) Do people use the recognition heuristic? The answer to this question is clearly "not all the time". A more reasonable question is what factors influence the degree to which people use the recognition heuristic? However no one has specified these factors well enough to examine this.

3) Is recognition used in a noncompensatory way? Addressing this question requires examining how other cues moderate the effect of recognition. Goldstein and Gigerenzer (2002) found that adding other cues did not affect the size of the recognition effect, whereas Oppenheimer found that they did. However in neither experiment were cues systematically manipulated within a single experiment. In our experiments we varied the amount of other cues available in order to address how information moderates recognition effects and thus throw light on the issue of whether recognition is used in a compensatory or noncompensatory way.

Experiment 1

In Experiment 1 we induced in Americans recognition of small German cities from an induction list of eight, then presented them with each of these cities paired with one from the alternative list of eight cities. We predicted that participants would be more likely to select the induced city in the pair. We also manipulated giving a positive (has a major league soccer team) or a neutral (the state the city was in) cue to the size of one city in the pair, either the induced or noninduced city. The least amount of extra cues was none, the next least neutral only, the next positive only, and the most extra cues received was both neutral and positive. If recognition is a compensatory cue, then the more information presented, the smaller the effect of recognition should be.

Method

Participants

A total of 256 members of the Michigan State University participant pool participated for partial course credit.

Materials

The two induction lists were the same as those described for the pilot experiment. For the *city-size task*, the eight cities from one induction list were paired with the eight from the other. Thus for each pair, one city was induced (i.e., appeared on the participant's induction list) and one was noninduced (i.e., appeared on the list the participant did not see). For each pair, participants chose which city they thought was larger. To obscure the purpose of the task, Oppenheimer (2003) included some pairs with obvious answers. Similarly we added three pairs containing a well-known large city (Berlin, Frankfurt, Munich).

With each city pair extra cues could appear, though cues were always independent of reality allowing us to freely manipulate information. (No participants pointed out that the information was incorrect.) There were four cue conditions. For the two *cue-none* pairs it was stated for both cities that there was no information available regarding whether it had a soccer team or which state it was in (Germany consists of 16 states). For the two *cue-neutral* pairs soccer team status was said to be unknown but a state was given for one city. For the two *cue-positive* pairs state was said to be unknown but one city was said to have a soccer team. For the two *cue-all* pairs for one city a state was given and it was said to have a soccer team, whereas this information was said to be unknown for the other city. Eight pairs for each participant were necessary because for four pairs the cue conditions were applied to the induced city, and for the other four pairs the cue conditions were applied to the noninduced city.

Note that Goldstein and Gigerenzer (2002) also conducted an experiment in which a city having a major soccer team was used as an extra cue to city size. They taught participants that having a team was indicative of being a large city, but found that it did not appear to alter the effect of recognition based on a between experiments comparison. We did not teach participants about this relationship but instead relied on participants generalizing from their likely awareness that the major American professional sports teams are rarely in small cities.

The same cities were always paired but each pair appeared equally often in each cue and induced condition. Cues appeared in two possible orders (maximum information to none, or vice-versa), and the cities appeared in two different orders. Thus there were 16 versions of the city-size task (four cue by two cue-order by two city-order conditions) that appeared equally often with each induction list.

Procedure

Participants were first given one of the two induction lists and told that their task was to write down the number of syllables in each city name as best they could. They then spent 30 minutes doing unrelated tasks until they were given one version of the city-size task and asked to choose which city in each pair they thought was larger. After completing this task they were given a questionnaire that asked them: 1) Does the last task you completed relate to any of the previous tasks? 2) Were your responses to the last task you completed affected by any of the previous tasks? For each question they had to answer "yes" or "no" and to explain their answer. These questions were used to determine if participants were explicitly connecting together the induction and city size tasks. Participants who said the syllable task affected them when choosing cities were replaced in the design. This was to protect against the possibility that participants might just select cities because they thought they were supposed to select cities from the induction list. Fewer than 10% of participants were replaced and subsequent analyses found no evidence that the replaced subjects responded differently.

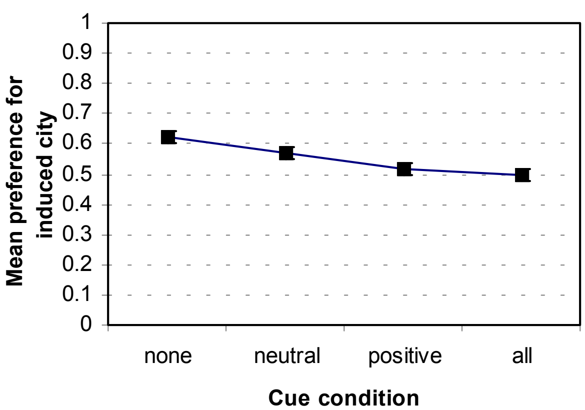

Figure 1: Mean preference for the induced city for each cue level (Bars represent one standard error). Above .50 represent preference towards induced cities.

Results

Figure 1 indicates mean preferences for the induced cities for each cue level. To calculate preferences we examined the two city pairs in each of the cue conditions. If a participant chose the induced city in both pairs (i.e., the pair in which cues were given for the induced city and the pair in which cues were given for the noninduced city) they were assigned 1.0, if they chose the induced city once and the noninduced once then they were assigned 0.5, if they chose the noninduced city both times then they were assigned 0.0. Thus mean preferences range from 0.0 to 1.0. Preferences above .50 indicate a bias towards induced cities, whereas below .50 indicates a bias towards noninduced cities.

Participants had preferences for the induced city above .50 for the cue-none (.62, $t[255] = 5.72$, $p < .001$) and cue-neutral (.57, $t[255] = 3.78$, $p < .001$) conditions, but not for the cue-positive (.52, $t[255] = 1.14$, $p = .258$) or cue-both conditions (.50, $t[255] = -0.14$, $p = .887$). Ordering the four cue condition in terms of amount of extras information given (none, neutral, positive, all) produced a significant linear trend, $t(765) = 5.38$, $p < .001$. Separately calculating the proportion of participants choosing the city for which cues were given, but ignoring whether this was the induced or noninduced city, we found a strong effect of how much information participants were given (cue-none .50; cue-neutral .58; cue-positive .79; cue-all .84), $F(3, 576) = 62.8$, $p < .001$.

Of the 256 participants, 44 indicated that they thought the city size task related to the syllable task, but they were not eliminated from the sample because they said that the syllable task did not affected their responses. However it is possible that effects were driven by just these participants who explicitly remembered the syllable task. Analyzing separately these 44 participants and the other 212, we found the same pattern of results for both groups as we found for the whole sample.

Discussion

When recognition was not confounded with any other information and it was the only cue available, then the city likely to be recognized was selected more than chance. The 62% selection rate for the cue-none condition was not as high as Goldstein and Gigerenzer (2002) report but there could be several reasons for this. First, we did not test which cities participants recognized and thus we did not only analyze pairs for which only one city was recognized, as Goldstein and Gigerenzer and Oppenheimer (2003) did. Based on the recognition pilot data, it could be estimated that this condition would apply for only 77% of our pairs. (To avoid any possible biases, we analyzed all pairs.) Second, our induction procedure may produce recognition that is relatively weak and uncertain compared to that based on experience. Goldstein and Gigerenzer treat recognition as a binary, all-or-none distinction; however creating this distinction is not without error. As the work on eyewitness testimony has amply shown (Wells & Loftus, 1984), recognition and can be uncertain and it may be hard for a person to decide if they recognize something. This may be especially true for foreign, hard to pronounce words briefly experienced once. Our induction procedure allowed us to manipulate recognition, but it may produce recognition with a different character to that in the previous experiments.

The results also showed that the presence of other cues can moderate the influence of recognition. Oppenheimer (2003) suggested that any evidence of such moderation is evidence against noncompensatory decision making of the type Goldstein and Gigerenzer (2002) described. However evidence that one cue moderates the mean effect of another cue does not establish that individuals are integrating cues as in compensatory multi-cue strategies. Our data may be consistent with Goldstein and Gigerenzer's approach in which only one cue is applied at a time but cues form a hierarchy based on validity. When recognition is uncertain other information may easily be seen as more valid.

Of course there is no true validity for either recognition or other information in this experiment, as relaxing that constraint is what allows us to freely manipulate these factors. We are assuming that participants come to the experiment with cue validities, thus it is not surprising if there may be individual differences in how they assign validity. There may also be individual differences in strategy selection (Fasolo, Miscuraca, & McClelland, 2003).

Experiment 2

One way of investigating how recognition is combined (or not) with other cues is to equalize the amount of extra information given for each city in a pair. Different compensatory decision strategies differ in the way in which they combine cues, but the impact of a cue in these strategies is greatest when that cue differentiates between options. Thus cues that provide equivalent information for both choices should have no impact on decision making. Therefore the moderating effects of extra cues on recognition should largely disappear.

As Gigerenzer and Goldstein (1996) describe noncompensatory algorithms, cues should continue to be considered until one is found that differentiates the options. This stopping rule implies that only differential cues could moderate the effect of recognition because even if a nondifferential cue is higher in the validity hierarchy, it can have no impact on the final decision. Thus a noncompensatory strategy also predicts that when extra cues are not differential then the moderating effect of those cues on the impact of recognition should disappear.

Experiment 2 varied the same cues as in Experiment 1, but instead of giving cues about just one of the two cities, we gave equivalent cues for both. Thus the extra cues never distinguished the two cities, allowing us to test if undifferentiating information still moderated the recognition effect. Both compensatory and noncompensatory approaches make the same prediction: Whatever recognition effect is found for the cue-none condition, the same recognition effect should be found for other cue conditions. If this prediction is violated and cue condition still moderates the recognition effect, then it can point to modifications necessary to these approaches.

Method

Participants

A total of 128 members of the Michigan State University participant pool participated for partial course credit.

Materials and procedure

The exact same procedures and induction lists were used as in Experiment 1. The city-size task was identical except that equivalent cues were given for *both* members of the eight pairs. Thus for the two pairs in the *cue-all* condition a state was given for both cities and both cities were said to have a major league soccer team. For the two pairs in the *cue-positive* condition it was stated that both cities had soccer teams and that the states were not known. For the two pairs in the *cue-neutral* condition a state was given for both cities and it was stated that whether or not these cities had a soccer team was unknown. For the two pairs in the *cue-none* condition it was stated that neither piece of information was known. Thus the design of Experiment 2 was simpler than Experiment 1 but eight pairs were still given. We again counterbalanced the four cue conditions across the city pairs, used two orders of presentation, and two city-orders, which yielded sixteen version of the city task. Each version was presented equally often with each induction list.

Results & Discussion

Figure 2 presents the mean proportions of participants in each information condition who selected the induced city. In the *cue-none* condition the rate of choosing the induced city (.63) was significantly above .50, $t(127) = 4.29$, $p < .001$, but this was not the case for the *cue-all* condition (.54), $t(127) = 1.37$, $p = .175$. Proportions above 50% were almost statistically significant for both the *cue-neutral* (.56), $t(127) = 1.78$, $p = .075$, and *cue-positive* (.56) conditions, $t(127) = 1.91$, $p = .058$. Thus this experiment again found a clear effect of induced recognition when no prior knowledge could be confounded with recognition, especially when no new information about the cities was given.

Overall, there was a significant linear trend for cue condition on the proportions of induced cities selected, $t(381) = 2.15$, $p = .033$. Just as in Experiment 1, giving participants other cues reduced the impact of recognition. However it appears that the volume of information was critical, as this information did not differentiate the options.

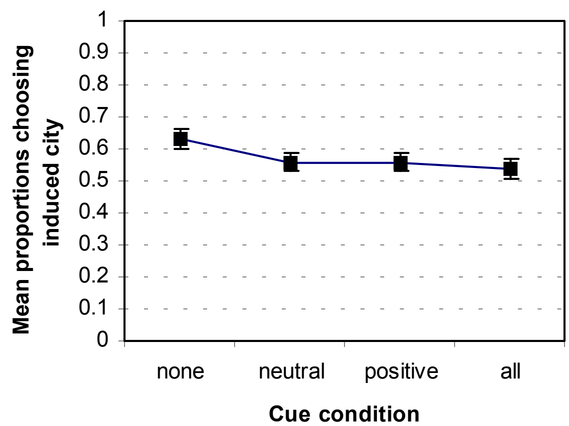

Figure 2: Mean proportions of participant in each cue condition choosing the induced city rather than the noninduced city (Bars represent one standard error). Above .50 indicates a preference for the induced city.

General Discussion

Our results show that recognition effects of the type Goldstein and Gigerenzer (2002) found are not only due to recognition being confounded with other cues. When recognition was unconfounded and was the only available cue the city more likely to be recognized was selected at a rate above chance.

Using within experiment manipulations our results supported Oppenheimer's (2003) finding that the presence of other cues could moderate a recognition effect. However the results of Experiment 1 are consistent with recognition being part of either compensatory or noncompensatory strategies, as long as recognition is not always the most valid cue. In contrast, the results of Experiment 2 are consistent with the predictions of neither type of strategy, as nondifferential cues should have no impact on decision making. What assumptions would need to be added to these approaches in order for them to explain these results?

Whatever function a compensatory strategy applies to options, the same function would be applied to both cities in a pair. Thus providing the same cue for both cities should just add a constant to the evaluation of both cities. Thus the difference between evaluations will not change. One way to deal with the evidence from Experiment 2 would be to make the total amount of information part of the integration process. Perhaps there is a Weber function for comparing options like there is for comparing perceptual stimuli. This would represent a revision to current compensatory strategies that would yield testable predictions.

Nondifferential cues should be ignored by noncompensatory strategies. However, they could have an impact if the algorithm had a stopping rule that may stop evaluating cues before one is found that differentiates. It seems consistent with bounded rationality that sometimes the evaluation is made by an organism that there is little value in continuing looking for discriminating information. Thus as each nondifferentiating cue is examined there may be a nonzero probability that the organism will decide to stop. If the extra cues may be placed higher in the validity hierarchy than recognition (as Experiment 1 may suggest) then such a stopping rule could lead nondifferential cues to moderate the utilization of differential recognition.

Such a stopping rule might take into account the anticipated cost of evaluating information. This may be particular relevant in our paradigm as the type of uncertain recognition we might have induced may have a cost. Anderson's ACT-R framework emphasizes the cost of any remembering (Anderson, Lebiere, & Lovett, 1998). Recognition is not necessarily more accurate than recall (Tulving & Thomson, 1973), and it may be inaccurate and uncertain (Wells & Loftus, 1984). Thus even a single nondifferential cue may reduce the impact of recognition if it can be higher in the cue hierarchy.

Experiments that examine recognition free of confounds are useful for understanding this heuristic as a processes rather than just a phenomenon, and the importance of doing this in general was pointed to by Gigerenzer (1996). Both the compensatory and noncompensatory approaches to how multiple cues affect decision-making seem under-specified, and thus unable to explain the results of Experiment 2. The paradigm we introduced here has promise for furthering the understanding of heuristics utilizing recognition and the process by which recognition affects choices.

Acknowledgements

We would like to thank Erik Altmann and Tom Carr for helpful comments on earlier drafts. These experiments were done as partial fulfillment of the first author's requirements for the degree of Bachelor of Science (Honors).

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