Revisiting diversification bias and partition dependence:
Replication and extension of Fox, Ratner, and Lieb (2005) Studies 1, 2, and 5

MeiYee Li

ORCID: 0000-0002-3720-7035

The University of Hong Kong, Hong Kong SAR

u3591223@connect.hku.hk / meiyee970522@gmail.com

^Gilad Feldman

ORCID: 0000-0003-2812-6599

Department of Psychology, University of Hong Kong, Hong Kong SAR

gfeldman@hku.hk/ giladfel@gmail.com

^Corresponding author

## Author bios:

MeiYee Li was a masters student at the University of Hong Kong during the academic year 2021-2022.

Gilad Feldman is an assistant professor with the University of Hong Kong psychology department. His research focuses on judgment and decision-making.

## Declaration of Conflict of Interest:

The author(s) declared no potential conflicts of interests with respect to the authorship and/orpublication of this article.

## Financial disclosure/funding:

The author(s) received no financial support for the research and/or authorship of this article.

## Authorship declaration:

MeiYee Li conducted the replication as part of her dissertation in psychology PSYC7308 course.

Gilad guided and supervised each step in the project, (later: conducted the pre-registrations, and ran data collection), and edited the manuscript for submission.

## Corresponding author

Gilad Feldman, Department of Psychology, University of Hong Kong, Hong Kong SAR; gfeldman@hku.hk ; 0000-0003-2812-6599

## Rights:

CC BY or equivalent license is applied to the AAM arising from this submission. ([clarification](https://bit.ly/rrs-primer))

## Acknowledgements

We thank the target article’s authors - Prof. Craig Fox and Prof. Rebecca Ratner, for being very supportive and helpful in providing us with materials from their studies.

## Contributor Roles Taxonomy

In the table below, employ CRediT (Contributor Roles Taxonomy) to identify the contribution and roles played by the contributors in the current replication effort. Please refer to <https://www.casrai.org/credit.html> for details and definitions of each of the roles listed below.

|  |  |  |
| --- | --- | --- |
| **Role** | **MeiYee Li**  | **Gilad Feldman** |
| Conceptualization | X | X |
| Pre-registration | X |  |
| Data curation |  | X |
| Formal analysis | X |  |
| Funding acquisition |  | X |
| Investigation  | X |  |
| Pre-registration peer review / verification |  | X |
| Data analysis peer review / verification |  | X |
| Methodology | X |  |
| Project administration |  | X |
| Resources |  |  |
| Software | X |  |
| Supervision |  | X |
| Validation |  | X |
| Visualization | X |  |
| Writing-original draft | X |  |
| Writing-review and editing |  | X |

# Abstract

**[IMPORTANT:
Method and results were written using a randomized dataset produced by Qualtrics to simulate what these sections will look like after data collection. These will be updated following the data collection. For the purpose of the simulation, we wrote things in past tense, but no pre-registration or data collection took place yet.]**

People aim to diversify choices evenly resulting in a phenomenon coined “partition dependence” - partitioning options in a choice-set leads people to diversify allocations across and within partitions. We conducted a pre-registered replication and extensions of Experiments 1, 2, and 5 from the seminal paper on partition dependence by Fox et al. (2005) with an American online Amazon Mechanical Turk sample (*N* = 520). We found support for partition dependence in replication of Study 1 (original: *d* = 3.54, 95%CI [3.10, 3.98], replication: *d*=2.14, 95% CI [1.93, 2.36]), no support in Study 2 (original: d=1.34 [0.56, 2.12], replication: *d* = -.02, 95% CI [-.19, .15]), and no support in Study 5 (original: Wald x^2= 7.62, *p* < .0001, replication: Wald x^2= .04, *p* = .84). Thus, we conclude mixed empirical support for the partition dependence hypothesis. Extending the replication, we examined the desire for choice diversity to test and found that … Materials, data, and code are available on the OSF: <https://osf.io/fujsv/> .

*Keywords:* Partition dependence, diversification bias, bias, judgment and decision making, registered replication

#

# PCIRR-Study Design Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Question | Hypothesis | Analysis plan | Interpretation given different outcomes | Theory that could be reframed/shown wrong by the outcomes |
| How does partitioning affect allocations across options? | More money is allocated to poorer families in the low-income partition condition than in the high-income partition condition. | Independent t-test | Based on the criteria used by Lebel et al. (2019)We examine the replicability of the findings of Fox et al. (2005), and support for our suggested extensions. | Partition dependence |
| Less donation is allocated to the international funds in the nonhierarchical-partition condition than in the hierarchical-partition condition. | Independent t-test |
| Partitioning selection based on a certain factor leads to greater diversification based on that factor (e.g., grapes vs. region in wine selection) | Fisher’s exact test |
| Is partition dependence attenuated among individuals with greater relevant expertise | Greater expertise related to the items in the choice-set is associated with lower susceptibility to partition dependence. | Logistic regression |

#

# Revisiting diversification bias and partition dependence: Replication and extension of Fox, Ratner, and Lieb (2005) Studies 1, 2, and 5

## Background

Diversification bias is the tendency to prefer more variety when making a combined (simultaneous) decision than when making separate decisions (sequentially) (Read & Loewenstein, 1995). The tendency for diversification also occurs for option grouping and categories resulting in a phenomenon coined “partition dependence” (Fox & Rottenstreich, 2003) - decision makers seek to diversify across and within partitions. For instance, imagine a philanthropist choosing where to donate from a wide selection of children charities. Children charities can be compared against one another in one combined choice-set, or they might be partitioned into different categories, like by their location (domestic or international) or by target age groups (babies, young, older, etc.). Following partition dependence, depending on the salient categorization the philanthropist will tend to first diversify her investment among the salient categories, and to then diversify within each of the categories, resulting in a very different allocation than if making the decision without any categorization or using a different categorization. In this case, having location as the salient categorization may lead to first diversifying donations across the domestic versus international categories, and then to diversity within each of those categories based on the first high-level split allocation.

We conducted a replication and extensions of Fox et al. (2005) with the following goals. Our first goal was to conduct an independent close replication of a classic article on partition dependence. Our second goal was to add an extension to the original’s design in examining the associations between partitioning bias and individual differences regarding desire for choice diversity and specific choice related views.

We begin by introducing the literature on partition dependence and the chosen article for replication - Fox, Ratner, and Lieb (2005). We outline the target’s chosen studies for replication, the original’s experimental design, and our adaptations and extensions.

## Diversification heuristic and partition dependence

When people make multiple selections or allocations from a set of available options, they tend to evenly spread out their choices. For instance, investors generally follow this “diversification heuristic”, in that they tend to allocate their investments evenly over the investment options that were offered to them, and with little regard to the particular investments that were provided (Benartzi & Thaler, 2001). People tend to diversify their choices over both individual options and groups of options that are formed arbitrarily or subjectively. This may result in a “partition dependence”, first diversifying across high-level categories and then diversifying across the options within those categories. Thus, choices regarding the choice-set in the categories used and the allocation of options within those categories, may systematically affect the choices and allocations within the categories.

Fox et al. (2005) provided a demonstration of the phenomenon by asking student participants to allocate three free lunches over an academic year that was partitioned in three different ways. In particular, the academic year was divided into two semesters (Fall and Spring) and each semester was further subdivided into Term I & II in the Fall, and Term III & IV in the Spring. Participants were randomly assigned to one of the three experimental conditions, including a I-II-Spring condition, in which the Fall term was subdivided alongside with a full Spring term, a Fall-III-IV condition, in which the Spring term was subdivided alongside with a full Fall term, or a Fall-Spring condition. They found that participants who were assigned to the Fall-III-IV condition chose to assign more free lunches in the Spring, compared to those who were in the other two conditions.

## Choice of study for replication: Fox et al. (2005)

We chose the article by Fox et al. (2005) based on several factors: its impact, the large effect sizes, and the nuanced mixed findings in follow-up studies in the literature.

The article has had a major impact on scholarly research in the area of judgment and decision making. At the time of writing, there were 190 Google Scholar citations of the article. Fox et al. (2005)'s work also has important practical implications. For example, marketers, policy makers, or managers may be able to use very simple subtle techniques to have a very large impact on the choices and allocations of targeted audiences.

We are currently aware of only one successful non registered direct replication of Fox et al. (2005)'s Study 1 by Xing et al. (2020) who found similar effects (*N* = 121; *η*2 = .76). We note that the effect-sizes reported in both the Fox et al. (2005) and Xing et al. (2020) are remarkably high (converted to Cohen’s *d* = 3.56). If these effects are true, these findings would be - by far - some of the strongest effects in judgment and decision making and social psychology, and would mean very high potential benefits (or risks) for implementations in practice. There are also very large effects reported for Studies 2 (*d* = 1.34) and 5 (Wald chi-squared = 23.57; converted to Cohen’s *d* = 0.87).

In contrast to the success of replicating Study 1, Reichelson et al. (2018) conducted a replication of the original’s Study 4, yet they only managed to replicate the effect among children but not adults, despite three attempts, one of those being a very close replication. Here we note that despite the extremely large effects of Study 1, the effects reported in Study 4 were weaker, though still considered large by social psychology literature standards (*N* = 74; *t*(73) = 2.79; *d* = 0.65). Some follow-up conceptual replication studies also provided evidence for partition dependence among children only, and they suggested that the transparency of the task might be a contributing factor for this phenomenon. (Reichelson et al., 2019; Williams et al., 2020).

To our knowledge, there are no published pre-registered well-powered replications of Studies 1, 2, and 5. Given the mixed findings, the very large effects reported, and the observed moderators, we aimed to revisit Studies 1, 2, and 5 to reassess the robustness of the findings and the magnitude of the reported effects. We expect to find support for the phenomenon, yet with weaker more standard effects.

## Hypotheses and findings in target article

The article by Fox et al. (2005) consisted of six experiments, and we focused on Studies 1, 2, and 5. We chose these studies given our target online sample, requiring minimal adjustments for online data collection. We combined the three studies into a singular data collection, displayed in random order, and made slight adjustments to Study 2 and 5. This was a within-subject design replication, but in each of the three studies we ran participants between-subjects. This design allowed us to both test the designs of the original studies, and to then run further tests in comparing the effects of the different studies with the potential of additional insights. We successfully employed similar designs in previous replications in our team (e.g., Adelina & Feldman, 2022; Vonasch et al., 2022; Yeung & Feldman, 2022).

Study 1 was a between-subject design, in which participants were asked to allocate financial aid to applicants whose family household income fell in various ranges. Participants were assigned to either a low-income partition condition, in which they were either assigned to a low-income partition condition with income categories that equal to $75,000 per year or more, and five other lower options; or assigned to a high-income partition condition, in which they were provided with income ranges of $75,000 per year or less, and five other higher options. The researchers found that more money was allocated to poorer families in the low-income condition than in the high-income condition.

Study 2 was a between-subject design and participants were asked to allocate a sum of charitable donations to an international fund and/or four different local Durham County funds of the United Way charities. Participants who were assigned to the nonhierarchical condition, were asked to indicate their donation allocations in a combined presentation of both the international fund and the Durham County funds together; whereas those in the hierarchical condition had to first allocate their donations geographically: international versus Durham County, then to more specific funds: each of the four Durham County funds. The authors found that less donations were allocated to the international funds in the nonhierarchical condition than in the hierarchical condition.

Study 5 was a between-subject design and participants were asked to choose three wines from a list of six, as well as report the number of wines that they had purchased in the previous year. For participants who were assigned to the grape-partition condition, they were presented with wine lists organized by grape types; whereas participants who were assigned to the region-partition condition were provided with wine lists organized by regions. They found that: 1) partitioning based on a certain category (e.g. grape versus region) led to greater diversification based on that category; and 2) greater expertise related to the items in the choice-set (e.g., drinking more wine) weakened susceptibility to partition dependence.

We summarized the hypotheses of the target’s Studies 1, 2, and 5 in Table 1, and the findings of these studies in Table 2.

Table 1

*Summary of replication hypotheses*

|  |  |  |
| --- | --- | --- |
| Study | Hypothesis | Prediction |
| 1 | 1 | More money is allocated to poorer families in the low-income partition condition than in the high-income partition condition. |
| 2 | 1 | Less donation is allocated to the international funds in the nonhierarchical-partition condition than in the hierarchical-partition condition.  |
| 5 | 1 | Partitioning selection based on a certain factor leads to greater diversification based on that factor (e.g., grapes vs. region in wine selection) |
| 5 | 2 | Greater expertise related to the items in the choice-set is associated with lower susceptibility to partition dependence. |

Table 2

*Studies 1, 2, and 5: Summary of findings in the target article*

|  |  |  |  |
| --- | --- | --- | --- |
| **Factors** | **Cohen’s *d*** | **CIL** | **CIH** |
| Study 1 :Partition dependence effect | 3.54 | 3.10 | 3.98 |
| Study 2: Partition dependence effect | 1.34 | 0.56 | 2.12 |
| Study 5: | **Wald X^2** | ***p*** |  |
| Partition dependence  | 23.57 | < .0001 |  |
| Expertise | 0.67 | = .41 |  |
| Interaction: Expertise x Partition  | 7.62 | = .006 |  |

*Note*. CIL = lower bound CIs. CIH = higher bound CIs.

## Extension: Desire for choice diversity

We aimed to extend the replication study by considering individual differences in the desire for choice diversity as predictors of partition dependence. Early studies have suggested that desire for novelty and change is associated with variety-seeking behavior (Venkatesan, 1973). We were surprised by the lack of research in this direction, including the lack of scales directly aimed at measuring diversity related traits, especially given how fundamental diversity seems to consumer choice and decision-making behaviors, and so we sought to try and take a first exploratory step in this direction.

## Pre-registration and open-science

We will pre-register the experiment on the Open Science Framework (OSF) and data collection will be launched shortly after pre-registration. Pre-registrations and all materials used in these experiments are available in the supplementary materials. We provided all materials, data, code, and pre-registration on: <https://osf.io/fujsv/> .

We provided additional open-science details and disclosures in the supplementary materials under “Open Science disclosures” sub-section. All measures, manipulations, exclusions conducted for this investigation will be reported, all studies will be pre-registered with power analyses, and data collection will be completed before analyses.

# Method

[IMPORTANT:
Method and results were written using a randomized dataset produced by Qualtrics to simulate what these sections will look like after data collection. These will be updated following the data collection. For the purpose of the simulation, we wrote things in past tense, but no pre-registration or data collection took place yet.]

## Power analysis

We first calculated effect sizes (ES) and power based on the statistics reported in the target article (detailed provided in the supplementary materials). Once we did, we realized that the effect sizes in the original were too large for us to base our power analysis on, as - for example - the effect sizes for Studies 1 and 2 were Cohen’s *d* of 3.54 and 1.34, which if aiming for a 95% power with an α level of 5% would mean required samples of 8 and 32.

Given the very high likelihood that the original effects are overestimated, we used the suggested Simonsohn (2015) rule of thumb, even if meant for other designs, and multiplied the largest study in the target (208) by 2.5 to result in 520. Accounting for possible exclusions and the integrated design, and allowing for the potential of additional analyses, we aimed for a larger total sample of 600 participants. A sensitivity analysis indicated that a sample of 600 would allow the detection of *d* = 0.27 for independent t-test contrasts and *f* = 0.16 given two conditions and two covariates in an ANCOVA for our extensions (both 95% power, alpha = 5%, one-tail). Our targeted effects are 7% and 20% of the originally detected effects.

To demonstrate what the results would look like after data collection we simulated a dataset of 520 participants using Qualtrics, which we will later update with the real data and our sample of ~600.

## Participants

We simulated a dataset of 520 participants using Qualtrics, and we reported the analyses based on the simulated dataset (*Mage* =47.37, *SD* = 28.72; 116 females).

We will recruit participants from Amazon Mechanical Turk using the CloudResearch/ Turkprime platform (Litman et al., 2017). Based on our extensive experience of running similar judgment and decision making replications on MTurk and to ensure high quality data collection, we will employ the following CloudResearch options: Duplicate IP Block. Duplicate Geocode Block, Suspicious Geocode Block, Verify Worker Country Location, Enhanced Privacy, CloudResearch Approved Participants, Block Low Quality Participants. We will also employ the [Qualtrics fraud and spam prevention measures](https://www.qualtrics.com/support/survey-platform/survey-module/survey-checker/fraud-detection/): reCAPTCHA, prevent multiple submission, prevent ballotstuffing, bot detection, security scan monitor, relevantID.

Assigned pay is based on the federal wage of 7.25USD/hour, per minute. For example, 5-8 minutes survey would be paid 1USD per participant. We first pretested survey duration with 30 participants to ensure our time run estimate was accurate and adjusted pay as needed, the data of the 30 participants was not analyzed other than to access survey completion duration and needed pay adjustments. [For those pretest participants, if survey duration was longer than expected, they would be paid a bonus as pay adjustment. All of these will be reported after data collection.]

We provided a comparison of the target article samples of three studies and the replication sample in Table 3.

Table 3

*Difference and similarities between original study and replication*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Fox et al. (2005) study 1 | Fox et al. (2005) study 2 | Fox et al. (2005) study 5 | US MTurk/Prolific workers |
| Sample size | 208 | 31 | 149 | 520 |
| Geographic origin | US American |  |  | US American |
| Gender  | Not reported | Not reported | Not reported | 133 males, 116 females, 271 other/did not disclose |
| Median age (years) | Not reported | Not reported | Not reported | 46 |
| Average age (years) | Not reported | Not reported | Not reported | 47.4 |
| Standard deviation age (years) | Not reported | Not reported | Not reported | 28.72 |
| Age range (years) | Not reported | Not reported | Not reported | 0-100 |
| Medium (location) | Paper and pencil questionnaire (in person) | Paper and pencil questionnaire (in person) | Paper and pencil questionnaire (in person) | Computer (online) |
| Compensation | Earning a respite from campout | $5 | Earning a respite from campout | Nominal payment |
| Year  | 2005 | 2005 | 2005 | 2022 |

## Design: Replication and extension

We summarized the experimental designs in Tables 4, 5, and 6. To conduct a replication of the three studies in the original article, we will run the three studies together in a single data collection. The display of scenarios and conditions were counterbalanced using the randomizer “evenly present” function in Qualtrics. Scenarios were presented in random order and participants were randomly and evenly assigned into different conditions. This method was previously tested successfully in many of the replications and extensions conducted by our team (e.g., Adelina & Feldman, 2022; Vonasch et al., 2022; Yeung & Feldman, 2022), and is especially powerful in addressing concerns about the target sample (naivety, attentiveness, etc.) when some studies replicate successful whereas others do not, as well as in the potential in drawing inferences about the links between the different studies and consistency in participants’ responding to similar decision-making paradigms.

Table 4

*Study 1 replication: Experimental design (between-subject)*

|  |
| --- |
| Individual differences predictor (Extension)Desire for choice diversity constructed scale |
| IV: Low-income partition condition Lower income ranges are broken into subintervals (i.e. income less than $75,000) | IV: High-income partition conditionHigher income ranges are broken into subintervals (i.e. income more than $75,000) |
| DV: Allocations of financial aidWhat percentage of the budget would you allocate to aid applicants whose family household incomes fall in various ranges?  |

Table 5

*Study 2: Replication and extension experimental design (between-subject + predictor)*

|  |
| --- |
| Individual differences predictor (Extension)Desire for choice diversity constructed scale (extension) |
| IV: Nonhierarchical partition condition One-step combined allocation of donations between 5 options: 1 international and 4 US funds | IV: Hierarchical partition conditionTwo-step partitioned allocationFirst allocation based on location: International versus USSecond allocation within categories to specific US funds (4). |
| DV: Allocations of charitable donationsWhat percentage of the donation would you allocate to international funds and/or US funds? |

Table 6

*Study 5: Replication and extension experimental design (between + 2 predictors)*

|  |
| --- |
| Individual differences predictorsExpertise: Bottles of wines purchases in the previous year (replication)Desire for choice diversity constructed scale (extension) |
| IV: Grape partition conditionWines divided according to three different grape types | IV: Region partition conditionWines divided according to three different region types |
| DV: Wine choicesWhat would be the three wine choices out of the list of six? |

## Procedures

[*For review: The Qualtrics survey .QSF file and an exported DOCX file are provided on the OSF folder. A preview link of the Qualtrics survey is provided on:* [*https://hku.au1.qualtrics.com/jfe/preview/SV\_9Lbg9AMWKEBZagC?Q\_CHL=preview&Q\_SurveyVersionID=current*](https://hku.au1.qualtrics.com/jfe/preview/SV_9Lbg9AMWKEBZagC?Q_CHL=preview&Q_SurveyVersionID=current)]

Participants then answered a trait scale measuring desire for choice diversity

We summarized the manipulations and measures for each study in Tables 4, 5, and 6, and provided additional details and all scales and measures in the supplementary.

## Manipulations

### Study 1 replication: Income partitioning

Participants were randomly assigned to either a low-income partition condition or a high-income partition condition. As in the original, we manipulated the presentation of the available options by grouping different income intervals in each condition, as shown in Table 7.

Table 7

*Income intervals in low-income partition condition and high-income partition condition*

|  |  |
| --- | --- |
| Low-income partition  | High-income partition  |
| ≤15,000 | ≤75,000 |
| 15,000-30,000 | 75,000-85,000 |
| 30,000-45,000 | 85,000-100,000 |
| 45,000-60,000 | 100,000-120,000 |
| 60,000-75,000 | 120,000-145,000 |
| >75,000 | >145,000 |

### Study 2 replication: Hierarchy partitioning

Participants were randomly assigned to either a nonhierarchical partition condition or a hierarchical partition condition. We manipulated the experiment by asking participants to allocate at the level of superordinate category. In the nonhierarchical partition condition participants were asked to indicate their proposed allocations among a five option choice-set including one international fund and four US funds, as illustrated in figure 1.

US funds: Seniors

US funds:

Young children

US funds: Health and Wellness

US funds:

Families

International

funds

*Figure 1*. Visual representation of the single-stage (nonhierarchical) elicitation in the nonhierarchical partition condition.

In the hierarchical partition condition, participants first allocated geographically either to the international fund or to the US funds category, and then in a second step indicated allocation to the four specific funds within the US, as shown in figure 2.

International

funds

US

funds

Seniors

Young children

Health and wellness

Families

*Figure 2*. Visual representation of the two-stage (hierarchical) elicitation in the hierarchical partition condition.

### Study 5 replication: Category partitioning

Participants were randomly assigned to either a grape partition condition or a region partition condition. We presented participants with a six wine choice-set, manipulating display to be either grouped by grape (Chardonnays, Pinot Grigio, and Sauvignon Blancs) or grouped by region (Australia, California, and Italy). We provided additional details on the wine elicitation in the supplementary.

## Measures

### Study 5: Expertise (replication + exploratory extensions)

Study 5 involved wine choice, with expertise hypothesized to moderate partition dependence. Therefore, in Study 5 we asked participants to indicate the number of wines purchased in the last year and treated it as a continuous covariate.

### We also included several exploratory measures asking participants to indicate their reasons (“Briefly describe your reasoning for choosing the three wines you selected on the previous page”), eliciting self reported familiarity with wine (“How familiar are you with white wines?”; 1 = *Not familiar at all*, 7 = *Extremely familiar*), knowledge regarding wine (“I know a lot about white wines.”, 1 = *Strongly disagree*, 7 = *Strongly agree*; “How clear of an idea do you have about which characteristics of a white wine are important in providing you maximum satisfaction?”), winery names (“List here the winery names (if any) that you recognized on the previous page”), and reading wine magazines (“How often do you read wine magazines?”; 1 = *Never read them*, 7 = *Read them all the time*). We intended to use these questions for exploratory robustness checks, especially in case we fail to find support for the hypotheses.

### Study 2: Clarity (exploratory extension)

Given feedback in the peer review process, we were concerned with the clarity of the Study 2 design, the possibility that the hierarchical condition was more complex to understand than the non-hierarchical, and that participants may not have processed the percentages calculations correctly. We therefore presented the participants with a page displaying a summary of their choices and asked them to indicate whether our summary of their decisions was what they intended to choose (0 = “*NO, these are not the allocations I intended to make (please explain)*”; 1 = “*YES, these are the allocations I intended to make*”). Those who answered no were given the option to explain further.

We considered this an exploratory measure to examine if the instructions in the nonhierarchical partition condition would be more clear to participants, in comparison to the hierarchical partition condition in Study 2, with the aim to address any possible failed replications that may be due to a misinterpretation of the instructions.

### All studies: Desire for choice diversity (extension)

We added a scale aimed at measuring trait desires to diversify. We searched the literature for such a scale and were surprised we were not able to identify one. We therefore constructed our own exploratory scale (1 = *Strongly disagree*, 7 = *Strongly agree*); = [Cronbach alpha here after data analysis]). We brained-stormed these with the Twitter community on <https://twitter.com/giladfeldman/status/1487439022771572744?s=20&t=JRPKX-g2ROKTwK1TXxLUqQ> and ended up with six items measuring different aspects of diversity preferences. We would appreciate any feedback on the scale. We do not mean this as a comprehensive validated scale, this goes beyond the scope of our investigation and our aims with the replication, and is simply meant as an initial measure to explore possibilities in using trait diversity preference as predictors of partition dependence.

### Attention checks

Given feedback received in the peer-review process we added three items to the desire for choice diversity scale, randomized in order among the other items, which serve as attention checks (1 = *Strongly disagree*; 4 = *Neutral*; 7 = *Strongly agree*): “100 is larger than fifty.” (failure: <=4) , “One hundred is smaller than 50.” (failure: >=4), “Please select “Agree” (failure: != 6). Failing to answer two out of the three correctly will qualify for exclusion.

## Deviations

We made slight adjustments to the replication of Study 1 and 2. Specifically, we changed Duke University to an unidentified university in Study 1, and Durham County funds to US funds in Study 2, with the aim to facilitate decisions of participants who come from different states, given our labor market online sample.

Moreover, we made some changes to Study 5 with the aim of improving on the original’s methodology. For instance, we updated the wine years as a means to make the wine choices more relevant to participants. In addition, we modified and treated the measure of expertise as a continuous variable, as opposed to the original study where a dichotomous variable was used, for the purpose of enhancing the strategy as the distribution of wine expertise is likely to differ in the present online sample in comparison to the original participants of graduate students in 2005.

## Replication closeness evaluation

We provided details on the classification of the replications using the criteria by LeBel et al., (2018) criteria in Table 9 below (see section “replication closeness evaluation” in the supplementary). We summarized the replication as a close replication.

Table 9

*Classification of the replication, based on LeBel et al. (2018)*

|  |  |  |
| --- | --- | --- |
| **Design facet** | **Replication** | **Details of deviation** |
| Effect/hypothesis | Same |  |
| IV construct | Same |  |
| DV construct | Same |  |
| IV operationalization | Same |  |
| DV operationalization | Same |  |

|  |  |  |
| --- | --- | --- |
|  |  |  |

|  |  |  |
| --- | --- | --- |
| IV stimuli | Similar | Slight modifications to adjust to our target sample |
| DV stimuli |  | Slight modifications to adjust to our target sample |
| Procedural details | Similar (combined) | Combined the three studies into a singular study design with studies in randomized order |
| Physical settings | Different | Online questionnaire |
| Contextual variables | Different | Different year; the original study was conducted in 2005, whereas the replication study was conducted in 2022 |
| Population (e.g. age) | Different | Same country, but from a more diverse population |
| Replication classification | Close replication |  |

## Data analysis strategy

### Replication: As in the original

In Study 1, we conduct an independent sample t-test to analyze the mean percentages of financial aid allocated to families with income less than $75,000 in each condition.

In Study 2, we conduct an independent t-test to analyze the mean donation to the international funds in nonhierarchical and hierarchical conditions.

In Study 5, the number of levels selected of the two attributes (grape and region) are not statistically independent. Therefore, we grouped participants according to four choice combinations, including wine choices that were selected from 2 types of grapes and 2 regions, 2 types of grapes and 3 regions, 3 types of grapes and 2 regions, and 3 types of grapes and 3 regions. We used a fisher’s exact test to determine the combinations of the number of regions and types of grapes that participants would be more likely to choose in each of the two conditions. Then, we conducted a logistic regression to examine whether expertise moderated the impact of partition dependence. The dependent variable was the combinations of regions and grapes of wine choices that were previously supported (the choice of 2 grapes and 3 regions versus 3 grapes and 2 regions); the independent variables include the expertise measure, partition manipulation and an Expertise ⨉ Partition interaction term.

### Extensions: Diversity desire

We conduct a logistic regression to test whether individual differences in desire for choice diversity as a covariate interact with partition conditions on wine choices.

### Exploratory: Clarity

We performed a two-proportion z-test in Study 2, to analyze the proportions of participants indicating the lack of clarity in the hierarchical partition condition compared to the nonhierarchical partition condition.

### Exclusions

We have done our best to structure the survey in a way that would minimize the need for exclusions, and have a preference for reporting based on the full sample only. However, in case of a failed replication, we will examine exclusions as indicated in the supplementary, and report a both pre and post exclusions findings with a summary of the comparison between the two.

# Results

 **[IMPORTANT:
Method and results were written using a randomized dataset produced by Qualtrics to simulate what these sections will look like after data collection. These will be updated following the data collection. For the purpose of the simulation, we wrote things in past tense, but no pre-registration or data collection took place yet.]**

## Replication

### Study 1

We provided descriptive statistics of all measures in Table 10 and the statistical tests of the hypotheses were summarized in Table 11 and Figure 3.

Table 10

*Study 1: Descriptive statistics*

|  |  |  |
| --- | --- | --- |
| Low-income partition | Income | Mean % allocation  |
|  | ≤15,000 | 51.0 |
|  | 15,000-30,000 | 26.1 |
|  | 30,000-45,000 | 12.5 |
|  | 45,000-60,000 | 5.2 |
|  | 60,000-75,000 | 2.4 |
|  | >75,000 | 2.8 |
| High-income partition | Income | Mean % allocation  |
|  | ≤75,000 | 51.5 |
|  | 75,000-85,000 | 24.5 |
|  | 85,000-100,000 | 12.3 |
|  | 100,000-120,000 | 5.5 |
|  | 120,000-145,000 | 3.1 |
|  | >145,000 | 3.2 |

*Note*. Percentages for the high-income partition condition do not sum to 100% because of rounding error.



*Figure 3.* Study 1:Plots for the partitioning manipulation on the mean allocation to families with income less than $75,000.

Table 11

*Studies 1 and 2: Statistics summary*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Study  | *t* | df | *p* | *Mdiff* | Cohen's *d* and CI | Interpretation |
| 1 | 24.45 | 278.6 | < .001 | 45.75 | 2.14 [1.93, 2.36] | TBD |
| 2 | -.23 | 517.9 | = .816 | .612 | -.02 [-.19, .15] | TBD |

*Note*. Independent samples t-test, *N* = 520. CI = 95% confidence intervals. The interpretation of outcome is based on LeBel et al. (2019).

We conducted an independent t-test and found that the mean percentage of financial aid allocated to families with income less than $75,000 was 97.22% in the low-income partition condition (*n* = 260; *M* = 97.22%, *SD* = 5.76), but only 51.47% in the high-income partition condition (*n* = 260; *M* = 51.47%, *SD* = 29.6; *Md* = 45.75; *t*(278.6) =24.45, *p* < .002; *d* = 2.14, 95% CI [1.93, 2.36]).

We found support for the hypothesis that more money was allocated to poorer families in the low-income partition condition than the high-income partition condition.

In comparison, the original study found that the effect size was 3.54, with confidence intervals [3.10, 3.98]; whereas the replicating study had an effect size of 2.14, CI 95% [1.93, 2.36], which indicates that the finding successfully replicates.

### Study 2

We provided descriptive statistics of all measures in Table 12 and the statistical tests of the hypotheses were summarized in Table 12 and Figure 4.

Table 12

*Study 2: Descriptive statistics*

|  |  |  |
| --- | --- | --- |
| Fund category | Nonhierarchical*M* [*SD*] (*n*) | Hierarchical*M* [*SD*] (*n*) |
| International  | 48.8 [29.8] (260) | 49.4 [30.2] (260) |
| US | 51.2 [29.8] (260) | 50.6 [30.2] (260) |



*Figure 4.* Study 2: Plots for the partitioning manipulation on the mean donation percentages allocated to international funds in the hierarchical and nonhierarchical conditions.

 We conducted an independent t-test (two tailed) and found that the mean percentage of donation allocated to the international funds was 49.4% in the hierarchical condition(*n* = 260; *M* = 49.4%, *SD* = 30.2), but only 48.8% in the nonhierarchical partition condition (*n* = 260; *M* = 48.8%, *SD* = 29.8; *Md* =.612; *t*(517.9) = -.23, *p* =.816; *d* = -.02, 95% CI [-.19, .15]).

We failed to find support for the hypothesis that less donation was allocated to the international funds in the nonhierarchical-partition condition than the hierarchical-partition condition.

In comparison, the original study found the effect size to be 1.34 and confidence intervals [.56, 2.12], and the current study found an effect size of -.02 with confidence intervals [-.19, .15]. This may indicate that the findings did not replicate successfully.

### Study 5

We provided descriptive statistics of all measures in Table 13 and the statistical tests of the hypotheses were summarized in Table 14.

Table 13

*Study 5: Descriptive statistics*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Partition | 2,2 | 2,3 | 3,2  | 3,3  |
| Grape | 81 | 73 | 75 | 27 |
| Region | 82 | 90 | 65 | 23 |

*Note*. The first number in each column heading indicates the number of grapes selected; the second number indicates the number of regions selected.

We conducted a fisher’s exact test to examine two hypotheses. The first one was that participants would be less likely to choose a set including 2 types of grapes and 2 regions; and 3 types of grapes and 3 regions in either experimental condition. The second hypothesis was that participants would be more likely to choose 3 types of grapes and 2 regions in the grape-partition condition and that they would be more likely to choose 2 types of grapes and 3 regions in the region-partition condition. We found support for the hypotheses: the frequencies listed in the outer two columns of table 14 did not seem to differ by experimental condition (*p* =.630, two-tailed); the frequencies listed in the inner two columns of table 14 seemed to differ by experimental condition (*p* =.140, two tailed).

*Study 3: Summary of logistic regression and confidence intervals of the moderation of expertise on the impact of partitioning manipulation*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  Variable | *r* | *SE* | *p* | OR [95% CI] | Wald X^2 (p-value) | Interpretation |
| Partition  | -.53 | .24 | = .020 | .59 [.72, 2.68] | 5.00 (.02) | TBD |
| Expertise | -.00 | .01 | = .560 | 1.00 [.97, 1.01] | .33 (.57) | TBD |
| Expertise x partition | -.00 | .01 | = .840 | 1.00 [.98, 1.01] | .04 (.84) | TBD |

*Note*. Logistic regression, N = 307. r = coefficient, SE = standard error, CI = 95% confidence intervals, OR = odds ratio, Wald x^2 = Wald chi square. The interpretation of outcome is based on LeBel et al. (2019).

We conducted a logistic regression and found support for partition dependence (Wald x^2 = 5.0, *p* =.02, OR = .59, 95%CI[.72, 2.68]). We did not find support for expertise as a predictor of whether people choose two grapes and three regions versus three grapes and two regions (Wald x^2=.33, p=.57, OR = .997, 95%CI[.97, 1.01]). We also failed to find support for the expertise x partition interaction (Wald x^2=.04, *p* = .84, OR = .998, 95%CI[.98, 1.01]). We therefore failed to find support for the hypothesis that greater expertise related to the items in the choice-set leads to lower susceptibility to partition dependence.

In comparison, the original study found support for expertise moderating the impact of partitioning manipulation ([stats], *p* = .006), yet we failed to find support for it (b = -0.00, *p* = .840).

We conducted a two-way chi squared test as a supplementary analysis to check the robustness of the results, which showed similar failure for support (*X*2 = 0.14, *p* = .711)

## Extension: Desire for choice diversity

Examining desire for choice diversity, we found no support for an interaction between trait desire for choice diversity partition manipulation on wine choices.

## Exploratory analyses: Clarity

For the exploratory extension of clarity, we conducted a two-proportion z-test and found no support for differences between the proportions of “NO” in the hierarchical and nonhierarchical partition condition (*p* = .930).

## Comparing replication to original findings

As the results section was written based on randomly generated data, we will finish the comparison between replication and original findings after data collection. We will describe whether the current replication successfully replicated the original findings. The results will also be compared based on LeBel et al. (2019) outcome interpretation criteria, by comparing the replication effect confidence intervals to the original effect size for different hypotheses.

# Discussion

[Please note that the discussion is only to be completed in Stage 2 following data collection]

## Limitations and directions for future research

 [We will discuss differences in time/context/sample/method, and how these may have contributed to differences in findings.]

 [We will discuss the adaptation we did to the wine expertise from dichotomous to continuous, and the issue of wine expertise more broadly, along the lines of the following indicated in peer-review by the original author: The effect of expertise on partition dependence may depend on whether there is sufficient variance on the number of wine experts among the targeted population. Since if most participants are “experts”, meaning they have greater relevant expertise, they would be less likely to be affected by partition dependence. Hence, the moderation effect of expertise might be less pronounced.]

 [Given peer-review feedback, we plan to discuss the desire for choice diversity extension and its placement at the end of the survey.]

 [We will discuss the need for further improvements and conceptual replications.]

# References

Adelina, N., & Feldman, G. (2021). Are past and future selves perceived differently from present self? Replication and extension of Pronin and Ross (2006) temporal differences in trait self-ascriptions. *International Review of Social Psychology*, 34(1): 29, 1–16. DOI: 10.5334/irsp.571

Benartzi, R., & Thaler, R. (2001). Naïve diversification strategies in retirement saving plans. *American Economic Review*, 91, 475–482. <https://doi.org/10.1257/aer.91.1.79>

Brandt, M. J., IJzerman, H., Dijksterhuis, A., Farach, F. J., Geller, J., Giner-Sorolla, R., Grange, J. A., Perugini, M., Spies, J. R., & van ’t Veer, A. (2014). The Replication Recipe: What makes for a convincing replication? *Journal of Experimental Social Psychology*, *50*, 217–224. <https://doi.org/10.1016/j.jesp.2013.10.005>

Chan, O., & Feldman, G. (2022). Young and Saxe (2011): Replication and extension. DOI: 10.17605/OSF.IO/QSWE3. Retrieved from <https://osf.io/u59ab/>

Deutsch, M. (1975). Equity, Equality, and Need: What Determines Which Value Will Be Used as the Basis of Distributive Justice? *Journal of Social Issues*, *31*(3), 137–149. <https://doi.org/10.1111/j.1540-4560.1975.tb01000.x>

Fox, C. R., Bardolet, D., & Lieb, D. S. (2005) Partition Dependence in Decision Analysis, Resource Allocation, and Consumer Choice. In: Zwick R., Rapoport A. (eds) *Experimental Business Research*. Springer, Boston, MA. <https://doi.org/10.1007/0-387-24244-9_10>

Fox, C. R., Ratner, R. K., & Lieb, D. S. (2005). How subjective grouping of options influences choice and allocation: Diversification Bias and the phenomenon of Partition Dependence. *Journal of Experimental Psychology: General*, 134(4), 538-551. <https://doi.org/10.1037/0096-3445.134.4.538>

### Fox, C. R., & Rottenstreich, Y. (2003). Partition priming in judgment under uncertainty. *Psychological Science*, 14(3), 195-200. [https://doi.org/10.1111/1467-9280.02431](https://psycnet.apa.org/doi/10.1111/1467-9280.02431)

LeBel, E. P., McCarthy, R. J., Earp, B. D., Elson, M., & Vanpaemel, W. (2018). A unified framework to quantify the credibility of scientific findings. *Advances in Methods and Practices in Psychological Science*, *1*, 389-402. <https://doi.org/10.1177/2515245918787489>

LeBel, E. P., Vanpaemel, W., Cheung, I., & Campbell, L. (2019). A brief guide to evaluate replications. *Meta-Psychology*, 3, 1-9. <https://doi.org/10.15626/MP.2018.843>

Leys, C., Delacre, M., Mora, Y. L., Lakens, D., & Ley, C. (2019). [How to classify, detect, and manage univariate and multivariate outliers, with emphasis on pre-registration](https://osf.io/9q4fy/). *International Review of Social Psychology*, 32(1).]

Litman, L., Robinson, J., & Abberbock, T. (2017). TurkPrime. com: A versatile crowdsourcing data acquisition platform for the behavioral sciences. *Behavior research methods*, 49(2), 433-442.

Read, D., & Loewenstein, G. (1995). Diversification bias: Explaining the discrepancy in variety seeking between combined and separated choices. *Journal of Experimental Psychology: Applied*, 1, 34-49. <https://doi.org/10.1037/1076-898X.1.1.34>

Reichelson, S., Zax, A., Bass, I., Patalano, A. L., & Barth, H. C. (2018). Partition dependence in consumer choice: Perceptual groupings do not reliably shape decisions. *Psychonomic Bulletin & Review*, *25*(3), 1178–1183. <https://doi.org/10.3758/s13423-017-1326-4>

### Reichelson, S., Zax, A., Patalano, A. L., & Barth, H. C. (2019). Partition dependence in development: Are children’s decisions shaped by the arbitrary grouping of options?. *Quarterly Journal of Experimental Psychology*, 72(5), 1029-1036. <https://doi-org.eproxy.lib.hku.hk/10.1177/1747021818777720>

Simonsohn, U. (2015). Small Telescopes: Detectability and the Evaluation of Replication Results. *Psychological Science*, 26(5), 559–569. <https://doi.org/10.1177/0956797614567341>

Venkatesan, M. (1973). Cognitive consistency and novelty seeking. In S. Ward & T. S. Robertson (Eds.), Consumer behavior: Theoretical sources (pp. 355–384). Englewood Cliffs, NJ: Prentice Hall.

Vonasch, A., Hung, W., Leung, W., Nguyen, T., Chan, S., Cheng, B., & Feldman‎, G. (2022). "Less is better" in separate evaluations versus "More is better" in joint evaluations: Mostly successful close replication and extension of Hsee (1998). DOI 10.17605/OSF.IO/9UWNS, retrieved from <https://osf.io/nhyp9/>

### Williams, K., Zax, A., Reichelson, S., Patalano, A. L., & Barth, H. (2020). Developmental change in partition dependent resource allocation behavior. *Memory & Cognition*, 48(6), 1007-1014. DOI:10.3758/s13421-020-01030-8

Xing, C., Williams, K., Hom, J., Kandlur, M., Owoyemi, P., Paul, J., Alexander, R., Shackney, E., & Barth, H. (2020). Partition dependence in financial aid distribution to income categories. *PloS one*, *15*(4), e0231135. <https://doi.org/10.1371/journal.pone.0231135>

Yeung, S. & Feldman, G. (2022). Revisiting the Temporal Pattern of Regret: Replication of Gilovich and Medvec (1994) with extensions examining responsibility. DOI 10.17605/OSF.IO/7M3Q2, retrieved from <https://osf.io/vncy7/>