How Income Volatility Influences Saving Decisions: Evidence from the Lab

Nathan Wang-Ly[*,1], Ben R. Newell[1,2]

[1] School of Psychology, UNSW Sydney, NSW 2052, Australia

[2] UNSW Institute of Climate Risk & Response, UNSW Sydney, NSW 2052, Australia

* Corresponding author (Email: nathan.wang-ly@unsw.edu.au).

July 14, 2023

Abstract

Around the world, it is becoming increasingly common for individuals to have volatile incomes, which fluctuate from pay to pay. Previous research offers mixed evidence as to whether this uncertainty about one's income may increase or decrease saving behaviour. Across four incentivised online experiments (N = 712), we examine the relationship between income volatility and saving behaviour using a novel financial decision making task. In this task, participants receive hypothetical income that is either consistent or that varies to different degrees. We capture participants' perceptions of how volatile their income is and observe how this influences their decision to spend this income or save it towards an impending emergency. Our results indicate that receiving a more volatile income, as measured by its coefficient of variation (CV), leads to higher savings within our task (£213 more saved per 0.1 increase in CV). However, there appears to be a threshold level of volatility that must be exceeded before participants save differently relative to receiving a stable income.

Keywords: Income volatility, Precautionary saving, Uncertainty, Financial decision making

PSYCInfo classification: 3900, 3920

JEL classification: D14, G51

1. Introduction

No one can be certain about how much they will earn in the future. However, not all uncertainties are equal; some individuals have greater confidence in their future incomes than others. An individual working in a traditional salaried role can reasonably expect to earn the same amount each pay cycle. In contrast, an individual who is employed casually or who freelances may find that their earnings fluctuate unpredictably. Around the world, economic trends suggest that this latter scenario is becoming increasingly common. In Australia, permanent full-time employment rates have declined from previous decades, insecure part-time employment has become prevalent, and there has been a dramatic rise in platform work (often referred to as 'gig work') (Senate Select Committee on Job Security, 2022). Similar trends have been observed across other advanced economies in Asia and Europe (Hipp et al., 2015; Kalleberg & Hewison, 2013).

Previous research has identified numerous ways in which income uncertainty may negatively impact individuals' and their families' lives. Experiencing fluctuations in income has been associated with psychological depression (Prause et al., 2009), higher risk of mortality (Halliday, 2007), greater risk of divorce (Nunley & Seals, 2010), and increased probability of mortgage default (Diaz-Serrano, 2005). Much of this research has been based on 'inter-year' income volatility (income that varies between years), with research on 'intra-year' income volatility (income that varies within a year) being comparatively scarce. Only recently has there been an increase in studies examining how financial and health outcomes are influenced by monthly fluctuations in income (e.g., Anvari-Clark & Ansong, 2022; Gladstone et al., 2020), many of which have been motivated by the growth of the gig economy (e.g., Sayre, 2022; Wang et al., 2022), as well as the severe disruption to income caused by the COVID-19 pandemic (Wang-Ly & Newell, 2022). However, given the challenges of manipulating income in real-world settings, these studies have typically been observational in nature. These observational studies are inherently limited in their ability to prove causal links between the experience of income volatility and outcomes of interest (Rosenbaum, 2015).

To our knowledge, only two studies have investigated the influence of intra-year income volatility via experimental methods, with both finding evidence suggesting that volatility drives individuals to behave in a more financially impatient manner. The first study involved providing income spikes to Kenyan participants via an unconditional cash transfer program (West et al., 2020). Financial impatience was measured by giving participants multiple hypothetical choices between a 'smaller-sooner' reward (e.g., KSH 500 today) and a 'larger-later' reward (e.g., KSH 525 in six months). Participants who received the income spikes tended to choose the smaller-sooner option more often compared to those who did not receive the spikes, demonstrating a greater degree of financial impatience. In the second study, participants completed simulated work tasks for hypothetical income as part of a lab-based experiment (Peetz et al., 2021). Participants either received

a stable income (the same income per work task) or a volatile income (income that varied between work tasks). At the end of the experiment, participants who received the volatile income were more likely to choose the smaller-sooner participation reward (USD 15 today vs USD 17 in two weeks) compared to those who had received the stable income.

Inspired by these two studies, we saw an opportunity to apply a similar experimental approach to better understand how income volatility influences key household financial decisions. In the present research, we chose to focus our attention on saving behaviour for two reasons. First, income uncertainty tends to be more severe for individuals in poorer financial circumstances (Bania & Leete, 2022). For these individuals, the ability to accumulate savings and create 'financial slack' is especially critical for meeting unexpected expenses and avoiding debt (Mullainathan & Shafir, 2009). Second, the literature offers conflicting perspectives on whether income volatility should increase or decrease saving behaviour, meaning our work could offer useful clarifying evidence.

On the one hand, the argument that experiencing income volatility increases saving behaviour seems intuitive. To illustrate, imagine that you wanted to accumulate a certain amount of savings for future needs (e.g., a holiday or to buffer against future emergencies). If you earned a steady and predictable income, a prudent strategy might involve setting aside a consistent amount of money such that you would achieve the goal within your desired timeframe. Now suppose that your income was instead volatile and unpredictable. The consistent saving strategy would no longer be feasible; instead, it might be necessary to save more to insure against a potential dip in future income. This is the basic premise underlying the traditional economic perspective of how income volatility should affect saving behaviour. Early theoretical work suggested that being uncertain about one's future earnings should boost precautionary saving motives (Drèze & Modigliani, 1972; Leland, 1968; Sandmo, 1970). This view has been supported by numerous empirical studies (for an overview, see Lugilde et al., 2019).[1] For example, one study involving US personal income data found that doubling the level of income uncertainty of an individual or household was associated with a 29 percent increase in their ratio of wealth to income (i.e., a greater saving rate) (Kazarosian, 1997).

On the other hand, there are several valid reasons why income volatility might instead be expected to reduce saving behaviour. First, if income volatility results in greater financial impatience (Peetz et al., 2021; West et al., 2020), individuals may be biased towards actions that offer immediate benefits (spending) over actions that offer benefits in the distant future (saving). This would be consistent with previous work showing that more present-focused time preferences are associated with lower retirement savings balances (Goda et al., 2019). Second, experiencing income volatility may induce feelings of stress or scarcity, as dips in income can create temporary shortfalls between

[1] However, see Fulford (2015) for evidence that income uncertainty is not an important motive for precautionary saving.

available funds and upcoming expenses, forcing individuals to make difficult trade-offs between their immediate and future needs (Bania & Leete, 2022). Both stress and scarcity have been found to impair long-term and goal-directed decision making (Haushofer & Fehr, 2014; Mani et al., 2013, 2020; Schwabe & Wolf, 2009), providing additional reason to believe that income volatility might reduce one's propensity to save. Third, individuals may decide to save less as part of a considered choice to abandon (or at least heavily discount) their focus on the long-term. They may instead shift their focus to achieving short-term outcomes, where the associated rewards are typically better defined and allow for earlier gratification—an approach that has been argued to be a rational response to uncertainty (Fawcett et al., 2012; Pepper & Nettle, 2017). Consistent with this view, numerous studies have shown that saving rates are negatively impacted when individuals feel a lack of control over their future circumstances (Cobb-Clark et al., 2016; Perry & Morris, 2005; Shapiro & Wu, 2011).

2. Overview of studies

To assess the merit of these opposing perspectives, we conducted four laboratory-based experiments in which we manipulated the volatility of participants' income and observed how this affected the way they traded off between spending and saving. All four experiments involved a novel financial decision making task where participants received hypothetical income for completing work tasks (similar to Peetz et al., 2021) and could choose between spending their earnings or saving for an impending emergency.

In Experiment 1, we tested three levels of income volatility (including no volatility) and observed the highest saving rates from participants whose income was most volatile. However, we also observed a discrepancy between participants' self-reported perceptions of how volatile their income was and their observed saving behaviour. Experiment 2 examined whether this was because participants' saving behaviour was instead being driven by other dimensions of the income sequence (e.g., the minimum income received). Experiment 3 provided evidence that the discrepancy was due to participants being asked to provide an absolute judgment of volatility; participants were able to distinguish between levels of volatility when instead making relative judgments. Finally, in Experiment 4, we tested a single condition in which we made participants' income even more volatile than the most volatile condition in Experiment 1. This established a clearer relationship between income volatility and increased saving behaviour while also suggesting the existence of a volatility threshold that needed to be exceeded for saving behaviour to be influenced.

Our study seeks to make several contributions to the literature. First, we continue to expand the body of experimental work examining the effect of income volatility on financial decisions. We offer experimental evidence in support of the view that experiencing volatile income increases saving behaviour. Second, we examine the impact of different degrees of income volatility, allowing us to

investigate not only on the extensive margin of the income volatility effect, but also the intensive margin. Third, we offer a novel financial decision making task that has potential for reuse in future income volatility experiments or could be adapted to answer similar questions around influences on saving behaviour.

3. Experiment 1

The purpose of Experiment 1 was to examine how participants' saving behaviour within our financial decision making task was influenced by the level of income volatility they experienced. We generated different sequences of income that varied in their coefficients of variation (CV). CV is a commonly referenced measure of income volatility (Bania & Leete, 2009; Farrell & Greig, 2016; Hannagan & Morduch, 2015) that can be calculated by dividing the standard deviation of a sequence by its mean. Therefore, the larger the CV value, the more volatile the income. One advantage of the CV metric is that it provides a standardised value that allows for comparison across incomes that may differ in magnitude, frequency, and timing.[2] For Experiment 1, we tested three income sequences with CV values of 0 (i.e., no volatility), 0.30 and 0.60.

3.1. Method

3.1.1. Participants

We recruited 241 participants[3] (M_{age} = 39.65 years; 144 males; 95 females; 1 non-binary; 1 preferred not to say) from Prolific Academic, an online participant recruitment platform. Our sample size was based on an a priori power analysis conducted using statistical software G*Power (Faul et al., 2007) based on detecting a small effect in a between-subjects study (δ = .80; γ = .20; α = .05). To be eligible for our sample, participants needed to be between the ages of 18 and 65, located in the UK, and fluent in English. Participants received £3.00 (USD 3.77) in exchange for their participation and were also eligible for an additional bonus of £3.00 (USD 3.77) based on their performance in the financial decision making task. Additional details on the demographic and financial characteristics of our participant samples for each experiment are provided in the Online Appendix.

[2] However, see Kvålseth (2017) for an alternative measure of volatility (the 'second-order coefficient of variation') that has additional useful properties such as being restricted between zero and one, and being less sensitive to outliers.

[3] In both Experiments 1 and 2, we encountered an issue during data collection which led to having one participant more than was intended.

3.1.2. Materials

The financial decision making task[4] used in Experiment 1 involved completing work tasks for hypothetical income and making decisions around spending and saving for an impending emergency. In each round of the game, participants were asked to rearrange a six-character string of letters (e.g., "hksykjl") into alphabetical order as their work task. Upon completion, they received income and were asked how much they wanted to spend. Money could be spent to purchase points (£1.00 = 1 point), which were later used to determine eligibility for the bonus performance-based payment.[5] Any money that was not spent remained as savings and was carried over into subsequent rounds, where it could again be spent or saved.

The income participants received for their work tasks varied depending on which of the three experimental conditions they were allocated to: No Volatility (n = 81), Low Volatility (n = 80), and High Volatility (n = 80). In all three conditions, participants received the same total income across the 15 task rounds: £15,000. However, the extent to which their income fluctuated differed. In the No Volatility condition, participants received £1,000 after each work task—corresponding to a CV of 0. In the Low Volatility condition, participants' income ranged between £431 and £1,340, with the overall sequence of incomes having a CV of 0.30.[6] In the High Volatility condition, incomes ranged between £173 and £2,088, with a CV of 0.60. For participants in the Low and High Volatility conditions, the order in which they received the different incomes was randomised. For more details on the income sequences used across the experiments, see the Online Appendix.

At the end of the task (after the 15th round), participants encountered a financial emergency: home repairs costing £4,500 that had resulted from storm damages. When this emergency occurred, if participants had adequate savings, they "won" the task, meaning they could keep the points they had purchased. However, if participants' savings were inadequate, they lost all their purchased points. Importantly, while participants were advised at the start of the task that there would be a financial emergency, they were not told when it would occur nor how much it would cost. Therefore, their objective was to balance the competing goals of maximising points purchased (to potentially earn the bonus payment) while ensuring they saved enough to withstand the financial emergency (to avoid losing their points).

Just prior to revealing the cost of the financial emergency, participants were asked to provide a series of responses. This timing was deliberate such that participants' responses would not be

[4] Experimental instructions and select screenshots of the task are provided in the Online Appendix. Code for the task is available in the Supplementary Materials (https://osf.io/pqgha/).
[5] Participants were eligible for a bonus payment (in addition to their participation payment) if their final score in the task was within the top 10 percent of their experimental condition.
[6] Previous work has estimated that the average household experiences a CV of between 0.30 to 0.40 (Farrell et al., 2019; Hannagan & Morduch, 2015); however, this varies substantially between lower- and higher-income households (Mills & Amick, 2010; Morris et al., 2015).

affected by the outcome of the experiment (i.e., whether they had saved adequately). Participants were asked to rate how volatile they perceived their income to have been during the task (0 = "Not Volatile"; 10 = "Extremely volatile"). Participants were advised that they could think of volatility as a reflection of how well they could predict their income if there was an additional round (Konovalova & Pachur, 2021). We similarly asked participants to rate how difficult it was to decide how much to spend or save each round (0 = "Not difficult"; 10 = "Extremely difficult"). Finally, we measured financial impatience using the 'fill-in-the-blank' approach (Smith & Hantula, 2008), which has been previously used in studies involving delay discounting (Chapman, 1996; Kirby & Maraković, 1995; Weatherly et al., 2010). Participants were instructed to imagine that they were given the choice between two bonus rewards for their involvement in the experiment. The first option was to receive £50 in two weeks' time. Alternatively, they could opt for an immediate reward. Participants were asked to indicate the lowest amount they would accept immediately ('smaller-sooner amount') that would make it preferable to the larger, delayed reward. The response was bounded between £0 and £50, with a lower smaller-sooner amount indicating a higher degree of financial impatience.

3.1.3. Procedure

Participants were advised that they would be playing a financial decision making game and received instructions outlining the work tasks and the objective of the game. This was followed by a practice stage which included three practice rounds (with income of £50 per work task) and a practice financial emergency (a £50 parking ticket fine).

After the practice stage, participants' savings and points were reset to zero and they began the 15 experiment rounds. Once the experiment rounds were complete, participants were informed that the financial emergency was about to occur and were asked to provide responses to perceived volatility, perceived difficulty, and financial impatience measures described in the previous section. Following this, the cost of the emergency was revealed, and participants were advised of the outcome of the game. Finally, participants were asked to provide information about their demographics and financial situations before receiving a debrief of the experiment.

3.2. Results

For all four experiments, we conducted Bayesian statistical analyses (using default priors) and report the Bayes factors (BF_{10}) associated with our results. In cases where the Bayes factor was less than one (i.e., evidence favoured the null hypothesis), we reported the inverse Bayes factor (BF_{01}) to assist with comparability of evidence strength. Interpretations of Bayes factors were based on guidelines suggested in Lee and Wagenmakers (2013). Unless indicated otherwise, analyses of variance (ANOVAs) were used for overall tests of differences across multiple conditions and t-tests were used

for pairwise comparisons between conditions. Our experiment data and code have been made available in the Supplementary Materials (https://osf.io/pqgha/).

3.2.1. Perceived volatility ratings

We first examined whether there were differences between conditions in participants' ratings of how volatile their income was ('perceived volatility ratings'). As seen in Figure 1, our analysis indicated that there was extreme evidence that perceived volatility ratings differed between conditions (BF_{10} = 6.72×10^{13}), suggesting that our income volatility manipulation had worked. This difference was driven by substantially lower volatility ratings in the No Volatility condition (M = 3.17) compared to the Low Volatility (M = 6.00) and High Volatility (M = 6.40) conditions (BF_{10} = 2.04×10^{8} and 1.11×10^{11} respectively). However, there was moderate evidence suggesting that perceived volatility ratings did not differ between the Low and High Volatility conditions (BF_{01} = 3.15).

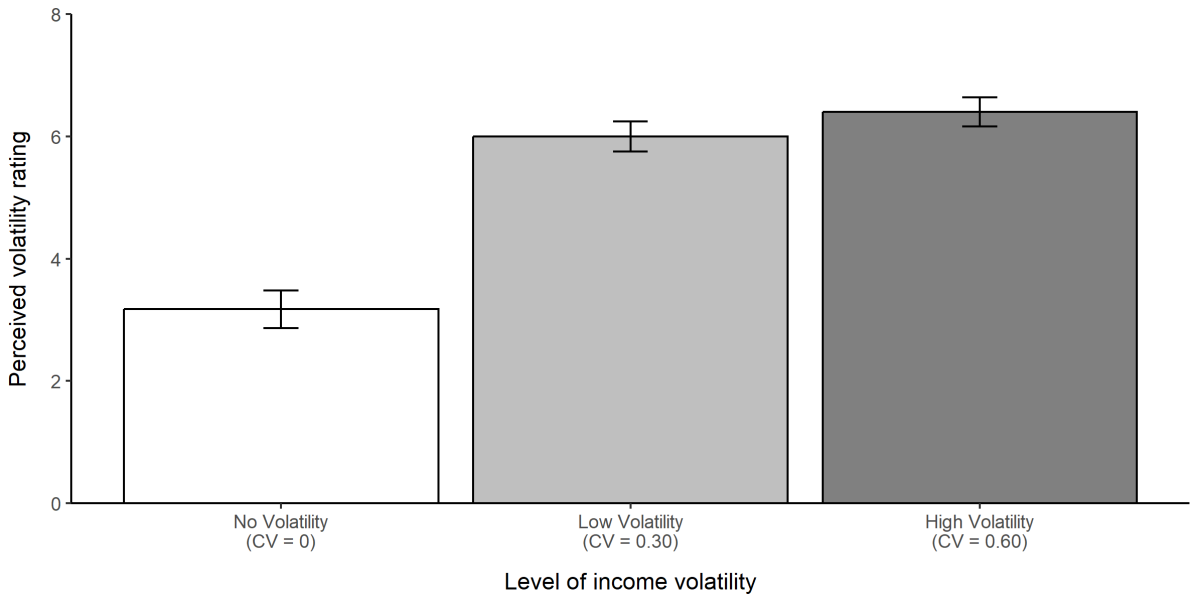


Figure 1. Mean perceived volatility ratings by level of income volatility in Experiment 1. Standard error bars indicated.

3.2.2. Final savings

We next analysed how much participants had saved at the end of the task ('final savings'). As seen in Figure 2, we observed very strong evidence that final savings differed between conditions (BF_{10} = 38.71). Participants saved substantially more in the High Volatility condition (M = £8,571.64) compared to the No Volatility (M = £6,647.88) and Low Volatility (M = £6,579.54) conditions (BF_{10} =

33.67 and 24.23 respectively). However, there was moderate evidence suggesting that final savings did not differ between the No and Low Volatility conditions (BF_{01} = 5.84).

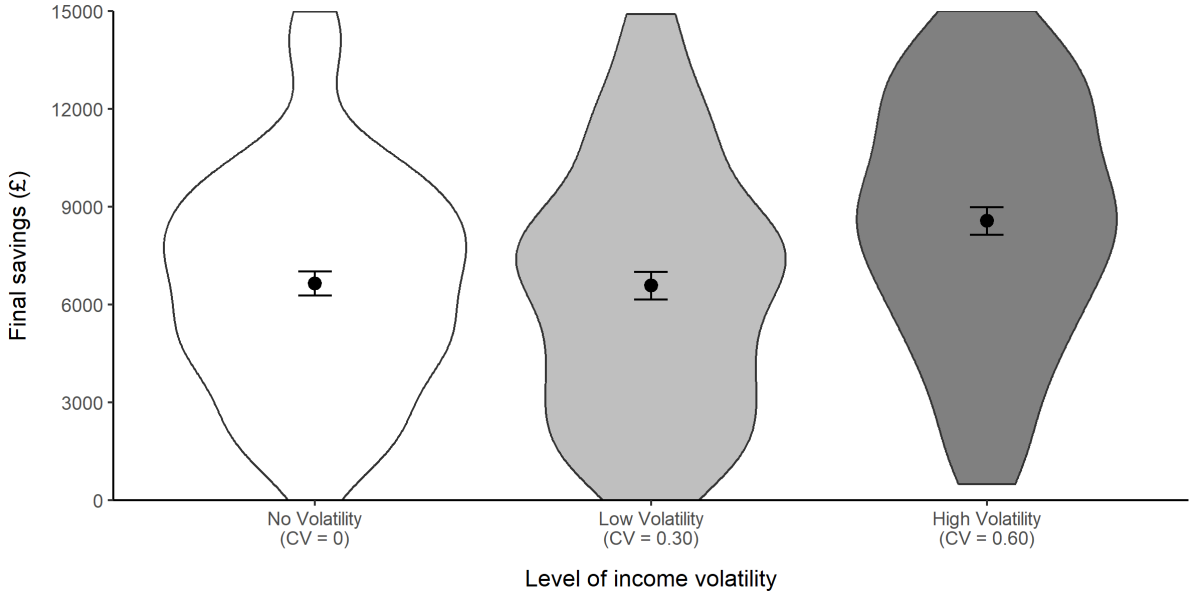


Figure 2. Distribution of final savings by level of income volatility in Experiment 1. Means and standard error bars indicated.

3.2.3. Perceived difficulty and financial impatience

We then examined participants' ratings of how difficult they found it to decide how much to spend or save throughout the task ('perceived difficulty'). There was moderate evidence that these ratings did not differ between conditions (BF_{01} = 6.44). The mean rating provided across the conditions was 4.07 (out of 10). Likewise, there was moderate evidence that financial impatience did not vary between conditions, as measured via participants' smaller-sooner amounts (BF_{01} = 7.67). The mean amount participants were willing to accept immediately instead of a £50 reward in two weeks' time was £37.60.

3.3. Discussion

Our results indicated that participants saved substantially more in the High Volatility condition than the No and Low Volatility conditions—consistent with the view that income volatility increases savings motives. However, we did not observe the same boost in savings for the Low Volatility condition relative to the No Volatility condition. The simplest explanation would be that participants' income was volatile enough to impact their saving behaviour in the High Volatility condition but was not volatile enough to do so in the Low Volatility condition. This would imply that

there exists a threshold between the CVs we used (0.30 for Low Volatility; 0.60 for High Volatility) which must be surpassed before a change in saving behaviour would be observed. However, complicating this explanation was the fact that participants in the Low and High Volatility conditions reported their income as being similarly volatile (based on their perceived volatility ratings). The question we thus needed to address was why participants in the Low Volatility condition did not save differently (relative to the No Volatility condition) despite perceiving their income to be as volatile as the High Volatility condition.

One possibility we considered was whether the increased saving behaviour observed from participants in the High Volatility condition was being driven by something other than income volatility (as defined by CV). This idea was inspired by recent work which showed that individuals' perceptions of a number sequence's variance is not always perfectly related to the objective statistical variance of the sequence (Konovalova & Pachur, 2021). In their study, Konovalova and Pachur (2021) examined how other characteristics of a number sequence (e.g., mean, range, pairwise distance) contributed to perceptions of variance. The study found that a sequence's range often served as a better individual predictor of participants' perceptions of variance than statistical variance itself.

This led us to examine in Experiment 2 whether three other dimensions of the income sequences we gave participants could better account for their saving behaviour: the minimum income participants received during the task, the maximum income, and the range of incomes. As shown in Table 1, the income sequences used in Experiment 1 varied not only in their CV, but also these additional dimensions. As an example, it may have been the minimum income participants received that was driving their saving decisions—perhaps because the income shock associated with earning an unexpectedly low income forced participants to update their view of how uncertain the (experimental) world was, thereby prompting them to save more as a precaution (Chamon et al., 2013; Collins & Gjertson, 2013). If this were the case, it would explain why participants' perceived volatility ratings did not neatly map onto their saving behaviour.

Table 1.

Dimensions of income sequences used in Experiment 1.

Condition	Incomes (£)	CV	Min	Max	Range
No Volatility	1,000 1,000 1,000 1,000 1,000 1,000 1,000 1,000 1,000 1,000 1,000 1,000 1,000 1,000 1,000	0.00	1,000	1,000	0
Low Volatility	431 570 656 794 873 883 910 990 1,158 1,202 1,277 1,279 1,311 1,326 1,340	0.30	431	1,340	909
High Volatility	173 274 466 526 529 650 661 847 1,101 1,374 1,404 1,436 1,571 1,900 2,088	0.60	173	2,088	1,915

Note. CV = Coefficient of variation. Min, Max = Minimum/Maximum incomes received during task.

While the main focus for this study is saving behaviour, it is worth noting that our income volatility manipulation did not appear to increase participants' financial impatience—contrary to prior findings (Peetz et al., 2021; West et al., 2020). One possible reason for our failure to observe an effect is that both our income volatility manipulation and our measure of financial impatience were hypothetical. While Peetz et al. (2021) also manipulated the volatility of hypothetical income, their measure of financial impatience involved participants choosing between two real payments. In the case of West et al. (2020), the measure of financial impatience involved hypothetical choices, but participants experienced volatility in their real income. Another possibility for the inconsistency in our findings could be due to our use of different methods of measuring financial impatience. While our study used a fill-in-the-blank approach, both prior studies used 'binary-choice' tasks, which give participants the choice between defined smaller-sooner and larger-later amounts. Previous work suggests that binary-choice tasks can produce steeper discounting rates compared to fill-in-the-blank tasks (Smith & Hantula, 2008). It is therefore possible that the effect of income volatility on financial impatience is small—one that our measure was unable to detect, but that more sensitive measures may have been able to. Though exploring these potential explanations (or any others) was beyond the scope of our study, our null result suggests the need for further investigation to have greater confidence in the link between income volatility and financial impatience.

4. Experiment 2

For Experiment 2, we generated three new income sequences that would allow us to tease apart whether the minimum income, maximum income, or range of incomes would provide a better account for saving behaviour than CV. The new sequences were designed such that they could be compared against one another, as well as against the High Volatility condition from Experiment 1. Each sequence shared a different set of dimensions with the High Volatility condition: either the minimum income (but not the maximum or range), the maximum income (but not the minimum or range), or both the minimum and maximum incomes (and therefore also the range). Notably, however, all three conditions shared the same statistical variance as one another (CVs = 0.37) but were deliberately created to be less volatile than the High Volatility condition (CV = 0.60).

4.1. Method

4.1.1. Participants

We recruited 241 new participants (M_{age} = 39.65 years; 108 males; 130 females; 2 non-binaries; 1 preferred not to say) from Prolific Academic using the same eligibility criteria described for Experiment 1. In addition to these criteria, we excluded anyone who had participated in the previous experiment. Participants again received a £3.00 (USD 3.77) participation payment and were eligible for a £3.00 (USD 3.77) bonus payment based on their task performance.

4.1.2. Materials and procedure

Experiment 2 used the same financial decision making task and procedure as described for Experiment 1. However, participants were assigned to three new conditions which used different income sequences from the prior experiment: “Same Range” (n = 80), “Same Min” (n = 81), and “Same Max” (n = 80). The names of these conditions indicated what characteristic(s) their income sequence shared with the High Volatility condition from Experiment 1.

In the Same Range condition, participants’ income sequence shared the same minimum and maximum values as the High Volatility condition (£173 and £2,088 respectively), and therefore the same range (£1,915). However, the income sequence was constructed to have a lower coefficient of variation (CV = 0.37 vs 0.60 for the High Volatility condition). This would allow us to directly compare the two conditions to determine whether CV was driving the difference in saving behaviour or whether it was one of the other dimensions.

In the Same Min condition, participants’ income ranged from £173 to £1,580 across rounds—sharing the same minimum income as the High Volatility condition but differing in the maximum income and range. Conversely, the Same Max condition shared the same maximum income as the

High Volatility condition (£2,088) but had a different minimum income (£681) and range. Notably, however, the range of the Same Min and Same Max conditions were designed to be identical (£1,407). Both sequences were also constructed to share the same CV as the Same Range condition (CV = 0.37).

All three sequences therefore shared the same statistical variance (unlike in Experiment 1), but varied in their minimum income, maximum income, and range of incomes. As with the previous experiment, regardless of which income sequence participants received, their total income across the task was £15,000. By keeping this and all other task parameters the same as Experiment 1, it became possible to directly compare the High Volatility condition from the first experiment with the new conditions in Experiment 2.

4.2. Results

4.2.1. Comparisons between Same Range, Same Min, and Same Max conditions

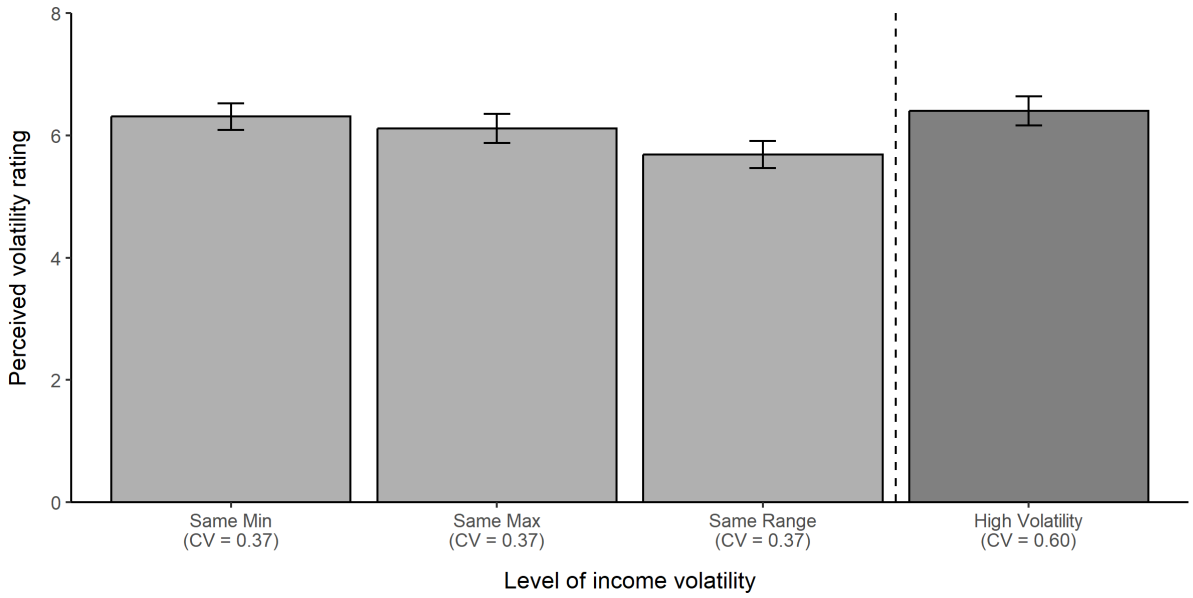
We first analysed the data from our three Experiment 2 conditions. This allowed us to explore whether any differences in our measures were being driven by dimensions of participants' income sequences other than CV.

Across our four measures (perceived volatility, final savings, perceived difficulty, and financial impatience), we consistently observed no differences between our three conditions. The evidence for this was moderate for perceived volatility (BF_{01} = 3.91), strong for final savings (BF_{01} = 16.19), moderate for perceived difficulty (BF_{01} = 6.82), and strong for financial impatience (BF_{01} = 12.50).

4.2.2. Comparisons against High Volatility condition

We then compared the perceived volatility ratings and final savings of our three Experiment 2 conditions against the High Volatility condition from Experiment 1 (see Figure 3).

(a) Mean perceived volatility ratings



(b) Distribution of final savings

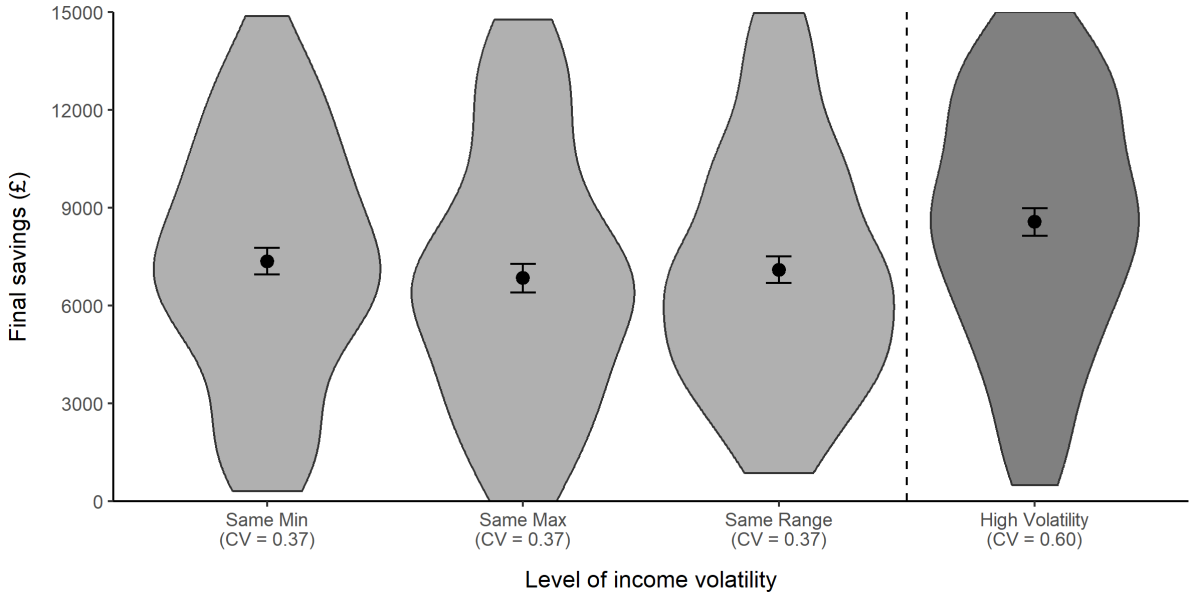


Figure 3. Perceived volatility ratings and final savings by level of income volatility in Experiment 2. High Volatility condition from Experiment 1 shown on right of dotted line for comparison. Means and standard error bars indicated.

There was anecdotal evidence that participants perceived their income to be more volatile in the High Volatility condition ($M = 6.40$) than the Same Range condition ($M = 5.69$) ($BF_{10} = 1.52$). However, there was moderate evidence that the perceived volatility ratings did not differ between the High Volatility condition and the Same Min ($M = 6.31$) or Same Max ($M = 6.11$) conditions ($BF_{01} = 5.66$ and 4.18 respectively).

In contrast, there was consistent evidence that participants saved more in the High Volatility condition (M = £8,571.64) compared to the other three conditions. The evidence was moderate for the Same Range (M = £7,096.65) and Same Max (M = £6,842.40) conditions (BF_{10} = 3.03 and 6.69 respectively), and anecdotal for the Same Min condition (M = £7,362.69) (BF_{10} = 1.16).

4.3. Discussion

Our results did not support the hypothesis that saving behaviour was being driven by a dimension of the income sequence other than CV. Despite varying the minimum income, maximum income, and range of incomes between conditions, participants all exhibited similar saving behaviour. If anything, our findings provided greater reason to believe that CV was the driver of saving behaviour. All three conditions saved less than the High Volatility condition, with the consistent difference being their lower CV (CV = 0.37 vs 0.60). Thus, we saw further evidence that increased income volatility corresponded to higher savings within our task.

However, we continued to observe a discrepancy between participants' perceptions of their income's volatility and their saving behaviour. While participants saved more in the High Volatility condition, their perceived volatility ratings were similar to the ratings provided in our Experiment 2 conditions (with the exception of the Same Range condition, where the evidence of a difference was only anecdotal). This echoed what we had observed in Experiment 1, in which participants from the Low and High Volatility conditions had rated their income as similarly volatile despite exhibiting different saving behaviour.

This led us to consider a new hypothesis: that participants were giving similar responses on our perceived volatility rating scale because we were asking them to make an absolute judgment with only one objective point of reference (0 = "not volatile at all"). Previous work suggests that judgments can differ when made from an absolute versus relative standpoint (e.g., Fox & Tversky, 1995; Goffin & Olson, 2011; Stewart et al., 2006). It was therefore possible that participants in different conditions were perceiving the volatility of their income differently, but shared similar thought processes in how this should be reflected in their response on the scale—for example, thinking "there is some volatility but not an extreme amount, so I will respond with a seven". This could explain why participants who experienced some degree of income volatility (i.e., all conditions except for the No Volatility condition) provided similar ratings of perceived volatility while differing in their saving behaviour.

To examine this hypothesis, we needed participants to provide relative judgments of their income's volatility. To obtain these judgments, we adapted our procedure in Experiment 3 such that participants would have two attempts at the financial decision making task. These two attempts used

income sequences with different levels of volatility, allowing us to compare participants' perceived volatility ratings between attempts.

5. Experiment 3

For Experiment 3, participants were given two attempts at the financial decision making task. In one attempt, participants received the same income as the Low Volatility condition from Experiment 1; in the other, they received the same income as the High Volatility condition. The ordering of the income sequences was counterbalanced.

Our goal was to examine whether participants would be sensitive to the different levels of volatility between their attempts. We preregistered[7] three key hypotheses based on this goal prior to conducting the experiment. First, participants would provide higher perceived volatility ratings during their High Volatility attempt compared to their Low Volatility attempt. Second, participants would provide similar ratings during their first attempt, irrespective of whether they received the Low Volatility or High Volatility income sequence. This would be consistent with what had been observed in Experiment 1. Third, perceived volatility ratings would differ when comparing second attempts at the task. We expected that since participants would be making relative judgments of volatility in their second attempts, they would provide higher ratings if this second attempt involved the High Volatility income sequence, whereas they would provide lower ratings if their second attempt instead involved the Low Volatility income sequence.

5.1. Method

5.1.1. Participants

We recruited 150 new participants (M_{age} = 38.85 years; 75 males; 74 females; 1 non-binary) from Prolific Academic using the same eligibility criteria as described in the previous two experiments. Sample size was based on an a priori power analysis that allowed for detection of a small effect in both between- and within-subjects comparisons (δ = .80; γ = .20; α = .05). Participants received a £4.50 (USD 5.66) participation payment and were eligible for a £3.00 (USD 3.77) bonus payment based on their task performance.

5.1.2. Materials and procedure

For Experiment 3, the procedure was adapted such that participants were given two attempts at the financial decision making task. In one attempt, participants received the same income sequence that

[7] Our experiment was preregistered using the AsPredicted platform (https://aspredicted.org/bg6gi.pdf).

was used in the Low Volatility condition from Experiment 1; in the other, they received the High Volatility income sequence. The order in which participants received these attempts was counterbalanced, meaning half of participants received the Low Volatility version first ("Low to High"; $n = 75$), while the other half received the High Volatility version first ("High to Low"; $n = 75$).

The inherent issue in allowing participants two attempts at the task is that participants' behaviour in the second attempt may be confounded by learnings from their first attempt. This would impair our ability to compare our results against the behaviour we had observed in Experiment 1. We sought to mitigate this concern through several deliberate design choices when adjusting our procedure from the previous experiments. First, at the end of participants' first attempt, we advised them that the emergency had occurred, but did not reveal how much it cost. This was only revealed at the end of the experiment after participants had completed both attempts. Second, we explicitly indicated to participants that the timing and cost of the emergency may differ between attempts. This sought to dissuade participants from assuming that the timing of the emergency would be the same for both attempts.[8] Finally, although participants' final score in the experiment was calculated by combining their performance in each attempt, we visually reset their score to zero in between attempts. This was intended to reiterate to participants that the two attempts were independent.

The overall procedure thus proceeded as follows. Participants were advised that they would be given two attempts at a financial decision making game. After reading the instructions, participants underwent the practice stage, followed by their first attempt at the task. At the end of the first attempt, participants were informed that the financial emergency was about to occur and were asked to rate the volatility of their income. Participants were then told that the cost of the emergency would only be revealed after they had completed their second attempt, which they subsequently commenced. At the end of their second attempt, participants were again asked to rate the volatility of their income. Following this, the cost of both emergencies was revealed[9] and participants were advised of the outcome of each attempt. Participants' total score across both attempts was used to determine eligibility for the bonus reward. Finally, participants were asked to provide information about their demographic and financial situations, before receiving a debrief.

[8] However, in both attempts, the emergency needed to occur after the 15th round so that the income sequences used would be consistent with those from Experiment 1.

[9] As with the previous experiments, the first emergency involved home repairs with a total cost of £4,500. The second emergency involved a car breakdown and cost £2,500.

5.2. Results

5.2.1. Comparison of volatility ratings between attempts

Figure 4 shows participants' mean perceived volatility ratings as a function of the level of volatility (Low or High) and whether it was their first or second attempt. As predicted, we observed moderate evidence that participants provided similar ratings during their first attempt, regardless of whether this was the Low Volatility or the High Volatility version (BF_{01} = 3.28). However, contrary to our prediction, there was also anecdotal evidence that ratings did not differ on participants' second attempt either (BF_{01} = 2.13).

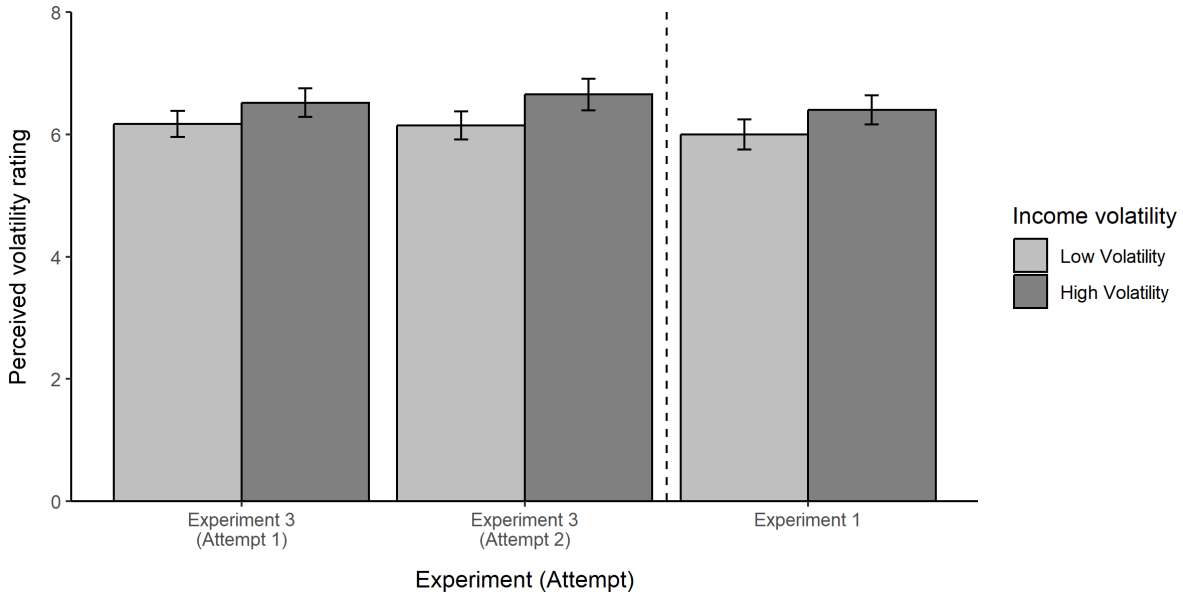


Figure 4. Mean perceived volatility ratings by level of income volatility and task attempt in Experiment 4. Low and High Volatility conditions from Experiment 1 shown on right of dotted line for comparison. Standard error bars indicated.

While we did not find evidence for our hypothesis when examining volatility ratings at the group level, we did observe evidence at the individual participant level. We conducted a paired t-test comparing participants' ratings in their Low Volatility and High Volatility attempts. This indicated that there was anecdotal evidence of participants providing higher ratings during their High Volatility attempt compared to their Low Volatility attempt (BF_{10} = 2.91), with the mean difference between ratings being 0.43.

5.2.2. Additional pre-registered analyses

As part of our preregistration, we planned two additional analyses that were unrelated to our main hypotheses about perceived volatility ratings. First, we hypothesised that participants would save

more in the High Volatility condition than in the Low Volatility condition (see Figure 5). We examined this by conducting a Bayesian ANOVA where level of income volatility and task attempt were entered as variables. This provided Bayes factors for different combinations of predictive models, from which we could compute inclusion factors.[10] Our findings contradicted our hypothesis; there was moderate evidence against an income volatility level effect ($BF_{01} = 3.36$). Instead, we observed extreme evidence in favour of a task attempt effect ($BF_{10} = 5.01 \times 10^6$), with participants saving substantially more in their second attempt regardless of whether it involved the Low or High Volatility income sequence. There was also anecdotal evidence against an interaction between task attempt and income volatility level ($BF_{01} = 2.11$).

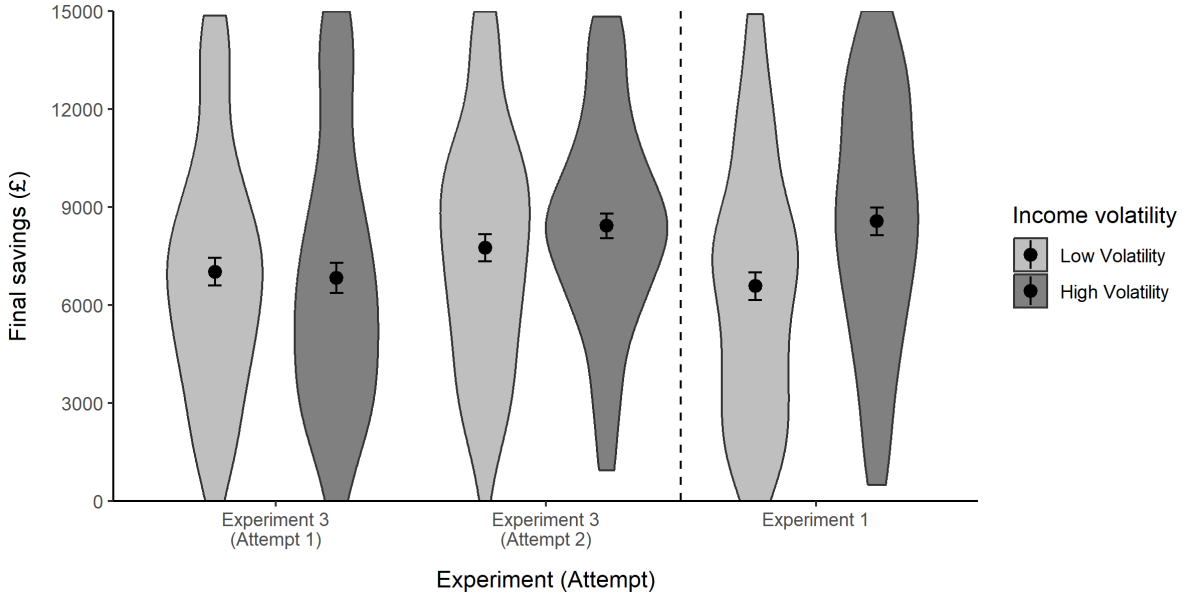


Figure 5. Distribution of final savings by level of income volatility and task attempt in Experiment 3. Low and High Volatility conditions from Experiment 1 shown on right of dotted line for comparison. Means and standard error bars indicated.

Our other additional hypothesis was that we should see similar perceived volatility ratings and final savings from participants completing their first attempts at the task as what was observed in Experiment 1. This would provide a signal of reliability for participants' behaviour within our task. We started by comparing the participants from Experiment 3 who received the Low Volatility income sequence first with participants in the Low Volatility condition from Experiment 1. There was moderate evidence to suggest that participants provided similar perceived volatility ratings (Figure 4) and ended the task with similar final savings amounts (Figure 5; $BF_{01} = 5.08$ and 4.51 respectively). When drawing the same comparison between the High Volatility counterparts, we again observed

[10] Inclusion factors are computed by comparing the posterior odds of models that include and exclude a predictor of interest (Van Den Bergh et al., 2020). These help to quantify the level of evidence for whether the predictor should be included.

moderate evidence in favour of the perceived volatility ratings being similar (BF_{01} = 5.44). However, we found moderate evidence that participants' final savings differed (BF_{10} = 5.50); participants who received the High Volatility income sequence in their first task attempt in Experiment 3 appeared to have saved substantially less than those who were in the High Volatility condition from Experiment 1 (*M* = £6,834.69 vs £8,571.64).

5.3. Discussion

Experiment 3 provided some credence to our hypothesis that participants were sensitive to different levels of income volatility, but we were failing to capture this when asking for an absolute judgment on our 11-point scale (0 = "Not Volatile"; 10 = "Extremely Volatile"). This helped to explain why participants' ratings of income volatility across our previous experiments did not necessarily align with their observed saving behaviour. It also reintroduced the possibility of an income volatility 'threshold' that needed to be exceeded for participants to adjust their behaviour within the task. As a reminder, we observed in Experiment 1 that participants saved more in the High Volatility condition relative to those who had received a stable income, but that this difference was not observed for the Low Volatility condition.

However, before we could make any claims about a potential threshold, we first needed to resolve the inconsistency between the saving behaviour we had observed from participants in Experiment 1's High Volatility condition and the participants who received the High Volatility condition as their first attempt in Experiment 3. In theory, these participants should have exhibited similar saving behaviour; the only difference was that those in Experiment 3 would have known that they would be completing a second (independent) attempt at the task. The fact that we observed higher savings in Experiment 1 but not 3 called into question how reliable our finding was, and by extension, whether there was even an income volatility effect at all.

This led us to run a single additional experimental condition in Experiment 4 in which we further increased the income volatility that participants would experience ("Very High Volatility"; CV = 0.90). We expected that running the results of this condition would help to build confidence in one of two conclusions. If these participants did not save any differently compared to participants who received stable incomes (in Experiment 1), we could be more confident that income volatility does not influence saving decisions, and that the increased saving effect we observed in the High Volatility condition from Experiment 1 was likely a false positive. In contrast, if we did observe higher savings in this Very High Volatility condition, we would instead have greater support for an effect of income volatility on saving behaviour and consider our results from Experiment 3 to be a false negative.

6. Experiment 4

In Experiment 4, we generated a new income sequence that was more volatile than the conditions from Experiment 1. This condition was known as the Very High Volatility condition and had a CV of 0.90. All participants were placed in this condition and completed only one attempt at the financial decision making task.

6.1. Method

6.1.1. Participants

We recruited 80 new participants (M_{age} = 36.63 years; 34 males; 46 females) from Prolific Academic using the same eligibility criteria as described in the previous experiments. Our sample size was based on having the same number of participants per condition as Experiment 1. Participants received £3.00 (USD 3.77) in exchange for their participation and were also eligible for an additional bonus of £3.00 (USD 3.77) based on their performance in the financial decision making task.

6.1.2. Materials and procedure

Experiment 4 used the same financial decision making task and followed the same procedure as Experiment 1. All participants—henceforth referred to as the Very High Volatility condition—received a newly generated income sequence that ranged from £44 to £3,457, with the CV of the sequence being 0.90. Consistent with all other income sequences, the total income received across the task remained at £15,000.

6.2. Results

In this section, we first compare perceived volatility ratings and final savings between our Very High Volatility condition and the No Volatility condition in Experiment 1. We then report on analyses using our combined data across all four experiments, where we grouped conditions with the same level of income volatility. We pooled our conditions from Experiment 2 into a group labelled "Medium Volatility", as these participants all received an income sequence with a CV of 0.37—between the CVs of Experiment 1's Low Volatility condition (CV = 0.30) and High Volatility condition (CV = 0.60). We then pooled participants' first attempts from Experiment 3 with their respective Experiment 1 conditions (i.e., Low or High Volatility). Finally, we excluded data from participants' second attempts in Experiment 3; our prior results suggested that participants tended to save more on their

second attempt (regardless of level of income volatility), rendering these data incomparable to our other conditions, where participants were completing their first or only attempt.[11]

6.2.1. Comparison of Very High Volatility to No Volatility

We observed extreme evidence that participants perceived their income to be substantially more volatile in the Very High Volatility condition (M = 6.79) compared to the No Volatility condition (M = 3.17) ($BF_{10} = 1.03\times10^{13}$). There was also strong evidence that participants saved more in the Very High Volatility condition than the No Volatility condition (M = £8,342.80 vs £6,647.88) (BF_{10} = 10.97).

6.2.2. Combined analyses on income volatility effect

A Bayesian ANOVA indicated that there was extreme evidence that perceived volatility ratings differed between income volatility levels ($BF_{10} = 4.62\times10^{25}$). However, as is evident from Figure 6, this effect appears to be entirely driven by lower volatility ratings in Experiment 1's No Volatility condition. When excluding this condition from the analysis, there was anecdotal evidence that the remaining conditions did not differ in their volatility ratings (BF_{01} = 1.41).

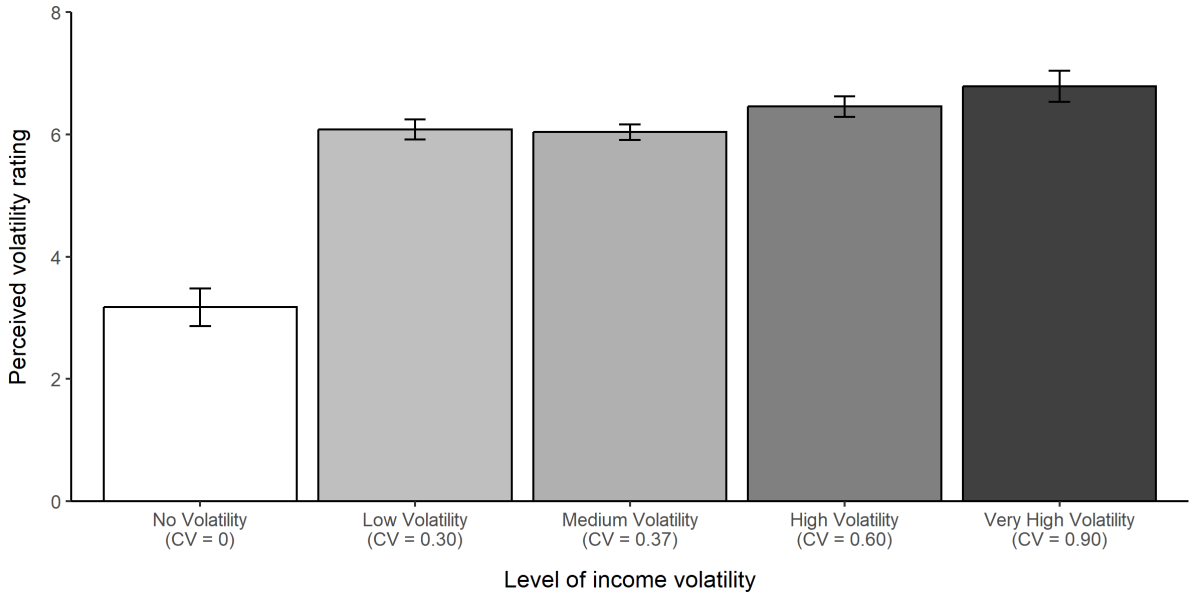


Figure 6. Mean perceived volatility ratings by level of income volatility across Experiments 1 to 4. Standard error bars indicated.

[11] We recognise that this pooled analysis approach forgoes random assignment of participants to experiment conditions. However, given our experiments drew from the same participant pool, offered similar incentives, and were conducted within months of each other, we considered it unlikely that any of our observed results would be driven by systematic differences in participant characteristics.

A similar analysis of participants' final savings yielded inconclusive evidence as to whether they differed as a function of income volatility level (BF_{01} = 1.01) (see Figure 7). We thus chose to exploit the fact that each income volatility level was quantifiable based on its CV and that this could be treated as a continuous measure. When instead analysing final savings as a function of CV, we observed very strong evidence that a higher CV was associated with more savings (BF_{10} = 45.89). A Bayesian regression approach yielded a median posterior estimate for the CV effect to be £2,134.69. This suggested that a 0.1 increase in CV corresponded to an average increase in savings of approximately £213 within our task (95% HDI: [£92, £328]).

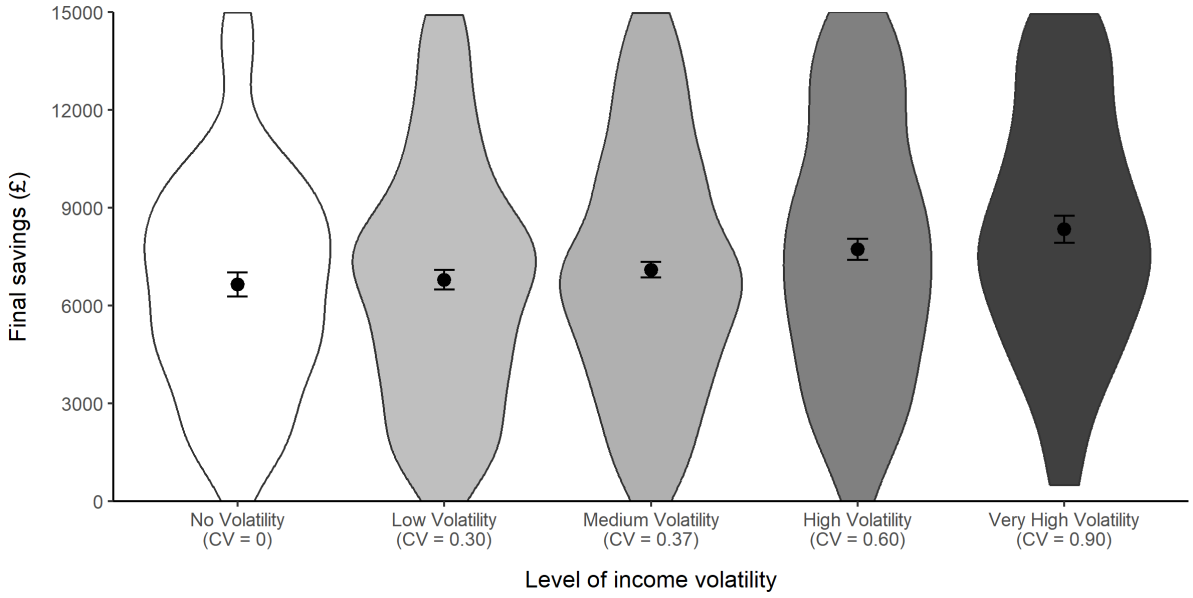


Figure 7. Distribution of final savings by level of income volatility across Experiments 1 to 4. Means and standard error bars indicated.

7. General Discussion

7.1. The relationship between income volatility and saving behaviour

Across four experiments, our collective results provide preliminary evidence that people save more when faced with fluctuations in income and are consistent with the view that uncertainty drives precautionary savings motives (Carroll & Kimball, 2018). However, the fact that there exists empirical work supporting both that income uncertainty increases saving behaviour (e.g., Caballero, 1991; Miles, 1997) and decreases saving behaviour (e.g., Cobb-Clark et al., 2016; Perry & Morris, 2005) suggests that the relationship is not so straightforward. Our findings could be interpreted as indicative of what people intend to do when faced with a volatile income, but not necessarily what they follow through with—a gap between saving intentions and behaviours (Rabinovich & Webley, 2007).

By design, our financial decision making task was a highly simplified version of the true trade-off that people must make between spending and saving for the future. One of the key differences between our hypothetical setting and the real world was that participants never needed to worry about their income being insufficient to meet immediate expenses as there were none within our task; instead, they could afford to entirely focus their attention on the long-term goal (i.e., accumulating adequate savings for the emergency). In contrast, in the real world, people with volatile incomes may be faced with the looming fear that an unanticipated drop in their income may leave them unable to fulfil their financial obligations. It is perhaps this financial pressure, or the feelings of stress and scarcity that accompany the pressure, that leads people to overly focus on the short-term and overrides their underlying intention to save more. One potential hypothesis is therefore that the experience of income volatility has differential effects on saving behaviour depending on one's financial situation (van Schie et al., 2012). The motivation to save more in response to a fluctuating income may be a luxury for those in strong financial positions who need not be concerned about it affecting their short-term liquidity.

7.2. Perceptions of income volatility

Our findings also suggest that income volatility may need to exceed some threshold before it impacts saving decisions. Within our experimental task, this threshold appeared to be around a coefficient of variation of 0.60. Below this CV level (i.e., in the Low Volatility condition of Experiment 1 and the three Experiment 2 conditions), saving behaviour did not differ relative from participants who received a steady income. At this CV level (i.e., our High Volatility conditions), we observed inconsistent results—increased saving behaviour in Experiment 1 but not in Experiment 3. Above this CV level (i.e., in the Very High Volatility condition), we observed the highest amount of savings. For reference, as noted earlier, the typical household is estimated to experience a CV of between 0.30 to 0.40.

If such a threshold does exist, this naturally raises the question of how people judge whether their income is volatile or not. While our results show that CV serves as a reasonable predictor for participants' savings within our task, we note three potential extensions upon our work. First, future work may seek to assess other definitions of volatility, such as the second-order coefficient of volatility proposed by Kvålseth (2017). Second, there may be opportunities to build upon our second experiment and further investigate whether other characteristics of income sequences better explain people's perceptions of their volatility (Konovalova & Pachur, 2021). Third, it may be worthwhile to distinguish between income volatility and predictability. For some individuals, income may fluctuate between pay periods, but in a predictable manner. This may occur if income is correlated with the

time of year (e.g., seasonal work or annual bonuses) or if individuals have control over how much they work and therefore their earnings (Peetz et al., 2021).

7.3. Facilitating intentions to save

Finally, our findings suggest there may be opportunities within the financial sector to better support consumers whose incomes are volatile. Banks in particular have visibility over their customers' income and can therefore readily identify which of their customers have highly volatile incomes and may be motivated to save more. It may be possible to then develop interventions that help consumers follow through with their intentions. For example, messages could be deployed to customers when a spike in income is detected (relative to their usual earnings). Such 'just-in-time' interventions can be highly effective (often used in health settings; e.g., Forman et al., 2019; Van Der Laan & Orcholska, 2022); in this case, potentially by combating the natural tendency to spend more of money that is considered a bonus or windfall (Arkes et al., 1994; Epley & Gneezy, 2007).

8. Conclusion

Recent economic trends, such as the rapid rise of the gig economy, have made it increasingly common for individuals to have incomes that are unstable and fluctuate within a year. Our study set out to investigate how experiencing this income volatility affects saving decisions. Using a novel financial decision making task, we provide evidence that higher income volatility results in increased saving behaviour. To the best of our knowledge, our study is the first to address this question experimentally and offers many fruitful avenues for further research. By improving our understanding of the relationship between income volatility and saving, we may be able to better tailor financial products and services for individuals with volatile incomes, and better meet their financial needs.

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ONLINE APPENDIX

Appendix A – Demographic and financial characteristics of our samples

Table A1. Demographic characteristics of samples in Experiments 1 to 4.

	Exp 1	Exp 2	Exp 3	Exp 4
N	241	241	150	80
Age (%)				
18-24 years old	11.6	10.8	9.3	17.5
25-34 years old	27.4	27.4	34.7	25.0
35-44 years old	26.1	28.2	24.0	31.2
45-54 years old	20.3	20.3	20.0	17.5
55-64 years old	13.7	12.4	12.0	6.3
65 years or older	0.8	0.8	0.0	1.3
Prefer not to say	0.0	0.0	0.0	1.3
Gender (%)				
Male	59.8	44.8	50.0	42.5
Female	39.4	53.9	49.3	57.5
Non-binary/Gender fluid	0.4	0.8	0.7	0.0
Different identity	0.4	0.0	0.0	0.0
Prefer not to say	0.0	0.4	0.0	0.0
Education level (%)				
Did not complete high school	0.8	1.2	1.3	2.5
High school graduate	36.1	41.1	42.0	35.0
Undergraduate degree (e.g., Bachelor's degree)	45.2	37.8	40.7	31.2
Postgraduate degree (e.g., Master's or Doctoral degree)	17.4	19.1	16.0	30.0
Prefer not to say	0.4	0.8	0.0	1.3

Note. Percentages are rounded and may not sum to 100 percent.

Table A2. Financial characteristics of samples in Experiments 1 to 4.

	Exp 1	Exp 2	Exp 3	Exp 4
N	241	241	150	80
Employment status (%)				
Full-time	61.0	52.7	55.3	48.8
Part-time	16.2	20.3	16.0	21.2
Contract/Temporary	2.5	1.7	0.0	1.3
Student	4.2	6.2	3.3	10.0
Unemployed	5.0	8.3	13.3	6.3
Unable to work	5.0	2.5	4.7	6.3
Other	5.0	7.8	7.3	5.0
Prefer not to say	1.7	0.4	0.0	1.3
Pay frequency				
Weekly	10.0	11.6	8.0	7.5
Fortnightly	5.0	2.1	2.7	1.3
Monthly	72.2	68.5	68.0	62.5
Other	4.2	5.8	5.3	3.8
Not applicable	7.1	10.8	15.3	18.8
Prefer not to say	1.7	1.2	0.7	6.3
Annual personal income (%)				
Negative or nil income	1.7	4.6	4.0	6.3
£0-£9,999	16.6	15.8	18.0	17.5
£10,000-£19,999	16.2	14.1	16.7	11.2
£20,000-£29,999	20.3	25.7	25.3	20.0
£30,000-£39,999	16.2	13.3	14.0	15.0
£40,000-£49,999	8.7	5.8	7.3	10.0
£50,000-£59,999	5.8	4.2	4.7	1.3
£60,000-£69,999	3.3	4.2	2.7	5.0
£70,000 or more	5.4	4.6	1.3	7.5
Prefer not to say	5.8	7.9	6.0	6.3

Note. Percentages are rounded and may not sum to 100 percent.

Appendix B – Summary of income sequences used across Experiments 1 to 4

Table B1. Dimensions of income sequences used across Experiments 1 to 4.

Condition	Incomes (£)	CV	Min	Max	Range
No Volatility	1,000 1,000 1,000 1,000 1,000 1,000 1,000 1,000 1,000 1,000 1,000 1,000 1,000 1,000 1,000	0.00	1,000	1,000	0
Low Volatility	431 570 656 794 873 883 910 990 1,158 1,202 1,277 1,279 1,311 1,326 1,340	0.30	431	1,340	909
High Volatility	173 274 466 526 529 650 661 847 1,101 1,374 1,404 1,436 1,571 1,900 2,088	0.60	173	2,088	1,915
Same Range	173 881 911 929 946 952 956 981 989 996 1,022 1,041 1,063 1,072 2,088	0.37	173	2,088	1,915
Same Min	173 552 654 851 863 864 889 1,017 1,036 1,211 1,240 1,257 1,310 1,503 1,580	0.37	173	1,580	1,407
Same Max	681 689 746 767 772 782 785 816 983 994 1,029 1,242 1,275 1,351 2,088	0.37	681	2,088	1,407
Very High Volatility	44 152 184 299 372 536 763 767 788 1,101 1,300 1,618 1,654 1,965 3,457				

Note. CV = Coefficient of variation. Min = Minimum income. Max = Maximum income.

Appendix C – Experimental instructions for financial decision making task

The following instructions were given to participants in Experiments 1, 2, and 4. Horizontal rules are used to indicate different instruction screens.

About this study

- *This study is being run by UNSW Sydney to investigate how people make financial decisions when faced with uncertainty.*
- *You will make decisions around spending and saving in a financial decision making game, as well as answer some simple questionnaires.*
- *You will receive £3.00 for participating in this experiment and may be eligible for a bonus payment of £3.00 depending on your performance in the game.*

How this experiment will run:

- *You will first be presented instructions that explain how the financial decision making game works.*
- *You will then be given a few practice rounds to get familiar with the game.*
- *After the practice rounds, you will begin the real experiment rounds.*
- *Finally, you will be asked to provide some information about yourself and your financial situation.*
- *The experiment should take about 20 minutes to complete. If you have any questions or issues during or after the experiment, please contact Nathan Wang-Ly (nathan.wang-ly@unsw.edu.au).*
- *Press the Continue button to proceed to the consent form for this experiment.*

How the Game Works – Spending or Saving

Each time you receive your income, you will be asked to decide how much of your money you want to spend or save. You can spend your money to buy points (1 point per £1 spent). These points will be used to determine whether you are eligible for a bonus payment. Any money that you don't spend will remain in your account as savings and carry over to future rounds.

How the Game Works – The Financial Emergency

At the end of the game, a financial emergency will occur that you will need to pay for. If you have enough saved in your account when this happens, you will win the game and get to keep your points. However, if you do not have enough saved, you will lose the game and lose all your points.

How the Game Works – Bonus Payment

Once we have finished collecting data for this experiment, the best performing participants (top 10% of scores) will receive a bonus payment of £3.00 in addition to their participation payment. Your goal is therefore to buy as many points as you can while still making sure you have enough saved for the financial emergency. Remember: You will not be told when this emergency will occur nor how much it will cost.

You will now get to play a few practice rounds to become familiar with how everything works. Just like in the real game, a financial emergency will occur at the end of these rounds. Once you finish with the practice rounds, the points you have earned and your account balance will be reset, and you will begin the experiment rounds. Click Continue when you are ready to begin.

[After practice rounds had been completed]

Thank you for completing the practice rounds. You will now begin the real experiment rounds. Your points and savings balance have been reset to zero. The number of rounds and the cost of the financial emergency will be different for the experiment stage. Your goal remains the same: To buy as many points as you can while making sure you have enough saved for the financial emergency.

Important: *You will later be asked questions about the income you received and your decisions to spend or save so please ensure you are paying attention throughout the game.*

The following instructions were given to participants in Experiment 3. Horizontal rules are used to indicate different instruction screens.

About this study

- *This study is being run by UNSW Sydney to investigate how people make financial decisions when faced with uncertainty.*
- *You will make decisions around spending and saving in a financial decision making game, as well as answer some simple questionnaires.*
- *You will receive £4.50 for participating in this experiment and may be eligible for a bonus payment of £3.00 depending on your performance in the game.*

How this experiment will run:

- *You will first be presented instructions that explain how the financial decision making game works.*
- *You will then be given a few practice rounds to get familiar with the game.*
- *After the practice rounds, you will be given the opportunity to play the game twice.*
- *Finally, you will be asked to provide some information about yourself and your financial situation.*
- *The experiment should take about 30 minutes to complete. If you have any questions or issues during or after the experiment, please contact Nathan Wang-Ly (nathan.wang-ly@unsw.edu.au).*
- *Press the Continue button to proceed to the consent form for this experiment.*

How the Game Works – Working for Income

The game will consist of multiple rounds where you will be asked to complete work tasks. Your task each round will be to arrange a sequence of letters in alphabetical order (see example image below). After completing each work task, you will receive money as your income.

How the Game Works – Spending or Saving

Each time you receive your income, you will be asked to decide how much of your money you want to spend or save. You can spend your money to buy points (1 point per £1 spent). These points will be used to determine whether you are eligible for a bonus payment. Any money that you don't spend will remain in your account as savings and carry over to future rounds.

How the Game Works – The Financial Emergency

At the end of the game, a financial emergency will occur that you will need to pay for. If you have enough saved in your account when this happens, you will win the game and get to keep your points. However, if you do not have enough saved, you will lose the game and lose all your points.

How the Game Works – Two Attempts

You will be given the opportunity to play the game twice. The timing and cost of the financial emergency may be different between attempts. The income you receive may also differ. The cost of the financial emergency and the outcome of each game will only be revealed once you have completed both attempts. However, your performance in your first attempt will not affect the second attempt. Your points and savings will be reset to zero in between attempts.

How the Game Works – Bonus Payment

After you have completed both attempts, we will add up your points from each attempt to give a final score for the experiment. If your final score is within the top 10% of participants who complete this experiment, you will receive a bonus payment of £4.50 in addition to your participation payment.

[After practice rounds had been completed]

Thank you for completing the practice rounds. You will now begin your first attempt at the game. Your points and savings balance have been reset to zero. The number of rounds and the cost of the financial emergency will be different for the experiment stage. Your goal remains the same: To buy as many points as you can while making sure you have enough saved for the financial emergency.

Important: *You will later be asked questions about the income you received and your decisions to spend or save so please ensure you are paying attention throughout the game.*

[After participants provided responses to the perceived income volatility, perceived financial difficulty, and financial impatience measures for their first task attempt]

Thank you for answering the question. Your performance in the first attempt has been recorded and we will now begin the second attempt when you press the button below. As this is a new attempt, your points and savings balance have been reset to zero. Your goal remains the same: To buy as many points as you can while making sure you have enough saved for the financial emergency.

Remember: *The timing and cost of the financial emergency may be different for this attempt. The income you receive may also differ.*

Appendix D – Select screenshots of financial decision making task

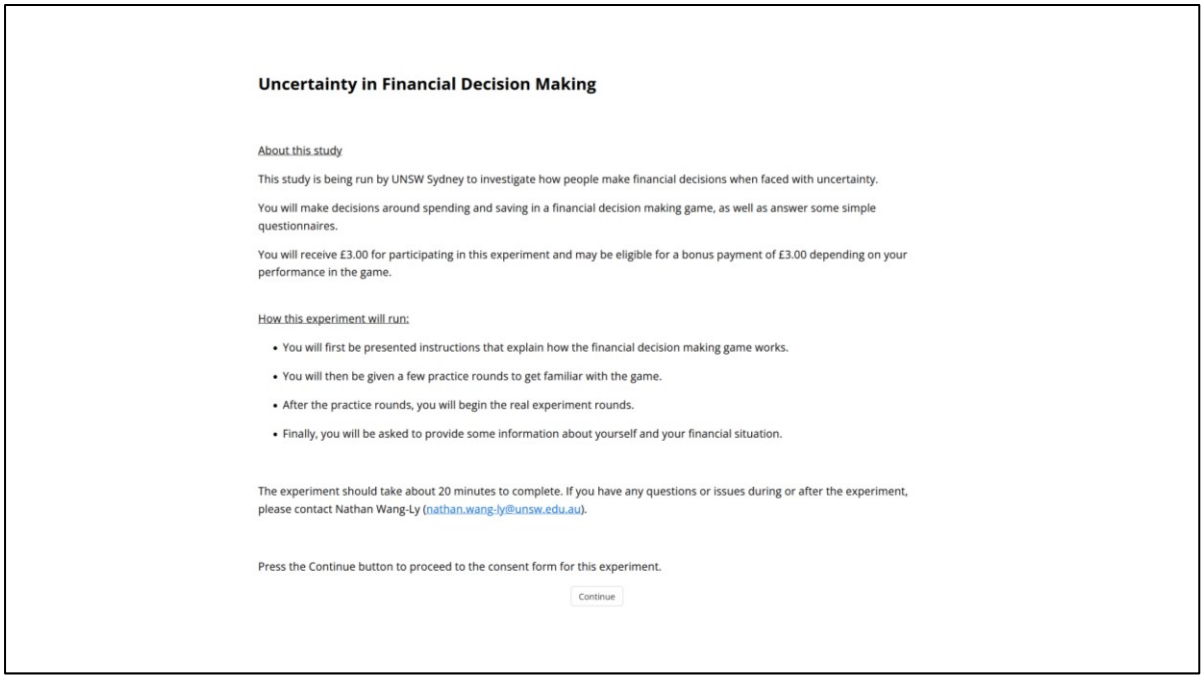

Figure D1. Introduction to the experimental study.

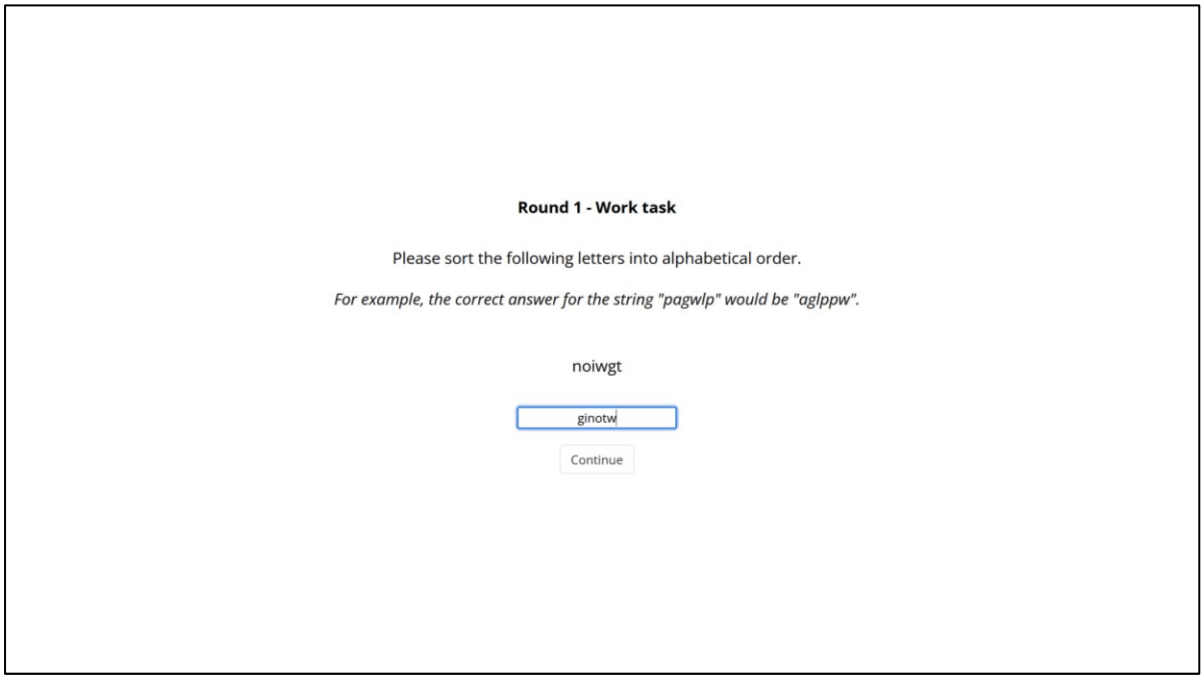

Figure D2. Example "work task" where participants rearranged a six-character string of letters into alphabetical order.

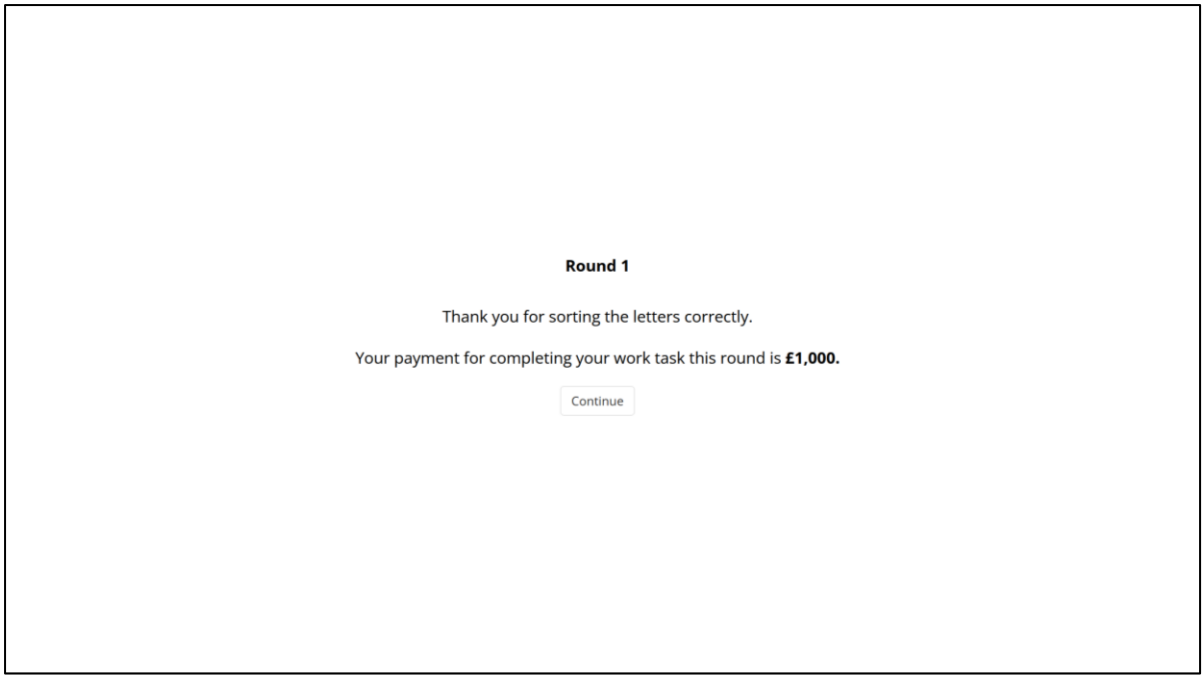

Figure D3. Example of participant receiving income upon completion of their work task.

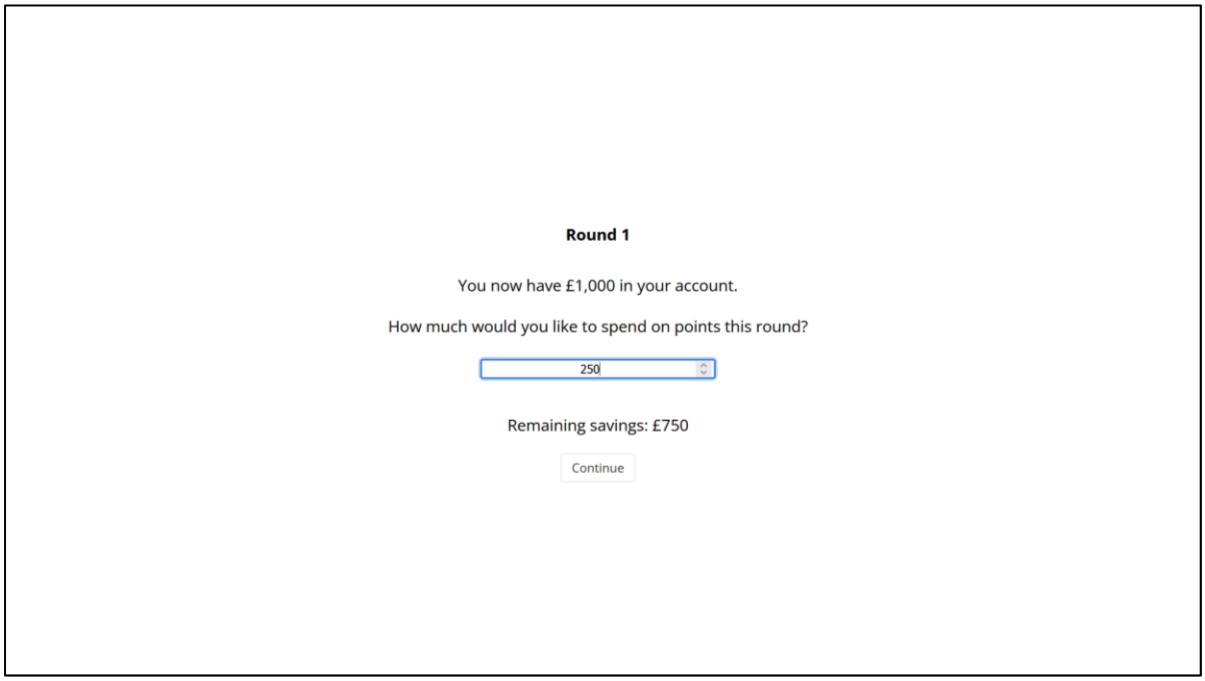

Figure D4. Example of participant deciding how much of their available funds to use on purchasing points.

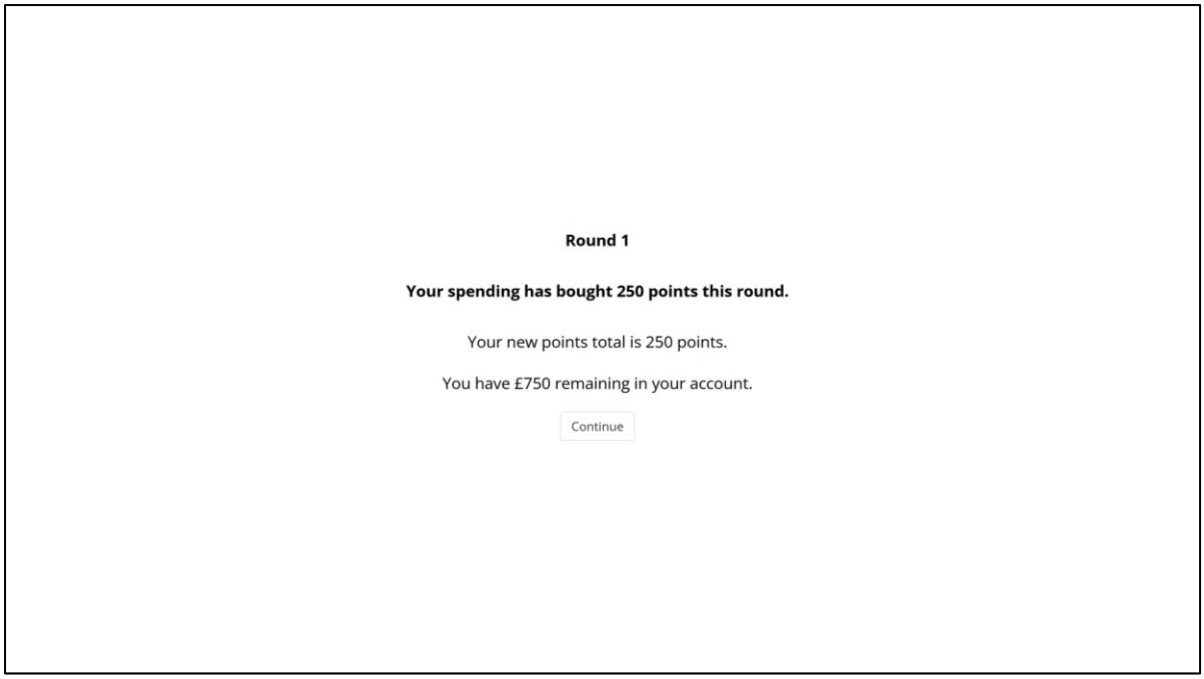

Figure D5. Example feedback screen indicating how many points participants had purchased, their new points total, and their remaining savings.

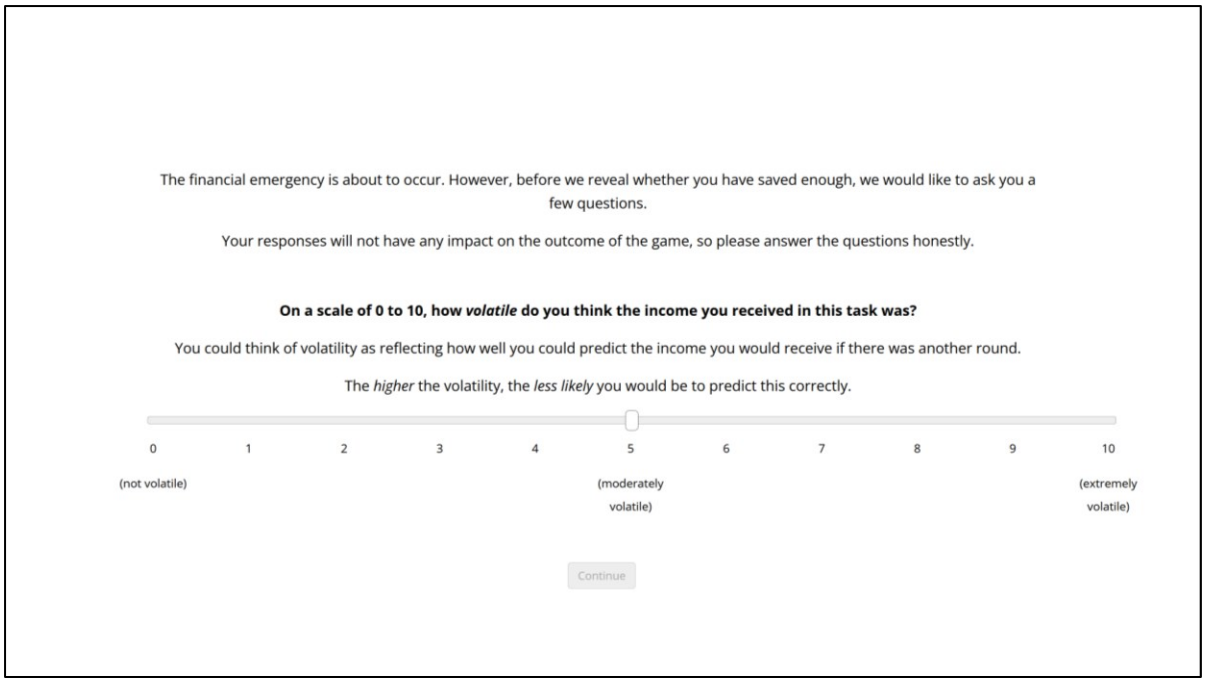

Figure D6. Perceived income volatility rating scale. Slider was set by default at 5 but was required to be moved to progress to the next screen.

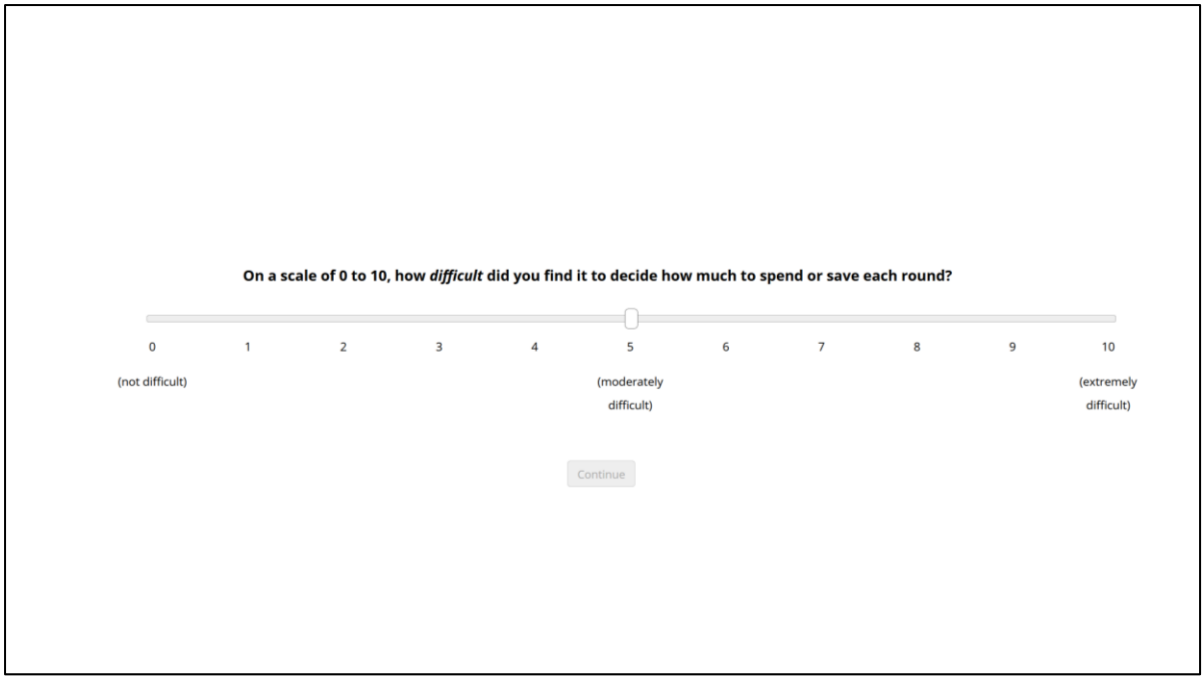

Figure D7. Perceived financial difficulty rating scale. Slider was set by default at 5 but was required to be moved to progress to the next screen.

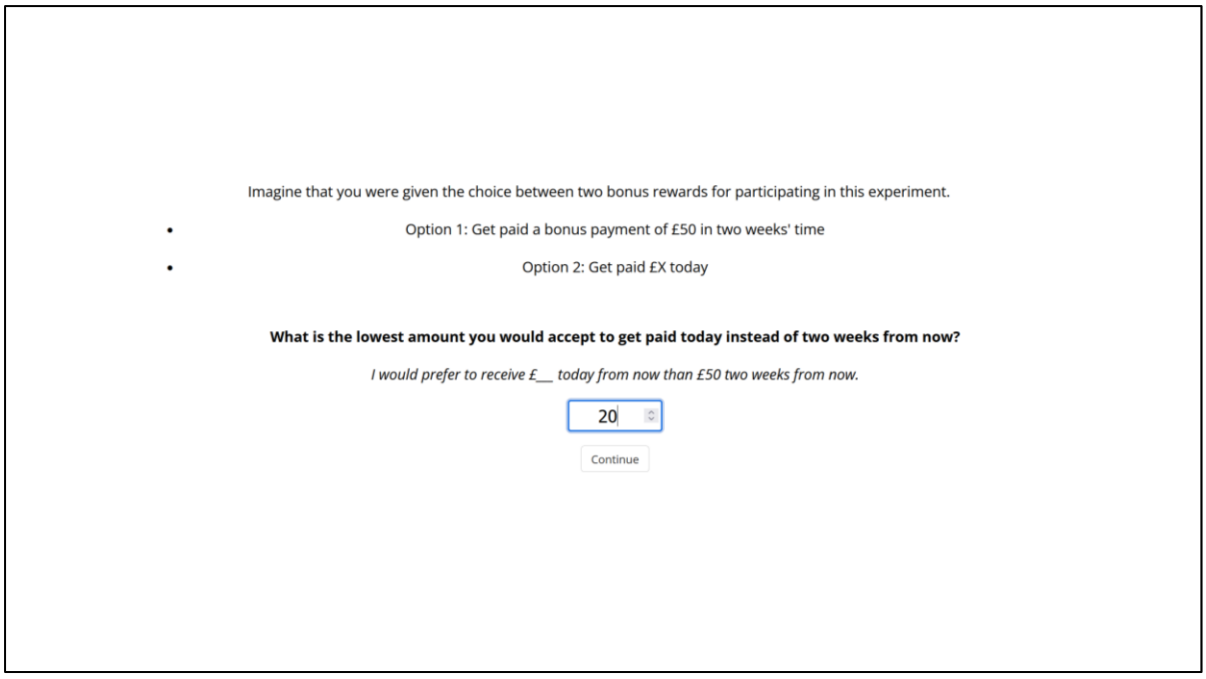

Figure D8. Financial impatience measure requiring participants to provide a hypothetical 'smaller-sooner' amount that would be preferred immediately over a larger later payment.

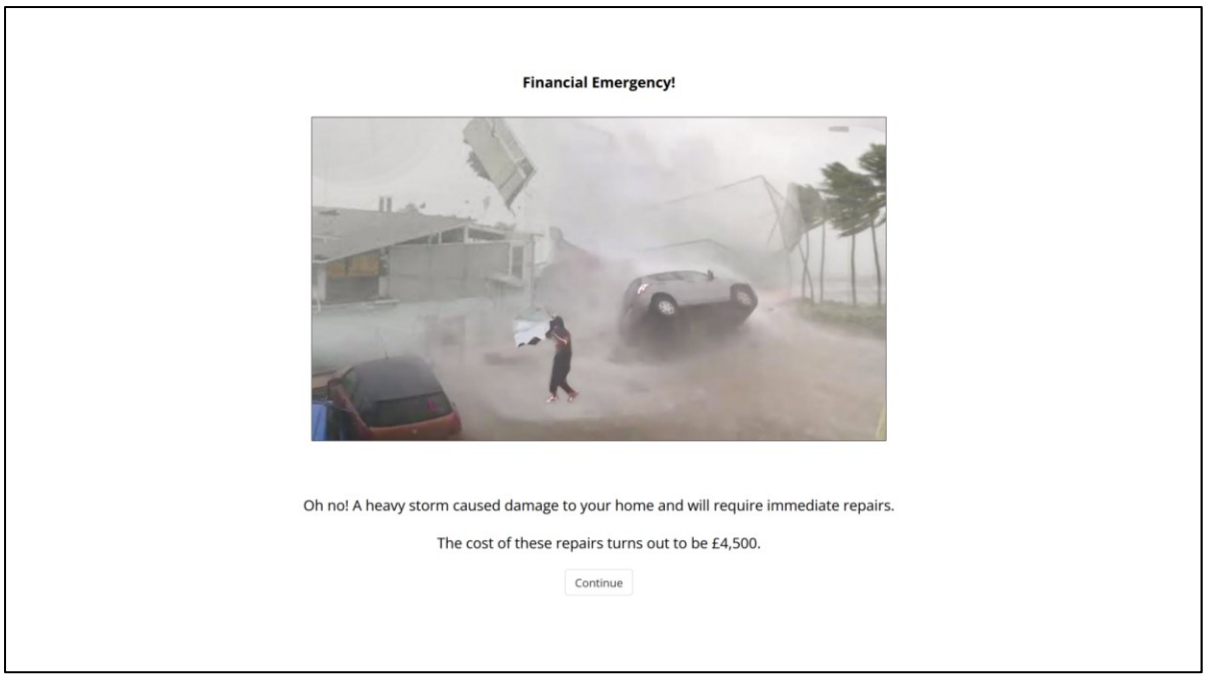

Figure D9. Announcement of the financial emergency occurring.

Figure D10. Outcome screen for a participant who won by saving adequately for the emergency. Participants who lost were shown a similar screen but were advised that they had lost their purchased points.