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ARTICLE

Rethinking elicitation methods in examining the effects of domain and context on individual preferences under risk and ambiguity

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Abstract

This paper examines preferences across domains and contexts under conditions of risk and ambiguity and estimates the effect of attributes of the prospects on individual preferences. The main contribution of this paper is that it examines preferences using prospects with continuous distributions—a deviation from the widely used gambles with discrete probabilities. The argument put forward in this paper is that this design is at least as realistic of many real-life situations and easier to comprehend. Data were obtained from field experiments where the tasks presented to subjects were framed as gain, loss and mixed and were not exclusively monetary. The findings show that risk preferences are context dependent, implying that the argument of risk-taking being a stable personality trait is untenable. Risk (resp., ambiguity) preferences differ within and between domains. Subjects are risk-avoiding and ambiguity avoiding in the gain domain and the reverse in the loss domain. An increase in the difference between the means of the smaller and larger variance prospects increases the preference for the larger variance prospect under risk but not under ambiguity. Stake orientation with regard to which ends of the prospects are bound at zero was crucial in subjects' decisions—an important finding not observed in discrete gamble experiments.

KEYWORDS
ambiguity, context, continuous prospect, decision-making, domain, framing, risk

1 | INTRODUCTION

The literature is replete with elicitation methods that rely on gambles with discrete probabilities. For example, subjects make binary choices between pairs of 50/50 gambles or are given a pair of gambles with probabilities varying from 0.1 to 0.9 across each choice. However, in many real-life situations, the outcomes and probabilities are not explicitly stated. Moreover, considering that many real-life situations are made of continuous prospects, but the focus of past experiments has been skewed in favour of discrete prospects, an understanding of people's attitudes when faced with continuous prospects is limited. This gap implies that we do not know enough about risk and ambiguity preferences beyond what gambles with discrete probabilities can permit.

This paper focuses on addressing two main issues. First, it investigated whether preferences differ across domains (gains, losses and mixed) and contexts (monetary and non-monetary) under conditions of risk and ambiguity[1]. Risk is distinguished from ambiguity through given and objectively known probabilities for the former, and where the probabilities of the outcome-generating processes are unknown, for the latter. Second, the paper examines the effects of attributes of prospects on preferences. While similar objectives have been examined in past studies using tasks having prospects with discrete probabilities, this paper relies on prospects (i.e., event-contingent payoffs) with continuous distributions (i.e., that can take any value within a defined range). One advantage in terms of eliciting attitudes using continuous prospect tasks is that it is easier to comprehend. The ease of comprehension is important considering several studies (Dave et al., 2010; Crosetto and Filippin, 2016; Attanasi et al., 2018) that have shown how elicitation tasks vary in predictive accuracy. For example, the Holt and Laury (2002) multiple price list (MPL) technique that has been used as the gold standard to elicit risk attitude is reported to be relatively complex for subjects resulting in a higher level of randomness in decisions (Dave et al. 2010; Charness et al. 2013). Given the shortcomings of these elicitation methods, a rethink of the technique is well founded. Besides, the literature is scant on examining the effects of domain and context on individual preferences under risk and ambiguity using continuous prospect tasks.

The main findings in this paper are that the choices people make differ across domain and context, and attributes of the prospects influence preferences. There is a correlation but not an exact duplication of preferences under risk and ambiguity. The findings also bring to light an important phenomenon which this paper refers to as negligible gain avoidance (i.e., avoiding riskier prospects with zero lower bound in the gain domain) and negligible loss seeking (i.e., preferring riskier prospects with zero upper bound in the loss domain).

The rest of this paper proceeds as follows: The remainder of Section 1 states the hypotheses. Section 2 explains the data, experimental procedures and analytical methods. In Section 3, the results are presented. Section 4 discusses the findings, while a summary in Section 5 concludes the paper.

1.1 | Research hypothesis

1.1.1 | Prospect attributes

Numerous studies have shown that within a specific domain, the levels of ambiguity (or risk) aversion or seeking may vary. From one perspective, there is evidence that stake sizes have a significant effect on domain-specific risk and ambiguity attitudes. For example, Binswanger (1980) showed that with increased stakes, subjects portrayed more risk-averse behaviour. Fullenkamp, Tenorio and Battalio (2003) buttressed the finding of the effect of stake sizes from their findings that the extent of the risk aversion varied substantially with stakes. On the other hand, Vieider (2012) showed that small variations of 20% or less in stake sizes do not generally affect risk attitudes.

From a different angle, prospect orientation with respect to zero payoffs (no payoff) may determine subject choices in a decision task. Weber, Anderson, and Birnbaum (1992) conclude that zero outcomes are typically treated as distinct. This is in consonance with Lopes and Oden (1999) findings that people distinguish between zero outcomes and a strict gain. Similarly, Cettolin and Tausch (2015) and Ert and Erev (2013) observe that when the risky prospect in the gain domain includes a zero outcome, there is the tendency to maximise the probability of a positive outcome; thus, zero payoffs facilitate risk aversion. However, these studies examine individual attitudes using discrete prospects. As such, the consequences of having payoffs in the neighbourhood of zero (as with the case of continuous prospects) have not been tested. Thus, to have a deeper understanding of risk and ambiguity preferences, an investigation is needed to determine whether stake sizes matter and whether prospects bound at zero might impact preferences within a specific domain. In line with these arguments, this paper tests whether there is consistency in preferences under ambiguity and risk within a specific domain. Specifically, the paper tests the following hypothesis:

Hypothesis 1: Attributes of prospects determine preferences

1.1.2 | Preferences under risk versus ambiguity

In some studies, reference to the terms risk and ambiguity is indistinguishable. This distinction was made clear in the seminal work of Knight (1921) and more recent works (e.g., in Camerer and Weber, 1992; Tversky and Fox, 1995; Koudstaal, Sloof and Van Praag, 2016). While this distinction is now acknowledged in many strands of the literature, the findings regarding correlation in attitudes under both conditions have been mixed. Several studies in the economics and psychology literature have evidence to support the postulation that people have a distinct attitude to risk and ambiguity. Using experiments, Cohen, Jaffray and Said (1987) observed that subjects did not equate uncertainty with risk under any scenario. But in some cases, in the loss domain, they equated risk with uncertainty. Di Mauro and Maffioletti (2004) find overall that the attitude to risk differs from uncertainty in more than half of their respondents. Further, evidence in Cerroni (2020) shows that respondents were more averse to uncertainty than risk. Thus, this paper conjectures:

Hypothesis 2: Preferences differ under risk and ambiguity within domains

The hypothesis is tested by comparing within-domain preferences under ambiguity with those under risk. This comparison is limited to monetary context to eliminate the possible effect of context-specific components on preferences.

1.1.3 | Domain specific attitudes

Many studies have compared risk-taking in the gain and loss domains. For example, Tversky and Kahneman's (1981, 1992) popularised preference reversals in choices even with identical outcomes. As such, individuals are often risk averse for choices involving gains, and risk-taking is portrayed for choices involving losses. This phenomenon is referred to as the reflection effect of prospect theory (PT). These seminal works have led to numerous studies examining how changes in the framing of prospects affect decisions. The predominant finding in the literature is in concordance with the reflection effect in PT. However, studies that have examined these phenomena on gambles with continuous distributions are scarce. From this reasoning, the following hypotheses are tested:

Hypothesis 3: Preferences vary with domains under risk
Hypothesis 4: Preferences vary with domains under ambiguity

Hypotheses 3 and 4 are tested by comparing within-subject preferences in the gain domain with the loss domain within the same context.

1.1.4 | Preferences determined by context

Psychologists have argued that risk attitudes are context specific, implying little or no relation of risk across different contexts. For example, Weber, Blais and Betz's (2002) assessment of risk attitude via psychometric scale across financial, health and safety, recreational, ethical and social decisions supports previous postulations that risk attitude is domain-specific. This finding is corroborated by Hanoch, Johnson and Wilke (2006), who find heterogeneity in participants' risk behaviour across contexts in their study. Similarly, Vlaev et al. (2010) found context effects on risk perceptions across seven scenarios using lottery choice and investment tasks. On the other hand, economists are apt to highlight underlying elements prevalent in the choices people make across different contexts and domains. For instance, Dohmen et al. (2011) report relative stability of risk across context. Similarly, Vieider et al. (2015) provide cross-country evidence that suggests uncertainty attitudes be related across most contexts and domains. Further, there is also the argument in traditional economic theory that individuals display consistent risk-loving or risk-avoiding preferences across contexts. Accordingly, this paper aims to find empirical support for or against these arguments by testing the following hypothesis:

Hypothesis 5: Risk preferences depend on context

This hypothesis is tested by comparing preferences with monetary and time outcomes. In the literature, while decision-making under risk is generally examined with discrete gambles having monetary payoffs, this paper extends the context to time spent because it features in day-to-day decisions. Like money, time is a characteristically scarce resource. Festjens, Bruyneel, Diecidue and Dewitte (2015) tested a similar hypothesis and found that subjects have similar risk preferences for time and money. However, their elicitation method was by 50-50 lottery tasks.

1.2 | Underlying theories forming the decision-making process

In the literature, the decision-making process of individuals when they choose between pairs of monetary lotteries (which is widely used in experiments) has been explained using several underlying theories. However, two of these are predominant in the literature. The expected utility theory (EUT) postulates that taking into account certain assumptions, a decision-maker's preferences towards lotteries can be represented as a linear function of the utility of each option multiplied by the respective probabilities. Risk aversion implies the concavity of the utility function. Several studies have proposed extensions of the EUT, nesting it in alternative models. Allais' (1953) paper highlighted that decision-makers do not necessarily behave according to the EUT's key assumptions.

Given the limitations of the EUT, several alternatives have been proposed (Starmer, 2000 provides a comprehensive review). PT emerges as the dominant descriptive alternative for expected utility PT (Kahneman and Tversky, 1979), where the utility function is defined over gains and losses separately. Also, the probabilities of the outcomes are weighted, transforming the underlying probabilities into subjective probabilities resulting in underweighted average events but overweighted events with low probabilities. These features, that is, reference dependence and probability weighting, are pivotal in explaining EUT anomalies. Tversky & Kahneman (1992) advanced the PT to the cumulative prospect theory (CPT), which applies to uncertain and risky prospects. The CPT employs cumulative rather than separable decision weights and gives different predictions from the PT. Besides, the CPT has been proven to be a formal correction of some theoretical issues in PT.

2 | MATERIALS AND METHODS

This paper analyses primary data collected from 158 Nigerian farmers through a field experiment. Subjects were obtained using a multistage random sampling that involved selecting two states, four local government areas (LGAs) from both states and 20 farmers each from the eight LGAs, resulting in a sample of 160. Two subjects were excluded due to incomplete information. The design of the prospects that constitute the experiments in this paper differs from previous studies. The rationale behind employing continuous prospects is that it is less cognitively demanding[2] than discrete prospects and more related to day-to-day decision tasks. The experimental design used in this paper is a within-subject design. Each subject participated in all aspects of the experiment spread across different (gains, loss and mixed) domains and contexts (monetary and time).

Several studies in the literature have shown that time constraint is almost as important as monetary constraints for smallholder farmers (Brown and Khamphoukeo, 2010; Carranza et al., 2017; Falsini, 2021). For this reason, farmers have to make important time-related decisions under risk and ambiguity as they do with money. Besides, the framing of the experiment in the time context shows the potential of the experiment to be applied in a non-monetary context.

The prospects were designed to elicit risk and ambiguity preferences within several domains and contexts using a range (i.e., seven categories) of subtasks. This design ensured that the relevant data necessary to test the hypotheses were obtained. Of the seven categories (Table 1), the pair of prospects presented to subjects in category 1 lies strictly in the gain domain. Category 2 has the lower end of the payoff of the 'riskier'[3] prospect at zero, with the upper end strictly in the gain domain. In category 3, each pair of prospects lies strictly in the loss domain. Category 4 has its upper end of the payoff of the 'riskier' prospect at zero, with the lower end strictly in the loss domain. For category 5, each pair of prospects lies strictly in the mixed domain (both prospects cut across gains and losses). Categories 6 and 7 are also mixed-domain prospects, but category 6 has the lower end of the payoff of the 'safer' prospect at zero, with the upper end strictly in the gain domain. In contrast, category 7 has the upper end of the payoff of the 'safer' prospect at zero, with the lower end strictly in the loss domain.

To elicit risk preferences, subjects were presented with prospects where payoffs were 'equally likely' over an interval. The difference between this and the case of ambiguity was that there was no specification of any associated probability density for the latter. Thus, for example, in the case of categories 1 and 2 respectively framed in the gain domain and under risk, subjects were given the task presented in Table 2:

> *…Which of these prospects would you choose if you are equally likely to get any amount between ₦2181 and ₦9199 or ₦4148 and ₦7777?*

> *…Which of these prospects would you choose if you are equally likely to get any amount between ₦0 and ₦8662 or ₦3579 and ₦6108?*

On the other hand, in the loss domain, an example of the task subjects faced in category 3 is presented in Table 3:

> *…Which of these prospects would you choose if you are equally likely to lose any amount between ₦1578 and ₦8362 or ₦3352 and ₦6005?*

For the time context under risk, examples of the prospects presented to subjects are shown in Table 4. These outcomes were in lost hours and minutes that otherwise would have been used on the farm or for agricultural activities. For category 3, subjects were asked:

TABLE 1 Summary of the seven categories of subtasks for risk and ambiguity

	Loss domain	Gain domain	Mixed domain
Category 1		A 'strictly' gain domain prospect, i.e., all the payoffs are strictly > 0	
Category 2		A gain domain prospect, i.e., the lower limit of one payoff $= 0$	
Category 3	A 'strictly' loss domain prospect, i.e., all the payoffs are strictly < 0		
Category 4	A loss domain prospect, i.e., the lower limit of one payoff $= 0$		
Category 5			Both prospects cut across gains and losses; no boundaries $= 0$
Category 6			Both prospects cut across gains and losses and the lower boundary of one payoff $= 0$ with the other strictly in the gain domain
Category 7			Both prospects cut across gains and losses and the lower boundary of one payoff $= 0$ with the other strictly in the loss domain

TABLE 2 Example of a task in the gain domain

	Larger variance prospect	**Smaller variance prospect**
Category 1	2181 — 9199	4148 — 7777
Category 2	0 — 8662	3579 — 6108

TABLE 3 Example of a task in the loss domain

	Larger variance prospect	**Smaller variance prospect**
Category 3	1578 — 8362	3352 — 6005
Category 4	0 — 8585	3947 — 5624

TABLE 4 Example of a task in the time context

	Larger variance prospect	**Smaller variance prospect**
Category 3	4.18 — 8.30	5.42 — 6.54
Category 4	0 — 7.24	3.36 — 4.42

> *…you are equally likely to lose between 4 hours 18 minutes and 8 hours 30 minutes or 5 hours 42 minutes and 6 hours 54 minutes that would otherwise have been used on the farm or for agricultural activities. Given that you have to choose between the larger variance prospects or smaller variance prospects, which one of the two will you choose?*

In the case of ambiguity, subjects were told they could earn similar to the examples in Tables 2–4 but without an associated probability density specification. Each category consisted of five questions. Thus, each subject preference was elicited from 35 tasks under risk and 35 under ambiguity for monetary prospects. Subject preferences in the time context were elicited from 10 additional tasks. During the experimental sessions, the subjects were randomly placed in groups[4]. Each task was presented to respondents one after the other. This process ensured that respondents made their choice on a particular prospect before proceeding to the next. Four trial questions preceded the actual experiment to test subjects' understanding, and if needed, a further explanation was made using a new pair of trial questions. Subjects were informed that they would get cash payment[5] according to the choices they had made earlier in the experiment for one set of gain domain prospects that will be chosen at random at the end of the experiment.

Similar to Hellerstein, Higgins and Horowitz (2013) and Sakha (2019), the categorisation of subjects as risk liking or ambiguity liking is based on the number of larger variance (LV) prospects chosen by subjects in the experiments[6]. The paper applied non-parametric statistics, that is, McNemar test, to compare consistency in subjects' preferences across different domains (gain and loss) under conditions of risk and ambiguity. Probit regression is estimated to determine the effect of attributes of the prospect on subjects' preferences.

2.1 | Probit regression model

The probit specification to explain a dichotomous dependent variable is expressed in terms of a latent response variable y^* (Greene, 2003). The dependent variable depends on k observable variables x_k,

where $k = 1,\ldots,K$).

$$y^* = \sum_{k=1}^{K} \beta_k \, x_k + \varepsilon, \varepsilon \sim N\,(0,\ 1)\,, \tag{1}$$

where x_k represents the different attributes of the prospect that may influence subjects' preferences under risk and ambiguity. β is the parameter values of these variables, while y represents the observed variable which is determined by y^* given as

$$y\begin{cases} 1 \text{ if } y^* > 0 \\ 0 \text{ otherwise} \end{cases}$$

$$Pr\ (y = 1) = Pr\left(\sum_{k=1}^{K} \beta_k x_k + \varepsilon > 0 \right)$$

$$Pr\ (y = 1) = Pr\left(\varepsilon > - \sum_{k\,=\,1}^{K} \beta_k x_k \right)$$

$$Pr\ (y = 1) = 1 - \Phi\left(- \sum_{k\,=\,1}^{K} \beta_k x_k \right),$$

where the cumulative distribution function ε is represented by Φ. Specifically, the dependent variable is binary, which signifies a subject prefers the prospect with LV = 1'; 0 otherwise[7]. As referred to further on in the paper, 'Mean' and 'SD' represent the differences in the mean and standard deviation, respectively, between the payoffs of the LV and smaller variance (SV) prospects. When the 'gain', 'loss' and 'mixed' domains take the value of 1, it indicates that the payoffs are strictly positive, strictly negative or mixed prospects, respectively (zero otherwise). Of these three, 'loss' is the reference category. 'ZB_LV_gain' implies that the gain domain task has the lower limit of the LV prospect bound at zero. 'ZB_LV_loss' represents that the loss domain task has the upper limit of the LV prospect bound at zero. Regarding the mixed-domain subtasks, 'lower_ZB_SV_mix' indicates a mixed-domain subtask represented by a dummy variable which takes the value 1 if the lower limit of SV prospect is bound at zero.

In contrast, 'upper_ZB_SV_mix' represents a dummy variable which takes the value 1 if the mixed domain subtask has the upper limit of the SV prospect bound at zero. The justification for the estimation model is that when subjects are faced with a pair of risky or uncertain prospects, they should prefer the SV prospect whenever the expected value of SV is greater and the variance is smaller than the prospect with LV. Similarly, the preference should be for the SV prospect when the variance of SV is smaller even when both have an equal expected value. The empirical results from the estimation of Equation (1) are presented in Section 3.

3 | RESULTS

3.1 | Respondents characteristics

The age range of subjects is between 27 to 87 years, with the largest age group falling into the 51–60 years category. There were more males (70%) than females (30%) in the sample. The distribution of

educational level attained shows that the level of formal education attained is low, with about 65% completing primary education at the most. Charness et al. 2013 pointed out that where the numeracy of subjects is an issue, employing popular elicitation techniques, for example, as in Holt and Laury (2002), is likely to result in higher levels of randomness in decisions. About 88% of subjects own their farms; thus, they were directly responsible for making important economic decisions for the farm business. Compared with the most comprehensive agricultural household data currently available in Nigeria, that is, the Living Standard Measurement Survey (LSMS)[8], the sample characteristics in this study were similar to the farming population characteristics reported in the 2015/2016 LSMS (except for gender distribution).

3.2 | Result of preferences across context and content domains

Three sets of results are presented. First, the results of subjects' preferences across different content (gain and loss) domains under conditions of risk and ambiguity are presented. This is followed by subjects' preferences in different contexts (monetary and time) but only for risk and limited to the loss domain. Finally, results on the effect of attributes of the prospect on subjects' preferences are presented. The likelihood-ratio test statistic is 403.91 for the risk model (383.00 for ambiguity), and the associated p value < 0.001. These statistics show that adding domain, context and attributes of the prospects as predictor variables together results in a statistically significant improvement in model fit.

A priori, it was expected that subjects will switch at some point (i.e., change their preference from SV to LV prospect or vice versa as the experiment progressed) irrespective of domains. However, the results show that not all the choices made by subjects conformed with a priori expectations. Specifically, subjects' choices differed across context and content domains, as will be discussed. As presented in Figure 1, three distinct patterns emerge for subjects' choice under risk and ambiguity, suggesting heterogeneous preferences under risk as well as ambiguity. First, one group of subjects switched (e.g., from SV to LV or vice versa) within a subtask, for example, switch within category 1. The second group of subjects consistently chose SV in a specific domain. Finally, the third group consisted of subjects that continually chose LV in each specific domain.

Monotonic switching was not imposed during the experiment. One of the reasons for this was to reflect subjects' behaviour when faced with real problems and capture this without imposing added assumptions on preferences. Besides, it provided the avenue to possibly examine any inconsistencies in subjects' choices. The proportion of subjects that violated monotonic switching was minimal (accounting for only 6%).

3.2.1 | Do preferences differ within the gain domain for risk and ambiguity?

As shown in Figure 1, with regard to the subtasks (categories 1 and 2), 52% and 72% of subjects, respectively, never switched within a category. That is, they always preferred the SV prospect in the gain domain under risk. Similarly, under the conditions of ambiguity, the majority of subjects (consisting of 56% and 70% for category 1 and category 2, respectively) chose the SV prospect consistently without switching, as presented in Figure 1. Thus, non-switching from the SV indicates stronger risk avoidance compared with subjects that switched. On aggregate[9], a larger proportion of subjects picked the SV prospect for category 2 (72%) than category 1 (61%).

Test for consistency in the overall preferences in category 1 and category 2 subtasks under risk shows statistically significant differences in the preferences at the 1% level (McNemar's test: $\chi^2 = 123$, $p < 0.001$). The hypothesis that there is no significant difference in subjects' preferences within the gain domain under risk is rejected. Similarly, the test for consistency in the preferences of subjects in category 1 and category 2 under ambiguity shows a statistically significant difference at the 1% level (McNemar's test: $\chi^2 = 41.5$ $p < 0.001$). Thus, the hypothesis that there is no significant difference

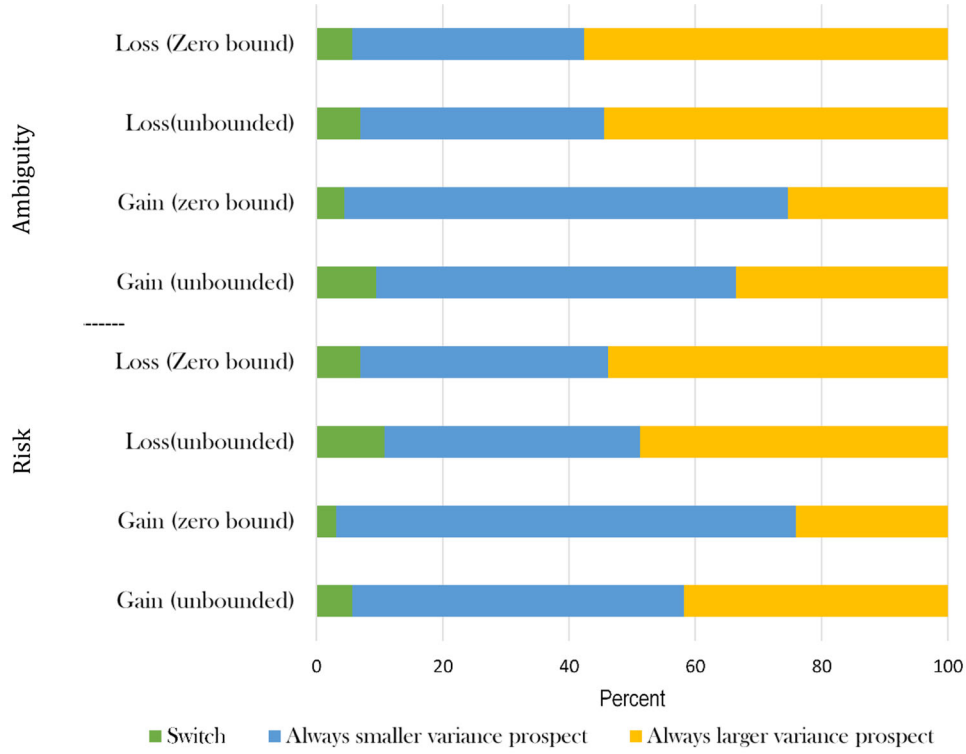

FIGURE 1 Risk and ambiguity preferences by domain [Colour figure can be viewed at wileyonlinelibrary.com]

in subjects' preferences in the gain domain under ambiguity is rejected. Altogether, these findings suggest that subjects' preferences under risk and ambiguity depend on the attributes of the prospects. This difference could be ascribed to the LV prospect of category 2 being bound between zero and a positive value as against category 1, where both prospect payoffs are positive without being zero bound. Crucially, the results show that whether under risk or ambiguity, subjects find the SV prospect more attractive for gains. As the SV prospect is less 'risky', this finding indicates subjects' dislike for risk and ambiguity in the gain domain.

3.2.2 | Do preferences differ within the loss domain for risk and ambiguity?

As presented in Figure 1, subjects' preferences in the loss domain subtasks (categories 3 and 4) reverse the gain domain case. Under risk, the predominant preference of subjects for losses was the LV prospect. The proportion that picked the LV prospect overall for category 3 is 54%, compared with 57% for category 4. Under ambiguity, a larger proportion (58%) preferred the LV prospect for category 3, compared with category 4 (60%).

The non-parametric test determined that subjects' preferences were inconsistent when comparing category 3 and category 4 subtasks under risk (McNemar's test: $\chi^2 = 4.6$, $p = 0.032$) as well as under ambiguity (McNemar's test: $\chi^2 = 3.53$, $p = 0.060$). Thus, the hypothesis that preferences are consistent within the loss domain under risk (and ambiguity, respectively) is rejected. In line with the reasons advanced under risk, the differences observed could be attributed to the LV prospect of category 4 being bound between zero and a negative payoff against category 3, where both prospect payoffs are negative and non-zero bound. This finding implies that the assumptions of homogenous preferences across all stakes in a specific domain are untenable. Overall, the results confirm that both under risk

and ambiguity, subjects deem the LV prospect more attractive for losses. Given that the outer prospect is 'riskier', these patterns of preferences indicate subjects are risk loving and ambiguity loving in the loss domain.

3.2.3 | Do preferences differ between gain and loss for risk and ambiguity?

Having examined and compared preferences within domains under risk and ambiguity, the next comparison is across domains (i.e., gain versus loss). There were significant differences in the preference in gain and loss domains for risk (McNemar's test: $\chi^2 = 113.3$, $p < 0.001$) and ambiguity (McNemar's test: $\chi^2 = 198.9$ $p < 0.001$), suggesting that domains (i.e., risk and ambiguity) have an effect on preferences. Consequently, the hypothesis that preferences between gain and loss are similar under risk (and ambiguity, respectively) is rejected. These findings of risk (resp., ambiguity) avoidance and risk- (resp., ambiguity) taking in the gain and loss domains, respectively, agree with the reflection effect of PT and in accord with several studies in the literature.

3.2.4 | How do preferences under ambiguity and under risk compare within a domain?

When preferences under risk and ambiguity were compared for consistency, there was no statistical difference among gain-framed tasks (McNemar's test: $\chi^2 = 1.74$, $p > 0.187$). Therefore, the hypothesis that subjects' preferences under risk are consistent with ambiguity cannot be rejected for gain domain prospects. This finding contradicts Cerroni (2020), who found that their respondents were more averse to ambiguity than risk. On the other hand, McNemar's test determined a statistically significant difference in preferences under risk and ambiguity in the loss domain at the 5% level ($\chi^2 = 6.11$, $p = 0.013$). Crucially, subjects exhibit a higher degree of risk-taking under ambiguity compared with risk in the loss domain. Thus, the hypothesis that risk preference does not differ from ambiguity preferences in the loss domain is rejected. The strength of a linear association between risk and ambiguity was determined through Pearson correlation. Subjects' risk and ambiguity preferences were positively correlated for gains (resp., losses), $r(156) = 0.68$, $p = < .000$ (resp., $r(156) = 0.60$, $p = < .000$).

3.2.5 | Do attitudes to risk differ between time and monetary context?

Here, subjects' preferences in monetary and time context limited to the loss domain (and only for conditions under risk) are examined. A comparison of subjects' preferences in the time[10] context and the monetary context reveals differences in proportion in the number of subjects that continually chose the LV prospect without switching (42% in the time compared with 38% in the monetary context) shown in Figure 2. Similarly, there was a difference in the proportion of subjects that switched within subtask (e.g., within category 3) is 15% in the time context compared with 22% in the monetary context for losses. On the other hand, subjects that switched across subtasks (e.g., from category 3 to category 4) accounted for 18% in the time context compared with 12% in the monetary context.

Test for consistency in the overall preferences between time and the monetary contexts shows that more subjects preferred the LV in the time than the monetary context (McNemar's test: $\chi^2 = 16.9$, $p < 0.001$). This result indicates that risk preferences differ across contexts. Therefore, the hypothesis that attitudes to risk do not depend on context is rejected, and the notion regarding risk-taking being a stable personality trait is shown to be untenable. However, in terms of the direction of preferences across both contexts, the results suggest that subjects are risk loving in time and monetary

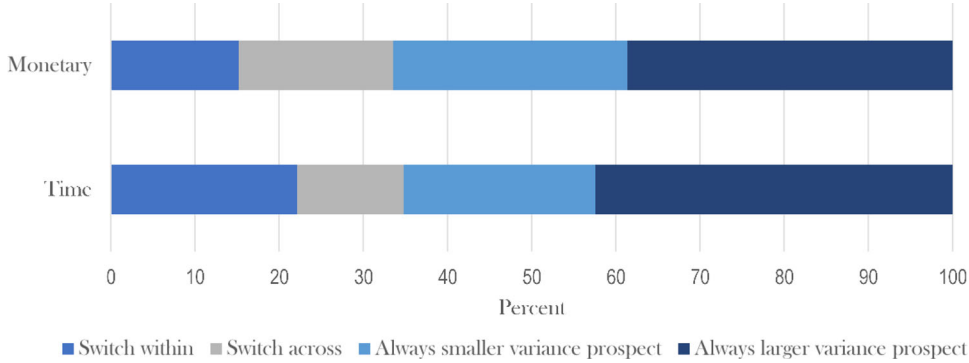

FIGURE 2 Risk preferences by context [Colour figure can be viewed at wileyonlinelibrary.com]

context framed as a loss, which agrees with previous findings (e.g., Festjens, Bruyneel, Diecidue and Dewitte, 2015). A Pearson product–moment correlation coefficient was computed to assess the linear relationship between preferences in the time and monetary context. Overall, there was a moderate positive correlation $r(156) = 0.35$, $p = < .000$.

3.3 | Result of Probit regression estimating the effect of prospect attributes on subjects' preferences

The Probit regression results are presented in Table 4. The model includes domain-specific variables in addition to the prospect attributes. In line with the a priori expectations, subjects' preference was determined by the prospect's attributes. Precisely, the results indicate that the mean value of the prospect, the domain (gain, loss or mixed) and stake orientation (with regard to which ends of the prospects are bound at zero) determined the likelihood of choosing the LV.

As shown in Table 5, an increase in the difference between the SV and LV prospects' means will increase the likelihood of choosing the LV option for risk but not for ambiguity. Under risk and ambiguity, prospects framed as gains had a significant negative effect on preference for LV. This suggests that it is more likely that the SV prospect will be preferred in the gain domain. The reverse is the case for preferences in the loss domain.

These findings are consistent with numerous findings in the literature predicting risk avoidance for gains and risk-taking for losses. In addition, the effect of the mixed domain is similar to gain domain framing, as subjects are more likely to avoid the LV prospect if the prospect is framed so that payoffs cut across gains and losses. However, the likelihood of choosing the LV is higher in the mixed domain compared with the gain domain.

The effect of *zero-bound outer prospect* (as in category 2) in the gain domain is negative and significant. This finding supports preceding results that not only are subjects more likely to avoid the LV prospect in the gain domain, but the magnitude of this effect is larger when LV is lower bound at zero. This result highlights the preference for substantive deterministic gains. In addition, the coefficient of the *upper-zero-bound LV* (as in category 7) in the mixed domain is positive and significant, indicating that subjects are likely to prefer the more risky/uncertain prospect (i.e., LV) if within the alternative prospect there is no possibility of making a gain in the payoff. These findings do not materialise in prospects with discrete probabilities. An examination of whether subjects' characteristics influenced their decision is presented in Models II and IV. Only age appeared to be a statistically significant determinant of subjects' choice. Thus, being an older subject increases the likelihood of choosing the LV option under risk and ambiguity.

TABLE 5 Probit results estimating the effect of attributes of prospects on risk and ambiguity preferences

	Risk		Ambiguity	
Variable	**I**	**II**	**III**	**IV**
Mean	0.065**	0.066**	0.037	0.038
	(0.020)	(0.020)	(0.023)	(0.023)
SD	-0.032	-0.032	0.005	0.005
	(0.039)	(0.040)	(0.036)	(0.036)
Gain × SD	0.003	0.003	0.028	0.028
	(0.070)	(0.071)	(0.073)	(0.073)
Loss × SD	0.001	0.001	-0.009	-0.009
	(0.084)	(0.084)	(0.052)	(0.052)
Gain	-0.136**	-0.770***	-0.305***	-0.937***
	(0.067)	(0.143)	(0.057)	(0.138)
Loss	0.133*	-0.498***	0.190***	-0.439***
	(0.073)	(0.146)	(0.060)	(0.139)
Mix	-0.454***	-1.092***	-0.412***	-1.047***
	(0.078)	(0.149)	(0.075)	(0.147)
ZB_LV_Gain	-0.510***	-0.516	-0.340***	-0.344***
	(0.066)	(0.067)	(0.073)	(0.073)
ZB_LV_Loss	0.120	0.119	0.095	0.096
	(0.077)	(0.077)	(0.064)	(0.064)
Lower_ZB _SV_Mix	-0.118	-0.118	-0.107	-0.106
	(0.069)	(0.069)	(0.071)	(0.071)
Upper_ZB_SV_Mix	0.587***	0.593***	0.403***	0.408***
	(0.072)	(0.072)	(0.070)	(0.070)
Age (years)		0.010***		0.010***
		(0.002)		(0.002)
Gender		0.027		0.052
		(0.040)		(0.040)
Education (highest level)		0.003		-0.004
		(0.018)		(0.018)
Ownership of farm		0.005		0.039
		(0.020)		(0.020)
Farm size (ha)		0.021		-0.003
		(0.033)		(0.034)
Log likelihood	-3574.47	-3551.97	-3602.40	-3580.97
LR chi2(10)	358.07	403.07	339.96	382.80
Prob > chi2	0.000	0.000	0.000	0.000

Abbreviations: LR, likelihood ratio; SD, standard deviation.
*p<.05.
**p<.01.
***p<.001, Std. Err. in parenthesis.

4 | DISCUSSION

This paper offers a unique understanding of how risk and ambiguity preferences are impacted by context and domains. Attitudes have mainly been observed using lotteries where outcomes and probabilities are explicitly stated. Considering that attitudes to ambiguity and risk are important primitives of economics, extensive study of risk and ambiguity preferences using new elicitation tasks provides further insights into individual economic behaviour. Crucially, contrary to studies where risk and ambiguity are used interchangeably, the finding of correlation but not exact duplication in preferences between risk and ambiguity documented in this paper underscores the untenable use of the terminology in a non-standardised manner. Overall, this paper provides new directions for testing and improving elicitation techniques and consequently improving predictive accuracy. This has been advocated in several recent studies (e.g., Loomes and Pogrebna, 2014; Csermely and Rabas, 2016).

The finding that it mattered to subjects when one of the bounds of the prospect was pegged at zero despite the payoffs being positive (or negative) was a priori not expected[11]. A plausible explanation is that subjects may adopt different decision rules that may well reflect those used in their day-to-day decision-making even if it may not be 'rational' or rely on available information that has no value for normative theories. However, as these findings do not align with many theories originally developed around discrete prospects, the extent to which these decision-making theories reflect behaviour in real-life situations may be limited.

There are important implications related to more general findings in the agricultural economics and wider economics literature. For instance, the findings on risk-taking under losses add to the explanation of why a farmer may be more willing to risk large losses in the hope of eliminating small losses—a pathway with potentially significant consequences. The finding that the potential average payoff value of the prospect determines preference provides some logical basis why people avoid or seek prospects that may otherwise appear to be 'irrational' decisions when judged using a different yardstick. Findings of this nature have the potential to assist institutions and policymakers in thoroughly understanding and synchronising their expectations with those of their target population. Following the findings of the significance of the mean of prospects, one can conjecture that adding cues such as making mid-point 'stand out' when presenting options (e.g., investment) could drive preference in the desired direction.

The main contribution of this paper is experimental, both from the perspective of improving elicitation techniques and ensuring predictive accuracy. However, there are some theoretical contributions. The results confirm some well-established theoretical predictions, for example, of the CPT's risk (and ambiguity) seeking for unlikely gains and likely losses. Other results are also mainly in line with theoretical predictions that preferences under risk depend on the context and that risk and ambiguity preferences differ within and between domains. Most importantly, the paper highlights behaviours that do not materialise in prospects with discrete probabilities, that is, that the prospect's attributes influenced participants' decisions. Whether one fixes the lottery's lower or upper payoff to zero is theoretically not expected to influence choices for payoffs that are equally likely. This also means that the behaviour should not differ from the prospect's attribute for a similar stake size in the same domain. For discrete lotteries where the lower payoff is zero, the skewness and the variance of the lottery change by changing the probability. Hence, the finding in this paper differs from previous studies that observed zero avoidance in subjects (Payne, 2005; Ert and Erev, 2013; Cettolin and Tausch, 2015).

The use of continuous prospect highlights the possibility that people may treat the likelihood of earning no (zero) payoff as a 'loss' in the gain domain and vice-versa. Hence, suggesting that a guarantee of either a strictly positive gain or not losing any money (zero loss) at the very least, may be the main aspiration for gain- and loss-framed prospects, respectively. This finding also suggests that when subjects are presented with such prospects, the driver of the decision may be the aversion for payoff around zero rather than the attraction of the non-zero outcomes in the gain domain and vice-versa for

losses. Considering that several of one's decisions concern continuums of uncertain events and possible outcomes, relying only on discrete lotteries means our understanding of such behaviours may be limited.

In summary, the goal of this paper is not to provide conclusive evidence on the suitability of continuous prospect over discrete prospect tasks in eliciting risk and ambiguity preferences. However, the paper seeks to provide new insights into elicitation tasks that are more realistic of real-life decisions and less cognitively demanding. The expectation is that this paper will stimulate discussion and give directions for future research.

5 | CONCLUSION

This paper examines preferences across domains and contexts under conditions of risk and ambiguity and estimates the effect of attributes of prospects on preferences. The main findings are that the mean value of the prospects had an effect on the choices subjects made, and crucially, an increase in the difference between the means of the LV and SV prospects resulted in an increase in the likelihood of choosing the LV prospects. The results also showed that under risk and ambiguity, subjects found the SV prospect more (resp., less) attractive for gains (resp., losses), which is an indication of dislike (resp., liking) for risk and ambiguity in the gain (resp., loss) domain. There is a strong correlation but not exact duplication in preferences between risk and ambiguity. Altogether, people's choices are different across domain and context, and attributes of the prospects influence preferences.

Overall, there was a higher likelihood of specifically avoiding the LV prospect when its lower bound is at zero—a phenomenon this paper refers to as negligible gain avoidance. The opposite preference in the loss domain—negligible loss seeking—was also observed. As most experiments in the decision-making literature have employed discrete prospects, findings on this pattern of preference in the literature are scant. This is because this behaviour cannot be observed in discrete probability experiments. In the discrete experiment literature, the closest to this finding is zero avoidance; however, this is remarkably different in the continuous prospect context, as subjects were not necessarily avoiding zero but regions in the neighbourhood of zero. This phenomenon accentuates the importance of moving beyond reliance on discrete prospects as the gold standard in measuring risk and ambiguity preferences. The extent to which they completely reflect many real-life situations is debatable.

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ENDNOTES

[1] There is debate in the literature in the definition of and distinction between risk and ambiguity. See Volz and Gigerenzer (2012) and Vieider et al. (2015), where this distinction is discussed further. Note that this perspective differs from the sociological dialogue (e.g., Sena, 2014).

[2] In the works of Crosetto and Filippin (2013) and Dave et al. (2010), the importance of considering the cognitive load at the design phase such that the experiments are simple enough to comprehend while simultaneously presenting little or no difficulties to implement is emphasised. However, experiments (especially the multiple price list) can only be successful if subjects understand basic probability concepts.

[3] For simplicity, the context in which 'riskier' is used in this section of the paper is to differentiate the prospect with the larger variance.

[4] Six orders of the experiment were designed. ABCD, ABDC, ACBD, ACDB, ADBC and ADCB, where A = risk in the monetary domain (gain, loss, mixed), B = ambiguity in the monetary domain (gain, loss, mixed), C = risk in the time domain (loss only) and D = risk in other monetary domain (gain only). The effect of ordering on risk and ambiguity preferences was tested, and the results suggest there was no order effect.

[5] Kühberger et al. (2002) found that hypothetical choices were similar to real choices both for small and large payoffs.

[6] The paper does not consider model estimation in the measure of subjects' risk and ambiguity preferences. The decision to rely on a non-model-based approach is to categorise subjects based on their preferences while avoiding the assumptions and

restrictions that arise from assuming a specific model. However, several papers in the literature estimate structural models from the EUT,rank-dependent utility (RDU),

CPT and other decision models.

[7] The proportion of 1 and 0 in the data was approximately 1:2, so this was not an issue for estimation.

[8] The Nigerian National Bureau of Statistics and Federal Ministry of Agriculture and Rural Development carried out the representative survey in 2015/16 with support from the World Bank.

[9] By aggregating, categories 1 and 2 are summed to the overall gain domain task. Categories 3 and 4 are added to the overall loss domain task, while categories 5, 6 and 7 jointly constitute mixed domain tasks.

[10] Monetary loss refers to tasks in the monetary domain framed as a pure loss, while time loss implies risk framed as a loss to otherwise productive farm hours. In this paper, time is tested only in the loss domain and under risk.

[11] Further experiment and analysis to examine if these preferences are nothing more than an artefact of the design dispute this presumption.

CONFLICT OF INTEREST

The author declares that there is no conflict of interest.

DATA AVAILABILITY STATEMENT

The data used in this study are available on request.

PEER REVIEW

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